



GigE Area Scan Industrial Camera User Manual

CAM-CIC-12-9M-IP67
CAM-CIC-12-9C-IP67

V1.0.0

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1 WELCOME!

The CAM-CIC-12-9 is a ruggedized camera designed for industrial environments where dirt, dust or water are present. Its lightweight, dust-proof, and water-resistant 29 x 29 mm camera enclosure and lens tube makes this camera the smallest IP67-rated camera in the world. Its robust M12 and M8 connectors and Sony Pregius CMOS sensor make this camera ideal for a wide variety of industrial applications.

2 SAFETY AND PRECAUTIONS

Follow these guidelines carefully before using your CAM-CIC-12-9.

2.1 Definitions and Symbols

Below are some warning, safety, and/or tips icons used in this document.



The **Warning** icon indicates a potentially hazardous situation. If not avoided, the situation can result in damage to the product.



The **ESD** icon indicates a situation involving electrostatic discharge. If not avoided, the situation can result in damage to the product.



The **Help** icon indicates important instructions and steps to follow.



The **Light Bulb** icon indicates useful hints for understanding the operation of the camera.



The **Computer** icon represents useful resources found outside of this documentation.

2.2 General Safety Notices

	Powering the Camera • The camera may not work, may be damaged, or may exhibit unintended behavior if powered outside of the specified power range. • When using Power over Ethernet, the power supply must comply with IEEE 802.3af. • When using the GPIO, the supplied power must be within the stated voltage range. See the Power section for further information.
	Operating Temperature • The camera may not work, may be damaged, or may exhibit unintended behavior if operated outside of the specified temperature range. • See the Temperature section for further information.
	Electrostatic Discharge • Ensure proper precautions are implemented to prevent damage from an electrostatic discharge.
	Image Quality • Dust or fingerprints on the sensor may result in a loss of image quality. • Work in a clean and dust-free environment. • Attach the dust cap to the camera when a lens is not mounted. • Use only compressed ionized air or an optics cleaner to clean the surface of the sensor window.

3

INSTALLING THE CAMERA HARDWARE

3.1 Mounting

The camera is equipped with seven M3 mounting holes and six M2 mounting holes. One pair of M2 and one pair of M3 holes are present on opposite sides of the lens mount surface. Two more M2 holes are located on the bottom side of the camera towards the center.

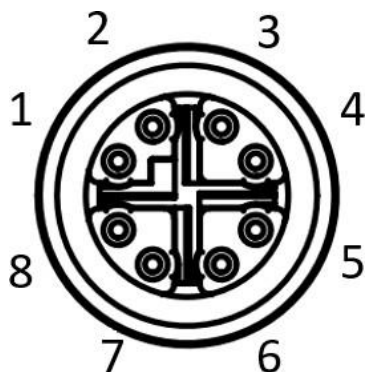
If you are using a heavy lens, we recommend that you use the M3 mounting holes on the CAM-CIC-12-9 to maximize the overall system rigidity.



The four corner-located M3 mounting holes on the bottom should be used whenever possible for mounting instead of the M2 mounting holes for applications involving vibration and applications using the IP67 lens tube.

3.2 Connector

The CAM-CIC-12-9 camera uses an x-coded 8-pin M12 connector with the following pin mapping as seen from rear of the camera.



Pin Number (Camera Side)	Pin Description
1	BI_DA+
2	BI_DA-
3	BI_DB+
4	BI_DB-
5	BI_DD+
6	BI_DD-
7	BI_DC-
8	BI_DC+

3.3 GigE Cable

The CAM-CIC-12-9 camera uses an x-coded 8-position M12 connector (compliant with IEC 61076-2-109) for Ethernet communication.

- For the best performance, a shielded Ethernet Cat5e or higher should be used. STP shielding is recommended to minimize electromagnetic interference in environments with harsh EMI conditions.
- An unshielded or lower grade/quality Ethernet cable may result in loss of camera connection and/or lost and inconsistent image data.
- The maximum cable length from camera to host with no switch or repeater in between is 100 meters.
- Cognex recommends using qualified Ethernet cables from our web store.

3.4 GPIO Cable

The CAM-CIC-12-9 camera is equipped with an 8-pin General Purpose Input/Output (GPIO) connector at the back.

