e-CAM217_CUMI0234_MOD

MCU Protocol Application Note

Version 1.1

e-con Systems

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e-con Systems®

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Introduction to e-CAM217_CUMI0234_MOD

e-con Systems is a leading Embedded Product Design Services Company which specializes in advanced camera solutions. e-CAM217_CUMI0234_MOD is a new 2-lane or 4-lane Mobile Industry Processor Interface (MIPI) camera which uses the AR0234CS camera module.

e-CAM217_CUMI0234_MOD is a low voltage, small form factor, high performance 2 MP pluggable camera module with S-Mount lens holder. It is based on AR0234CS Complementary Metal Oxide Semiconductor. (CMOS) image sensor from onsemi™. e-CAM217_CUMI0234_MOD is designed to connect with any application processor that has MIPI interface. The standard S-Mount lens holder can accommodate a wide range of lenses based on your choice.

This document provides a detailed understanding of I^2C based protocol used by the host application processor, for communicating with the microcontroller which is provided as part of e-con Systems e-CAM217_CUMI0234_MOD camera board.

Description

e-CAM217_CUMI0234_MOD can stream uncompressed HD at 120 fps, FHD at 65 fps, 2.3 MP at 60 fps UYVY formats. It can be used with any application processor which supports 2-lane or 4-lane MIPI CSI-2 interface.

This document explains the microcontroller unit (MCU) protocol corresponding to the 32-byte MCU firmware version ID mentioned in below table.

Table 1: MCU Firmware Version

Jetson Orin Platform	MCU Firmware Version ID
Jetson Orin Nx™	1125CUONXXXXX01110dfe152cXXXXXXX
Jetson Orin Nano™	1125CUONXXXXX01110dfe152cXXXXXXX

Note: This MCU firmware version is subject to get updated in future.

Frame Rate Supported

The below table lists the frame rate supported for 2-lane configuration in e-CAM217_CUMI0234_MOD.

Table 2: Frame Rate Supported for 2-Lane Configuration

Format	Resolution	Frame Rate
UYVY	VGA	120 fps
	HD	120 fps
	FHD	65 fps

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	2.3MP	60 fps

The below table lists the frame rate supported for 4-lane configuration in e-CAM217_CUMI0234_MOD.

Table 3: Frame Rate Supported for 4-Lane Configuration

Format	Resolution	Frame Rate
UYVY	HD	120 fps
	FHD	70 fps
	2.3MP	60 fps

Note:

- The frame rates listed in the above table varies based on platform capability.

Camera Operation Sequence

This section describes the basic operation for initiating the stream sequence and changing the control values using MCU.

The basic operation for initiating the stream sequence is explained below:

- Host processor refers to the application processor, for example, Orin Nano™, Orin NX™ or FX3 processors will act as I²C Master throughout this protocol.
- MCU acts as I²C Slave in this entire protocol.
- The I²C Master always initializes every transaction.
- Length of the byte sequence between the MCU and host processor is either constant or pre-negotiated for each transaction.
- If a transaction is from host processor to MCU, the host processor will perform the following I²C sequence:
  - I²C start condition.
  - 7-bit slave address of MCU.
  - Write bit.
  - Host processor provides data according to the byte sequence defined for that specific command. For more details, please refer to the *MCU Command Description* section.
  - I²C stop condition.
- If a transaction is from MCU to host processor, the host processor will perform the following I²C sequence:
  - I²C start condition.
  - 7-bit slave address of MCU.
  - Read bit.
  - MCU will provide data according to the byte sequence specified in the command.
  - I²C stop condition.
- Checksum is calculated by performing bitwise XOR of the payload data which is not same as the traditional checksum.

The below table lists the legend and its description used in flowchart.

Table 4: Legend and its Description

Legend	Description
	Start or Stop
	MCU Command Block

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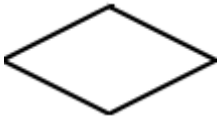
	Process Block
	Decision Block

Streaming Start Sequence

To start streaming, the sequence to be performed are as follows:

1. Send **Init Camera** command through I^2C interface.
2. Send **Get Command Status** command sequence through I^2C interface repeatedly, until the return status code is 0x0000.
3. Send **Stream Configure** command with desired frame format, width, height and frame rate.
4. Send **Get Command Status** command sequence through I^2C interface repeatedly, until the return status code is 0x0000.
5. Send **Stream ON** command to initiate streaming with updated stream configurations.
6. Send **Get Command Status** command sequence through I^2C interface repeatedly, until the return status code is 0x0000.

The flowchart of streaming start sequence is shown below.

