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See3CAM_CU135

Datasheet

Revision 1.3
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Contents

See3CAM_CU135

1 Revision History

Rev	Date	Description	Author
1.0	16-May-2017	Initial Draft	Camera Team
1.1	19-May-2017	Reviewed and added Changes	Camera Team
1.2	23-May-2017	Added iHDR feature and updated electrical specification details	Camera Team
1.3	26-December-2017	Updated Resolution and frame rate table. Added FOV and Crop details	Camera Team

2 Introduction

The See3CAM_CU135 is a 13.0 Mega pixel, colour, UVC Compliant, USB3.0 SuperSpeed camera with Type C connector from e-con Systems, a leading embedded Product Design Company which specializes in the advanced camera solutions. The See3CAM_CU135 is a USB3.0 SuperSpeed camera product with reversible plug and play Type C connector interface.

The See3CAM_CU135 is a 13.0 MP Colour camera with the 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. The See3CAM_CU135 is a two-board solution containing the camera sensor module board containing 1/3.2" AR1335 CMOS image sensor from ON Semiconductor and the USB3.0 interface board. With USB3.0 interface to the host PC, this See3CAM_CU135 can stream uncompressed VGA@ 120 & 60 fps, HD@ 60 & 30 fps (720p60, 720p30), 960P@ 60 & 30fps, FHD @ 60 & 30 fps (1080p60, 1080p30),1440P@ 45 & 22.5 fps, 2880P (2880 x 2160) @ 20 & 10 fps, 4K@ 15 & 7.5 fps (UHD & QFHD), 13MP at 9 & 4.5 fps UYVY formats.

It also streams compressed MJPEG VGA@ 120 fps, HD@ 60 fps (720p60), 960P@ 60 fps, FHD @ 60 fps (1080p60), 1440P@ 60 fps, 2880P (2880 x 2160) @ 30 fps, 4K (UHD & QFHD) at 30 fps. This can also stream the compressed MJPEG 13MP at 20 fps. This See3CAM_CU135 is a UVC-compliant USB3.0 SuperSpeed Camera that is also backward compatible with USB2.0 host ports and does not require any special camera drivers to be installed in the host PC. When connected to USB2.0 host ports, the See3CAM_CU135 supports fewer resolutions and at lower frame rates.

The See3CAM_CU135 is UVC-compliant camera and it does not require any drivers to be installed on the PC. The native UVC drivers of Windows and Linux Operating Systems shall be compatible with this camera. e-con also provides the sample application that demonstrates some of the features of this camera. However, this camera can be utilized any DirectShow application such as Skype etc.

This document describes about the features and See3CAM_CU135 board and the pin-outs of the connectors including with mechanical diagram.

3 Scope

The scope of this document is limited to a description, features of this board including the mechanical diagram. This document serves as the datasheet for See3CAM_CU135 with electrical, mechanical and software features supported by it.

4 Disclaimer

The specifications and features of See3CAM_CU135 camera board are provided here as reference only and e-con Systems reserves the right to edit/modify this document without any prior intimation of whatsoever.