- Cognex cameras are designed to use shielded or unshielded Ethernet cables.
- When using a shielded GPIO cable in an industrial setting, care must be taken to prevent ground loops from forming between the camera chassis, Ethernet PoE power sourcing equipment, IT infrastructure, and devices connected to GPIO.
- The GPIO cable can be shielded if terminated properly. An improper GPIO shield termination scheme can cause substantial EMC emissions and immunity issues, induce noise, and cause damage to the camera or equipment attached to the GPIO cable. Using a shielded GPIO cable requires careful consideration of the system level EMC when shielded Ethernet cables and PoE power are used.
- Only use shielded GPIO cables when powering the camera through GPIO. Be aware of the power supply earth connection, and the Ethernet shielding termination, which is best achieved by AC-coupling the Ethernet shield at the host chassis, or by using UTP cable.
- Any GPIO cable with M8 connector compliant with IEC 61076-2-104 will work.
- Cognex recommends using qualified GPIO cables from our web store.



Consult the GPIO Characteristics section for a GPIO pinout diagram.

3.5 Lens

Your camera has the lens mount shown below.

3.5.1 C mount lens

C mount lenses can be used on a C mount camera. According to the standard, the C mount flange back distance is 17.53 mm.

3.5.2 Using a heavy lens

Mounting a heavy and long lens may damage the camera board. If the lens is considerably heavier than the camera, the lens' weight may exert excessive force on the lens mount attached to the camera's board, causing unexpected damage to the board and soldered components. If a heavy lens is necessary for the production environment, it is recommended to use the lens as the mounting point rather than the camera to avoid damage to the camera.

3.6 IP67 Rating

This section describes the parts required to achieve the IP67 rating for CAM-CIC-12-9.

3.6.1 IP67 Cables

Use IP67-rated cables with your CAM-CIC-12-9 to keep dust and water out of the connection ports.



Custom cables must be qualified by the integrator to maintain the IP67 rating.

Find IP67-rated GigE and GPIO cables on our website.

3.6.2 GPIO Plug

When the GPIO port on the CAM-CIC-12-9 is not in use, you must attach the GPIO plug to achieve the IP67 rating.

3.6.3 Lens Tube

Without a lens tube, the CAM-CIC-12-9 achieves the **IP50** rating, which is protection against dust but not water. With a lens tube from Cognex, the CAM-CIC-12-9 achieves the **IP67** rating, which is dust proof and water resistant.



Custom lens tubes must be qualified by the integrator to maintain the IP67 rating.

3.6.4 Adapter Ring

The adapter ring is used to attach a lens tube on to the camera. When attaching the adapter ring, the C-mount barrel on the CAM-CIC-12-9 should also extend past the ring by approximately **0.3 mm**.



Use a rubber piece such as the [Multipurpose Neoprene Rubber Strip from McMaster-Carr \(part number 1372N13\)](#) to assist in removing the adapter ring.

3.6.5 IP67 Kit

The IP67 kits from Cognex for CAM-CIC-12-9 consists of the following:

- An adapter ring with O-ring installed
- A lens tube

Find the IP67 kits on our website.



Pair a compact C mount lens with the associated lens tube to create a small IP67-rated device. Note the optical format of the camera used.



The camera is **not** waterproof. It should not be submerged under water for longer than 30 minutes.

4

CONFIGURING THE CAMERA & HOST SYSTEM

4.1 Installing the Ethernet Driver

Cognex recommends updating to the latest version of your Ethernet adapter's driver before connecting your camera. You may need to navigate to the manufacturer's website to find the latest version of the driver.

4.2 Device Discovery and Enumeration

Cognex cameras are discovered and enumerated with the following process:

4.2.1 Camera IP Setup

There are three methods used by this camera to obtain an IP address:

- Persistent - The camera uses a fixed IP address.
- Dynamic Host Configuration Protocol (DHCP) - The camera is assigned an address from a DHCP server.
- Link-Local Address (LLA) - The camera obtains an address in the Link-Local Address range from 169.254.1.0 to 169.254.254.255.



