Allied Vision

mipi Direct Register Access

MIPI CSI-2 Cameras

Direct Register Access Controls Reference

V2.6.1

Latest FW: V00.15.00.c67f770e

Allied Vision Technologies GmbH // Taschenweg 2a, 07646 Stadtroda / Germany

2026-Aug-20

This reference at a glance

This document describes controls for the **Direct Register Access** of Alvium CSI-2 cameras.

CSI-2 access mode	Description
Direct Register Access 	Controls the camera by reading from and writing to registers, using an embedded board or an FPGA.
Video4Linux Access 	Controls the camera by V4L2 controls, using the Allied Vision MIPI CSI-2 V4L2 and GenICam Hybrid Driver directly. Existing PC-based machine vision applications can be scaled down to V4L2 on lean embedded systems, reducing power consumption and costs.

Table 1: CSI-2 Access modes overview

Parameter	Value
Firmware release version	00.15.00.c67f770e
CCI Register Layout Version	1.0

Table 2: Supported firmware version and CCI Register Layout Version

What else do you need?

The following downloads provide additional information.

Document	Link
Alvium CSI-2 Cameras User Guide	www.alliedvision.com/en/support/camera-documentation/area-scan-cameras-documentation/alvium-csi-2-documentation
Various other documents and downloads	
Descriptions for Allied Vision CSI V4L2 I2C Subdevice Driver Features	www.alliedvision.com/downloads/docs/Allied_Vision_CSI_V4L2_IC2_Subdevice_Driver_Features

Table 3: Additional downloads overview

Contact us

Quick links

Products
www.alliedvision.com/en/products

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Contents

Document history and conventions

This chapter includes:

Document history

Alvium X- in document history entries

The letter X in Alvium X- represents any Alvium series, such as Alvium 1500 C or Alvium FP3.

Version	Date	Remarks
V2.6.1	2026-Aug-20	**Firmware versions** • Alvium CSI-2 main firmware: 00.15.00.c67f770e • Alvium 1500 C-050: 00.11.00.9cf0c21e **Applied changes** • Applied editorial changes.
V2.6.0	2026-Apr-23	**Firmware versions** • **Release**: Alvium CSI-2 main firmware: 00.15.00.c67f770e • Alvium 1500 C-050: 00.11.00.9cf0c21e **Applied changes** • Updated the reference firmware version. • Updated graphic elements in Image data flow on page 27. • Updated Pixel format naming on page 18. • Added Regions of interest and auto mode regions on page 29. • Removed "Value" suffix from several control names for consistent naming. • General controls on page 32: - Added `Sensor Identification`, `User Data Index`, `User Data Value`, `Device Status`, and `Device Power Saving Mode`. - Renamed `Device Temperature` to `Main-board Temperature` and moved here. • Streaming on page 39: - Removed `CSI-2 Phy Reset`. - Renamed `Supported CSI-2 Lane Counts` to `CSI-2 Lane Count Inquiry`. • Acquisition on page 42: Added `Acquisition Abort` and `Frame Start Trigger Delay`. Continued on the next page.

Version	Date	Remarks

V2.6.0	2026-Apr-09	Continued from the previous page.
		
		• I/O controls on page 49:
		  - Replaced Line2 by Line0 and Line3 by Line1 for control descriptions
		  - Added `Frame Trigger Wait Output Line` and `Frame Trigger Wait Output Line Mode`.
		• Image Format on page 54:
		  - Renamed `Available MIPI Data Formats` to `MIPI Data Format Inquiry`, `Width Max` to `Width Max After Binning`, and `Height Max` to `Height Max After Binning` for better clarity.
		  - Updated values for `MIPI Data Formats` and `MIPI Data Formats Inquiry`.
		• Brightness on page 69: Added `Exposure Time And Gain` and `Intensity Controller Region`, and `Auto Mode Region` controls.
		• Color Management on page 90: Added `Color Transformation` controls.
		• Image Correction on page 105: Added `DPC Enable`.
		• Added controls for Test Pattern on page 106.
		• Applied editorial changes.

V2.5.1	2024-Nov-20	**Firmware versions** • Alvium CSI-2 main firmware: 00.14.00. baba1e3c • Alvium X-050: 00.11.00.9cf0c21e **Applied changes** • Updated values descriptions for `Gain Auto` in Brightness on page 69. • Applied editorial changes.

Version	Date	Remarks
V2.5.0	2024-Oct-11	**Firmware versions** • **Release**: Alvium CSI-2 main firmware: 00.14.00. baba1e3c • Alvium X-050: 00.11.00.9cf0c21e **Applied changes** • Updated the title image to include Alvium FP3 and Alvium GM2 models. • Updated addresses in Contact us on page 3. • Changes to CCI registers on page 20. - Updated the description for `Soft Reset`. - Added `Heartbeat`. • Update diagrams for Image data flow on page 27 and Control interdependencies on page 28. • Added links to Control interdependencies on page 28 for the order of flipping and cropping of images. • Added note in General controls on page 32 to use `Write Done Handshake` only for V4L2 registers. • In Image Format on page 54: - Removed “Digital” from Binning control names. - Added options for sensor binning in `Binning Inquiry` and `Binning Setting`. • Updated firmware versions in this table. • Applied editorial changes.
V2.4.2	2023-Sep-29	**Firmware versions** • **Release**: Alvium CSI-2 main firmware: 00.12.00.00611a22 • Alvium X-050: 00.11.00.9cf0c21e **Applied changes** • Corrected order for ***`YUV422 8-bit (UYVY)`*** option in 0x0148 | MIPI Data Format Inquiry on page 61. • Added Write access for 0x0154 | Bayer Pattern on page 63. • Applied editorial changes.

Version	Date	Remarks
V2.4.1	2023-Jun-15	**Firmware versions** • **Release**: Alvium CSI-2 main firmware: 00.12.00.00611a22 • Alvium X-050: 00.11.00.9cf0c21e **Applied changes** Corrected numbers in image data flow for Controls processing order on page 27.
V2.4.0	2023-Jun-05	**Firmware versions** • **Release**: Alvium CSI-2 main firmware: 00.12.00.00611a22 • Alvium X-050: 00.11.00.9cf0c21e **Applied changes** • Added register descriptions for Digital binning controls. • Added notes for `Height Max` and `Width Max` related to binning. • Added digital binning to Controls processing order on page 27. • Changed unit MBps to Mbit/s for 0x0044 and 0x0048 registers. • Adjusted Line IDs in control descriptions to match the convention: Line2 uses GPIO-EXT2 and Line3 uses GPIO-EXT3. • Applied editorial changes.
V2.3.1	2021-Dec-17	**Firmware version**: 00.07.00.81db3896 • Removed information on Digital Binning because it is not supported by the current camera driver. • Applied editorial changes.
V2.3.0	2021-Dec-07	**Firmware version**: 00.07.00.81db3896 • Added Controls processing order on page 27. • Added register descriptions for `Camera I2C Address` controls in CCI registers on page 20. • Added register descriptions for `Digital Binning` controls in V4L2 registers on page 31. • Applied editorial changes.

Version	Date	Remarks
V2.2.0	2021-Apr-22	**Firmware version**: 00.04.00.34658 • Added RAW pixel formats for 10-bit and 12-bit Mono in - `MIPI Data Format` - `Available MIPI Data Formats`. • Correct the address for ***`YUV422 8-bit (UYVY)`*** in `MIPI Data Format` • Added register descriptions: - `Exposure Active Output` controls - `Line Configuration` - `Line Status` • Applied editorial changes.

V2.1.0	2020-Dec-08	**Firmware version**: 00.03.00.31919
		• Added register descriptions:
		- `Intensity Auto` controls
		- Controls for value ranges of
		`Exposure Auto`
		`Gain Auto`
		- Controls for
		`Acquisition Frame Rate`
		`Frame Start Trigger`
		• Changed pixel format naming to improve clarity. See Pixel format naming on page 18.
		• Applied editorial changes.

V2.0.1	2020-Feb-14	**Firmware version**: 00.01.02.28100 • Added descriptions for target values used with `Exposure Auto` and `Gain Auto`. • Reworked descriptions for register addresses.
V2.0.0	2020-Jan-06	**Firmware version**: 00.01.02.28100 • Added register descriptions to control `Width`, `Offset X`, `Saturation`, and `Hue`. • Added notes for Improper operation on page 19. • Applied editorial changes.
V1.0.0	2019-Jun-14	**Firmware version**: 00.01.00.26405 Release version

Conventions used in this document

To give this document an easily understood layout and to emphasize important information, the following typographical styles are used:

Typographical styles

Style	Function
`Control`	Control names
Emphasis	Programs, or highlighting important things
`Value`	Control values (modes)
Web links and references	Links to webpages and internal cross references

Table 4: Typographical styles

Symbols and notes

Practical tip

Additional information helps to understand or ease handling the camera.

Avoiding malfunctions

Precautions are described.

Additional information

Web address or reference to an external source with more information is shown.

Controls access

Acronym	Meaning
R/W	Read and write control
R/C	Read-only control that is constant
R	Read-only control that may change
W	Write-only control

Table 5: Controls access

Controls order

The document defines controls listed by register address, grouped in categories.

Reading register descriptions

The following example shows the description for `V4L2 Register Map Version`. Contents highlighted in **red** are explained below.

0x0000 | V4L2 Register Map Version

Displays the version of the V4L2 register map layout. The first version is ***1.0***, where major version = ***1***, minor version = ***0***.

Offset	0x0000
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Availability	All camera models

Bit offset (LSB << x)	Width (bits)	Description
0	16	Minor version of the V4L2 register map.
16	16	Major version of the V4L2 register map.

Explanation

Offset: For CCI registers, addresses are absolute; for V4L2 registers, addresses are relative. Because of this, **Offset** is used for register addresses. See Registers and address spaces on page 18.

LSB: The LSB is shifted by the number of bits represented by **x**.

In the example, the LSB is shifted by 16 bit to set the value to ***Major Version***.

