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NileCAM20_CUNX

Datasheet

Revision 1.1

2nd Feb 2022

Contents

1 Revision History

Rev	Date	Description	Author
1.0	21-Dec-2021	Initial Draft	Product Marketing Team
1.1	02-Feb-2022	Nano support added	Product Marketing Team

2 Introduction

NileCAM20_CUNX is family of NileCAM cameras from e-con Systems with high-speed unified serial interface that carries video data, control data and power in a single coaxial cable. It uses serializer-deserializer (SerDes) technology that allows single coaxial cable interface for the camera. With coaxial cable lengths of up to 15m, NileCAM20_CUNX offers greater flexibility for the system architects to place the cameras in mechanically challenging designs of new generation embedded, automotive and autonomous driving applications. The flexibility of coaxial cable and the ability to carry video data, control data and power in a single cable makes NileCAM20_CUNX fast (low latency), flexible and yet reliable.

NileCAM20_CUNX uses Maxim's Gigabit Multimedia Serial Link (GMSL) interface technology for the serial interface to the camera. This serial interface uses coaxial cable that carries high-speed video data from the camera, bidirectional control data between the camera and host controller, and power supply for the camera. The power to the camera is supplied from the host processor through this coaxial cable. NileCAM20_CUNX embeds the Maxim's serializer which serializes the high-speed image data and transmits over coaxial cable. The serializer also supports the bidirectional control data communication between the camera and host controller. The on-board electronics of NileCAM20_CUNX serializer recovers the power supplied from the host controller without contaminating the data transfers.

NileCAM20_CUNX board has been designed and developed by e-con Systems for the NVIDIA® Jetson™ Xavier NX™/NANO development kits. NileCAM20_CUNX is a 2 MP GMSL camera contains a 1/2.7" AR0230AT CMOS image sensor from ON Semiconductor® along with on-board ISP. The coaxial cable is connected to Serializer board through a rugged FAKRA connector. NileCAM20_CUNX is interfaced to the J1 and J9 connectors on the Xavier NX™/ J13 and J49 connectors on Jetson Nano B00 board and J13 connector in Jetson nano A02 board using the NileCAM20_CUNX Deserializer board.

The NVIDIA® Jetson™ Xavier NX™/NANO developer kit is a full-featured development platform for visual computing. It is ideal for applications requiring high computational performance in a low power envelope. The Jetson™ Xavier NX™/NANO developer kit is pre-flashed with a Linux environment which includes support for many common APIs. This kit is supported by NVIDIA® complete development tool chain.

e-con Systems provides the sample applications that demonstrates the features of this camera. However, this camera can also be utilized by any V4L2 application.

This document describes about the features of NileCAM20_CUNX board including the mechanical diagram.

3 Disclaimer

The specifications and features of NileCAM20_CUNX camera board are provided here as reference only and e-con Systems reserve the right to edit/modify this document without any prior intimation of whatsoever.

4 Description

The NileCAM20_CUNX board is designed to interface the 2 MP custom lens camera modules with the Jetson™ Xavier NX™/Nano development kits. NileCAM20_CUNX is a three-board solution and has two parts. The first part has two boards: one is standard NileCAM20_CUNX camera module that has 1/2.7"AR0230AT image sensor from ON Semiconductor® along with Image Signal Processor (ISP) and the other one is Serializer board. The second part is Deserializer board which is used to interface with Jetson™ Xavier NX™/NANO development kits.

NileCAM20_CUNX is a multi-board solution, which has three boards as follows:

- e-CAM20_CU0230_MOD (Camera Module Board)
- e-CAM20_CUXVR_SER_BRD (Serializer Board)
- e-CAM50_CUNANO_DESER_BRD (Deserializer Board)

The following figures show the Camera Module board, Serializer board and Deserializer board.

Figure 1: NileCAM20_CUNX Camera Module

Figure 2: NileCAM20_CUNXSerializer Board

Figure 3: NileCAM20_CUNX Deserializer Board

The camera board is based on AR0230AT, a 1/2.7" CMOS image sensor from ON Semiconductor® along with Image Signal Processor (ISP). The camera is available with M12 metal lens holder allowing customers to choose the lens as per their requirements. The Serializer board is based on Maxim GMSL serializer and has all the circuitry required for bidirectional data communication, power and data separation and so on. FAKRA connectors are used for the coaxial cable interface. The Deserializer board needs external power supply, which supplies the power to the Serializer board over coaxial cable using the FAKRA connector. The Deserializer board also has a Fakra connector, through which you can connect camera's serializer.

