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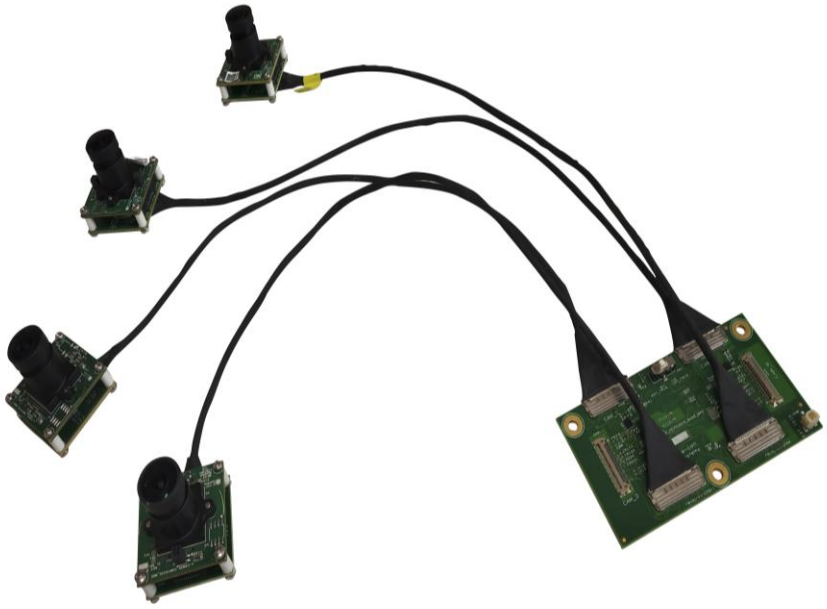
e-CAM130A_CUXVR



Datasheet

Revision 1.0
30th June 2020

Contents

1 Revision History

Rev	Date	Description	Author
1.0	30-June-2020	Initial Release	Camera Team

2 Introduction

e-con Systems is specialized in designing the multi-camera synchronous solution for Jetson™ platforms. In continuation to multi-camera solutions, e-con Systems has developed a new multi-camera board called e-CAM130A_CUXVR board. This multi-camera board targets the NVIDIA® Jetson AGX Xavier™ development kit. It can be directly interfaced with Jetson AGX Xavier™ development kit through J509 connector.

e-CAM130A_CUXVR board connects maximum of four 13 MP custom lens camera modules based on AR1335 CMOS image sensor from ON Semiconductor®. This 1/3.2" AR1335 CMOS image sensor from ON Semiconductor® provides near CCD image quality with its breakthrough low noise CMOS imaging technology. This 13 MP color camera is provided with S-mount lens holder (also known as M12 board lens), which is the most commonly used small form factor lens mounts for board cameras and offers customized optics.

This document describes the features of e-CAM130A_CUXVR board and the pin-outs of the connectors including the mechanical diagram.

3 Disclaimer

The specifications and features of e-CAM130A_CUXVR camera board are provided here as reference only and e-con Systems reserves the right to edit or modify this document without any prior intimation of whatsoever.

4 Description

Xavier™ is a newly launched high performance ARM based evaluation board by NVIDIA®. It contains powerful hardware GPU, hardware codec and 16 camera MIPI lanes. With this 16 MIPI lane, Xavier™ platform supports maximum of six 2-Lane MIPI CSI or four 4-Lane MIPI CSI camera interfaces. e-CAM130A_CUXVR uses these four 4-Lane MIPI CSI interfaces for connecting four 13 MP camera modules.

e-CAM130A_CUXVR is a multi-board solution, which has three boards as follows:

- Camera base board (e-CAM30_HEXCUXVR_BASE_BRD)
- Adaptor board (e-CAM130_TRICUTX2_ADAPTOR)
- Module board (e-CAM137A_CUMI1335_MOD)

The below figures show the camera base board, adaptor board and module board.

Figure 1: Camera Base Board

Figure 2: Adaptor Board

Figure 3: Module Board

The module board is based on AR1335 CMOS image sensor from ON Semiconductor® and an on-board image signal processor (ISP) and MCU. These 4-Lane MIPI camera modules can be synchronously streamed in 4K resolution, which will be best fit for high end multi-camera solution. This high-resolution synchronous camera frames can be used in various applications which includes Sports camera, 360-degree camera and so on.

e-CAM130A_CUXVR has four different variants, which are listed in below table.