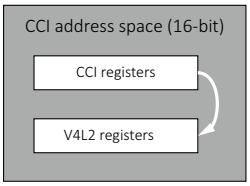
Controls behavior and registers

This chapter informs about writing registers:

Registers and address spaces

Alvium CSI-2 cameras are operated via the Camera Control Interface (CCI) protocol, which requires a 16-bit address space. Within this space, different register maps can be found:

Register map	Function	Reference
CCI register map	Basic information	CCI registers on page 20
V4L2 register map	**Video4Linux Access**	V4L2 registers on page 31



The CCI address space used to operate Alvium CSI-2 cameras contains the CCI register map and the V4L2 register map. To get the absolute address of V4L2 registers, you must consider the offset of the CCI register map.

For the absolute address of V4L2 registers:

1. Read out 0x0014 | V4L2 Register Map Address on page 21.
2. Add this value to the relative address of V4L2 registers in V4L2 registers on page 31.

Pixel format naming

In Direct Register Access, Alvium CSI-2 cameras output pixel formats according to the MIPI CSI-2 standard, **in Video4Linux Access**, according to V4L2 definitions. This document states extended MIPI CSI-2 definitions:

Naming pattern	Examples
MIPI CSI-2 (FOURCC)	RAW8 (GREY)
	RGB888 (RGB3)

Table 6: Extended MIPI CSI-2 definitions for pixel format naming

Media Bus Format describes the string output by the Alvium MIPI CSI-2 driver to be received by the MIPI CSI-2 driver installed on the embedded board. Every Media Bus Format is assigned to a single MIPI CSI-2 pixel format.

More than one 4L2 format for a Media Bus Format

Sometimes, host drivers offer more than one V4L2 format for Media Bus Formats. Use `media-ctl -p command` to query which Media Bus Format (and the corresponding CSI format) is currently used by the host driver.

MIPI CSI-2	Media Bus Format	V4L2	V4L2 FOURCC	PFNC
YUV422 8-bit	MEDIA_BUS_FMT_UYVY8_2X8	V4L2_PIX_FMT_UYVY	UYVY	YCbCr422_8_CbYCrY
RGB888	MEDIA_BUS_FMT_RGB888_1X24	V4L2_PIX_FMT_RGB24	RGB3	RGB8
RAW8	MEDIA_BUS_FMT_Y8_1X8	V4L2_PIX_FMT_GREY	GREY	Mono8
RAW8	MEDIA_BUS_FMT_SRGGB8_1X8	V4L2_PIX_FMT_SRGGB8	RGGB	BayerRG8*
RAW8	MEDIA_BUS_FMT_SGRGB8_1X8	V4L2_PIX_FMT_SGRBG8	GRBG	BayerGR8*
RAW8	MEDIA_BUS_FMT_SGBRG8_1X8	V4L2_PIX_FMT_SGBRG8	GBRG	BayerGB8*
RAW8	MEDIA_BUS_FMT_SBGGR8_1X8	V4L2_PIX_FMT_SBGGR8	BA81	BayerBG8*
RAW10	MEDIA_BUS_FMT_Y10_1X10	V4L2_PIX_FMT_Y10	Y10	Mono10
RAW10	MEDIA_BUS_FMT_SRGGB10_1X10	V4L2_PIX_FMT_SRGGB10	RG10	BayerRG10*
RAW10	MEDIA_BUS_FMT_SGRGB10_1X10	V4L2_PIX_FMT_SGRBG10	BA10	BayerGR10*
RAW10	MEDIA_BUS_FMT_SGBRG10_1X10	V4L2_PIX_FMT_SGBRG10	GB10	BayerGB10*
RAW10	MEDIA_BUS_FMT_SBGGR10_1X10	V4L2_PIX_FMT_SBGGR10	BG10	BayerBG10*
RAW12	MEDIA_BUS_FMT_Y12_1X12	V4L2_PIX_FMT_Y12	Y12	Mono12
RAW12	MEDIA_BUS_FMT_SRGGB12_1X12	V4L2_PIX_FMT_SRGGB12	RG12	BayerRG12*
RAW12	MEDIA_BUS_FMT_SGRGB12_1X12	V4L2_PIX_FMT_SGRBG12	BA12	BayerGR12*
RAW12	MEDIA_BUS_FMT_SGBRG12_1X12	V4L2_PIX_FMT_SGBRG12	GB12	BayerGB12*
RAW12	MEDIA_BUS_FMT_SBGGR12_1X12	V4L2_PIX_FMT_SBGGR12	BG12	BayerBG12*
* Depending on the camera model and Bayer pattern				

Table 7: Equivalent pixel formats in various standards

Availability of pixel formats

The availability of pixel formats depends on camera models and the abilities of the connected system.

Improper operation

If registers are not used properly, the camera may behave unexpectedly, such as changing values or ignoring operations. To avoid malfunctions and camera crashes, we recommend you to:

- Use only documented register addresses
- Keep values in the specified range
- Write only to registers specified for writing access, not to reading registers
- Write to one register at a time
- Ensure that the camera has completed writing to registers.
  Use 0x0018 | Write Done Handshake on page 35 to poll the camera.

As best practice, read written values back from the camera. Should errors occur:

- Verify register access options and adjust your script accordingly.
- Check for conflicts between settings.

CCI registers

0x0000 | CCI Register Layout Version

Displays the version of the CCI register layout. This register is used to check for the compatibility of the register layout with the previous version. The first version is ***1.0***, where major version = ***1***, minor version = ***0***.

Offset	0x0000
Type	UInt32
Access	R
Size [Bytes]	4

Bit offset (LSB << x)	Width (bits)	Description
0	16	Minor version of the CCI register layout.
16	16	Major version of the CCI register layout.

0x0008 | Device Capabilities

Displays information about the camera's capabilities, such as access modes or string encoding.

Offset	0x0008
Type	UInt64
Access	R
Size [Bytes]	8

Bit offset (LSB << x)	Width (bits)	Description
0	1	`User Defined Name` is supported.
1	1	**Video4Linux Access** is supported.
2	2	**Vimba Access** is supported (selected models only).
4	4	String encoding of I2C string registers is supported. • 0x0 -> ASCII
8	1	`Family Name` is supported.
9	55	Reserved.

0x0014 | V4L2 Register Map Address

Displays the address of V4L2 register map. Use as offset to get absolute addresses of V4L2 registers.

Offset	0x0014
Type	UInt16
Access	R
Size [Bytes]	2

0x0018 | Device GUID

Displays the GUID (Globally Unique Identifier) of the camera.

Offset	0x0018
Type	String
Access	R
Size [Bytes]	64

0x0058 | Manufacturer Name

Displays the camera manufacturer name.

Offset	0x0058
Type	String
Access	R
Size [Bytes]	64

0x0098 | Model Name

Displays the camera model name.

Offset	0x0098
Type	String
Access	R
Size [Bytes]	64

0x00D8 | Family Name

Displays the camera family name.

Offset	0x00D8
Type	String
Access	R
Size [Bytes]	64

0x0118 | Device Version

Displays the camera's device version.

Offset	0x0118
Type	String
Access	R
Size [Bytes]	64

0x0158 | Manufacturer Info

Displays the manufacturer information.

Offset	0x0158
Type	String
Access	R
Size [Bytes]	64

0x0198 | Serial Number

Displays the camera's serial number.

Offset	0x0198
Type	String
Access	R
Size [Bytes]	64

0x01D8 | User Defined Name

Controls the user defined name.

Offset	0x01D8
Type	String
Access	R/W
Size [Bytes]	64

0x0218 | Checksum

Displays the checksum which can be used for the register space 0x0000 to 0x0217.

Offset	0x0218
Type	UInt32
Access	R
Size [Bytes]	4

Use this control to check if data was transferred to the host correctly. Make sure that the host calculates the checksum with the following parameters:

Name	JAMCRC
Width	32 bit
Polynomial	0x4C11DB7
Input reflected	Yes
Output reflected	Yes
Output XOR value	0x00000000
Example output for ASCII input string "123456789" (9 bytes)	0x340BC6D9

0x021E | Soft Reset

Performs a soft reset of the camera.

Offset	0x021E
Type	UInt8
Access	W
Size [Bytes]	1

To reset the camera:

1. Write 0x80 to `Heartbeat`.
2. Write *1* to `Soft Reset`.
   This initiates the reset.
3. Poll `Heartbeat` every 400 milliseconds.
   The camera has been successfully reset, when the register value is >0 and <0x80.

Note: The camera's boot / reset time is about 5 to 8 seconds.

0x021F | Heartbeat

Controls the current heartbeat (clock frequency) of the CSI-2 link.

Note: The register value is incremented by ***1*** every 500 milliseconds approximately. When ***255*** is reached, it falls back to ***0***.

Offset	0x021F
Type	UInt8
Access	R/W
Size [Bytes]	1

0x0220 | Camera I2C Address

Controls the I2C address that becomes valid after the next camera reboot.

Offset	0x0220
Type	UInt8
Access	R/W
Size [Bytes]	1

Value	Description
0x3C	Default value

CSI-2 streaming setup

The following steps must be performed to transfer a lane count and clock frequency for CSI-2 between host and device:

1. The host determines which lane counts are supported by the host (by such as hardware and driver).
2. The host reads the `Supported CSI-2 Lane Count` register from the device. This register contains a bitfield to indicate which lane counts are supported by the device.
3. The host selects a lane count that is compatible to host and device. Potential modes:
   - Automatically select the highest lane count supported by host and device.
   - Manually select one of the lane counts that are supported by host and device.
4. The host determines the CSI clock frequency range supported by host (by hardware, driver etc.) for the selected lane count (from step 3).
5. The host writes the selected lane count (from step 3) into the `CSI-2 Lane Count` register.
6. The host reads `CSI-2 Clock Min Value` and `CSI-2 Clock Max Value` registers to get the range for the clock frequency supported by the device for the selected lane count (from step 3).
7. The host selects a clock frequency that is compatible to host and device. Potential modes:
   - Automatically select the highest clock frequency supported by host and device.
   - Manually select a clock frequency that is supported by host and device.
8. The host writes selected clock frequency (from step 7) to the `CSI-2 Clock` register. The device may not be able to support the exact clock frequency selected. In this case it will use the highest clock frequency that is lower or equal to the clock frequency written to the register.

   Example: The transport layer writes 650 MHz to the register of a device that only supports clock frequencies with a multiple of 100 MHz. In this case the device uses a clock frequency of 600 MHz (6 × 100 MHz).