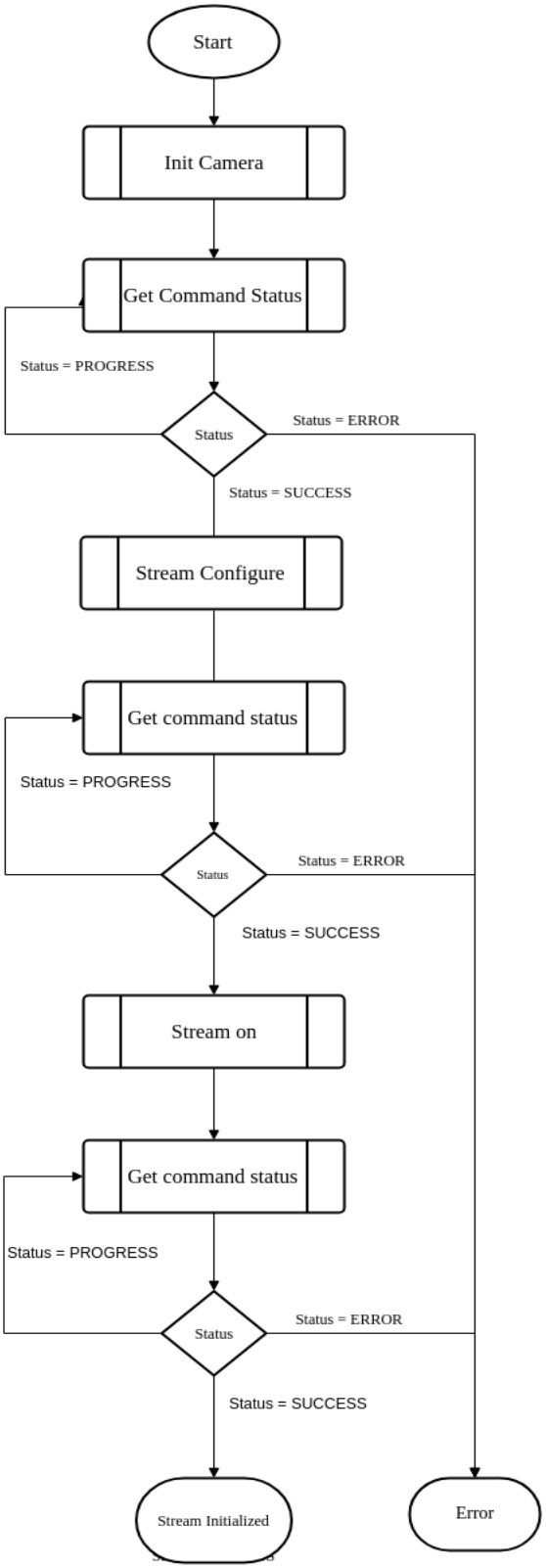


Figure 1: Flowchart of Streaming Start Sequence

Streaming Stop Sequence

To stop streaming, the sequence to be performed are as follows:

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1. Send **Stream OFF** command through I²C interface.
2. Send **Get Command Status** command sequence through I²C interface repeatedly, until the return status code is 0x0000.
3. Send **De-Init Camera** command through I²C interface.
4. Send **Get Command Status** command sequence through I²C interface repeatedly, until the return status code is 0x0000.

The flowchart of streaming stop sequence is shown below.