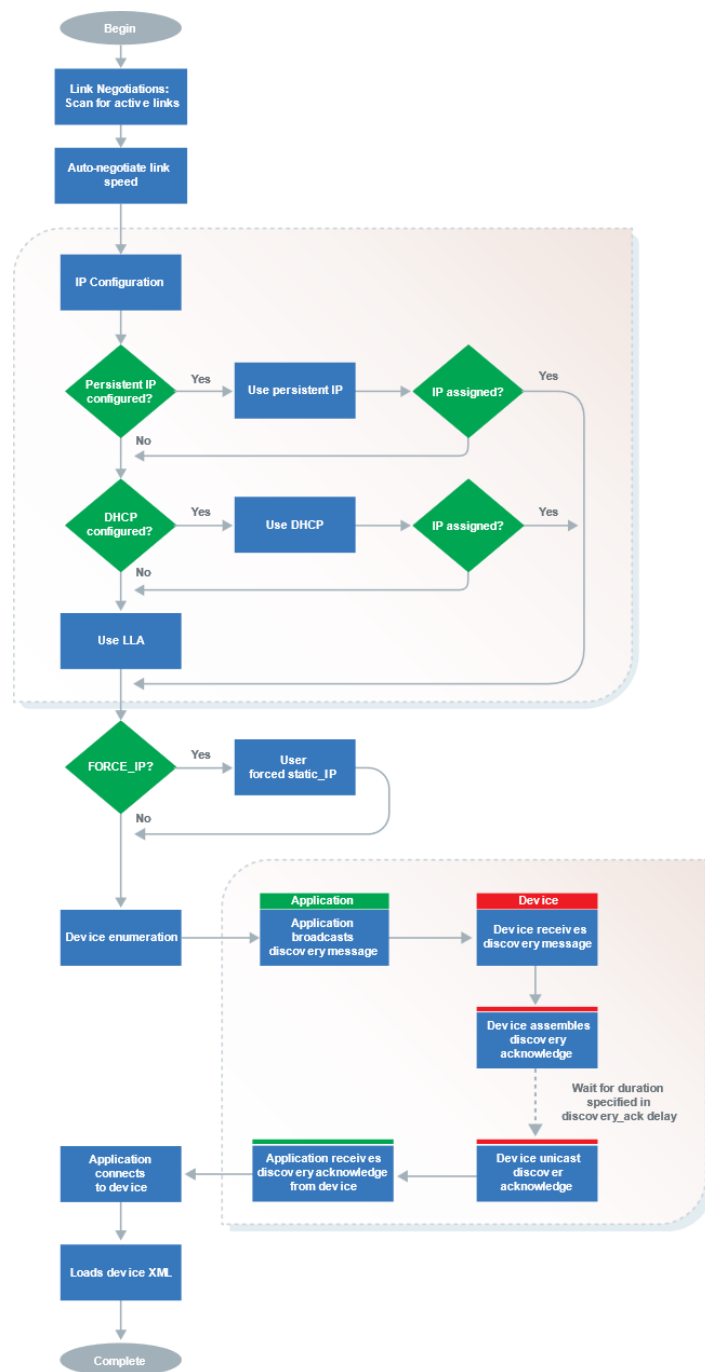
A Link-Local Address is selected with a pseudo-random number generator, so an LLA address cannot be reliably predicted. If you require a consistent IP address, you should set up a persistent IP on the camera. For more information on Link-Local Address selection, refer to [Section 2.1 in RFC 3927](#).



The camera must be on the same subnet as the Ethernet adapter and have a valid IP address before use.

Persistent IP and DHCP configurations can be disabled on the camera. The default camera configuration is as follows:

Persistent IP	Disabled
DHCP	Enabled
LLA	Enabled (always enabled)



Out of the box, the camera first attempts to connect using DHCP. If the camera is unable to connect using DHCP, it will use Link-Local Addressing.

4.2.2 Setting Up Persistent IP

The following pseudocode demonstrates how to set up persistent IP:

```
// Connect to camera
// Get device node map

GevPersistentIPAddress = 192.168.0.10; //Enter persistent IP address for the
camera
GevPersistentSubnetMask = 255.255.255.0;
GevPersistentDefaultGateway = 192.168.0.1;
```

4.3 Bandwidth Management

4.3.1 Jumbo Frames

Cognex recommends enabling jumbo frames on your Ethernet adapter. A jumbo frame is an Ethernet frame that is larger than 1500 bytes. Most Ethernet adapters support jumbo frames, but it is usually turned off by default.

Enabling jumbo frames on the Ethernet adapter allows a packet size of up to 9000 bytes to be set on the CAM-CIC-12-9. The larger packet size will enable optimal performance on high-bandwidth cameras, and it usually reduces CPU load on the host system. In order to set a 9000-byte packet size on the camera, the Ethernet adapter must support a jumbo frame size of 9000 bytes or higher.

If you still experience issues such as lost packets or dropped frames, you can also try the following:

- Update the Ethernet adapter driver (you may need to enable jumbo frames again after updating).
- Increase the receive buffer size in your Ethernet adapter properties.
- Reduce the DeviceLinkThroughputLimit value (this may reduce maximum frame rate).