NileCAM20_CUNX has the below parts, which are listed in following table.

Part Number	DeserializerBoard	Serializer Board	Module Board	Coaxial Cable	FPC Cable	Lens
NileCAM20_CUNX	1	1	1	1	1	1

NileCAM20_CUNX operates in only synchronous mode. For customization and support for synchronous mode, please write to techsupport@e-consystems.com.

4.1 Asynchronous Mode

The asynchronous mode is the normal streaming mode.

The following table list the maximum supported frame rates in asynchronous mode.

Resolution	640 x 480 (VGA)	960 x 540 (qHD)	1280 x 720 (HD)	1280 x 960 (960p)	1920 x 1080 (FHD)
UYVY	60	58	45	34	30

Table 2: Maximum Frame Rates in Asynchronous Mode

4.2 Features

The features of NileCAM20_CUNX are as follows:

- Multi-board solution
- 2 MP camera module with 1/2.7" optical form factor
- Standard M12 metal lens holder for use with customized optics or lenses for various applications.
- Shielded coaxial cable for transmission of both power and data for long distance (up to 15m)
- Uncompressed UYVY format
- Imaging applications: Still capture supported resolution VGA, qHD, HD, 960p, FHD.
- Light weight, versatile, and portable design
- Operating Temperature: −40°C to 85°C
- Typical Power consumption: 14.328W
- Restriction of Hazardous Substances (RoHS) compliant

Note: For NileCAM20_CUNX product, GMSL2 6Gbps mode is selected by default

5 Key Specifications

The following table lists the key specifications of NileCAM20_CUNX.

Description	Specification
Video Format	UYVY
Image Resolution	1920 x 1080 (2MP)
Supported OS	Ubuntu 18.04

Table 5: Key Specifications of NileCAM20_CUNX

5.1 CMOS Image Sensor Specification

The following table lists the specifications of the CMOS image sensor used in NileCAM20_CUNX board.

Sensor Specification	
Type / Optical Size	1/2.7” Optical format CMOS Image sensor
Resolution	2MP
Sensor Type	12-Bit RGB Bayer
Pixel Size	3.0 µm x 3.0 µm
Sensor Active Area	1928H x 1088V
Responsivity	4.0 V/lux-sec
Signal to Noise Ratio (SNR)	41 dB
Dynamic Range	Max up to 96 dB

OS Image Sensor Specification

For more information about the AR0230AT sensor or for datasheet, please contact ON Semiconductor®.

5.2 Maximum Frame Rates Supported by NileCAM20_CUNX

The following table lists the maximum frame rate supported when connected to the Jetson™ Xavier NX/NANO kit.

Resolution	Frame Rate (Uncompressed UYVY)	% Crop in FOV	
		Horizontal	Vertical
640 x 480	60 fps	66.67%	55.55 %
960 x 540	58 fps	50.00%	50.00 %
1280 x 720	45 fps	33.33%	33.33 %
1280 x 960	34 fps	33.33%	11.11 %
1920 x 1080	30 fps	0.00%	0.00%

Table 7: Maximum Frame Rate Supported for Jetson Xavier NX/NANO

6 Connector Details

The following sections describe the pins descriptions of the serializer board and deserializer board connectors.

- Serializer Board Connectors
- Deserializer Board Connectors

6.1 Serializer Board Connectors

The serializer board has two on-board connectors for user interface. The following section describes the pin-outs and connector locations.

6.1.1 Serializer to Module Mating Connectors (CN3 and CN4)

NileCAM20_CUNX Serializer board has two dual rows, 20-pin connectors. CN3 and CN4 connectors are used for mating with module board. The connector on Serializer board is shown in the following figure.

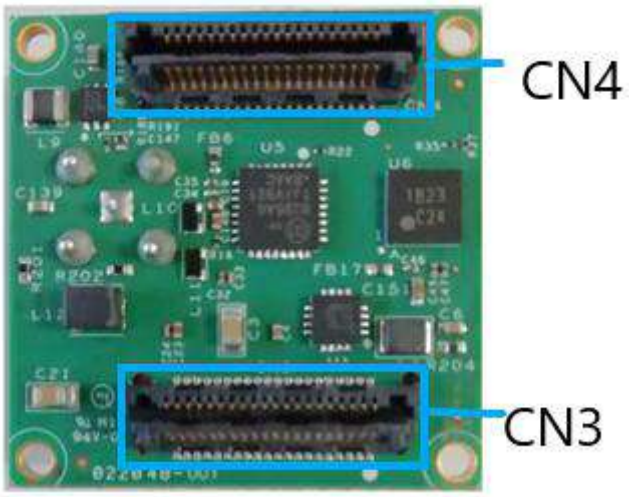

Figure 5: Connectors on Serializer Board

The CN3 pin numbers, signal names, pin types and their description from serializer board perspective are listed in following table.