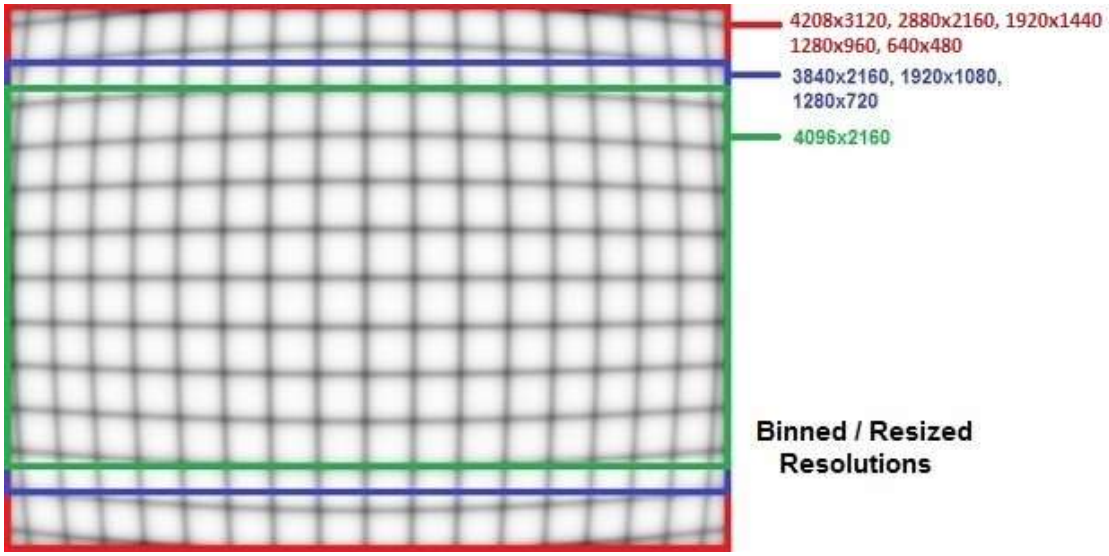
5 Description

The See3CAM_CU135 is a two-board solution of size 30mmx30mm. This camera board is based on AR1335 Image sensor from ON Semiconductor and the Image Signal Processor (ISP). The other board, has the USB interface controller and the Type-C connector. This See3CAM_CU135 is a Ready-to-Manufacture camera board with all the necessary firmware built in and compatible with the USB Video Class (UVC) version 1.0 standard. Customers can integrate this camera in to their products right away and this helps our customers to cut short the Time-to-Market. This camera board is USB Video Class compatible and this will work with the standard drivers available with Windows and Linux. There is no need for any additional driver installation.

Table 1: See3CAM_CU135 Resolution and Frame rates

FORMAT	RESOLUTION	FRAME RATE		% Crop in FOV	
		USB 3.0	USB 2.0	Horizontal	Vertical
UYVY	VGA (640 x 480)	120 fps and 60 fps	60 fps and 30 fps	0%	0%
	720P (1280 x 720)	60 fps and 30 fps	16 fps and 8 fps	0%	24.14%
	960P (1280 x 960)	60 fps and 30 fps	16 fps and 8 fps	0%	0%
	1080P (1920 x 1080)	60 fps and 30 fps	8 fps and 4 fps	0%	24.14%
	1440P (1920 x 1440)	45 fps and 22.5 fps	8 fps and 4 fps	0%	0%
	4K UHD (3840 x 2160)	15 fps and 7.5 fps	2 fps	0%	24.14%
	2.8K (2880 x 2160)	20 fps and 10 fps	3 fps	0%	0%
	4K Cinema (4096 x 2160)	15 fps and 7.5 fps	2 fps	0%	28.88%
	13MP (4208 x 3120)	9 fps and 4.5 fps	1 fps	0%	0%
MJPEG	VGA (640 x 480)	120 fps	120 fps	0%	0%
	720P (1280 x 720)	60 fps	60 fps	0%	24.14
	960P (1280 x 960)	60 fps	60 fps	0%	0%
	1080P (1920 x 1080)	60 fps	60 fps	0%	24.14
	1440P (1920 x 1440)	60 fps	60 fps	0%	0%
	4K UHD (3840 x 2160)	30 fps	30 fps	0%	24.14
	2.8K (2880 x 2160)	30 fps	30 fps	0%	0%
	4K Cinema (4096 x 2160)	30 fps	30 fps	0%	28.88
	13MP (4208 x 3120)	20 fps	20 fps	0%	0%

The following figure shows the Field of View (FOV) of See3CAM_CU135.



This UVC compliant See3CAM_CU135 camera supports Full-HD (1920x1080p) and HD (1280x720) resolutions. So, video streaming through UVC is possible without any special drivers on Operating Systems that have built-in support for UVC standards. For example, the See3CAM_CU135 does not require any device drivers to be installed on Windows (both regular PC versions and the embedded versions) as these Operating Systems come with the Microsoft supplied UVC drivers built-in. The camera is exposed as DirectShow Capture source to the Windows PC and e-con provides sample DirectShow application that demonstrates the features

of this camera. Any DirectShow compliant application such as Skype can work with this camera like any other webcam.

In the case of Linux, the built-in UVC driver works very well with this camera and there is no need for any additional driver installation. In Linux, this camera is exposed as a V4L2 camera and e-con also provides a sample application for Linux OS as well. Customers can also develop customized applications for the See3CAM_CU135 camera using standard V4L2 APIs.

The See3CAM_CU135 camera board has a 10-pin GPIO header that contains signals which can be used for customization requirements. The See3CAM_CU135 has serial I2C Signals (Clock, Data), and Trigger.