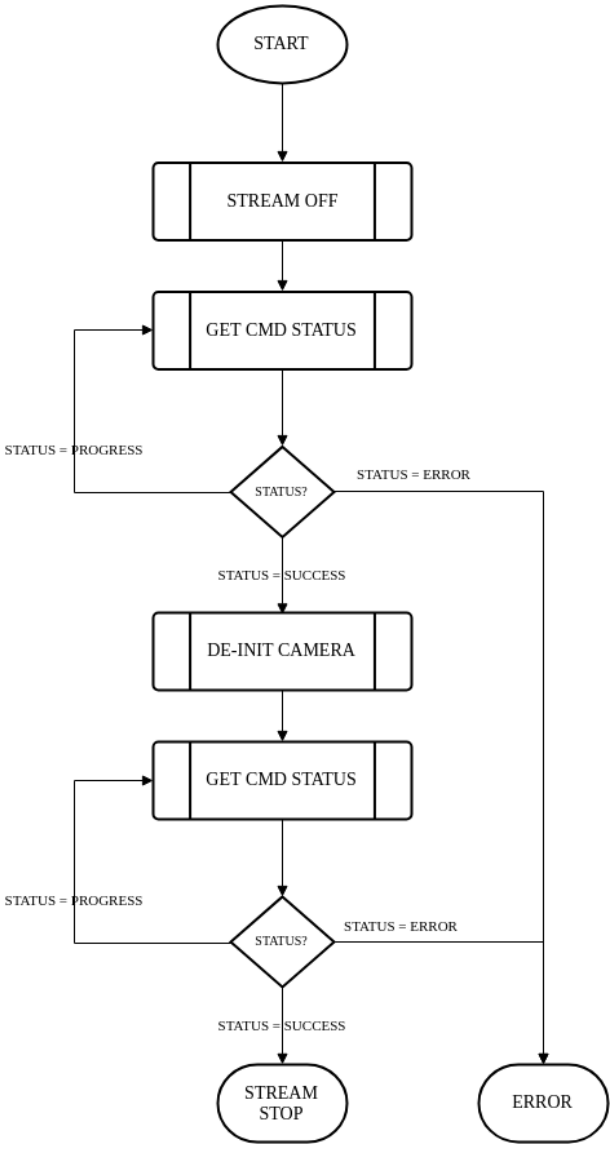

Figure 2: Flowchart of Streaming Stop Sequence

Changing Control Values

To change the control values, the sequence to be followed are as follows:

1. Ensure whether the camera is in streaming state, by performing the sequence of *Streaming Start Sequence* section.
2. Send **Set Control Value** command with desired control index, and ID value.

3. Send **Get Command Status** command sequence through I^2C interface repeatedly, until the return status code is 0x0000.

   The flowchart of changing control values is shown below.

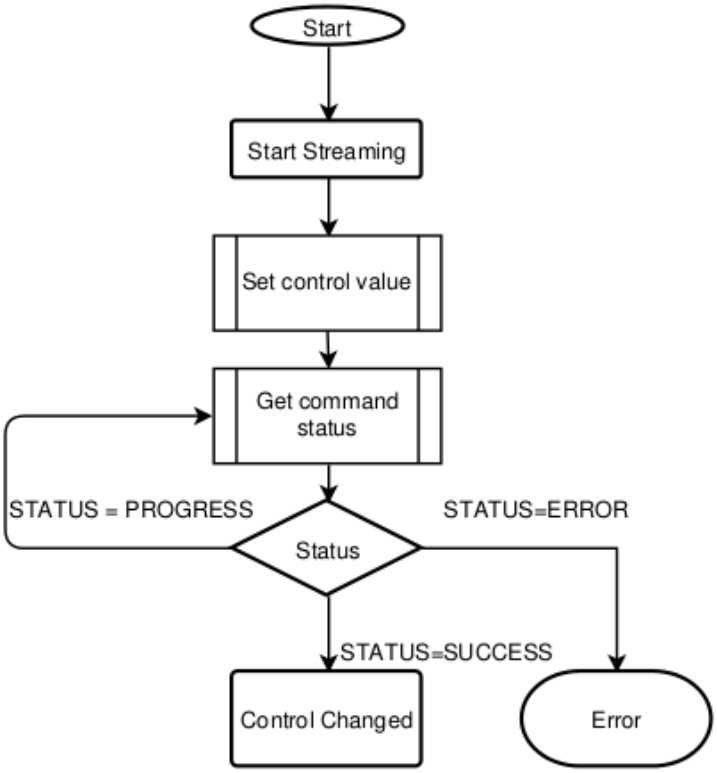

Figure 3: Flowchart of Changing Control Values

Changing Streaming Resolution

To change the streaming resolution, the sequence to be performed are as follows:

1. Follow the steps of *Streaming Stop Sequence* section if the streaming is already started.
2. Follow the steps of *Streaming Start Sequence* section with the desired stream configuration.

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MCU Command Overview

This section describes all the commands transferred between the host processor and MCU, and the return values from MCU to Host processor.

MCU I²C Slave Address

MCU has a I²C Slave address of 0x42, which is 7-bit addressing mode.

Note: The above address is required for all the transactions.

Types of Camera Commands

The different types of camera commands are as follows:

- Status command
- Configure command
- Query-Reply command

The below table lists the types of MCU commands.

Table 5: Types of MCU Commands

Status	Configure	Query-Reply
Get Command Status	Configure lane	Get Firmware Version
	Init Camera	Get Stream Info
	De-Init Camera	Get Control Info
	Stream ON	Get Control Value
	Stream OFF	
	Configure Stream	
	Set Control Value	

List of Camera Commands

The below table lists and describes all the camera commands that are supported by MCU.