CN3 Pin No	Signal Name	Pin Type	Description
1	PAR_D0	INPUT	2.8V IO parallel data0 signal from camera module
2	PAR_D8	INPUT	2.8V IO parallel data8 signal from camera module
3	PAR_D1	INPUT	2.8V IO parallel data1 signal from camera module
4	PAR_D9	INPUT	2.8V IO parallel data9 signal from camera module
5	PAR_D2	INPUT	2.8V IO parallel data2 signal from camera module
6	PAR_D10	INPUT	2.8V IO parallel data10 signal from camera module
7	PAR_D3	INPUT	2.8V IO parallel data3 signal from camera module
8	PAR_D11	INPUT	2.8V IO parallel data11 signal from camera module

9	GND	POWER	POWER
10	GND	POWER	POWER
11	PAR_D4	INPUT	2.8V IO parallel data4 signal from camera module
12	PAR_D12	INPUT	2.8V IO parallel data12 signal from camera module
13	PAR_D5	INPUT	2.8V IO parallel data5 signal from camera module
14	PAR_D13	INPUT	2.8V IO parallel data13 signal from camera module
15	PAR_D6	INPUT	2.8V IO parallel data6 signal from camera module
16	PAR_D14	INPUT	2.8V IO parallel data14 signal from camera module
17	PAR_D7	INPUT	2.8V IO parallel data7 signal from camera module
18	PAR_D15	INPUT	2.8V IO parallel data15 signal from camera module
19	GND	POWER	Ground
20	GND	POWER	Ground
21	VCC_2P8	POWER	2.8V Power supply for camera module
22	CLK_PARALLEL_ISP	INPUT	2.8V IO parallel clock signal from camera module
23	VCC_2P8	POWER	2.8V Power supply for camera module
24	GND	POWER	Ground
25	CAM_I2C_SCL	OUTPUT	I2C Clock signal with Internal pull up to 2.8V through 4.7k resistor
26	PAR_FV	INPUT	2.8V IO parallel vertical sync signal from camera module
27	CAM_I2C_SDA	BI-DIR	I2C Data signal with Internal pull up to 2.8V through 4.7k resistor
28	PAR_LV	INPUT	2.8V IO parallel horizontal sync signal from camera module
29	RSVD	-	Reserved
30	GND	POWER	Ground
31	GND	POWER	Ground
32	RSVD	-	Reserved
33	RSVD	-	Reserved
34	RSVD	-	Reserved
35	GND	POWER	Ground
36	GND	POWER	Ground
37	VCC_3P3	POWER	3.3V Power supply for camera module
38	VCC_3P3	POWER	3.3V Power supply for camera module
39	VCC_3P3	POWER	3.3V Power supply for camera module
40	VCC_3P3	POWER	3.3V Power supply for camera module

Table 8: CN3 Pin Descriptions

The CN4 pin numbers, signal names, pin types and their descriptions are listed in following table.

CN4 Pin No	Signal Name	Pin Type	Description
1	PAR_D16	INPUT	2.8V IO parallel data16 signal from camera module
2	RSVD	-	Reserved
3	PAR_D17	INPUT	2.8V IO parallel data17 signal from camera module
4	RSVD	-	Reserved
5	PAR_D18	INPUT	2.8V IO parallel data18 signal from camera module
6	RSVD	-	Reserved
7	PAR_D19	INPUT	2.8V IO parallel data19 signal from camera module
8	RSVD	-	Reserved
9	GND	POWER	POWER
10	GND	POWER	POWER
11	PAR_D20	INPUT	2.8V IO parallel data20 signal from camera module
12	RSVD	-	Reserved
13	PAR_D21	INPUT	2.8V IO parallel data21 signal from camera module
14	RSVD	-	Reserved
15	PAR_D22	INPUT	2.8V IO parallel data22 signal from camera module
16	RSVD	-	Reserved
17	PAR_D23	INPUT	2.8V IO parallel data23 signal from camera module
18	GPIO5	BI-DIR	2.8V GPIO signal for camera module
19	GND	POWER	Ground
20	GND	POWER	Ground
21	RSVD	-	Reserved
22	CAM_TRIGGER	OUTPUT	2.8V IO Camera Trigger signal for camera module
23	GPIO3	BI-DIR	2.8V IO GPIO signal for camera module
24	RSVD	-	Reserved
25	RSVD	-	Reserved
26	GND	POWER	Ground
27	RSVD	-	Reserved
28	VCC_1P8	POWER	1.8V Power supply for camera module
29	GND	POWER	Ground
30	VCC_1P8	POWER	1.8V Power supply for camera module