This functionality is embedded in the UVC firmware that is running on the See3CAM_CU135 camera UVC controller and also on the sample PC application. The description of these signals is given below along with their functionality.

1. Pin No: 1, 2 & 3 Power Supply for external flash circuitry (to be developed by the user). Refer to the Pin Description Table for maximum current that can be sourced.
2. Pin No: 4,5 Ground
3. Pin No: 6 I2C Serial Clock
4. Pin No: 7 I2C Serial Data (Both Clock and Data pulled up to 1.8V)
5. Pin No: 8 Ground
6. Pin No: 9 NC
7. Pin No: 10 External Trigger Signal to capture a still Image & Sensor Trigger.

Together with these specific purpose signals this See3CAM_CU135 can be customized for any application by our customers and e-con can support them with the necessary technical and programming help.

Figure 1: Front View of See3CAM_CU135

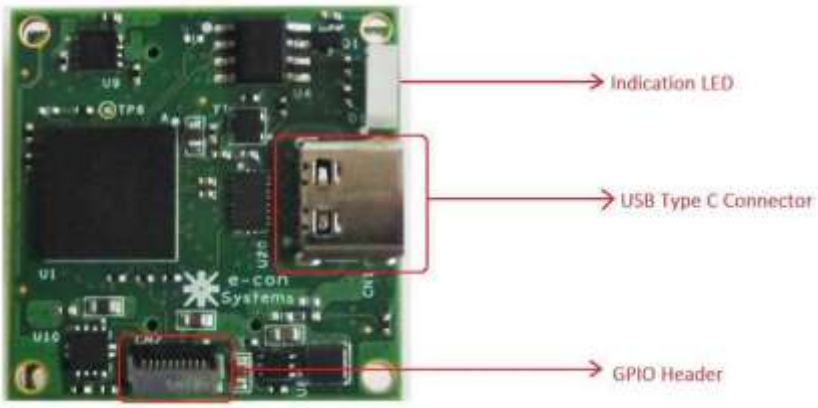


Figure 2: Rear View of See3CAM_CU135

5.1 Features

- Two Board Solution of size 30mm x 30mm
- 13.0 Megapixel colour camera sensor
- Uncompressed UYVY format and Compressed MJPEG format
- Standard M12 lens holder for use with customized optics or lenses for various applications
- USB3.0 device with Type C reversible interface connector.
- Lightweight, versatile, and portable design
- 10 pin GPIO header for standard and custom operations. GPIO pins accessible from the PC host application
- Plug-and-Play setup (UVC compliant) for Windows 7/ 8/ 8.1/10 and Linux
- Full resolution (4208x3120 – 13MP) Field of View (for the e-con Lens) is 67°
- Supported Interlaced High Dynamic Range (iHDR) feature.
- Imaging applications
    - True 13 megapixel CMOS Image sensor
    - Still Capture support in UYVY and MJPEG formats
    - Preview format UYVY – VGA, HD (720p), 960P, Full-HD (1080p), 1440P, Ultra-HD (4K), 2880P, 4K_Cinema and 13MP.
    - Preview format MJPEG – VGA, HD (720p), 960P, Full-HD (1080p), 1440P, Ultra-HD (4K), 2880P, 4K_Cinema and 13MP.
    - Field of View angle is not the same for all preview resolutions.
    - Output Video format – UYVY, MJPEG
- Operating Voltage - 5V +/- 5%, Current - 384mA
- RoHS compliant

6 Key Specification

Description	Specification
Size (L X W X H)	30 x 30 x 30.2 mm (without lens)
Video format	UYVY and MJPEG
USB	3.0 and 2.0
Image Resolution	4208x3120 (13 MP) and 3840x2160 (UHD)
Supported OS	Windows (both 32bit and 64bit)
	Linux
USB Video Class (UVC) Compliant	Yes. Compliant with UVC Version 1.0
PID (Product ID)	0xC1D1
VID (Vendor ID)	0x2560

6.1 Maximum Frame Rate Supported

Please note that the See3CAM_CU135 supports UVC-compliant streaming in Bulk Transport only. The frame rates mentioned below are based on the assumption that there are no other devices connected to the same USB port. If there are any other USB devices connected to the same USB host controller, such as removable mass storage drive etc., the frame rate will go down and depending on the bandwidth availability, the frame rate may even drop down to zero during those instances.