Table 6: List of Camera Commands

S.NO	Command	Description	Query Command ID (Hex)
1	Get Firmware Version	This command is used to get the actual firmware version in the MCU.	0x00
2	Init Camera	This command initializes the camera by changing state of	0x04

		hardware pins and writing appropriate settings to the camera. This command returns immediately.	
3	Get Command Status	This command is used to query the status of any executed command. Additionally, it will return the current status of camera (Idle, Busy, and so on) and the hardware specific errors with respect to MCU.	0x05
4	De-Init Camera	This command de-initializes the camera by changing the state of hardware pins and writing the necessary configuration settings.	0x06
5	Stream On	This command will start the camera streaming process.	0x07
6	Stream Off	This command will stop the camera streaming process.	0x08
7	Configure Stream	This command sets the format, width, height and frame rate in the camera. The valid values are specified by Get Stream Info command.	0x09
8	Get Control value	This command gets the value of any control enumerated by Get Control Info command.	0x10
9	Set Control Value	This command sets the value of any control enumerated by Set Control Info command.	0x11
10	Configure lane	This command is used to configure the number of lanes	0x17

List of Camera Formats

The below table lists the camera format codes that are returned from MCU to host processor.

Table 7: List of Camera Formats

Format Code	Description
0x59565955	YUV 4:2:2 (UYVY)

List of Return Codes

The below table lists all the return codes that are transmitted from MCU to host processor.

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Table 8: List of Return Codes

Return Code	Description
0x00	Success or Command Completed
0x01	Busy or Command in Progress
0x02	Invalid Argument
0x03	Permission Denied
0x04	Device Not Found
0x05	I/O Error between ISP and MCU
0x06	Hardware Specific Error
0x07	Try Again
0x08	Already in Effect
0x09	Not Implemented
0x0A	Out of Range
0x0B - 0xFE	Reserved
0xFF	Unknown Failure

Note: For more details, please refer to the *Status Command* section.

List of Command Status Codes

The length of command status is 2-bytes. The command status code is returned by the MCU to the host processor. The below table lists the command status code and its description.

Table 9: List of Command Status Codes (General)

Command Status Code	Description
0x0000	No error or Command Completed
0xF000	Command in Progress

Note: For more details, please refer to the *Status Command* section.

Camera Status Codes

The below table lists the error codes returned by camera to the host processor.

Table 10: List of Command Status Codes (ISP)

Command Status Code	Description
0x0FF0	Camera is Powered Down
0x0FF1	Camera is Uninitialized

MCU Status Codes

The below table lists the error codes which describes the enumerations of errors specific to MCU.

Table 11: List of Command Status Codes (MCU)

Command Status Code	Description
0x2001	Master I^2C Init Error
0x2002	Master I^2C Timeout

0x2003	Master I^2C I/O Error
0x2004	SPI Init Error
0x2005	SPI Timeout Error
0x2006	SPI I/O Error
0x2007	USART Init Error
0x2008	Framework Error
0x2009	Slave I^2C I/O Error
0x200A	CRC Error

Note: The return values help in querying the current state of MCU.

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MCU Command Description

This section explains the transactions handled from MCU to host processor while processing the basic MCU Commands.

Status Command

The status command is used to query the status of MCU using the **Get Command Status** command. This command involves three transactions where the reply length from MCU is always constant. The transaction of status command is shown below.

Transaction 1 (Host Processor to MCU) (Write)	0x43	0x05	0x00, 0x01	0x01		
	Communication ID (1 Byte)	Command ID (1 Byte)	Payload Length (2 Bytes)	Check Sum of Payload (1Byte)		
Transaction 2 (Host Processor to MCU) (Write)	0x43	0x05	0xFF			
	Communication ID (1 Byte)	Command ID (1 Byte)	Query Command ID (Payload length)			
Transaction 3 (MCU to Host Processor) (Read)	0x43	0x05	0xXX	0xXX, 0xXX	0xXX	0xXX
	Communication ID (1 Byte)	Command ID (1 Byte)	Command ID of Issued Command (1 Byte)	Command Status Code (2 Bytes)	Check Sum (1 Byte)	Return code (1 Byte)

Figure 4: Transaction of Status Command

Note: The command ID returned by the MCU in Transaction 3 corresponds to the Command ID that was used prior to **Get Command Status** command. Please refer to the *List of Command Status Codes* section to know the various command status codes returned by MCU.

Configure Command

The configure command is used for starting an operation in the sensor through MCU. For example, Lane Config, Stream Config, Set Control Config, Init Cam and so on. This command always returns immediately, while MCU executes the request in the background. The status of the last issued command can be queried through the **Get Command Status** command. The configure command involves two transactions as shown below.