31	GPIO8	BI-DIR	2.8V IOGPIO signal for camera module
32	GND	POWER	Ground
33	nRST_uC	OUTPUT	2.8V active low RESET signal for camera module
34	VCC_3P3	POWER	3.3V Power supply for camera module
35	uC_BOOT0	OUTPUT	2.8V active Boot selection signal for camera module 0 – Boot from MCU flash memory 1 – Reprogram the MCU Flash memory
36	VCC_3P3	POWER	3.3V Power supply for camera module
37	GND	POWER	Ground
38	GPIO6	BI-DIR	2.8V IO GPIO signal for camera module
39	VDDIO_2P8	POWER	2.8V IO Power supply for camera module
40	RSVD	-	Reserved

Table 9: CN4 Pin Descriptions

6.1.2 FAKRA Straight Plug (Coax Connector) Pin Description (CN1)

The connector on serializer board is shown in the following figure.

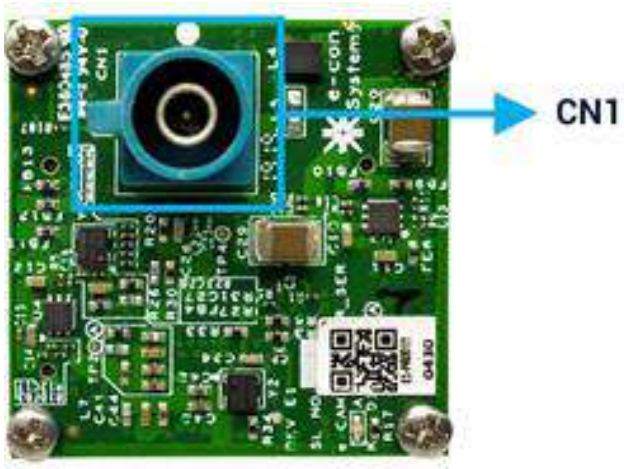

Figure 6: Connector on Serializer Board

The serializer board has a high frequency FAKRA straight plug (CN1) with neutral coding, to mate with coaxial cable. The same FAKRA straight plug and pinouts are used in the Deserializer board.

The following table lists the pinouts details of FAKRA plug.

Pin No	Signal	Pin Type	Description
1	Coax	Input / Output	Coaxial signal that carries both power and bidirectional data
2	GND	Power	Ground

3	GND		Ground
4	GND		Ground
5	GND		Ground

Table 10: FAKRA Plug Pinouts Details

6.2 Deserializer Board Connectors

The Deserializer board has one fakra connectors (CN1), power supply connector (CN3) and FPC connecter(CN4).

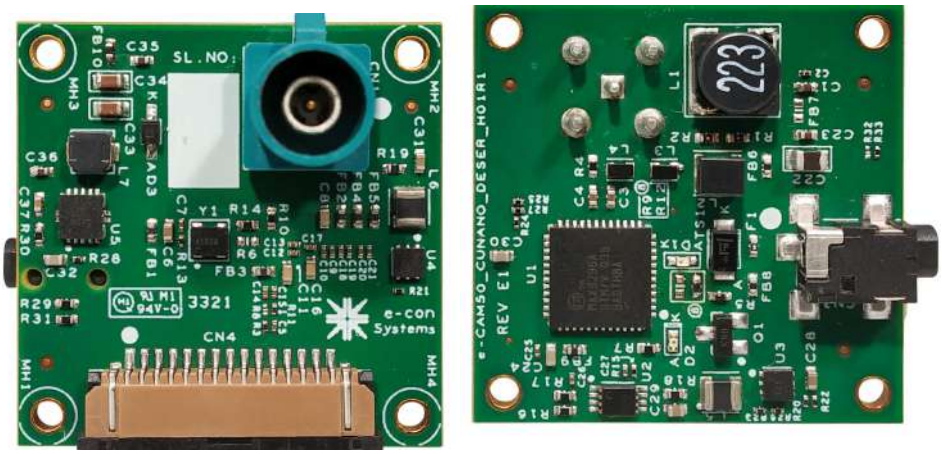

Figure 7: Connectors on Deserializer Board

6.2.1 Pin-out Details of Deserializer Board FPC Connector(CN4)

NileCAM20_CUNX Deserializer board has single FPC connector used for mating with Xavier NX/NANO board. The following table lists the pin-out details of CN4 connecter.