When the camera is configured for Auto-exposure mode, then the frame rate will be determined by the ambient light levels. When the ambient light is low, then the frame rate will drop down accordingly.

Note: *The maximum frame rates are assured only in manual exposure. When the exposure value is changed above -6 there will be a drop in the frame rate because the exposure time period is more than the time period of camera frame. In auto exposure, maximum frame rate could be achieved with maximum lighting.*

6.1.1 When Connected to USB3.0

This table lists the maximum frame rate supported when connected to the USB3.0 host controller and on the assumption, that there are no other active USB devices connected to the same USB host controller. These frame rates are achieved under the ambient brightness level of 500 Lux

Resolution	Frame rate	
	Uncompressed UYVY	Compressed MJPEG
VGA (640 x 480)	120 fps and 60 fps	120
720P (1280 x 720)	60 fps and 30 fps	60
960P (1280 x 960)	60 fps and 30 fps	60
1080P (1920 x 1080)	60 fps and 30 fps	60
1440P (1920 x 1440)	45 fps and 22.5 fps	60
4K UHD (3840 x 2160)	15 fps and 7.5 fps	30
2.8K (2880 x 2160)	20 fps and 10 fps	30
4K Cinema (4096 x 2160)	15 fps and 7.5 fps	30
13MP (4208 x 3120)	9 fps and 4.5 fps	20

6.1.2 When Connected to USB2.0

This table lists the maximum frame rate supported when connected to the USB2.0 host controller and on the assumption, that there are no other active USB devices connected to the same USB host controller.

Resolution	Frame rate	
	Uncompressed UYVY	Compressed MJPEG
VGA (640 x 480)	60 fps and 30 fps	120
720P (1280 x 720)	16 fps and 8 fps	60
960P (1280 x 960)	16 fps and 8 fps	60
1080P (1920 x 1080)	8 fps and 4 fps	60
1440P (1920 x 1440)	8 fps and 4 fps	60
4K UHD (3840 x 2160)	2 fps	30
2.8K (2880 x 2160)	3 fps	30
4K Cinema (4096 x 2160)	2 fps	30
13MP (4208 x 3120)	1 fps	20

6.2 CMOS Image Sensor specification

The following table describes the specifications of the CMOS Image sensor used in this See3CAM_CU135 camera board. For more information about the AR1335 sensor or for datasheet, please contact ON Semiconductor.

Sensor Specification	
Type / Optical Size	1/3.2" Optical format CMOS Image sensor
Resolution	13MP
Sensor type	Colour – UYVY, MJPEG-CMOS Rolling Shutter sensor with Bayer RGB
Pixel size	1.1 µm x 1.1 µm
Sensor Active Area	4208H x 3120V
Responsivity	0.76 V/lux-sec
SNR	37 dB
Dynamic Range	69 dB

7 Pin Description

See3CAM_CU135 has two connectors namely USB 3.1 / Type C connector and one GPIO Header.

7.1 General Purpose Pin description

General Purpose pins are used for specific camera image processing and LED control. The description is as follows

CN2 Pin no	Signal name	Pin Type	Description	Remarks
1	**VCC_5V** (1)	Power	Supply voltage for external Flash circuit	It can source up to 300mA in USB 3.0 only. Don't connect any load when See3CAM_CU135 connected with USB2.0. Any surge current drawn from this voltage source will affect the camera.
2	**VCC_5V**			
3	**VCC_5V**			
4	**GND**	Power	Ground	
5	**GND**			
6	**I2C_SCL**	Output (PU)	Serial Clock of I2C signal	Operating frequency is 400 kHz
7	**I2C_SDA**	Input / Output (PU)	Serial Data of I2C Signal	
8	**GND**	Power	Ground	
9	**NC**			
10	**TRIG** (2)	Input(PU)	External trigger signal to Camera Sensor	Connect to Ground through push button switch with necessary de-bouncing circuitry.

PU - Internally Pulled-up
PD - Internally Pulled-down

(1) **NOTE ON VCC_5V PIN:** *5V can be derived from this pin. This comes directly from the USB VBUS and there is no any internal current control circuit provided. Only when interfaced to USB3.0 port, this can source maximum current of 300mA. Please don't*

connect any load to VCC_5V when connected to USB2.0 port. Consuming beyond the maximum current will lead to drop in voltage and affect the performance of sensor.