Part Number	Base Board	Adaptor Board	Module Board	Micro Coaxial Cable	Lens
e-CAM130A_CUXVR_SOLO	1	1	1	1	1
e-CAM130A_CUXVR_QUAD	1	4	4	4	4

Table 1: e-CAM130A_CUXVR Variants

Note: The number of adaptor board, module board, lens and micro-coaxial cable differs for e-CAM130A_CUXVR variants and remains the same for base board.

The e-CAM130A_CUXVR camera base bard has one 120-pin connector (CN1) that can be directly mated with J509 connector of Jetson AGX Xavier™ development kit and six 30-pin micro-coaxial connectors (CN2 (CAM A), CN3 (CAM B), CN4 (CAM C), CN5 (CAM E), CN6 (CAM D), and CN7 (CAM F)) for interfacing with camera modules through 30 cm micro-coaxial cable. Among which, only CN2 (CAM A), CN4 (CAM C), CN5 (CAM E), CN7 (CAM F) are used for connecting 4-Lane 13 MP camera modules, and other two CN3 (CAM B) and CN6 (CAM D) are

reserved by econ Systems and left unconnected. The camera connector positions in e_CAM130A_CUXVR board is shown below.

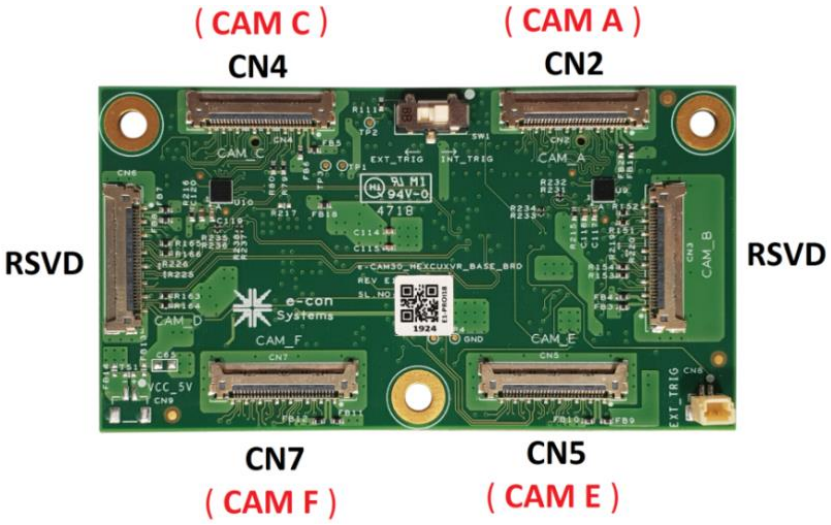


Figure 4: Camera Connector Positions in e_CAM130A_CUXVR Board

For detailed interfacing of the e-CAM130A_CUXVR camera board, please refer to the *e-CAM130A_CUXVR_Getting_Started_Manual.pdf*.

For e-CAM130A_CUXVR_SOLO, the given single camera can be connected to any connectors (CN2, CN4, CN5, CN7) of your choice. Similarly, for e-CAM130A_CUXVR_DUAL or e-CAM130A_CUXVR_TRIPLE, the given two or three cameras can be connected to any of the connectors as specified in *Figure 4*.

e-CAM130A_CUXVR operates in two modes as follows:

- Asynchronous Mode
- Synchronous Mode

4.1 Asynchronous Mode

The asynchronous mode is the normal streaming mode. In this mode, all four cameras can be controlled individually.

The below table lists the supported frame rates in asynchronous mode.

Resolution	640 x 480 (VGA)	1280 x 720 (HD)	1920 x 1080 (FHD)	3840 x 2160 (4K)	4096 x 2160 (4K Cinema)	4192 x 3120 (13 MP)
UYVY	100	72	72	30	28	19

Table 2: Maximum Frame Rates in Asynchronous Mode

4.2 Synchronous Mode

The synchronous mode is the special feature of e-CAM130A_CUXVR board. The e-CAM130A_CUXVR board contains on-board Pulse Width Modulation (PWM) generator circuit to provide the necessary trigger signal for synchronous mode. The camera output from each camera

is frame synchronized. By default, PWM trigger signal frequency is 30 Hz and can be changed to 60 Hz for some resolutions.