CN4 Pin No	Signal Name	Pin Type	Description
1	GND	POWER	Ground signal for digital and analog
2	MIPI_DATA0_N	OUTPUT	MIPI Data Lane 0 Differential Pair -
3	MIPI_DATA0_P	OUTPUT	MIPI Data Lane 0 Differential Pair +
4	GND	POWER	Ground signal for digital and analog
5	MIPI_DATA1_N	OUTPUT	MIPI Data Lane 1 Differential Pair -
6	MIPI_DATA1_P	OUTPUT	MIPI Data Lane 1 Differential Pair +
7	GND	POWER	Ground signal for digital and analog
8	MIPI_CLK_N	OUTPUT	MIPI Clock Lane Differential Pair -
9	MIPI_CLK_P	OUTPUT	MIPI Clock Lane Differential Pair +
10	GND	POWER	Ground signal for digital and analog
11	CAM_PWRDN	INPUT	Power down from carrier board
12	CAM_MCLK	--	Reserved
13	I2C_3P3_SCL	INPUT	3.3V IO I2C SCL signal

14	I2C_3P3_SDA	I/O	3.3V IO I2C SCL signal
15	VCC_3P3	POWER	3.3V Power supply for camera board

Table 10: FPC connecter Pinouts Details

6.2.2 Power Supply Connector (CN3)

This connector is used for supplying power for NileCAM20_CUNX camera module through POC.it is connected to a DC jack,The DC jack connector has internal diameter and outer diameteras 0.7x2.35mm. e-con Systems provides the mating power supply adapter with 12V 2A.

The following table lists the CN3 connector pin-out details.

Pin No	Signal	Pin Type	Description
1	VCC_POC	POWER	Power for camera Modules. Supports 5V to 15V.
2	GND	POWER	Ground
3	GND	POWER	Ground

Table 10: CN3 Connector Pin-out Details

Note: Kindly use e-con Systems provided adaptor or make ensure your power adaptor supports 24W power.

6.2.3 Fakra Connectors (CN1)

NileCAM20_CUNX deserializer board has one Fakra connector for interfacing with serializer board. This connector is used for carrying power to camera modules and receiving high speed data from camera module through POC. The following table lists the FAKRA plug pin-out details.

Pin No	Signal	Pin Type	Description
1	Coax	Input / Output	Coaxial signal that carries both power and bidirectional data
2	GND	Power	Ground
3	GND		Ground
4	GND		Ground
5	GND		Ground

Table 11: FAKRA Plug Pin-outs Details

7 Connector Part Numbers

The following table describes the connectors used in the NileCAM20_CUNX camera board and its compatible mating connectors.

Board	Connector	Manufacturer	Part Number
Serializer Board	CONN FAKRA Plug Receptacle 5Pos 50Ohm 6GHz Vertical Through Hole (CN1)	Rosenberger	59S10H-400T5-Z
	CONN Board to Board Hermaphroditic Strip P-0.64mm 40Pos Dual Row Vertical SMT (CN3, CN4)	Samtec	LSS-120-01-F-DV-A
Deserializer Board	CONN Jack Power Male 2 Conductors, 3 Contacts 24VDC 5A Right Angle Through Hole (CN3)	CUI Inc	PJ-042-SMT
	CONN FAKRA Plug Receptacle 5Pos 50 Ohm 6GHz Vertical Through Hole (CN1)	Rosenberger	59S10H-400T5-Z
	CONN FPC Bottom 15POS 1.00mm R/A(CN4)	Amphenol FCI	SFW15R-1STAE1LF

Table 14: Connectors Part Numbers

As the NileCAM20_CUNX boards are available as multi board solution, screws and spacers are used for holding the serializer & camera module

The following table lists the description of the part numbers.

Part No	Description	Manufacturer
1250388	Screws M2 Phillips Pan Head Stainless steel	Bossard
1241397	Nut Hex Head Dia-4.32mm min, Head Height-1.6mm max, Thread dia 2mm	Bossard

Table 15: Spacers and Screws Part Numbers

Note: The above mechanical parts are verified for mechanical clearance with nearby components.