9. The host reads the actual clock frequency from the `CSI-2 Clock` register.
10. The host checks if the actual clock frequency used in the device (from step 9) lies in the range of clock frequencies supported by the host (from step 4). If not, image acquisition cannot be started, and an error will be issued on the host.

Sometimes, this procedure does not transfer a lane count or it does not select a compatible clock frequency supported by the host. In this case, image acquisition cannot be started and an error is issued on the host.

The host must perform this negotiation during opening the device (for example, so that any frame rate limit calculation in the device can take the result of this negotiation into consideration).

Numeric registers

Most of the numeric controls listed in the next chapter consist of a list of four registers:

1. Value register: Used for reading or writing the current value of the control.
2. Minimum register: The minimal value that can be set to the value register.
3. Maximum register: The maximal value that can be set to the value register.
4. Increment register: The step or increment of values valid for the value register (beginning with minimal value).

For such a control, a valid value must hold the following three conditions true:

1. Value >= minimum
2. Value <= maximum
3. ((Value- minimum) % increment) == 0

If a value is written to such value register that is not valid, the camera will correct the value to the nearest valid value. The updated or corrected value can be read back by the user.

This control behavior is used for the following controls:

- `Acquisition Frame Rate`
- `Black Level`
- `Blue Balance Ratio`
- `Exposure Time`
- `Gain`
- `Gamma`
- `Height`
- `Hue`
- `Intensity Auto Target`
- `Offset X`
- `Offset Y`
- `Red Balance Ratio`
- `Saturation`
- `Width`

Target values for auto controls

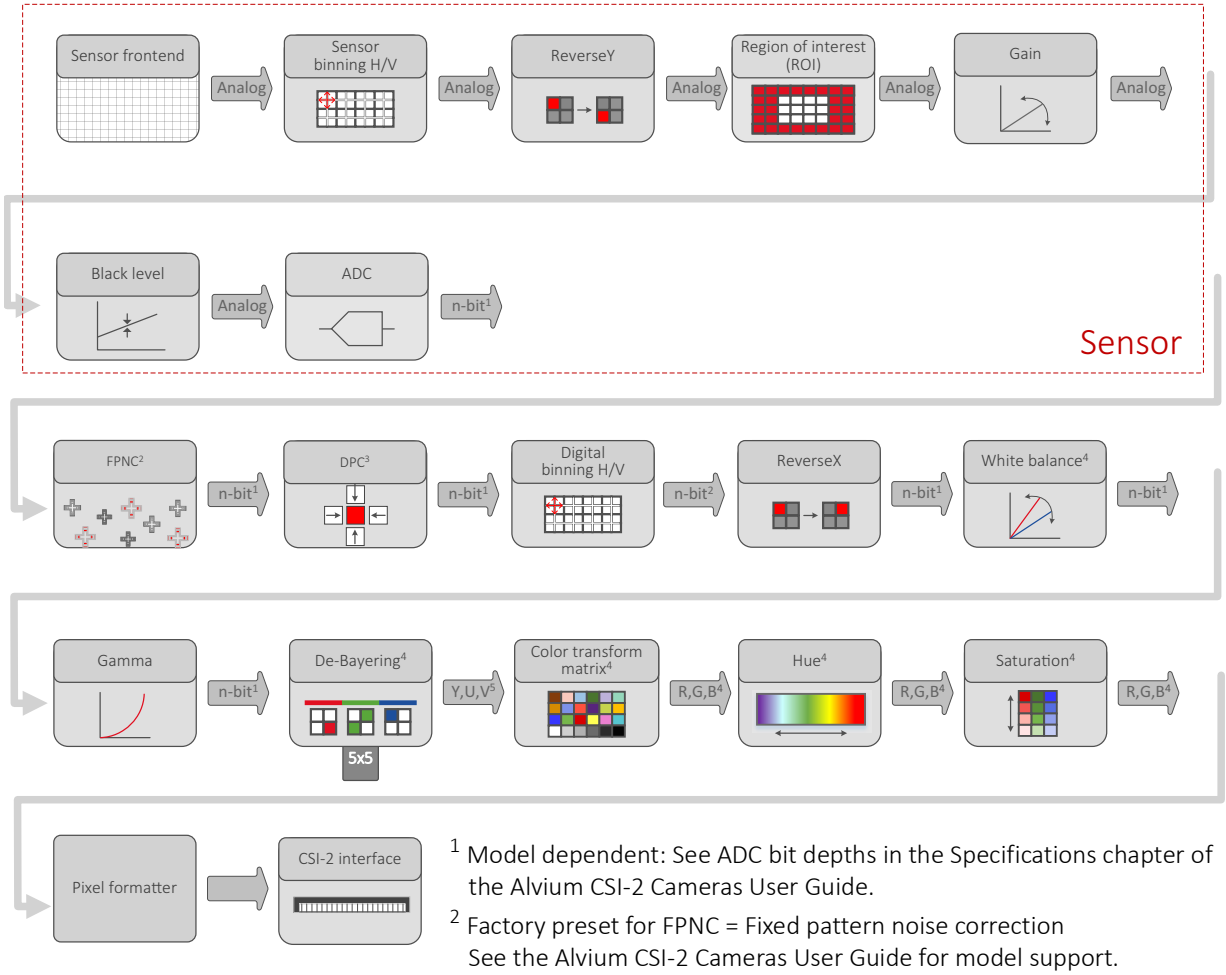
`Exposure Auto` and `Gain Auto` adjust the mean pixel intensity to a target value of 50% between minimum and maximum. Use `Intensity Auto Target` controls to adjust the target value (with a tolerance of 5%). Use `Intensity Auto Precedence` to set the priority between `Exposure Auto` and `Gain Auto`.

Controls processing order

Image data flow

To develop your application effectively, note the order in which the controls are **processed** in Alvium cameras. In the Alvium user guides, the image data flow describes the sequence of image processing steps inside the camera. The shown functionalities represent controls or control groups.

See Control interdependencies on page 28 for the recommended order to **configure** the camera.



[1] Model dependent: See ADC bit depths in the Specifications chapter of the Alvium CSI-2 Cameras User Guide.

[2] Factory preset for FPNC = Fixed pattern noise correction
See the Alvium CSI-2 Cameras User Guide for model support.

[3] Factory preset for DPC = Defect pixel correction

[4] Color models only

[5] For monochrome models: Y only

Figure 1: Image data flow for Alvium CSI-2 cameras

Control interdependencies

The conversion between time and clock cycles affects control values. Controls for pixel format, bandwidth, cropping (ROI), exposure time, and triggering are related to each other. Changing values for one control can change values for another control. For example, frame rates can be reduced when `Mipi Data Format` is changed subsequently. Figure 2 shows the interdependencies.

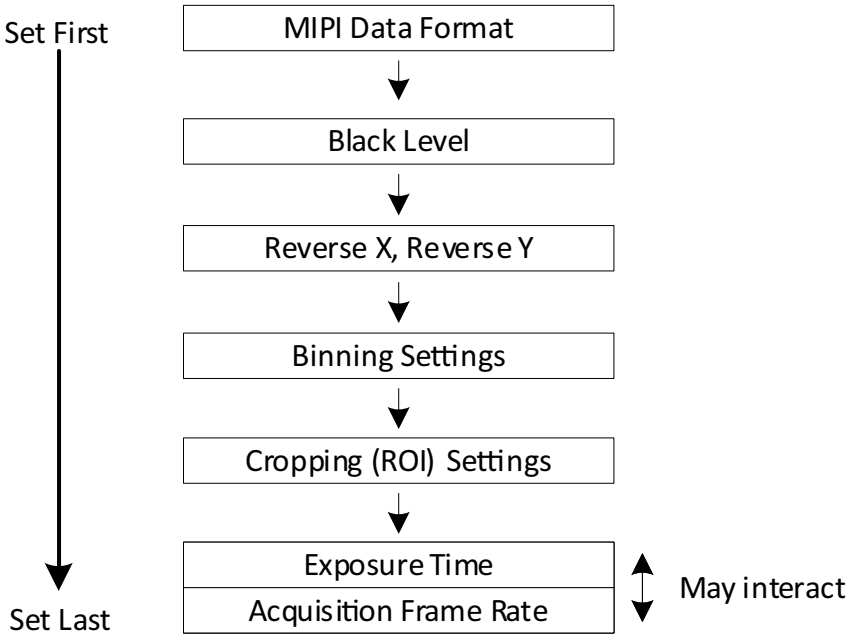


Figure 2: Interdependencies between controls

Regions of interest and auto mode regions

Term: ROI (region of interest)

In machine vision, this term is the equivalent to **Cropping** known from V4L2.

Auto mode regions are areas of the image, where measurements are done for various auto controls, such as for intensity with auto exposure. Several auto mode regions are supported. Figure 3 shows controls to define regions of interest (ROIs) and auto mode regions.

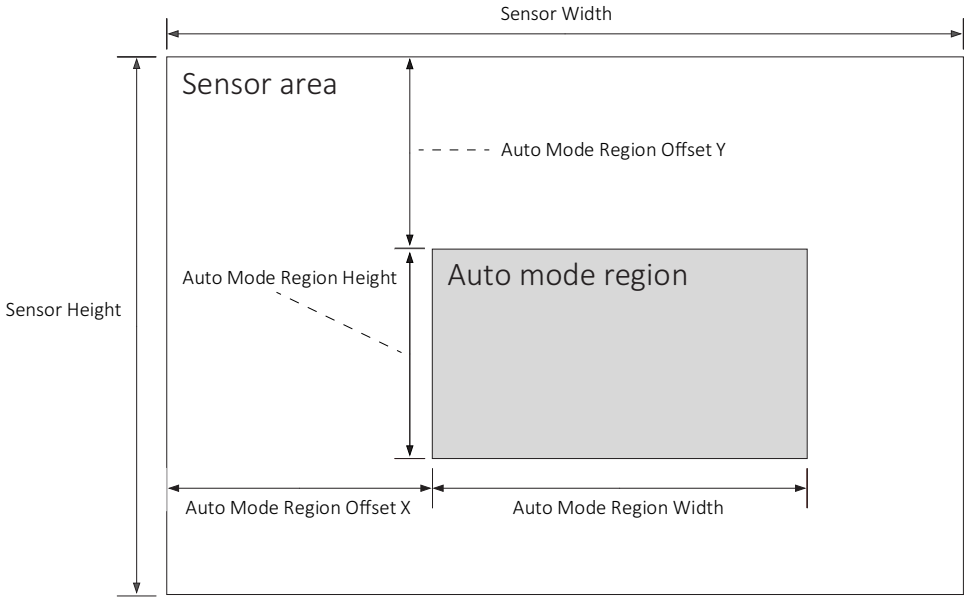


Figure 3: Auto mode region and ROI measurement controls

Basic rules

Set ROIs before auto mode regions:

- Auto mode region and ROI coordinates relate to the origin of the sensor pixel area. If the ROI position is changed, the absolute position of the auto mode region is maintained.
- The auto mode region must be a subset of the respective ROI.
- When auto mode regions are enabled initially, the position and size are the same as for the current ROI. Therefore: If adjust settings for an auto mode regions first, then disable and re enable it again, your previous settings will be lost. The position and size will be the same as for the current ROI again.
- Otherwise, if the ROI is changed so that the auto mode region the ROI do not overlap, the auto mode region is disabled.