The below table lists the supported frame rates in synchronous mode.

Resolution	640 x 480 (VGA)	1280 x 720 (HD)	1920 x 1080 (FHD)	3840 x 2160 (4K)
UYVY	30 and 60	30 and 60	30 and 60	30

Table 3: Maximum Frame Rates in Synchronous Mode

Note: Synchronous mode supports two or more cameras. Hence, e-CAM130A_CUXVR_SOLO is not supported in synchronous mode.

4.3 Features

The features of e-CAM130A_CUXVR are as follows:

- Multi-board solution.
- Four 13 MP cameras are supported.
- Standard M12 lens holder for use with customized optics or lenses for various applications.
- Light weight, versatile, and portable design.
- Asynchronous and synchronous modes.
- On-board PWM generator circuit to trigger all cameras.
- External trigger signal input option, that is, 3.3V signal or 5V signal can be provided.
- Control for individual cameras and numbers of cameras to be streamed is selectable.
- Imaging applications:
  - 13 MP CMOS image sensor with YUV422 output format.
  - Still capture supported resolution VGA, HD, FHD, 4K, 4K Cinema and 13 MP.
  - Preview format YUV422 - VGA, HD, FHD, 4K, 4K Cinema and 13 MP.
  - Field of View (FOV) angle is not the same for all preview resolutions.
- Operating Voltage - 3.3V +/- 5%, Current – 1.568 A(Four cameras streaming condition).
- Restriction of Hazardous Substances (RoHS) compliant.

4.4 PWM Control

The synchronous mode is a special feature of e-CAM130A_CUXVR board. e-CAM130A_CUXVR synchronize all the frames of camera according to the provided PWM pulse as trigger. This PWM trigger pulses can be provided internally (Internal Trigger Mode) or externally (External Trigger Mode).

In Internal Trigger Mode, e-CAM130A_CUXVR contains on-board PWM generator circuit to provide the necessary trigger signal for frame synchronization. The output from each camera is frame synchronized. The overall tolerance for the generated PWM signal frequency is 1%. econ Systems presently supports 30 Hz and 60 Hz PWM pulse in Internal Trigger Mode. For customization of PWM frequency, please write to techsupport@e-consystems.com.

In External Trigger Mode, e-CAM130A_CUXVR board has an I/O Header (CN8), through which you can provide PWM pulse of any frequency to synchronize all camera frames. The external trigger signal voltage can be 3.3V or 5V, more than 5V leads to permanent damage of the chip.

The Internal or External Trigger Mode is selected by using on-board switch (SW1) provided on the base board of e-CAM130A_CUXVR. The SW1 switch must be moved to EXT_TRIG position, when providing PWM trigger signal from external source, else the SW1 switch must remain in INT_TRIG position for getting frames in synchronous mode.

The position of SW1 switch and I/O Header (CN8) in camera base board is shown in below figure.

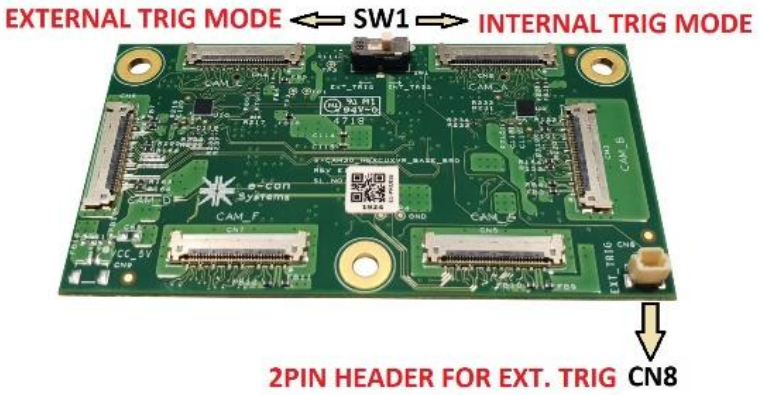


Figure 5: Position of SW1 Switch and I/O Header in Camera Base Board

5 Key Specifications

The below table lists the key specifications of e-CAM130A_CUXVR.

Description	Specification
Base Board Size (L x W)	75.03 mm x 40.69 mm
Video Format	YUV422
Image Resolution	4192 x 3120 (13 MP)
Supported OS	Linux

Table 4: Key Specifications of e-CAM130A_CUXVR

5.1 CMOS Image Sensor Specification

The below table lists the specification of CMOS image sensor used in e-CAM130A_CUXVR board.