(2) **NOTE ON TRIG PIN**: *The TRIG pin implements a Hardware snapshot trigger function. This is done with a still pin that is exposed as DirectShow filter object in WINDOWS OS. The DirectShow application should be developed to access this still pin of the camera to capture still image. In trigger mode, the pin acts as sensor trigger.*

7.2 USB Type C connector pin description

The below table describes the pin-outs of USB 3.0 connector which is used to connect See3CAM_CU135 board with PC through USB 3.0 Cable. This is a standard USB3.0 Micro-B connector.

Pin No	Signal	Description	Pin No	Signal	Description
A1	GND	Ground return	B12	GND	Ground return
A2	SSTXp1	SuperSpeed differential pair1, TX, positive	B11	SSRXp1	SuperSpeed differential pair 2, RX, positive
A3	SSTXn1	SuperSpeed differential pair #1, TX, negative	B10	SSRXn1	SuperSpeed differential pair 2, RX, negative
A4	VBUS	Bus power	B9	VBUS	Bus power
A5	CC1	Configuration channel	B8	SBU2	-
A6	Dp1	Hi-Speed differential pair, position 1, positive	B7	Dn2	Hi-Speed differential pair, position 2, negative
A7	Dn1	Hi-Speed differential pair, position 1, negative	B6	Dp2	Hi-Speed differential pair, position 2, positive
A8	SBU1	-	B5	CC2	Configuration channel
A9	VBUS	Bus power	B4	VBUS	Bus power
A10	SSRXn2	SuperSpeed differential pair 4, RX, negative	B3	SSTXn2	SuperSpeed differential pair 3, TX, negative
A11	SSRXp2	SuperSpeed differential pair 4, RX, positive	B2	SSTXp2	SuperSpeed differential pair 3, TX, positive
A12	GND	Ground return	B1	GND	Ground return

8 Connector Part Numbers

This table below describes the connectors used in the See3CAM_CU135 camera board and its compatible mating connectors. The USB connector is the standard USB 3.1/Type C connector as specified in the USB3.1 standards. Any USB standard compliant USB3.0 Type A to Type C cable will be compatible with this connector.

Connector	Description	Manufacturer	Part Number
USB 3.1 Type C connector	CONN RCPT USB C 3.1 SMT R/A	Molex	105450-0101
GPIO Header (CN8 on See3CAM_CU135	CONN FPC – 0.5mm Shrouded 10Pos SMT	Hirose	FH34SRJ-10S-0.5SH(50)

Base Board)			
Flex Cable	0.5mm Pitch 10 position FPC Cable, 29.97mm length	Molex	0152660095
Mating Connector on the other side of flex cable	CONN FPC – 0.5mm Shrouded 10Pos SMT	Hirose	FH34SRJ-10S-0.5SH(50)

9 Electrical Specification

The following section lists down the electrical specification and recommended operating conditions.

9.1 Recommended Operating Condition

Parameter	Typical Operating Voltage	Current (mA)	Typical Power consumption (W)
Idle condition	5V ± 250mV	95	0.475
Streaming Maximum Power 3840x2160 at 30 fps MJPEG		370	1.850
Streaming Minimum Power 640 x 480 at 120 fps MJPEG		282	1.410

The following table lists down the current consumed by the See3CAM_CU135 under various operating conditions. These values are measured in our 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.

9.1.1 UYVY with USB3.0

S. No	Resolution	Frame rate	Supply Voltage (V)	Typical Current (mA)	Power Consumption (W)
1	640 x 480	120	5	285	1.425
		60	5	310	1.55
2	1280 x 720	60	5	304	1.52
		30	5	352	1.76
3	1280 x 960	60	5	335	1.675
		30	5	272	1.36
4	1920 x 1080	60	5	336	1.68
		30	5	378	1.89
5	1920 x 1440	45	5	335	1.675
		22.5	5	277	1.385
6	2880 x 2160	20	5	384	1.92
		10	5	305	1.525
7	3840 x 2160	15	5	340	1.7
		7.5	5	280	1.4

8	4096 x 2160	15	5	340	1.7
		7.5	5	285	1.425
9	4208 x 3120	9	5	320	1.6
		4.5	5	270	1.35