ROI and auto mode region effects

Auto mode regions are always treated as a subset of ROIs. Figure 4 shows the interaction between ROIs and auto mode regions:

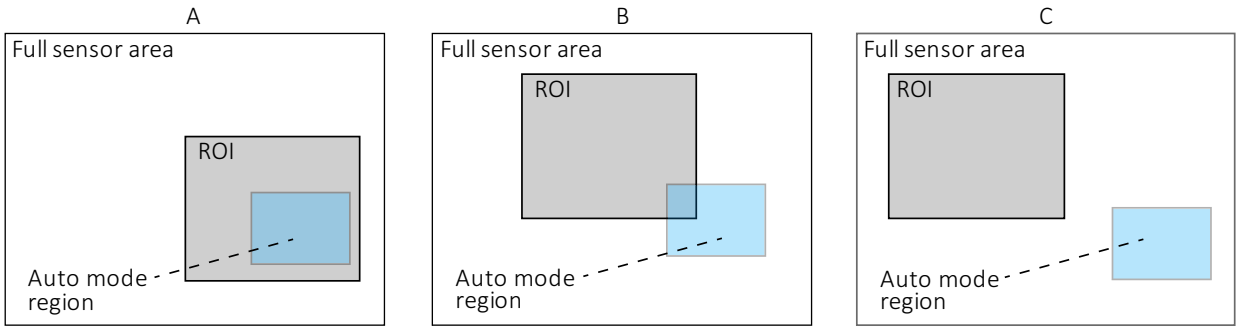


Figure 4: ROI and auto mode region > Effects

A.

Scenario: User input creates an auto mode region included by a larger ROI.

Result: Camera logic applies no changes to the selected auto mode region. The complete auto mode region is effective.

B.

Scenario: User input creates a common area between the ROI that partly overlaps with the auto mode region.

Result: Camera logic reduces the effective auto mode region to the common area between auto mode region and ROI.

Recommendation: Relocate and resize the auto mode region to become a subset of or to equal the ROI.

C.

Scenario: User input creates a ROI and auto mode region that do not overlap.

Result: Camera logic disables the auto mode region.

Recommendation: Create an auto mode region that overlaps or that is equal to the ROI.

V4L2 registers

This chapter defines controls listed by register address and grouped in controls categories:

Register offset

The CCI address space used to operate Alvium CSI-2 cameras contains the CCI register map and the V4L2 register map. To get the absolute address of V4L2 registers, you must consider the offset of the CCI register map.

For the absolute address of V4L2 registers:

1. Read out 0x0014 | V4L2 Register Map Address on page 21.
2. Add this value to the relative address of V4L2 registers.

General controls

0x0000 | V4L2 Register Map Version

Displays the version of the V4L2 register map layout. The first version is ***1.0***, where major version = ***1***, minor version = ***0***.

Offset	0x0000
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	General
Availability	All camera models

Bit offset (LSB << x)	Width (bits)	Description
0	16	Minor version of the V4L2 register map.
16	16	Major version of the V4L2 register map.

0x0008 | Register Inquiry

Displays if non-mandatory registers are available.

Note: Availability can change during runtime.

Offset	0x0008
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Control group	General
Availability	All camera models

Bit offset (LSB << x)	Width (bits)	Available features
0	1	`Reverse X`
1	1	`Reverse Y`
2	1	`Intensity Auto` controls
3	1	`Black Level` controls
4	1	`Gain` controls
5	1	`Gamma` controls
6	1	Reserved
7	1	`Saturation` controls
8	1	`Hue` controls
9	1	`White Balance`
10	1	Reserved
11	1	`Exposure Auto` controls
12	1	`Gain Auto` controls
13	1	`White Balance Auto`
14	1	`Mainboard Temperature`
15	1	`Acquisition Abort`
16	1	`Acquisition Frame Rate` controls
17	1	`Frame Start Trigger` controls
18	1	`Exposure Active Output Line`
19	1	`Auto Region` controls
20	1	`Frame Trigger Wait Line`
21	1	`Color Transformation` controls

Table 8: Regsiter Inquiry > Values (sheet 1 of 2)

22	1	`User Data` controls for persistent storage
23	1	`Device Status`
24 to 25	2	Reserved **Set to 0**.
26	1	`Exposure Mode`
27	1	`Device Power Saving Mode`
28 to 29	2	Reserved **Set to 0**.
30	1	`Exposure Time And Gain`
31	1	`DPC Enable`
32	21	Reserved **Set to 0**.
33	1	`Sensor Identification`
34 to 63	30	Reserved **Set to 0**.

Table 8: Regsiter Inquiry > Values (sheet 2 of 2)

0x0010 | Device Firmware Version

Displays the current firmware version installed on the camera.

Offset	0x0010
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Control group	General
Availability	All camera models

Bit offset (LSB << x)	Width (bits)	Description
0	8	Special firmware version
8	8	Major firmware version
16	16	Minor firmware version
32	32	Patch firmware version

0x0018 | Write Done Handshake

Read access: The camera confirms that the previous write access to registers has been processed.
Write access: Enables the control and resets the success confirmation.

Note: Handshake must only be used for V4L2 registers, not for CCI registers.

Offset	0x0018
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	General
Availability	All camera models

Bit offset (LSB << x)	Width (bits)	Description
0	1	***1***: The camera confirms the previous write access has been processed. ***0***: Written by the host to reset this flag.
1	6	Reserved, set to ***0***.
7	1	***1***: The camera outputs if it supports Write Done Handshake.

0x001C | User Data Index

Selects the slot to store user data. 8 slots are available.

Offset	0x001C
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	General
Availability	All camera models

0x0020 | User Data Value

Controls the data stored for the slot selected by `User Data Index`.

Offset	0x0020
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Control group	General
Availability	All camera models

0x0024 | Device Status

Displays the status for camera main functions.

Status okay: Bit = 1

Error: Bit = 0

Offset	0x0024
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	General
Availability	All camera models

Bit offset (LSB << x)	Width (bits)	Description
0	1	Backend buffer is okay.
1	1	Mainboard temperature is okay.[1]
2	1	Stream is ready.
3	1	MIPI Phy is okay.
4	1	Sensor board temperature is okay.[2]
5	1	Sensor communication is okay.
6 to 31	26	Reserved **Set to 1.**

0x0310 | Mainboard Temperature

Displays the temperature of the camera's mainboard.

Offset	0x0310
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	$^{1}/_{10}$ °C = d°C
Control group	General
Availability	Camera model dependent

0x0034 | Device Power Saving Mode

Enables or disables standby mode to save power.

Offset	0x0034
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Control group	General
Availability	All camera models

Value	Description
0	Normal operation with full functionality is enabled.
1	Standby mode is enabled. The camera is displayed and can be configured. But it cannot stream images.

0x039C | Sensor Identification

Displays basic sensor information.

Offset	0x039C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	General
Availability	All camera models

Bit offset (LSB << x)	**Description**
0 to 7	Sensor ID
8 to 15	Sensor platform ID
16 to 23	Sensor specific information: bit[16]: 1 = mono | 0 = color bit[17]: 0 = no polarizer | 1 = polarizer
30 to 31	Check bit: bit[30]: 1 = sensor detection okay bit[31]: 1 = sensor fits firmware

Streaming

0x0040 | CSI-2 Lane Count Inquiry

Displays the CSI-2 lane counts supported by the camera.

Offset	0x0040
Origin of control	Camera
Type	UInt8
Access	R
Size [Bytes]	1
Control group	Streaming
Availability	All camera models

Bit offset (LSB << x)	Width (bits)	Description
0	1	1-lane operation is supported.
1	1	2-lane operation is supported.
2	1	3-lane operation is supported.
3	1	4-lane operation is supported.
4	4	Reserved **Set to 0.**

0x0044 | CSI-2 Lane Count

Controls the current CSI-2 lane count.

Note: This control must be set before 0x0050 | CSI-2 Clock. See CSI-2 streaming setup on page 25 for details.

0x0048 | CSI-2 Clock Min Value supports a minimum value of 80 Mbit/s per lane. Select suitable settings so that the resulting data rate is supported by the host.

Offset	0x0044
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Streaming
Availability	All camera models

0x0048 | CSI-2 Clock Min Value

Displays the minimum CSI-2 clock frequency supported for the current CSI-2 lane count.

Note: The minimum supported value per lane is 80 Mbit/s. Select suitable settings for this control and for 0x0044 | CSI-2 Lane Count, so that the resulting data rate is supported by the host.

Offset	0x0048
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Hertz
Control group	Streaming
Availability	All camera models

0x004C | CSI-2 Clock Max Value

Displays the maximum CSI-2 clock frequency supported for the current CSI-2 lane count.

Offset	0x004C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Hertz
Control group	Streaming
Availability	All camera models

0x0050 | CSI-2 Clock

Controls the current CSI-2 clock frequency.

Note: Set 0x0044 | CSI-2 Lane Count before this control. See CSI-2 streaming setup on page 25 for details.

Offset	0x0050
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Unit	Hertz
Control group	Streaming
Availability	All camera models

0x0054 | Buffer Size

Displays the size of the streaming buffer (payload).

Offset	0x0054
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Bytes
Control group	Streaming
Availability	All camera models

Acquisition

0x007C | Acquisition Start Delay

Controls the timeout until `Acquisition Start` is executed.