Transaction 1 (Write)	0x43	0xXX	0xXX, 0xXX	0xXX
	Communication ID (1 Byte)	Command ID (1 Byte)	Payload Length (2 Bytes)	Checksum (1 Byte)

	0x43	0xXX	0xXX, 0xXX	0xXX
Transaction 2 (Write)	Communication ID (1 Byte	Command ID (1 Byte)	Payload Data (Payload Length bytes)	Checksum (1 Byte)

Figure 5: Transaction of Configure Command

The below table lists the transaction values of configure command.

Table 12: Configure Command Transaction Values

Transaction	Packet		Configure lane	Init Camera	De Init Camera	Stream ON	Stream OFF	Configure Stream	Set Control Value
Transaction 1 (Host Processor to MCU)	Communication ID		0x43	0x43	0x43	0x43	0x43	0x43	0x43
	Command ID		0x17	0x04	0x06	0x07	0x08	0x09	0x11
	Payload Length	Byte 1	0x00	0x00	0x00	0x00	0x00	0x00	0xXX, 0xXX (Based on Control Index)
		Byte 2	0x02	0x00	0x00	0x00	0x00	0x0E	
	Checksum		0x02	0x00	0x00	0x00	0x00	0x0E	0xXX (Based on Control Index)
Transaction 2 (Host Processor to MCU)	Communication ID		0x43	0x43	0x43	0x43	0x43	0x43	0x43
	Command ID		0x17	0x04	0x06	0x07	0x08	0x09	0x11
	Payload		2-byte data (Based on Number of lanes). For more details, please refer to *Table 13*	-	-	-	-	14-byte data (Based on Format Index). For more details, please refer to Table 14	0xXX (Based on Control Index). For more details, please refer to *Table 16*
	Checksum		0xXX (Based on	-	-	-	-	0xXX (Based on	0xXX (Based on

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		Number of lanes)					Format Index)	Control Type)

Note: Please traverse the above table from top to bottom.

The below table lists the details about the communication to MCU from host, for configure lane.

Table 13: Configure Lane Payload Data

Number of Lanes	Payload Data (2B)	Payload Checksum (1B)
1	0x00, 0x01	0x01
2	0x00, 0x02	0x02
4	0x00, 0x04	0x04

Note: Lanes must be configured before Camera Init.

The below table lists the details about the communication to MCU from host, for configure stream.

Table 14: Configure Stream Payload Data

Formats	Payload Data in Bytes						Payload Checksum (1 B)
	Stream Index (2 B)	FourCC Format (4 B)	Width (2 B)	Height (2 B)	Frame Rate (Numerator) (2 B)	Frame Rate (Denominator) (2 B)	
720pat 120 fps	0x00, 0x00	0x59,0x56, 0x59,0x55	0x05, 0x00	0x02, 0xD0	0x00, 0x78	0x00, 0x01	0xAD
1080p at 70 fps	0x00, 0x01	0x59,0x56, 0x59,0x55	0x07, 0x80	0x04, 0x38	0x00, 0x46	0x00, 0x01	0xFE
1920x1200 at 60 fps	0x00, 0x02	0x59,0x56, 0x59,0x55	0x07, 0x80	0x04, 0xB0	0x00, 0x3C	0x00, 0x01	0x0F

Note: Please traverse the above table from left to right.

Query-Reply Command

The query-reply command is used to query information such as Streaming formats, Controls and so on, from MCU. This command uses four transactions between the host and MCU as shown below.

Transaction 1 (Write)

0x43	0xXX	0xXX	0xXX
Communication ID (1 Byte)	Command ID (1 Byte)	Payload Length (2 Bytes)	Checksum (1 Byte)

Transaction 2 (Write)

0x43	0xXX	0xXX, 0xXX	0xXX
Communication ID (1 Byte)	Command ID (1 Byte)	Payload Data (Payload Length)	Checksum (1 Byte)

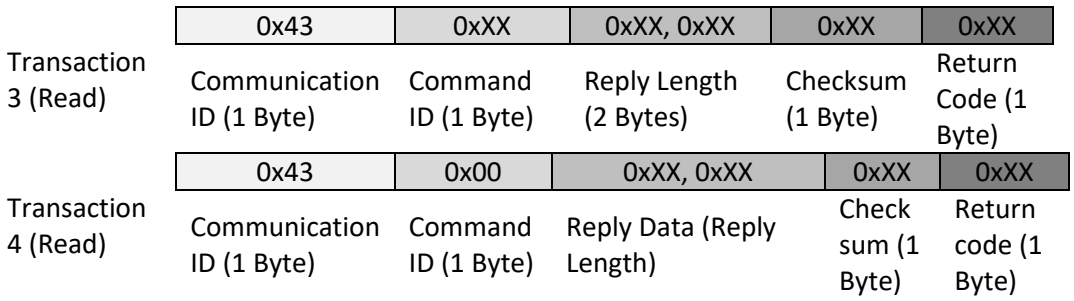

Figure 6: Transaction of Query-Reply Command

The below table lists the transaction values of query-reply command.