Sensor Specification	
Type / Optical Size	1/3.2” Optical format CMOS image sensor
Resolution	13 MP
Sensor Type	10-bit Raw format
Pixel size	1.1 µm x 1.1 µm BSI
Sensor Active Area	4208H x 3120V
Responsivity	4700 e-/lux-sec
Signal to Noise Ratio (SNR)	37 dB
Dynamic Range	69 dB

Table 5: CMOS Image Sensor Specification

For more information about the AR1335 CMOS image sensor or for *Datasheet*, please contact ON Semiconductor®.

6 Pin Description

The e-CAM130A_CUXVR base board has seven connectors such as interface connector (CN1), CAM A (CN2), CAM B (CN3), CAM C (CN4), CAM D (CN6), CAM E (CN5) and CAM F (CN7) connectors. CAM B (CN3) and CAM D (CN6) are reserved by e-con Systems and are not used in e-CAM130A_CUXVR board. The pin description of connectors is explained below.

6.1 Pin-out Details of Camera Connector CAM A (CN2)

The below table lists the pin-out details of CAM A connector.

Pin No	Signal Name	Pin Type	Description
1	VCC_3P3	POWER	3.3V Power supply for camera and adaptor boards
2	VCC_3P3	POWER	3.3V Power supply for camera and adaptor boards
3	VCC_1P8	POWER	1.8V Power supply for camera and adaptor boards
4	GND	POWER	Ground signal for digital and analog
5	GND	POWER	Ground signal for digital and analog
6	BOOT	OUTPUT	Boot control signal for Camera module MCU Low – Boot from internal flash memory High– Reprogram the internal flash memory
7	I2C_SCL	OUTPUT	I2C Clock signal
8	I2C_SDA	I/O	I2C Data Signal
9	GND	POWER	Ground signal for digital and analog
10	MIPI_D2_N	INPUT	MIPI Data Lane 2 Differential Pair -
11	MIPI_D2_P	INPUT	MIPI Data Lane 2 Differential Pair +
12	TRIGGER	OUTPUT	Camera trigger signal
13	RSVD	-	Reserved
14	GND	POWER	Ground signal for digital and analog
15	MIPI_D1_N	INPUT	MIPI Data Lane 1 Differential Pair -
16	MIPI_D1_P	INPUT	MIPI Data Lane 1 Differential Pair +
17	GND	POWER	Ground signal for digital and analog
18	GND	POWER	Ground signal for digital and analog
19	MIPI_D0_N	INPUT	MIPI Data Lane 0 Differential Pair -
20	MIPI_D0_P	INPUT	MIPI Data Lane 0 Differential Pair +
21	RESET	OUTPUT	Camera reset signal (Active low)
22	GND	POWER	Ground signal for digital and analog
23	RSVD	-	Reserved
24	MIPI_CLK_N	INPUT	MIPI Clock Lane Differential Pair -
25	MIPI_CLK_P	INPUT	MIPI Clock Lane Differential Pair +
26	GND	POWER	Ground signal for digital and analog
27	MIPI_D3_N	INPUT	MIPI Data Lane 3 Differential Pair -
28	MIPI_D3_P	INPUT	MIPI Data Lane 3 Differential Pair +
29	FLASH	INPUT	Camera Flash signal
30	RSVD	-	Reserved

Table 6: Pin-out Details of CAM A Connector

Jetson AGX Xavier™ development kit supports four 4-Lane MIPI interfaces and the above listed pin details are used to interface one 4-Lane camera with CAM A port. The camera connector pin-out details remain same for other connectors CAM C (CN4), CAM E (CN5) and CAM F (CN7) ports.

7 Connector Part Numbers

The below table lists connectors used in e-CAM130A_CUXVR and its compatible mating connectors.