Offset	0x007C
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Unit	Milliseconds
Control group	Acquisition
Availability	All camera models

0x0080 | Acquisition Start

Starts the acquisition. Reading the register returns the command value until the acquisition is stopped or aborted. Otherwise *0* is returned.

Read access: The register returns *1* if acquisition is active and *0* if acquisition has been stopped.

Note: The D-Phy only resets if `Acquisition Start Delay` is greater than *0*.

Offset	0x0080
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Acquisition
Availability	All camera models

Value	Description
1	Starts the acquisition.

0x0084 | Acquisition Stop

Stops the acquisition **after the current frame has been acquired**.

Read access: The register returns *1* if acquisition is active and *0* if acquisition has been stopped.

Offset	0x0084
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Acquisition
Availability	All camera models

Value	Description
1	Stops the acquisition.

0x0088 | Acquisition Abort

Stops the acquisition **immediately, a frame in the acquisition phase is discarded**.

Read access: The register returns *1* if acquisition is active and *0* if acquisition has been stopped.

Offset	0x0088
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Acquisition
Availability	All camera models

Value	Description
0	Acquisition has been started or is running.
1	Acquisition is stopped immediately.

0x008C | Acquisition Status

Displays if the camera is acquiring images.

Offset	0x008C
Origin of control	Camera
Type	UInt8
Access	R
Size [Bytes]	1
Control group	Acquisition
Availability	All camera models

Value	Description
0	Acquisition has been stopped.
1	Acquisition has been started or is running.

0x0090 | Acquisition Frame Rate

Controls the frequency at which the frames are captured.

Offset	0x0090
Origin of control	Camera
Type	UInt64
Access	R/W
Size [Bytes]	8
Unit	Micro Hertz [µHz]
Control group	Acquisition
Availability	All camera models

0x0098 | Acquisition Frame Rate Min

Displays the minimum value for `Acquisition Frame Rate`.

Offset	0x0098
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Unit	Micro Hertz [µHz]
Control group	Acquisition
Availability	All camera models

0x00A0 | Acquisition Frame Rate Max

Displays the maximum value for `Acquisition Frame Rate`.

Offset	0x00A0
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Unit	Micro Hertz [µHz]
Control group	Acquisition
Availability	All camera models

0x00A0 | Acquisition Frame Rate Increment

Displays the icrement value for `Acquisition Frame Rate`.

Offset	0x00A0
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Unit	Micro Hertz [µHz]
Control group	Acquisition
Availability	All camera models

0x00B0 | Acquisition Frame Rate Enable

Enables or disables `Acquisition Frame Rate`.

Note: `Acquisition Frame Rate` is used only if `Frame Start Trigger Mode` is set to *`Off`*.

Offset	0x00B0
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Acquisition
Availability	All camera models

Value	Description
0	`Acquisition Frame Rate` is disabled.
1	`Acquisition Frame Rate` is enabled.

0x00B4 | Frame Start Trigger Mode

Enables or disables the `Frame Start Trigger`.

Offset	0x00B4
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Acquisition
Availability	All camera models

Value	Description
0	The `Frame Start Trigger` is disabled.
1	The `Frame Start Trigger` is enabled.

0x00B8 | Frame Start Trigger Source

Selects the internal signal or physical input line to use as trigger source.

Notes:

- To use this control, the `Frame Start Trigger Mode` must be set to *`On`*.
- Line 2 and line 3 are used for I2C.

Offset	0x00B8
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Acquisition
Availability	All camera models

Value	Description
`0`	Line0 is selected.
`1`	Line1 is selected.
`4`	Software is selected.

0x00BC | Frame Start Trigger Activation

Selects how signals activate the `Frame Start Trigger`.

Offset	0x00BC
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Acquisition
Availability	All camera models

Value	Description
`0`	The trigger is enabled on the rising edge of the signal.
`1`	The trigger is enabled on the falling edge of the signal.
`2`	The trigger is enabled on the any edge of the signal.
`3`	The trigger is enabled by a high-level signal.
`4`	The trigger is enabled by a low-level signal.

0x00C0 | Frame Start Trigger Software

Generates a software trigger.

Note: `Trigger Source` must be set to *`Software`*.

Offset	0x00C0
Origin of control	Camera
Type	UInt8
Access	W
Size [Bytes]	1
Control group	Acquisition
Availability	All camera models

Value	Description
1	A trigger is generated.

0x00C4 | Frame Start Trigger Delay

Controls the delay to apply after the trigger reception before activating it.

Offset	0x00C4
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Unit	Microseconds [µs]
Control group	Acquisition
Availability	All camera models

I/O controls

Recommended workflow for using the exposure active output controls

1. Disable the signal by `Exposure Active Output Line Mode` for the selected output line.
2. Select the desired line for exposure active output signal by `Exposure Active Output Line`.
3. Set the selected line to output (option: enable *`Invert`* to invert exposure active output signal) by `Line Configuration`.
3. Enable the exposure active output signal by `Exposure Active Output Line Mode`.
4. Read the signal level from the oscilloscope (option: use `Line Status`).

0x00C8 | Exposure Active Output Line Mode

Enables or disables the exposure active output signal on the line selected by `Exposure Active Output Line`.

Offset	0x00C8
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	I/O
Availability	All camera models

Value	Description
`0`	**Off**: The signal is disabled.
`1`	**On**: The signal is enabled.

0x00CC | Exposure Active Output Line

Selects the physical output line for the exposure active output signal.

Note: `Exposure Active Output Line Mode` must be set to *`Off`* before output lines can be changed.

Offset	0x00CC
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	I/O
Availability	All camera models

Value	Description
`0`	Line0 is selected.
`1`	Line1 is selected.

0x00D0 | Line Configuration

Configures the line as input or output and inverted or not-inverted.

Note: To get **constant low** on a line, please set the line to output mode with invert bit set to 0. For **constant high**, please set the invert bit to 1.

Offset	0x00D0
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Control group	I/O
Availability	All camera models

Bit offset (lsb << X)	Width (bits)	Description
0	1	Line0 is set to input or output.
1	1	Line0 is set to inverted or not inverted.
2 to 7	6	Reserved
8	1	Line1 is set to input or output.
9	1	Line1 is set to inverted or not inverted.
10 to 31	22	Reserved

To switch between input or output, set bits as follows:

Value	Description
0	**False**: The selected line is set to input.
1	**True**: The selected line is set to output.

To switch between inverted and not inverted, set bits as follows:

Value	Description
0	**False**: The selected line is set to not inverted.
1	**True**: The selected line is set to inverted.

0x00D4 | Line Status

Returns the logical state (high or low) of the selected line.

Offset	0x00D4
Origin of control	Camera
Type	UInt8
Access	R
Size [Bytes]	1
Control group	I/O
Availability	All camera models

Bit offset (lsb << X)	Width (bits)	Description
0	1	The logical state (high or low) of Line0 is returned
1	1	The logical state (high or low) of Line1 is returned

The logical state of the selected line is displayed as follows:

Value	Description
0	**False**: The logical state is low.
1	**True**: The logical state is high.

0x00D8 | Frame Trigger Wait Output Line

Selects the physical output line for the Frame Trigger Wait signal.

Offset	0x00D8
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	I/O
Availability	All camera models

Value	Description
0	Selects Line0.
1	Selects Line1.

0x00DC | Frame Trigger Wait Output Line Mode

Enables or disables the Frame Trigger Wait signal on the line selected by `Frame Trigger Wait Output Line`.

Offset	0x00DC
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	I/O
Availability	All camera models

Value	Description
0	Disables the signal.
1	Enables the signal.

Image Format

0x0100 | Width

Controls the current image width.

Offset	0x0100
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0104 | Width Min

Displays the minimum image width available.

Offset	0x0104
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0108 | Width Max After Binning

Displays the maximum image width available.

Offset	0x0108
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x010C | Width Increment

Displays the increment value available for `Width`.

Offset	0x010C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0110 | Height

Controls the current image height.

Offset	0x0110
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0114 | Height Min

Displays the minimum image height available.

Offset	0x0114
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0118 | Height Max After Binning

Displays the maximum image height available.

Note: This excludes region of interest, as known from GenICam SFNC features.

Offset	0x0118
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x011C | Height Increment

Displays the increment value available for `Height`.

Offset	0x011C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0120 | Offset X

Controls the horizontal offset from the origin to the region of interest (ROI).

Offset	0x0120
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0124 | Offset X Min

Displays the minimum value available for `Offset X`.

Offset	0x0124
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0128 | Offset X Max

Displays the maximum value available for `Offset X`.

Offset	0x0128
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x012C | Offset X Increment

Displays the increment value available for `Offset X`.

Offset	0x012C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0130 | Offset Y

Controls the vertical offset from the origin to the region of interest (ROI).

Offset	0x0130
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0134 | Offset Y Min

Displays the minimum value available for `Offset Y`.

Offset	0x0134
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0138 | Offset Y Max

Displays the maximum value available for `Offset Y`.

Offset	0x0138
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x013C | Offset Y Increment

Displays the increment value available for `Offset Y`.

Offset	0x013C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0140 | MIPI Data Format

Controls the (pixel) data format provided by the camera.

Offset	0x0140
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Control group	Image Format
Availability	Sensor model dependent

MIPI CSI-2 format	Value	Description
YUV420_8_LEG	0x1A	
YUV420_8	0x18	
YUV420_10	0x19	
YUV420_8_CSPS	0x1C	
YUV420_10_CSPS	0x1D	
YUV422_8	0x1E	
YUV422_10	0x1F	
RGB888	0x24	
RGB666	0x23	
RGB565	0x22	
RGB555	0x21	
RGB444	0x20	
RAW6	0x28	6 bit raw data. Monochrome or Bayer pattern.
RAW7	0x29	7 bit raw data. Monochrome or Bayer pattern.
RAW8	0x2A	8 bit raw data. Monochrome or Bayer pattern.
RAW10	0x2B	10 bit raw data. Monochrome or Bayer pattern.
RAW12	0x2C	12 bit raw data. Monochrome or Bayer pattern.
RAW14	0x2D	14 bit raw data. Monochrome or Bayer pattern.
JPEG	0x30	JPEG format

Pixel format availability and naming

- The **availability** of pixel formats depends on camera models and the abilities of the connected system.
- For the **naming**, see Pixel format naming on page 18.