9.1.2 MJPEG with USB3.0

S. No	Resolution	Supply Voltage (V)	Typical Current (mA)	Power Consumption (W)
1	640 x 480 at 60 fps	5	281	1.405
2	1280 x 720 at 60 fps	5	292	1.46
3	1280 x 960 at 60 fps	5	314	1.57
4	1920 x 1080 at 60 fps	5	297	1.485
5	1920 x 1440 at 60 fps	5	321	1.605
6	2880 x 2160 at 30 fps	5	403	2.015
7	3840 x 2160 at 30 fps	5	368	1.84
8	4096 x 2160 at 30 fps	5	361	1.805
9	4208 x 3120 at 20 fps	5	352	1.76

9.1.3 UYVY with USB2.0

S. No	Resolution	Frame rate	Supply Voltage (V)	Typical Current (mA)	Power Consumption (W)
1	640 x 480	60	5	299	1.495
		30	5	233	1.165
2	1280 x 720	16	5	286	1.43
		8	5	231	1.155
3	1280 x 960	16	5	315	1.575
		8	5	245	1.225
4	1920 x 1080	8	5	250	1.25
		4	5	210	1.05
5	1920 x 1440	8	5	265	1.325
		4	5	224	1.12
6	2880 x 2160	3	5	232	1.16
7	3840 x 2160	2	5	220	1.1
8	4096 x 2160	1	5	223	1.115
9	4208 x 3120	1	5	212	1.06

9.1.4 MJPEG with USB2.0

S. No	Resolution	Supply Voltage (V)	Typical Current (mA)	Power Consumption (W)
1	640 x 480 at 60 fps	5	246	1.23
2	1280 x 720 at 60 fps	5	259	1.295

3	1280 x 960 at 60 fps	5	292	1.46
4	1920 x 1080 at 60 fps	5	260	1.3
5	1920 x 1440 at 60 fps	5	294	1.47
6	2880 x 2160 at 30 fps	5	402	2.01
7	3840 x 2160 at 30 fps	5	352	1.76
8	4096 x 2160 at 30 fps	5	364	1.82
9	4208 x 3120 at 20 fps	5	348	1.74

9.2 DC Characteristics

ABSOLUTE MAXIMUM FOR GPIO PINS

Parameter	Description	Value	Units
Vinput[a]	DC Input voltage to any input pin	2.1	V

[a] Exceeding the maximum value may shorten the life of the device or cause permanent damage to the device

GPIO VOLTAGE LEVELS

Symbol	Parameter	Min	Typ	Max	Unit
Digital Input signals					
V_{IL}	Input voltage LOW			0.45	V
V_{IH}	Input voltage HIGH	1.4			V
Digital Output signals					
V_{OL}	Output voltage LOW			0.18	V
V_{OH}	Output voltage HIGH	1.62			V

GPIO DRIVING STRENGTH

Symbol	Parameter	Min	Typ	Max	Unit
I_O	Output current (source current)			9	mA
I_i	Input current (sink current)			100	uA

9.3 Operating Temperature range

Parameter Description	Temperature Range
Operating temperature range[1]	-30°C to 70°C

[1]This is the maximum temperature range up to which the camera sensor can be operated. Value measured at junction.

NOTE: *When operating beyond 50°C, the image quality is affected badly with thermal flickering noise all over the image. Continuously operating the camera at 70°C (maximum value) will cause irreparable damage to the camera module. Customers are advised to make necessary arrangements on their products to dissipate the heat generated in the module to maintain the operating temperature* below *50°C*

10 Mechanical Specifications

See3CAM_CU135 size is 30 mm x 30 mm x 30.2 mm (without Lens). Board drawing and dimensions are given below.

10.1 See3CAM_CU135 Dimension

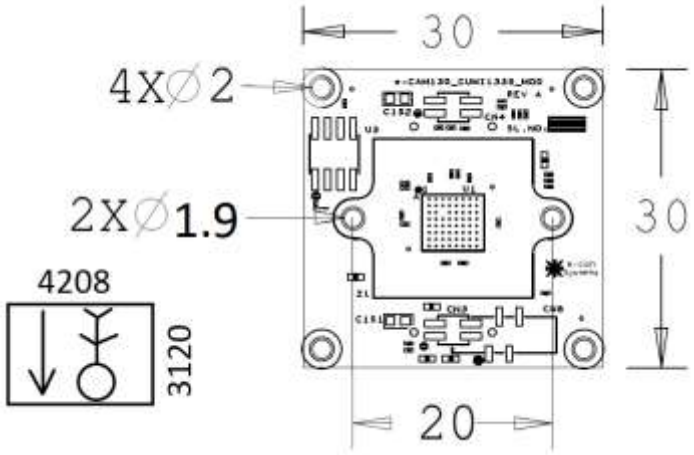


Figure 3: Front Portion of See3CAM_CU135 Module Board mechanical dimensions – the image will be upside down when the board is placed as shown above