Connector	Description	Manufacturer	Part Number
e-CAM130A_CUXVR base board mating connector (CN1) with Xavier	120-pin SMT Connector with 0.5 mm pitch	Samtec	QTH-060-01-H-D-A-K
e-CAM130A_CUXVR headers (CN2, CN4, CN5, CN7) for mating base board with adaptor boards	30-pin receptacle connector with 0.4 mm pitch fully shielded	I-PEX	20682-030E-02
Micro-coaxial cable assembly to connect base board and adaptor board	30 cm length micro-coaxial cable with pin 1 to 1 compatible	I-PEX	20679-030T-01
Mating connector for external trigger signal	2 position rectangular housing connector receptacle with 1.00 mm pitch	JST Sales America Inc	SHR-02V-S-B
External trigger connector crimp	Socket contact tin 28-32 AWG crimp	JST Sales America Inc	SSH-003T-P0.2

Table 7: Connector Part Numbers

8 Electrical Specification

The electrical specifications of e-CAM130A_CUXVR are as follows:

- Recommended Operating Condition
- Functional Temperature Range
- YUV422 Asynchronous Mode
- YUV422 Synchronous Mode

The values described in this section are measured in e-con Systems lab and this can be used as reference only. The current measurements are typical values and are subject to change for different camera boards under different conditions. However, these values can be taken as a reference for power estimation and power supply design.

8.1 Recommended Operating Condition

The below table lists the recommended operating condition of e-CAM130A_CUXVR.

Parameter	Typical Operating Voltage	Typical Power Consumption
Input Voltage	3.3V	5.17W

Table 8: Recommended Operating Condition

8.2 Functional Temperature Range

The functional temperature range of e-CAM130A_CUXVR is listed in below table.

Temperature Range	Parameter Description
−30°C to 70°C	Electrically functional operating range

Table 9: Functional Temperature Range

8.3 YUV422 Asynchronous Mode

The below table lists the power consumption details of e-CAM130A_CUXVR_SOLO in YUV422 asynchronous mode.

S. No	Resolution	Supply Voltage (V)	Typical Current (mA)	Power Consumption (W)
1	640 x 480 at 100 fps	3.3	206	0.68
2	1280 x 720 at 72 fps	3.3	265	0.87
3	1920 x 1080 at 72 fps	3.3	269	0.89
4	3840 x 2160 at 30 fps	3.3	375	1.24
5	4096 x 2160 at 28 fps	3.3	347	1.15
6	4192 x 3120 at 19 fps	3.3	337	1.11

Table 10: Power Consumption of e-CAM130A_CUXVR_SOLO in Asynchronous Mode

The below table lists the power consumption details of e-CAM130A_CUXVR_QUAD in YUV422 asynchronous mode.

S. No	Resolution	Supply Voltage (V)	Typical Current (mA)	Power Consumption (W)
1	640 x 480 at 100 fps	3.3	823	2.72
2	1280 x 720 at 72 fps	3.3	1084	3.58
3	1920 x 1080 at 72 fps	3.3	1106	3.65
4	3840 x 2160 at 30 fps	3.3	1568	5.17
5	4096 x 2160 at 28 fps	3.3	1484	4.90
6	4192 x 3120 at 19 fps	3.3	1414	4.67

Table 11: Power Consumption of e-CAM130A_CUXVR_QUAD in Asynchronous Mode

8.4 YUV422 Synchronous Mode

The below table lists the power consumption details of e-CAM130A_CUXVR_QUAD in YUV422 synchronous mode.

S. No	Resolution	Supply Voltage (V)	Typical Current (mA)		Power Consumption (W)	
			30 fps	60 fps	30 fps	60 fps
1	640 x 480	3.3	569	678	1.88	2.24
2	1280 x 720	3.3	721	972	2.38	3.21
3	1920 x 1080	3.3	736	1002	2.43	3.31
4	3840 x 2160	3.3	1536	-	5.07	-

Table 12: Power Consumption of e-CAM130A_CUXVR_QUAD in Synchronous Mode

Note: Since synchronous mode supports two or more cameras, e-CAM130A_CUXVR_SOLO is not supported in synchronous mode. Hence, power consumption for e-CAM130A_CUXVR_SOLO in synchronous mode is not provided in this document.

9 Mechanical Specifications

e-CAM130A_CUXVR base board size is 75.03 mm x 40.69 mm. The board drawing and its dimensions are described in the following section.

9.1 e-CAM130A_CUXVR Dimension

The front portion of e-CAM130A_CUXVR base board with mechanical dimensions is shown below.