0x0148 | MIPI Data Format Inquiry

Displays a bitmap with the representation of the available MIPI (pixel) data formats.

Offset	0x0148
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Control group	Image Format
Availability	Sensor model dependent

Bit offset (LSB << x)	Width (bits)	Available format
0	1	YUV420_8_LEG
1	1	YUV420_8
2	1	YUV420_10
3	1	YUV420_8_CSPS
4	1	YUV420_10_CSPS
5	1	YUV422_8
6	1	YUV422_10
7	1	RGB888
8	1	RGB666
9	1	RGB565
10	1	RGB555
11	1	RGB444
12	1	RAW6
13	1	RAW7
14	1	RAW8
15	1	RAW10
16	1	RAW12
17	1	RAW14
18	1	JPEG
19 to 63	45	Reserved. **Set to 0**.

Pixel format availability and naming

- The **availability** of pixel formats depends on camera models and the abilities of the connected system.
- For the **naming**, see Pixel format naming on page 18.

0x0150 | Bayer Pattern Inquiry

Displays the Bayer pattern availability for RAW formats, independent of the currently selected MIPI Data Format.

Offset	0x0150
Origin of control	Camera
Type	UInt8
Access	R
Size [Bytes]	1
Control group	Image Format
Availability	All camera models

Bit offset (LSB << x)	Width (bits)	Description
0	1	Monochrome format is available.
1	1	Bayer GR is available.
2	1	Bayer RG is available.
3	1	Bayer GB is available.
4	1	Bayer BG is available.
5 to 7	3	Reserved. **Set to 0.**

0x0154 | Bayer Pattern

Controls the Bayer pattern for RAW formats. If the current MIPI Data Format is not a RAW format, this register value is ignored.

Offset	0x0154
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Image Format
Availability	All camera models

Value	Description
0	Selects monochrome format.
1	Selects Bayer GR.
2	Selects Bayer RG.
3	Selects Bayer GB.
4	Selects Bayer BG.

0x0158 | Reverse X

Flips the image horizontally.

Note: Cropping is applied after this control.
See Control interdependencies on page 28.

Offset	0x0158
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Image Format
Availability	All camera models

Value	Description
0	Image remains unchanged.
1	The image is flipped horizontally.

0x015C | Reverse Y

Flips the image vertically.

Note: Cropping is applied after this control.
See Control interdependencies on page 28.

Offset	0x015C
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Image Format
Availability	All camera models

Value	Description
0	Image remains unchanged.
1	The image is flipped vertically.

0x0160 | Sensor Width

Displays the number of horizontal pixels of the image sensor.

Offset	0x0160
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0164 | Sensor Height

Displays the number of vertical pixels of the image sensor.

Offset	0x0164
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0168 | Width Max

Displays the number of horizontal pixels of the image sensor available, after binning and before region of interest has been applied.

Offset	0x0168
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x016C | Height Max

Displays the number of vertical pixels of the image sensor available, after binning and before region of interest has been applied.

Offset	0x016C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixel
Control group	Image Format
Availability	All camera models

0x0170 | Binning Inquiry

Displays the availability of binning factors.

Note: This control is available with NVIDIA Driver 5.1 or higher.

Offset	0x0170
Origin of control	Camera
Type	UInt16
Access	R
Size [Bytes]	2
Control group	Image Format
Availability	All camera models

Bit offset (LSB << x)	Width (bits)	Description
0	1	2 × 2 Digital
1	1	3 × 3 Digital
2	1	4 × 4 Digital
3	1	5 × 5 Digital
4	1	6 × 6 Digital
5	1	7 × 7 Digital
6	1	8 × 8 Digital
7	1	2 × 2 Sensor
8	1	4 × 4 Sensor
9 to 15	7	Reserved Set to *0*.

0x0174 | Binning Setting

Controls the binning factor.

Note: This control is available with NVIDIA Driver 5.1 or higher.

Offset	0x0174
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Image Format
Availability	All camera models

Value	Description
0	Off (1 × 1) (Default)
1	2 × 2 Digital
2	3 × 3 Digital
3	4 × 4 Digital
4	5 × 5 Digital
5	6 × 6 Digital
6	7 × 7 Digital
7	8 × 8 Digital
8	2 × 2 Sensor
9	4 × 4 Sensor

0x0178 | Binning Mode

Controls whether the result of binned pixels is averaged or summed up.
Note: This control is available with NVIDIA Driver 5.1 or higher.

Offset	0x0178
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Image Format
Availability	All camera models

Value	Description
0	Average: The charge or gray value of adjacent pixels is averaged.
1	Sum: The charge or gray value of adjacent pixels is summed up.

Brightness

0x00E0 | Exposure Mode

Selects the operation mode used for exposure.

Offset	0x00E0
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Brightness
Availability	All camera models

Value	Description
1	*`Timed`*: The exposure time is set by `Exposure Time` or by `Exposure Auto`.
2	*`Trigger Width`*: The width of the current frame trigger signal(s) pulse controls the exposure time. Available only with selected sensor families.

0x0180 | Exposure Time

Sets the exposure time when `Exposure Auto` is *`Off`*. This controls the duration during which the photosensitive cells are exposed to light.

Offset	0x0180
Origin of control	Camera
Type	UInt64
Access	R/W
Size [Bytes]	8
Unit	Nanoseconds [ns]
Control group	Brightness
Availability	All camera models

0x0188 | Exposure Time Min

Displays the minimum value available for `Exposure Time`.

Offset	0x0188
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Unit	Nanoseconds [ns]
Control group	Brightness
Availability	All camera models

0x0190 | Exposure Time Max

Displays the maximum value available for `Exposure Time`.

Offset	0x0190
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Unit	Nanoseconds [ns]
Control group	Brightness
Availability	All camera models

0x0198 | Exposure Time Increment

Displays the increment value available for `Exposure Time`.

Offset	0x0198
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Unit	Nanoseconds [ns]
Control group	Brightness
Availability	All camera models

0x01A0 | Exposure Auto

Sets the auto exposure mode. The output of the auto exposure function affects the whole image. `Exposure Time` is disabled.

Note: The pixel intensity is set to a target value of 50% of the mean. Use `Intensity Auto Target` to adjust the target value or use `Intensity Auto Precedence` to set the priority between `Exposure Auto` and `Gain Auto`.

Offset	0x01A0
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Brightness
Availability	Camera model dependent

Value	Description
0	*Off*: Exposure duration is user controlled using `Exposure Time`.
1	*Once*: Exposure duration is adjusted once by the device. After it has converged, it returns to the *Off* state.
2	*Continuous*: Exposure duration is constantly adjusted by the device according to scene illumination.

0x0330 | Exposure Auto Min

Controls the minimum value for auto exposure time. The range of this register is:

- `Exposure Auto Min` >= `Exposure Time Min`
- `Exposure Auto Min` <= `Exposure Time Max`
- `Exposure Auto Min` <= `Exposure Auto Max`

Notes:

- This control is not supported by CSI-2 driver versions up to V1.0.4.
- This control must be displayed as available in `Register Inquiry` and `Exposure Auto Max` value must not be ***0***.

Offset	0x0330
Origin of control	Camera
Type	UInt64
Access	R/W
Size [Bytes]	8
Unit	Nanoseconds [ns]
Control group	Brightness
Availability	Camera model dependent

0x0338 | Exposure Auto Max

Controls the maximum value for auto exposure time. The range of this register is:

- `Exposure Auto Max` >= `Exposure Time Min`
- `Exposure Auto Max` <= `Exposure Time Max`
- `Exposure Auto Max` >= `Exposure Auto Min`

Notes:

- This control is not supported by CSI-2 driver versions up to V1.0.4.
- This control must be displayed as available in `Register Inquiry` and `Exposure Auto Max` value must not be ***0***.

Offset	0x0338
Origin of control	Camera
Type	UInt64
Access	R/W
Size [Bytes]	8
Unit	Nanoseconds [ns]
Control group	Brightness
Availability	Camera model dependent

0x01A4 | Intensity Auto Precedence

Selects the priority between exposure and gain control loops for auto intensity.
Note: This parameter is used only if both `Exposure Auto` and `Gain Auto` are available and set to *`Once`* or *`Continuous`*.

Offset	0x01A4
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Brightness
Availability	All camera models

Value	Description
`0`	*`Minimize noise`*: Loops for `Exposure Time` are applied before loops for `Gain`.
`1`	*`Minimize blur`*: Loops for `Gain` are applied before loops for `Exposure Time`.

0x022C | Intensity Controller Region

Controls the subregion of the image where the intensity controller operates on.

Offset	0x022C
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Brightness
Availability	All camera models

Value	Description
`0`	*`Full image`*: The full sensor size is used.
`1`	*`Auto region`*: The area is used that is defined by Auto region controls.

0x01AC | Intensity Auto Target Min Value

Displays the minimum target value available for pixel intensity with auto controls.

Offset	0x01AC
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	0.1%
Control group	Brightness
Availability	All camera models

0x01B0 | Intensity Auto Target Max Value

Displays the maximum target value available for pixel intensity with auto controls.

Offset	0x01B0
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	0.1%
Control group	Brightness
Availability	All camera models

0x01B4 | Intensity Auto Target Increment

Displays the increment for target values available for pixel intensity with auto controls.

Offset	0x01B4
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	0.1%
Control group	Brightness
Availability	All camera models

0x01B8 | Black Level

Controls the analog black level as DC offset applied to the video signal.

Offset	0x01B8
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Control group	Brightness
Availability	Camera model dependent

0x01BC | Black Level Min

Displays the minimum value available for `Black Level`.

Offset	0x01BC
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	Brightness
Availability	Camera model dependent

0x01C0 | Black Level Max

Displays the maximum value available for `Black Level`.

Offset	0x01C0
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	Brightness
Availability	Camera model dependent

0x01C4 | Black Level Increment

Displays the increment value available for `Black Level`.

Offset	0x01C4
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	Brightness
Availability	Camera model dependent

0x01C8 | Gain

Controls the amplification factor applied to the video signal.

Offset	0x01C8
Origin of control	Camera
Type	UInt64
Access	R/W
Size [Bytes]	8
Unit	Millibel ($1/_{100}$ Decibel)
Control group	Brightness
Availability	Camera model dependent

0x01D0 | Gain Min

Displays the minimum value available for `Gain`.