Table 15: Query-Reply Command Transaction Values

Transaction	Packet		Get Firmware Version	Get Control Value
Transaction 1 (Host Processor to MCU)	Communication ID		0x43	0x43
	Command ID		0x00	0x10
	Payload Length	Byte 1	0x00	0x00
		Byte 2	0x00	0x02
	Checksum		0x00	0x02
Transaction 2 (Host Processor to MCU)	Communication ID		0x43	0x43
	Command ID		0x00	0x10
	Payload Data		-	0xXX, 0xXX (Control Index)
	Checksum		-	0x00
Transaction 3 (MCU to Host Processor)	Communication ID		0x43	0x43
	Command ID		0x00	0x10
	Reply Length	Byte 1	0x00	0x00
		Byte 2	0x20	0x09
	Checksum		0x20	0x09
	Return Code		0x00	0x00
Transaction 4 (MCU to Host Processor)	Communication ID		0x43	0x43
	Command ID		0x00	0x10
	Reply Data		Firmware version - 32-bytes	Based on Control Index. For more details, please refer to *Table 16*
	Checksum		Based on reply data	Based on reply data
	Return Code		0x00	0x00

Note: Please traverse the above table from top to bottom.

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Controls of e-CAM217_CUMI0234_MOD

This section describes the controls available in e-CAM217_CUMI0234_MOD, which can be set or get through the MCU.

The available controls of e-CAM217_CUMI0234_MOD are as follows:

- Brightness
- Contrast
- Saturation
- White Balance (both automatic and manual)
- Gamma
- Gain
- Horizontal Flip
- Vertical Flip
- Sharpness
- Exposure (auto, manual and region of interest (ROI) based exposure)
- ROI Window Size
- External Trigger
- Strobe
- Denoise
- Exposure Compensation

The below table lists the get or set control payload data of e-CAM217_CUMI0234_MOD controls.

Table 16: Get or Set Control Payload Data

Control Name	Control Index (2 B)		Payload Data in Bytes								
			Control ID (4 B)				Control Type (1 B)	Current Value (4 B)			
Brightness	0x00	0x00	0x00	0x98	0x09	0x00	0x01	0xXX	0xXX	0xXX	0xXX
Contrast	0x00	0x01	0x00	0x98	0x09	0x01	0x01	0xXX	0xXX	0xXX	0xXX
Saturation	0x00	0x02	0x00	0x98	0x09	0x02	0x01	0xXX	0xXX	0xXX	0xXX
White Balance (Auto)	0x00	0x03	0x00	0x98	0x09	0x0C	0x01	0xXX	0xXX	0xXX	0xXX
Gamma	0x00	0x04	0x00	0x98	0x09	0x10	0x01	0xXX	0xXX	0xXX	0xXX
White Balance Temperature	0x00	0x05	0x00	0x98	0x09	0x1A	0x01	0xXX	0xXX	0xXX	0xXX
Sharpness	0x00	0x06	0x00	0x98	0x09	0x1B	0x01	0xXX	0xXX	0xXX	0xXX
Gain	0x00	0x07	0x00	0x98	0x09	0x13	0x01	0xXX	0xXX	0xXX	0xXX
Auto Exposure	0x00	0x08	0x00	0x9A	0x09	0x01	0x01	0xXX	0xXX	0xXX	0xXX
Manual Exposure	0x00	0x09	0x00	0x9A	0x09	0x02	0x01	0xXX	0xXX	0xXX	0xXX
Denoise	0x00	0x0A	0x00	0x9A	0x09	0x2d	0x01	0xXX	0xXX	0xXX	0xXX
Horizontal Flip	0x00	0x0B	0x00	0x98	0x09	0x14	0x01	0xXX	0xXX	0xXX	0xXX
Vertical Flip	0x00	0x0C	0x00	0x98	0x09	0x15	0x01	0xXX	0xXX	0xXX	0xXX

ROI Based Exposure	0x00	0x0D	0x00	0x9A	0x09	0x26	0x01	0xXX	0xXX	0xXX	0xXX
ROI Window Size	0x00	0x0E	0x00	0x9A	0x09	0x24	0x01	0xXX	0xXX	0xXX	0xXX
Exposure Compensation	0x00	0x0F	0x00	0x9A	0x09	0x31	0x01	0xXX	0xXX	0xXX	0xXX
External Trigger	0x00	0x10	0x00	0x9A	0x09	0x2A	0x01	0xXX	0xXX	0xXX	0xXX
Strobe	0x00	0x11	0x00	0x9A	0x09	0x2B	0x01	0xXX	0xXX	0xXX	0xXX

Note: Please traverse the above table from left to right.