4.3.2 Receive Buffers

A receive buffer is the size of system memory that can be used by the Ethernet adapter to receive packets. Some Ethernet adapter drivers or the operating system itself may set the receive buffer value to a low value by default, which may result in decreased performance. Increasing the receive buffer size, however, will also increase system memory usage.

4.3.3 Device Link Throughput Limit

The Device Link Throughput Limit is the maximum available bandwidth for transmission of data represented in bytes per second. This can be used to control the amount of bandwidth used by the camera. The maximum available frame rate may decrease when this value is lowered since less bandwidth is available for transmission.

4.4 User Sets, Streamables, and File Access

4.4.1 User Sets

The CAM-CIC-12-9 features two customizable user sets to load or save user-defined settings on the camera. Accessing the user set named Default will allow loading or saving of factory default settings. The CAM-CIC-12-9 will load the user set selected in UserSetDefault when powering up or when reset.



If the camera is acquiring images, AcquisitionStop must be called before loading or saving a user set.

4.4.2 Streamables

A camera feature marked as Streamable indicates that the feature's current value can be stored to and loaded from the streamables file.

4.4.3 File Access

The CAM-CIC-12-9 features persistent storage for generic file access on the camera. This feature allows users to save and load a custom file up to 16 megabytes with UserFile. Users can also save and load User Set contents to and from a file.



Loading new firmware on to the camera may overwrite existing UserFile contents

The following pseudocode demonstrates how to read from the camera using file access:

```
// Connect to camera
// Get device node map
FileSelector = UserFile1;
FileOpenMode = Read;
FileOperationSelector = Open;
FileOperationExecute();
// Device sets FileOperationSelector = Close
// Read custom file from camera
FileOperationExecute();
// Device sets FileOperationSelector = Open
```

The following pseudocode demonstrates how to write to the camera using file access:

```
// Connect to camera
// Get device node map
FileSelector = UserFile1;
FileOpenMode = Write;
FileOperationSelector = Open;
FileOperationExecute();
// Device sets FileOperationSelector = Close
// Write custom file to camera
FileOperationExecute();
// Device sets FileOperationSelector = Open
```

The following pseudocode demonstrates how to delete the user file on the camera using file access:

```
// Connect to camera
// Get device node map
FileSelector = UserFile1;
FileOperationSelector = Delete;
FileOperationExecute();
// Power cycle the camera
DeviceReset();
```



User Sets, Streamables, and File Access functions do not load or save camera IP configuration settings.

5 CAMERA SPECIFICATIONS

5.1 Power

The CAM-CIC-12-9 can be powered via the Ethernet cable using Power over Ethernet (PoE) or the GPIO using the pins described in the GPIO Characteristics section.

When using PoE, the power supply must comply with IEEE 802.3af. You can find recommended parts to power the camera in our web store.

5.2 Temperature

The CAM-CIC-12-9 should be kept in the following storage, operating, and humidity conditions.

Storage Temperature	-30 to 60°C
Operating Temperature	-20 to 55°C ambient
Humidity Operating:	20% ~ 80%, relative, non-condensing

Placing the camera outside of these conditions may result in damage to the device.

The CAM-CIC-12-9 has a built-in temperature sensor that can be read by reading the DeviceTemperature property.



The camera can get hot to touch if it has been streaming images for an extended period of time.



DeviceTemperature can show values outside of the operating temperature range. This is generally acceptable as long as the camera is kept within the specified operating temperature range.

5.3 GPIO Characteristics

5.3.1 GPIO Pinout Diagram



The GPIO connector as seen from the rear of the CAM-CIC-12-9.

Pin Number	Pin Description
1	V _{AUX} (12-24V DC Power Input)
2	Non-isolated bi-directional GPIO channel (Line 2)
3	V _{DD} GPIO (2.5V Power Output) (Line 4)
4	Non-isolated bi-directional GPIO channel (Line 3)
5	GND (Camera GND)
6	OPTO GND (Opto-isolated Reference)
7	OPTO OUT (Opto-isolated Output) (Line 1)
8	OPTO IN (Opto-isolated Input) (Line 0)