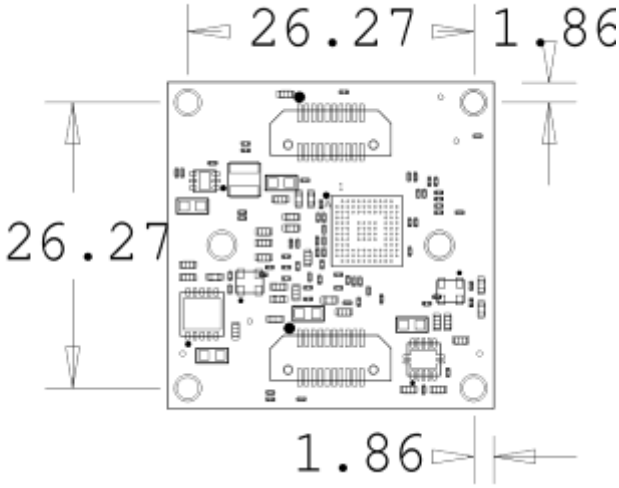


Figure 4: Rear Portion of See3CAM_CU135 Module Board mechanical dimensions

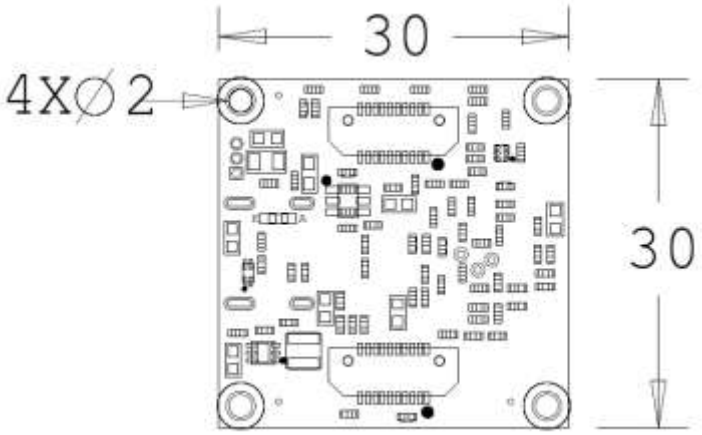


Figure 5: Front Portion of See3CAM_CU135 Base Board mechanical dimensions

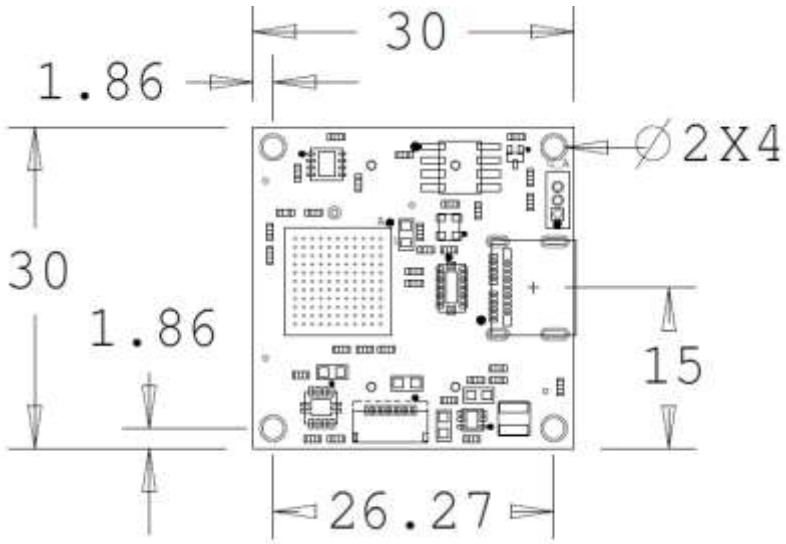


Figure 6: Rear Portion of See3CAM_CU135 Base Board mechanical dimensions