Brightness Control

The brightness values can be changed from a minimum value of -15 to 15. This control increases the low light performance of e-CAM217_CUMI0234_MOD. The default value is 0.

Range: -15 (0xFFFFFFF1) to 15 (0x0000000F)

Data Type: 32-bit signed integer

Control ID: 0x00980900

Setting (Write) Brightness Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12*.

Getting (Read) Current Brightness Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15*.

Contrast Control

The contrast values can be changed from a minimum value of 0 to 30. Increasing the contrast value increases the luminance of e-CAM217_CUMI0234_MOD. The default value is 10.

Range: 0 (0x00000000) to 30 (0x0000001E)

Data Type: 32-bit unsigned integer

Control ID: 0x00980901

Setting (Write) Contrast Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12.*

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Getting (Read) Current Contrast Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15*.

Saturation Control

The saturation values can be changed from a minimum value of 0 to 60. Increasing the saturation value increases the intensity of the color of e-CAM217_CUMI0234_MOD. The default value is 16.

Range: 0 (0x00000000) to 60 (0x0000003C)

Data Type: 32-bit unsigned integer

Control ID: 0x00980902

Setting (Write) Saturation Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12*.

Getting (Read) Current Saturation Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 13*.

Auto White Balance Control

The white balance values can be toggled between 0 (manual) to 1 (auto). The default value is 1.

Range: 0 (0x00000000) to 1 (0x00000001)

Data Type: 32-bit unsigned integer

Control ID: 0x0098090C

Setting (Write) White Balance Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12*.

Getting (Read) Current White Balance Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15*.

White Balance Temperature Control

The manual white balance values can be changed from 10 to 10000. The default value is 4600. This control can be enabled only when auto white balance is set to 0 (manual).

Range: 1000 (0x0000000A) to 10000 (0x00002710)

Data Type: 32-bit unsigned integer

Control ID: 0x0098091A

Setting (Write) White Balance Temperature Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12*.

Getting (Read) Current White Balance Temperature Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15.*

Gamma Control

The gamma values can be changed from a minimum value of 40 to 500. The default value is 220.

Range: 40 (0x00000028) to 500 (0x000000DC)

Data Type: 32-bit unsigned integer

Control ID: 0x00980910

Setting (Write) Gamma Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12*.

Getting (Read) Current Gamma Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15*.

Gain Control

The gain values can be changed from a minimum value of 1 to 40. The changes will be updated only when exposure mode is set to manual. The default value is 1.

Range: 1 (0x00000001) to 40(0x00000028)

Data Type: 32-bit unsigned integer

Control ID: 0x00980913

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Setting (Write) Gain Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12.*

Getting (Read) Current Gain Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15.*

Horizontal Flip Control

The preview from the sensor can be horizontally flipped by setting the horizontal flip mode control value to 1 (ON). The default value is 0 (OFF).

Values: 0x00000000 (OFF) or 0x00000001 (ON)

Data Type: 32-bit unsigned integer

Control ID: 0x00980914

Setting (Write) Horizontal Flip Value

MCU Command type: Configuration command. Please refer to the *Set Control Value* of *Table 12.*

Getting (Read) Current Horizontal Flip Value

MCU Command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15.*

Vertical Flip Control

The preview from the sensor can be vertically flipped by setting the vertical flip mode control value to 1 (ON). The default value is 0 (OFF).

Values: 0x00000000 (OFF) or 0x00000001 (ON)

Data Type: 32-bit unsigned integer

Control ID: 0x00980915

Setting (Write) Vertical Flip Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12*.

Getting (Read) Current Vertical Flip Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15.*

Sharpness Control

The sharpness values can be changed from a minimum value of 0 to 127. This control increases the image clarity of e-CAM217_CUMI0234_MOD. The default value is 16.

Range: 0x00000000 to 0x0000007F

Data Type: 32-bit unsigned integer

Control ID: 0x0098091B

Setting (Write) Sharpness Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12.*

Getting (Read) Current Sharpness Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15.*

Exposure Control

e-CAM217_CUMI0234_MOD supports manual, auto and ROI based exposure controls. When exposure time is changed, the frame rate varies accordingly. The default exposure mode is Full FOV Auto Mode.