Offset	0x01D0
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Unit	Millibel ($1/_{100}$ Decibel)
Control group	Brightness
Availability	Camera model dependent

0x01D8 | Gain Max

Displays the maximum value available for `Gain`.

Offset	0x01D8
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Unit	Millibel ($1/_{100}$ Decibel)
Control group	Brightness
Availability	Camera model dependent

0x01E0 | Gain Increment

Displays the increment value available for `Gain`.

Offset	0x01E0
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Unit	Millibel ($1/_{100}$ Decibel)
Control group	Brightness
Availability	Camera model dependent

0x01E8 | Gain Auto

Controls the automatic gain control (AGC) mode. The output of the auto gain function affects the whole image.

Note: The pixel intensity is set to a target value of 50% of the mean. Use `Intensity Auto Target` controls to adjust the target value or use `Intensity Auto Precedence` to set the priority between `Exposure Auto` and `Gain Auto`.

Offset	0x01E8
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Brightness
Availability	Camera model dependent

Value	Description
0	*Off*: Gain is User-controlled using `Gain`.
1	*Once*: Gain is adjusted once by the device. After it has converged, it returns to the *Off* state.
2	*Continuous*: Gain is constantly adjusted by the device according to scene illumination.

0x0340 | Gain Auto Min

Controls the minimum value for auto gain. The range of this register is:

- `Gain Auto Min` >= `Gain Min`
- `Gain Auto Min` <= `Gain Max`
- `Gain Auto Min` <= `Gain Auto Max`

Notes:

- This control is not supported by CSI-2 driver versions up to V1.0.4.
- This control must be displayed as available in `Register Inquiry` and `Gain Auto Max` value must not be *0*.

Offset	0x0340
Origin of control	Camera
Type	UInt64
Access	R/W
Size [Bytes]	8
Unit	Millibel ($1/_{100}$ Decibel)
Control group	Brightness
Availability	All camera models

0x0348 | Gain Auto Max

Controls the maximum value for auto gain. The range of this register is:

- `Gain Auto Max` >= `Gain Min`
- `Gain Auto Max` <= `Gain Max`
- `Gain Auto Max` >= `Gain Auto Min`

Notes:

- This control is not supported by CSI-2 driver versions up to V1.0.4.
- This control must be displayed as available in `Register Inquiry` and `Gain Auto Max` value must not be `0`.

Offset	0x0348
Origin of control	Camera
Type	UInt64
Access	R/W
Size [Bytes]	8
Unit	Millibel ($1/_{100}$ Decibel)
Control group	Brightness
Availability	All camera models

0x0350 | Auto Mode Region Width

Controls the current width of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x0350
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x0354 | Auto Mode Region Width Min

Displays the minimum width of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x0354
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x0358 | Auto Mode Region Width Max

Displays the maximum width of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x0358
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x035C | Auto Mode Region Width Increment

Displays the increment value for the width of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x035C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x0360 | Auto Mode Region Height

Controls the current height of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x0360
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x0364 | Auto Mode Region Height Min

Displays the minimum height of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x0364
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x0368 | Auto Mode Region Height Max

Displays the maximum height of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x0368
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x036C | Auto Mode Region Height Increment

Displays the increment value for the height of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x036C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x0370 | Auto Mode Region Offset X

Controls the current horizontal offset of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x0370
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x0374 | Auto Mode Region Offset X Min

Displays the minimum horizontal offset of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x0374
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x0378 | Auto Mode Region Offset X Max

Displays the maximum horizontal offset of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x0378
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x037C | Auto Mode Region Offset X Increment

Displays the increment value for the horizontal offset of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x037C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x0380 | Auto Mode Region Offset Y

Controls the current vertical offset of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x0380
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x0384 | Auto Mode Region Offset Y Min

Displays the minimum vertical offset of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x0384
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x0388 | Auto Mode Region Offset Y Max

Displays the maximum vertical offset of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x0388
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x038C | Auto Mode Region Offset Y Increment

Displays the increment value for the vertical offset of the auto mode region.

Note: See Regions of interest and auto mode regions on page 29 for additional information.

Offset	0x038C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Unit	Pixels
Control group	Brightness
Availability	All camera models

0x01F0 | Gamma

Controls the correction of pixel intensity.

$Y' = ((Y / Y_{max})^{(Gamma \times 0.01)}) \times Y_{max}$

where
Y' is the new pixel intensity
Y is the original pixel intensity
Y_{max} is the maximum pixel value (for example, 255 for RAW8)
Gamma is the hundredfold correction factor.

Offset	0x01F0
Origin of control	Camera
Type	UInt64
Access	R/W
Size [Bytes]	8
Control group	Brightness
Availability	Camera model dependent

0x01F8 | Gamma Min

Displays the minimum value available for `Gamma`.

Offset	0x01F8
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Control group	Brightness
Availability	Camera model dependent

0x0200 | Gamma Max

Displays the maximum value available for `Gamma`.

Offset	0x0200
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Control group	Brightness
Availability	Camera model dependent

0x0208 | Gamma Increment

Displays the increment value available for `Gamma`.

Offset	0x0208
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Control group	Brightness
Availability	Camera model dependent

0x0224| Exposure Time And Gain

Controls exposure time and gain by using a common register.

Offset	0x0224
Origin of control	Camera
Type	UInt64
Access	R/W
Size [Bytes]	8
Control group	Brightness
Availability	Camera model dependent

Byte offset	**Description**
0 to *1*	Controls gain in Millibels.
2 to *7*	Controls the exposure time in Nanosecobds [ns].

Color Management

0x0240 | Saturation

Controls the amplification of the chrominance signal as 100 × factor.

Offset	0x0240
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Control group	Color Management
Availability	All color models

0x0244 | Saturation Min

Displays the minimum value available for `Saturation`.

Offset	0x0244
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	Color Management
Availability	All color models

0x0248 | Saturation Max

Displays the maximum value available for `Saturation`.

Offset	0x0248
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	Color Management
Availability	All color models

0x024C | Saturation Increment

Displays the increment value available for `Saturation`.

Offset	0x024C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	Color Management
Availability	All color models

0x0250 | Hue

Controls the color tone by rotating the chrominance field clockwise with values > 0 and counter clockwise with values < 0. Values are 100 × factor.

Offset	0x0250
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Unit	$^{1}/_{100}$ degrees [°]
Control group	Color Management
Availability	All color models

0x0254 | Hue Min

Displays the minimum value available for **Hue**.

Offset	0x0254
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	Color Management
Availability	All color models

0x0258 | Hue Max

Displays the maximum value available for **Hue**.

Offset	0x0258
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	Color Management
Availability	All color models

0x025C | Hue Increment

Displays the increment value available for **Hue**.

Offset	0x025C
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	Color Management
Availability	All color models

0x0280 | Red Balance Ratio

Controls the ratio of the red color component to the green color component (variable C). It is used for white balancing. The color balance is realized by the following formula:

C_w = `Red Balance Ratio` × C

C_w: Intensity of selected color component after white balancing
`Red Balance Ratio`: White balance coefficient
C: Intensity of the color component before white balancing.

Note: Float values are calculated as register value / 1000 (decimal factor).

Offset	0x0280
Origin of control	Camera
Type	UInt64
Access	R/W
Size [Bytes]	8
Control group	Color Management
Availability	All color models

0x0288 | Red Balance Ratio Min

Displays the minimum value available for `Red Balance Ratio`.

Note: Float values are calculated as register value / 1000 (decimal factor).

Offset	0x0288
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Control group	Color Management
Availability	All color models

0x0290 | Red Balance Ratio Max

Displays the maximum value available for `Red Balance Ratio`.

Note: Float values are calculated as register value / 1000 (decimal factor).

Offset	0x0290
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Control group	Color Management
Availability	All color models

0x0298 | Red Balance Ratio Increment

Displays the increment value available for `Red Balance Ratio`.

Note: Float values are calculated as register value / 1000 (decimal factor).

Offset	0x0298
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Control group	Color Management
Availability	All color models

0x02C0 | Blue Balance Ratio

Controls the ratio of the blue color component to the green color component (variable C). It is used for white balancing. The color balance is realized by the following formula:

C_w = `Blue Balance Ratio` × C

C_w: Intensity of selected color component after white balancing
`Blue Balance Ratio`: White balance coefficient
C: Intensity of the color component before white balancing.

Note: Float values are calculated as register value / 1000 (decimal factor).

Offset	0x02C0
Origin of control	Camera
Type	UInt64
Access	R/W
Size [Bytes]	8
Control group	Color Management
Availability	All color models

0x02C8 | Blue Balance Ratio Min

Displays the minimum value available for `Blue Balance Ratio`.

Note: Float values are calculated as register value / 1000 (decimal factor).

Offset	0x02C8
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Control group	Color Management
Availability	All color models

0x02D0 | Blue Balance Ratio Max

Displays the maximum value available for `Blue Balance Ratio`.

Note: Float values are calculated as register value / 1000 (decimal factor).

Offset	0x02D0
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Control group	Color Management
Availability	All color models

0x02D8 | Blue Balance Ratio Increment

Displays the increment value available for `Blue Balance Ratio`.

Note: Float values are calculated as register value / 1000 (decimal factor).

Offset	0x02D8
Origin of control	Camera
Type	UInt64
Access	R
Size [Bytes]	8
Control group	Color Management
Availability	All color models

0x02E0 | White Balance Auto

Controls the mode for automatic white balancing between the color channels. The white balancing ratios are adjusted automatically.

Offset	0x02E0
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Color Management
Availability	All color models

Value	Description
0	*Off*: The automatic adjustment of white balance is turned off.
1	*Once*: White balance is adjusted once by the device. Once it has converged, it returns to the *Off* state.
2	*Continuous*: White balance is constantly adjusted by the device.

Color transformation controls

Color Transformation controls are only valid if using on-camera interpolated pixel formats. The color transformation is a linear operation taking as input the triplet R_{in}, G_{in}, B_{in} for an RGB color pixel. This triplet is multiplied by a 3×3 matrix.