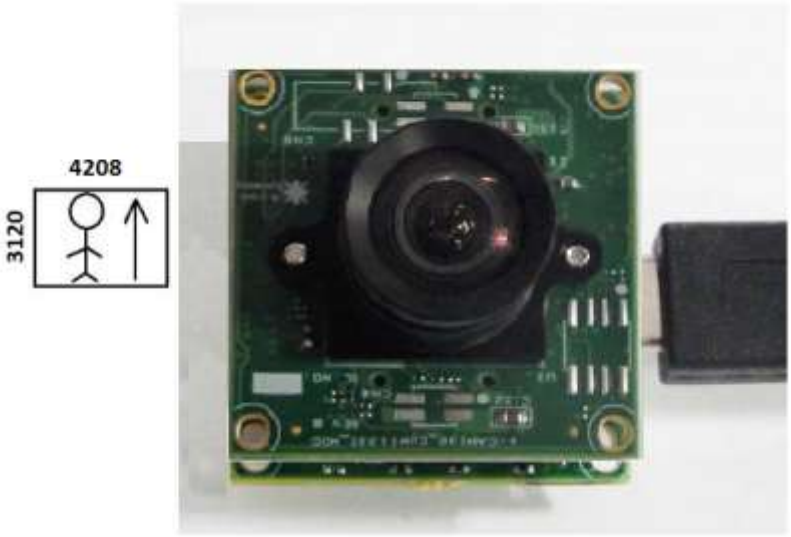


Figure 7: Camera Image orientation with respect to USB Cable

10.2 Lens Holder Dimension

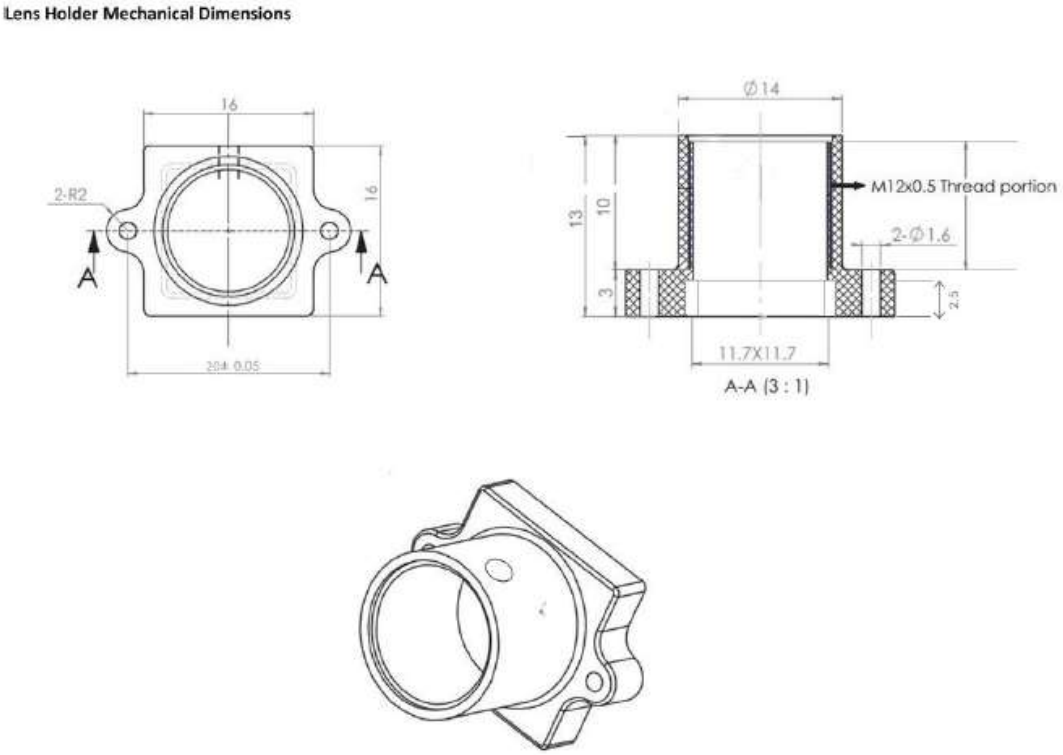


Figure 8: Lens Holder mechanical dimensions

11 Conclusion

This document describes about the features and See3CAM_CU135 board and the pin-outs of the connectors including mechanical specifications.