Values: 0x00000000 (Full FOV Auto Mode)

0x00000001 (Manual Mode)

0x00000002 (ROI based Auto Mode)

Data Type: 32-bit unsigned integer

Control ID: 0x009A0901

Setting (Write) Exposure Control Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12.*

Getting (Read) Current Exposure Control Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15.*

Manual Exposure Control

The manual exposure control is used to set the absolute exposure time for e-CAM217_CUMI0234_MOD. When exposure time is changed, the frame rate varies accordingly. The values range from 1 to 10000. The default value is 312. This control can be changed only when exposure control is set to manual mode.

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Values: 1 (0x00000001) to 4300 (0x00002710)

Data Type: 32-bit unsigned integer

Control ID: 0x009A0902

Setting (Write) Manual Exposure Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12.*

Getting (Read) Current Manual Exposure Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15.*

ROI Based Exposure Control

The ROI based exposure control is used to set the ROI to adjust the exposure. This control can be changed only when exposure control is set to ROI based auto mode. The preview window is mapped from 0 to 255 in both X and Y coordinates and is used as value.

The Y coordinate is represented in bits from 0 to 7.

The X coordinate is represented in bits from 8 to 15.

For example, (X, Y) = (100, 200) is represented as 0x000064C8.

The control values range from (X, Y) = (0,0) to (X, Y) = (255, 255).

Default value is (X, Y) = (128, 128).

Values: 0x00000000 (0, 0) to 0x0000FFFF (255, 255)

Data Type: 32-bit unsigned integer

Control ID: 0x009A0926

Setting (Write) ROI Based Exposure Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12.*

Getting (Read) Current ROI Based Exposure Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15.*

ROI Window Size

The ROI window size can be changed from a minimum value of 8 to 64. The default size is 24. This control can only be changed in steps of 8, for example, 8, 16, 24 and so on.

Values: 8 (0x00000008) to 64 (0x00000040)

Data Type: 32-bit unsigned integer

Control ID: 0x009A0924

Setting (Write) ROI Window Size Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12.*

Getting (Read) Current ROI Window Size Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15.*

External Trigger Control

The External Trigger control is used to enable external sensor trigger. The default value is 0.

Values: 0 (0x00000000) to 1 (0x00000001)

Data Type: 32-bit unsigned integer

Control ID: 0x009A092A

Setting (Write) External Trigger Control Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12.*

Getting (Read) Current External Trigger Control Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15.*

Strobe

The Strobe control is used to enable strobe. The default value is 0.

Values: 0 (0x00000000) to 1(0x00000001)

Data Type: 32-bit unsigned integer

Control ID: 0x009A092B

Setting (Write)Strobe Control Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12*.

Getting (Read) Current Strobe Control Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15*.

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Denoise Control

The denoise control is used to reduce noise in low lighting conditions. The default value is 8.

Values: 0 (0x00000000) to 15 (0x0000000F)

Data Type: 32-bit unsigned integer

Control ID: 0x009A092D

Setting (Write) Denoise Control Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12.*

Getting (Read) Current Denoise Control Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 15.*

Exposure Compensation Control

The exposure compensation control adjusts the upper limit of auto exposure. The default value is 16000.

Values: 8000 (0x00001F40) to 1000000 (0x000F4240)

Data Type: 32-bit unsigned integer

Control ID: 0x009A0931

Setting (Write) Exposure Compensation Control Value

MCU command type: Configuration command. Please refer to the *Set Control Value* of *Table 12.*

Getting (Read) Current Exposure Compensation Control Value

MCU command type: Query-Reply command. Please refer to the *Get Control Value* of *Table 125.*

What's Next?

After understanding the detailed information of I^2C based protocol used by the host application processor for communicating with the microcontroller, you can refer to the *e-CAM217_CUMI0234_MOD Datasheet* to understand more about e-CAM217_CUMI0234_MOD.

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Glossary

CMOS: Complementary Metal Oxide Semiconductor.

CSI: Camera Serial Interface.

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

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

MCU: Microcontroller unit.

MIPI: Mobile Industry Processor Interface.

ROI: Region of Interest.

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

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

Support

Contact Us

If you need any support on e-CAM217_CUMI0234_MOD 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

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Revision History

Rev	Date	Description	Author
1.0	19-Apr-2023	Initial draft	Camera Dev Team
1.1	24-Mar-2025	The mode 320 x 240 is removed and updated MCU firmware version	Camera Dev Team