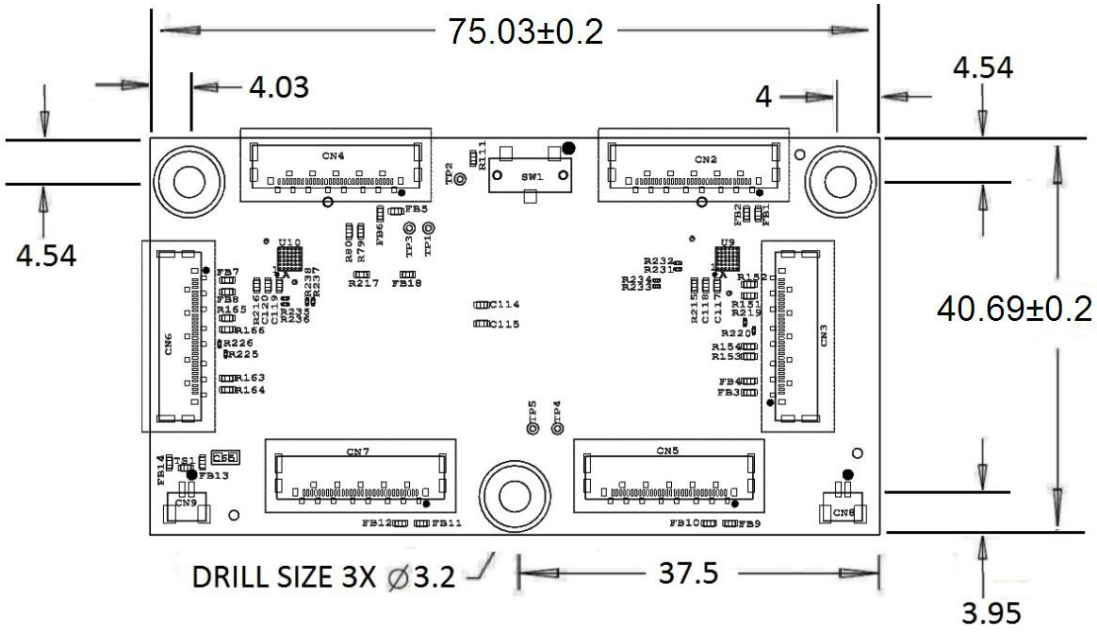


Figure 6: Front Portion of e-CAM130A_CUXVR Base Board Mechanical Dimensions

The e-CAM130A_CUXVR adaptor board with mechanical dimensions is shown below.

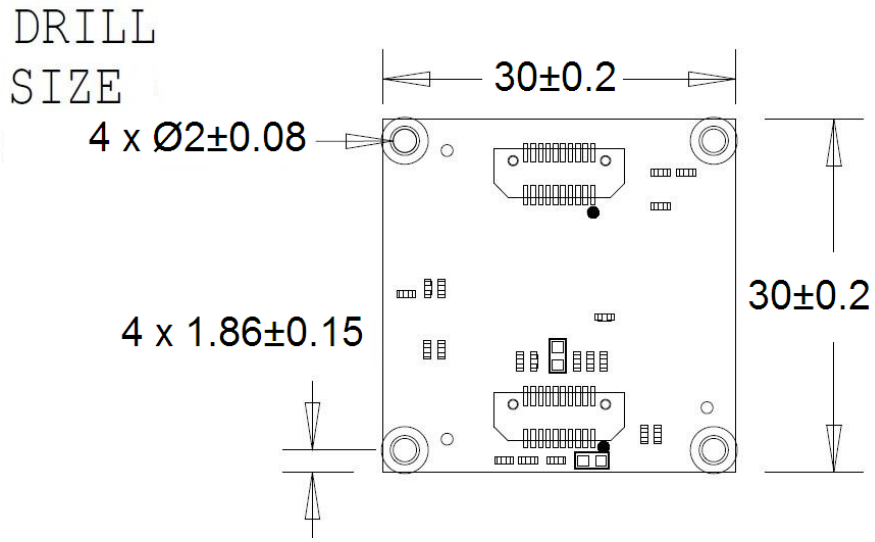


Figure 7: e-CAM130A_CUXVR Adaptor Board Mechanical Dimensions

Note: All dimensions are in mm.

For e-CAM130A_CUXVR module board mechanical dimension information, please refer to the *e-CAM137A_CUMI1335_MOD_Datasheet.pdf*.

Support

Contact Us

If you need any support on e-CAM130A_CUXVR 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