Warning: e-con Systems does not recommend using new mechanical screws and allied parts with the product. If new mechanical parts are to be used, care should be taken to avoid interference with nearby components.

8 Electrical Specification

This section lists the electrical specification and recommended operating conditions of NileCAM20_CUNX.

8.1 Recommended Operating Condition

NileCAM20_CUNX requires two power sources for normal operation. One is for deserializer board and the other is for camera module plus serializer boards. NileCAM20_CUNX uses Jetson Xavier NX / NANO's camera expansion connector power for powering deserializer board and CN3 connector power for powering camera modules.

8.1.1 Power Consumption of Deserializer Board

NileCAM20_CUNX deserializer board uses only 1.8V and 3.3V power supplies from Jetson Xavier NX/NANO camera expansion connector where else 2.8V and 5V power supplies are unused. The power consumption details are listed in the following table.

Parameter	Typical Power consumption (W) in 1.8V supply	Typical Power consumption (W) In 3.3V supply
Single camera streaming condition (Maximum Power)	0.162	3.03

Table 16: Power Consumption Details

Note: These values 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.

8.1.2 Power Consumption of Serializer and Module Boards

For Camera modules and serializer boards, NileCAM20_CUNX uses power from CN3 connector, which supports 5 to 15V power supply. By default, e-con provides 12V 2A power adapter. The power consumption details for NileCAM20_CUNX in asynchronous modes are listed below.

Asynchronous Mode Power Consumption:

The following table lists the power consumption of NileCAM20_CUNX in Asynchronous Mode.

S. No	Resolution	Frame Rate	Power Consumption
1	640 x 480	60 fps	1.884W
2	960 x 540	58 fps	1.944W
3	1280 x 720	45 fps	2.052W
4	1280 x 960	34 fps	2.100W

5	1920 x 1080	30 fps	2.196W

Table 18: Power Consumption Details of NileCAM20_CUNX in Asynchronous Mode

Note: These values 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.

8.2 Operating Temperature Range

The following table lists the operating temperature range of NileCAM20_CUNX.

Parameter Description	Temperature Range
Operating Temperature Range[1]	−40°C to 85°C
Stable Image Temperature Range	−40°C to 70°C

Table 19: Operating Temperature Range

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

Note: The default lens supplied with this camera has an operating range of -30°C to 75°C. You can choose wider operating temperature lens as per your requirements. You are advised to make necessary arrangements on the products to dissipate the heat generated in the module to maintain the operating temperature below 85°C.

9 Mechanical Specifications

NileCAM20_CUNXis a three-board solution. The camera module, serializer boards and deserializer each of size is 30 mm x 30 mm.

The board dimensions are shown in the following sections:

- Camera Module Board Dimensions
- Serializer Board Dimensions
- Deserializer Board Dimensions
- Lens Holder Dimensions

9.1 Camera Module Board Dimensions

The front and rear views of NileCAM20_CUNX board with mechanical details are shown in the following figures.