Color transformation controls allow to change the coefficients as shown in Formula 1: Color transformation matrix on page 98.

$$\begin{bmatrix} \mathrm{R}C0_{out} \\ \mathrm{G}C1_{out} \\ \mathrm{B}C2_{out} \end{bmatrix} = \begin{bmatrix} \mathrm{Gain00} & \mathrm{Gain01} & \mathrm{Gain02} \\ \mathrm{Gain10} & \mathrm{Gain11} & \mathrm{Gain12} \\ \mathrm{Gain20} & \mathrm{Gain21} & \mathrm{Gain22} \end{bmatrix} x \begin{bmatrix} C0_{in} \\ C1_{in} \\ C2_{in} \end{bmatrix} + \begin{bmatrix} Offset0 \\ Offset1 \\ Offset2 \end{bmatrix}$$

Equivalent:

$$\begin{bmatrix} R_{out} \\ G_{out} \\ B_{out} \end{bmatrix} = \begin{bmatrix} \mathrm{Gain00} & \mathrm{Gain01} & \mathrm{Gain02} \\ \mathrm{Gain10} & \mathrm{Gain11} & \mathrm{Gain12} \\ \mathrm{Gain20} & \mathrm{Gain21} & \mathrm{Gain22} \end{bmatrix} x \begin{bmatrix} R_{in} \\ G_{in} \\ B_{in} \end{bmatrix}$$

Formula 1: Color transformation matrix

The parameters above are filled as follows:

Variable	Value description
$C0_{In}$	First component of the incoming pixel
$C1_{In}$	Second component of the incoming pixel
$C2_{In}$	Third component of the incoming pixel
*Offset*0	Red offset
*Offset*1	Green offset
*Offset*2	Blue offset

Variable	Color contribution (multiplicative factor)	Affected color pixel
Gain00	Red	Red
Gain01	Green	Red
Gain02	Blue	Red
Gain10	Red	Green
Gain11	Green	Green
Gain12	Blue	Green
Gain20	Red	Blue
Gain21	Green	Blue
Gain22	Blue	Blue

0x02E4| Color Transformation Enable

Enables or disables to control the interpolation of the RGB channels for the color image output.

Note: Availability is displayed in 0x0008 | Register Inquiry for color transformation.

Offset	0x02E4
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Color Management
Availability	All color models

Value	Description
0	*Off*: Color transformation is disabled.
1	*On*: Color transformation is enabled.

0x02E8| Color Transformation Value of Index 0 and 1

Controls the color transformation value of Index 0 and 1.

Transformation value = Bit value × 100
Value range: -400 to +400

Example for color transformation values (CTV) 0 and 1

CTV[0] = -4.0
CTV[1] = 3.0
Register values = [300][-400] = [0x012C'FE70]

Note: Availability is displayed in 0x0008 | Register Inquiry for color transformation.

Offset	0x02E8
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Control group	Color Management
Availability	All color models

Direct register controls		**SFNC features**	
Bits	**Description**	**Value**	**Description**
0 to *15*	Index 0 Type Int16	*Gain00*	Gain 00 for the red contribution to the red pixel (multiplicative factor) is selected.
16 to *31*	Index 1 Type Int16	*Gain01*	Gain 01 for the green contribution to the red pixel (multiplicative factor) is selected.

0x02EC| Color Transformation Value of Index 2 and 3

Controls the color transformation value of Index 2 and 3.

Transformation value = Bit value × 100
Value range: -400 to +400

Example for color transformation values (CTV) 2 and 3

CTV[2] = -4.0
CTV[3] = 3.0
Register values = [300][-400] = [0x012C'FE70]

Note: Availability is displayed in 0x0008 | Register Inquiry for color transformation.

Offset	0x02EC
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Control group	Color Management
Availability	All color models

Direct register controls		**SFNC features**	
Bits	**Description**	**Value**	**Description**
0 to *15*	Index 2 Type Int16	*Gain02*	Gain 02 for the blue contribution to the red pixel (multiplicative factor) is selected.
16 to *31*	Index 3 Type Int16	*Gain10*	Gain 10 for the red contribution to the green pixel (multiplicative factor) is selected.

0x02F0| Color Transformation Value of Index 4 and 5

Controls the color transformation value of Index 4 and 5.

Transformation value = Bit value × 100
Value range: -400 to +400

Example for color transformation values (CTV) 4 and 5

CTV[4] = -4.0
CTV[5] = 3.0
Register values = [300][-400] = [0x012C'FE70]

Note: Availability is displayed in 0x0008 | Register Inquiry for color transformation.

Offset	0x02F0
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Control group	Color Management
Availability	All color models

Direct register controls		**SFNC features**	
Bits	**Description**	**Value**	**Description**
0 to *15*	Index 4 Type Int16	*Gain11*	Gain 11 for the green contribution to the green pixel (multiplicative factor) is selected.
16 to *31*	Index 5 Type Int16	*Gain12*	Gain 12 for the blue contribution to the green pixel (multiplicative factor) is selected.

0x02F4| Color Transformation Value of Index 6 and 7

Controls the color transformation value of Index 6 and 7.

Transformation value = Bit value × 100
Value range: -400 to +400

Example for color transformation values (CTV) 6 and 7

CTV[6] = -4.0
CTV[7] = 3.0
Register values = [300][-400] = [0x012C'FE70]

Note: Availability is displayed in 0x0008 | Register Inquiry for color transformation.

Offset	0x02F4
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Control group	Color Management
Availability	All color models

Direct register controls		**SFNC features**	
Bits	**Description**	**Value**	**Description**
0 to *15*	Index 6 Type Int16	*Gain20*	Gain 20 for the red contribution to the blue pixel (multiplicative factor) is selected.
16 to *31*	Index 7 Type Int16	*Gain21*	Gain 21 for the green contribution to the blue pixel (multiplicative factor) is selected.

0x02F8| Color Transformation Value of Index 8

Controls the color transformation value of Index 8.

Transformation value = Bit value × 100
Value range: -400 to +400

Example for color transformation value (CTV) 8

CTV[8] = 3.0
Register value = [300] = [0x012C]

Note: Availability is displayed in 0x0008 | Register Inquiry for color transformation.

Offset	0x02F8
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Control group	Color Management
Availability	All color models

Bits	**Description**
0 to *15*	Index 8 – type Int16

Direct register controls		**SFNC features**	
Bits	**Description**	**Value**	**Description**
0 to *15*	Index 8 Type Int16	*Gain22*	Gain 22 for the blue contribution to the blue pixel (multiplicative factor) is selected.

Image Correction

0x00E4 | DPC Enable

Enables or disables the DPC (Defect pixel correction).

Offset	0x00E4
Origin of control	Camera
Type	UInt8
Access	R/W
Size [Bytes]	1
Control group	Image Correction and Test Image
Availability	Camera model dependent

Value	Description
0	Disables the DPC.
1	Enables the DPC.

Test Pattern

0x03B0 | Test Pattern Inquiry

Displays if non-mandatory registers are available.

Note: Availability of individual test patterns depends on sensor abilities.

Offset	0x03B0
Origin of control	Camera
Type	UInt32
Access	R
Size [Bytes]	4
Control group	Test Pattern
Availability	Camera model dependent

Bit offset (LSB << x)	Width (bits)	Description
0	1	Black
1	1	White
2	1	Gray
3	1	Red
4	1	Green
5	1	Blue
6	1	Color Horizontal Bar
7	1	Color Vertical Bar
8	1	Color Vertical Bar Fade Gray
9	1	Gray Alternating Stripe
10	1	Gray Alternating Pixel
11	1	Gray Vertical Bar1
12	1	Gray Vertical Bar2
13	1	Gray Horizontal Ramp
14	1	Gray Diagonal Ramp Moving
15	1	Gray Diagonal Ramp
16 to 31	16	Reserved **Set to 0**.

0x03B4 | Test Pattern Setting

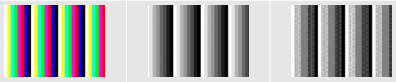
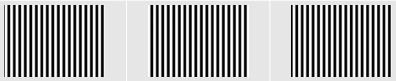
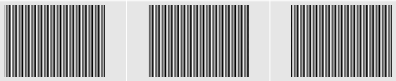
Selects the test pattern to be output by the camera.

Notes:

- Available test patterns vary between sensor models.
- Disable `White Balance Auto`.
- Set values for `Red Balance Ratio` to 1 for neutral gray.
- Set values for `Blue Balance Ratio` to 1 for neutral gray.
- Disable color interpolation.
- For gray test patterns, use RGB3 (V4L2 FOURCC) pixel formats.

Offset	0x03B4
Origin of control	Camera
Type	UInt32
Access	R/W
Size [Bytes]	4
Control group	Test Pattern
Availability	Camera model dependent

Pixel formats in Table 9: Test Pattern Settings > Values on page 108 refer to the V4L2 FOURCC convention.

Value	Description	Pixel format	Sensor models	Description		
			Sensor chroma ->	Color		Mono
			Pixel format ->	Color	Mono	Mono
0	Off	N.a.	All	The sensor image is output (default).		
1	Black	RGB3/GREY	IMX RS			
2	White	RGB3/GREY	IMX RS			
3	Grey	RGB3/GREY	AR0135, AR0521, AR0522			
4	Red	RGB3	AR0135, AR0521, AR0522			
5	Green	RGB3	AR0135, AR0521, AR0522			
6	Blue	RGB3	AR0135, AR0521, AR0522			
7	Color Horizontal Bar	RGB3/GREY/ RGGB	IMX GS/RS			
8	Color Vertical Bar	RGB3/GREY/ RGGB	AR0135, AR0521, AR0522			
			IMX GS/RS			
9	Color Vertical Bar Fade Grey	RGB3/GREY/ RGGB	AR0135, AR0521, AR0522			
10	Grey Alternating Stripe	RGGB/GREY	IMX GS			
11	Grey Alternating Pixel	RGGB/GREY	IMX GS			
12	Grey Vertical Bar1	RGGB/GREY	IMX GS			
13	Grey Vertical Bar2	RGGB/GREY	IMX GS			
14	Grey Horizontal Ramp	RGGB/GREY	IMX GS			
15	Gray Horizontal Ramp Moving	*				
16	Gray Diagonal Ramp	*				

* Current sensors for Alvium CSI-2 cameras do not support these modes.

Table 9: Test Pattern Settings > Values

Index

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