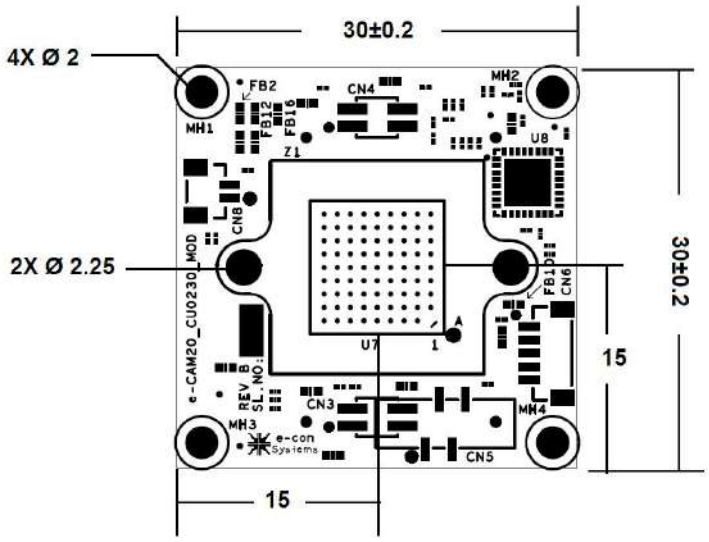

Figure 8: NileCAM20_CUNX Camera Module Board Front View

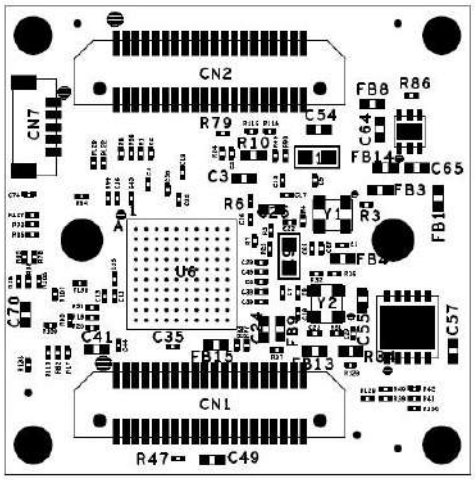

Figure 9: NileCAM20_CUNX Camera Module Board Rear View

Note: All dimensions are in mm.

9.2 NileCAM20_CUNX Serializer Board Dimensions

The front and rear views of NileCAM20_CUNXserializerboard with mechanical details is shown in the following figures.

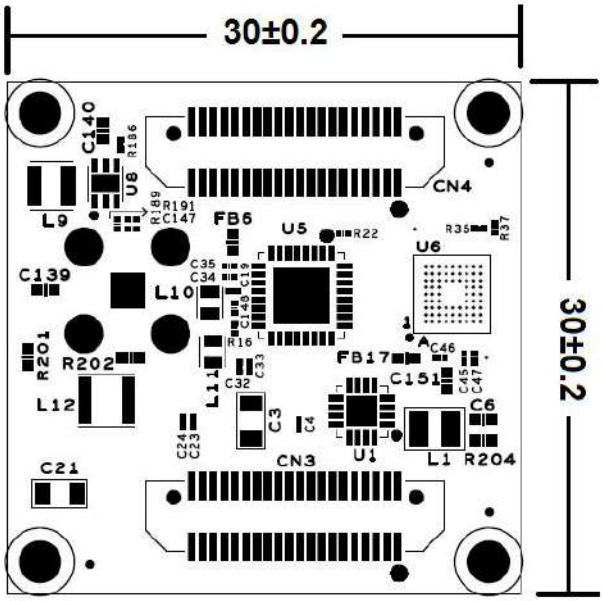

Figure 10: NileCAM20_CUNX Serializer Board Front View

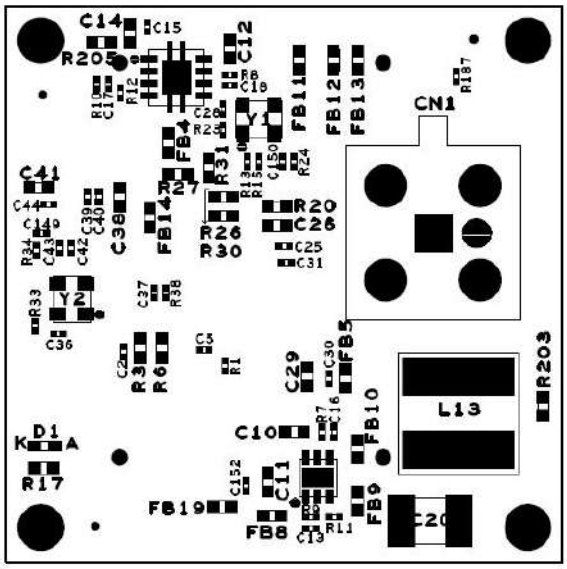

Figure 11: NileCAM20_CUNX Serializer Board Rear View

Note: All dimensions are in mm.

9.3 Deserializer Board Dimensions

The front and rear views of NileCAM20_CUNX deserializer board with mechanical details are shown in the following figures.

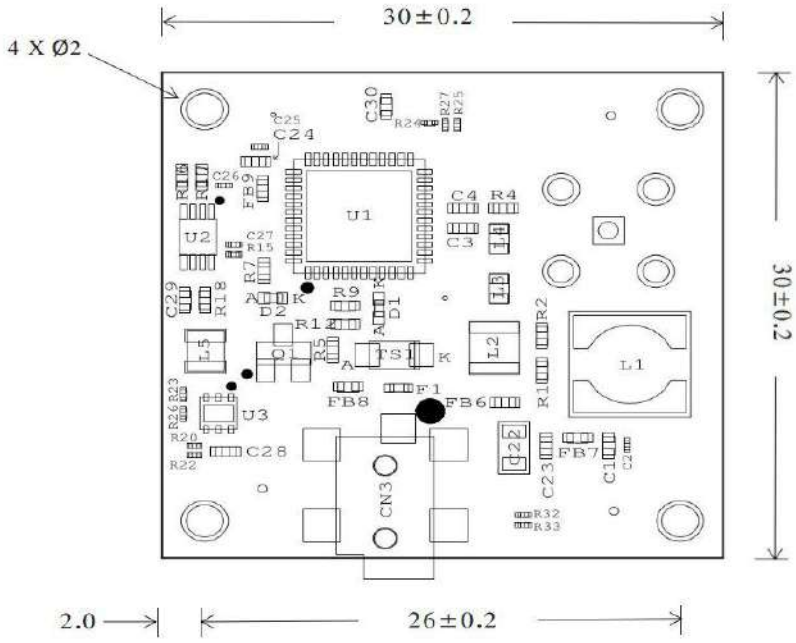

Figure 12: NileCAM20_CUNX Deserializer Board Front View

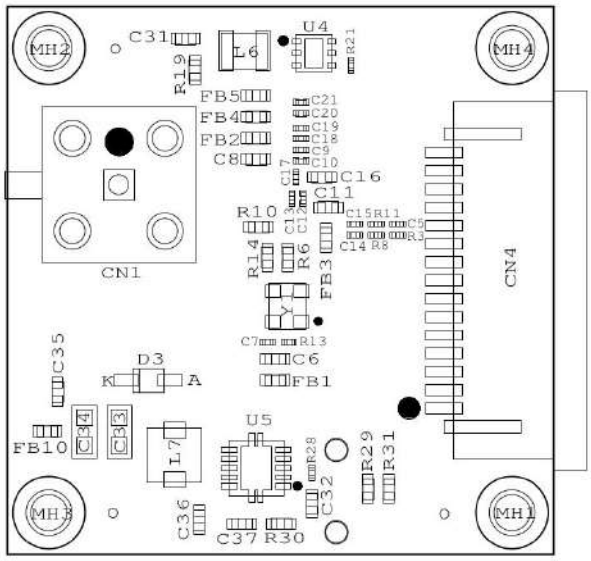

Figure 13: NileCAM20_CUNX Deserializer Board Rear View

Note: All dimensions are in mm.

9.4 Lens Holder Dimensions

The following figure shows the dimension details of S-Mount metal lens holder.

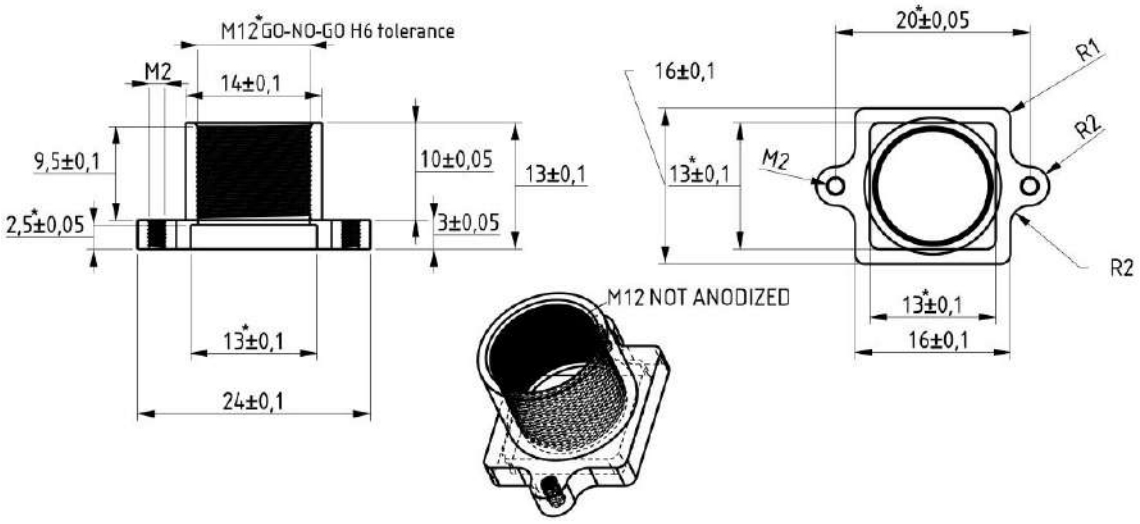

Figure 14: S-Mount Metal Lens Holder Outline Dimension

Note: All dimensions are in mm.

Support

Contact Us

If you need any support on NileCAM20_CUNX 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