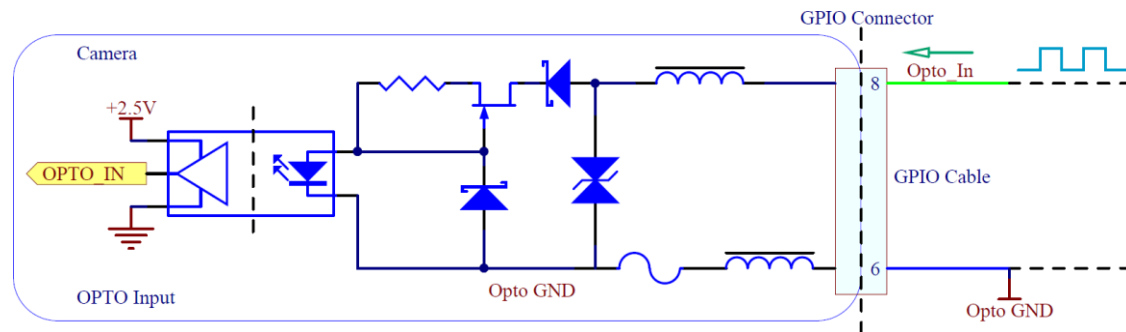
Maximum supported input voltage: 24V

Maximum supported output voltage: 24V

Consult the Turning on GPIO Voltage Output section for enabling V_{DD}.

5.4 GPIO Schematics

5.4.1 Opto-isolated Input – GPIO Line 0

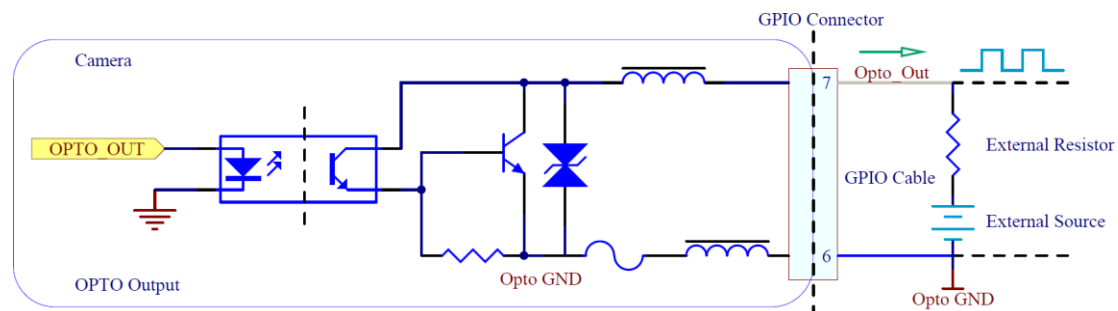


Opto-isolated Input Measurements:

Voltage (V)	Max Rise Delay (us)	Max Fall Delay (us)	Max Rise Time (us)	Max Fall Time (us)	Min Pulse Input (us)	Min Input High (V)	Min Input Low (V)
2.5	1	1	1	1	2	2.5	1.0
5	1	1	1	1	2	2.5	1.0

Sample values measured at room temperature. Results may vary with the temperature and setup. Note that the maximum input voltage is 24V.

5.4.2 Opto-isolated Output – GPIO Line 1



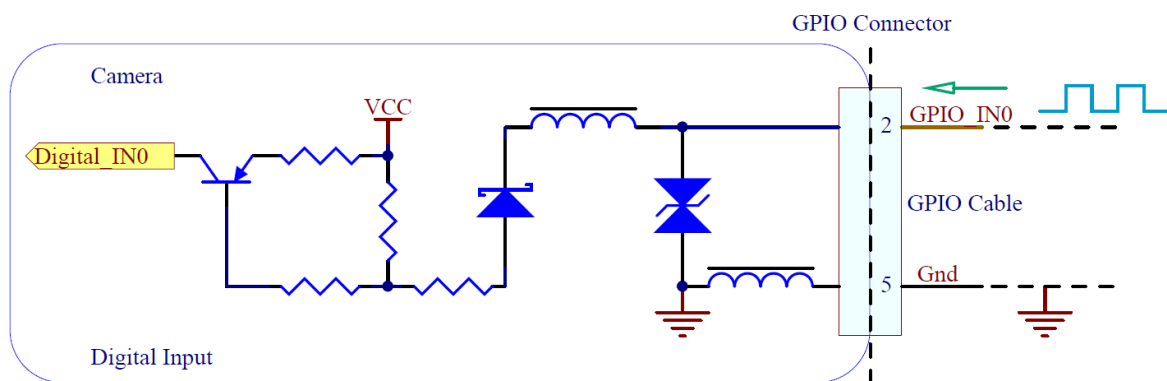
Opto-isolated Output Measurements:

Voltage (V)	External Resistor (Ω)	Max Rise Delay (us)	Max Fall Delay (us)	Max Rise Time (us)	Max Fall Time (us)	Current (mA)	Low Level (V)
2.5	150	50	5	40	5	5.7	0.9
2.5	330	50	5	40	5	2.9	0.8
2.5	560	50	5	40	5	1.9	0.5
2.5	1k	50	5	40	5	1.2	0.3
5	330	50	5	50	5	6.6	0.9

5	560	50	5	50	5	4	0.7
5	1k	50	5	50	5	2.4	0.5
5	1.8k	50	5	50	5	1.4	0.4
12	1k	50	5	60	5	6	0.9
12	1.8k	50	5	60	5	3.4	0.9
12	2.7k	50	5	60	5	2.4	0.7
12	4.7k	50	5	60	5	1.5	0.5
24	1.8k	60	5	60	5	7.1	0.9
24	2.7k	60	5	60	5	4.7	0.9
24	4.7k	60	5	60	5	2.8	0.7
24	6.8k	60	5	60	5	2.1	0.6

Sample values measured at room temperature. Results may vary with the temperature and setup.

5.4.3 Non-isolated Input - GPIO Line 2

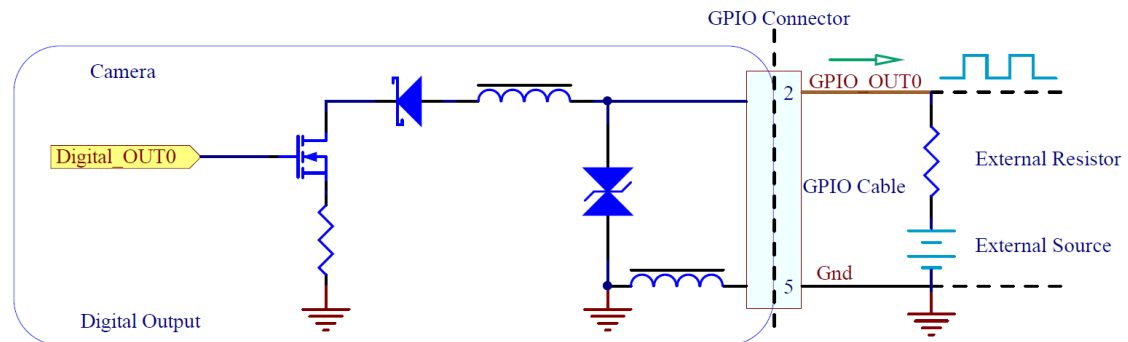


Non-isolated Input Measurements:

Voltage (V)	Max Rise Delay (us)	Max Fall Delay (us)	Max Rise Time (us)	Max Fall Time (us)	Min Pulse Input (us)	Min Input High (V)	Min Input Low (V)
2.5	1	1	1	1	2	2.5	0.5
5	1	1	1	1	2	2.5	0.5

Typical values measured at room temperature. Results may vary with temperature. Note that the maximum input voltage is 24V.

5.4.4 Non-isolated Output - GPIO Line 2



Non-isolated Output Measurements:

Voltage (V)	External Resistor (Ω)	Max Rise Delay (us)	Max Fall Delay (us)	Max Rise Time (us)	Max Fall Time (us)	Current (mA)	Low Level (V)
2.5	150	0.5	0.5	1	0.5	4.3	1.3
2.5	330	0.5	0.5	1	0.5	2.6	1
2.5	560	0.5	0.5	1	0.5	1.8	0.8
2.5	1k	0.5	0.5	1	0.5	1.1	0.6
5	330	0.5	0.5	1	0.5	5.6	1.4
5	560	0.5	0.5	1	0.5	3.7	1.1
5	1k	0.5	0.5	1	0.5	2.3	0.9
5	1.8k	0.5	0.5	1	0.5	1.4	0.7
12	1k	0.5	0.5	1	0.5	5.5	1.4
12	1.8k	0.5	0.5	1	0.5	3.2	0.9
12	2.7k	0.5	0.5	1	0.5	2.3	0.9
12	4.7k	0.5	0.5	1	0.5	1.5	0.7
24	1.8k	0.5	0.5	2	0.5	6.5	1.6
24	2.7k	0.5	0.5	2	0.5	4.5	1.3
24	4.7k	0.5	0.5	2	0.5	2.6	0.9
24	6.8k	0.5	0.5	2	0.5	1.8	0.8

Typical values measured at room temperature. Results may vary with temperature.

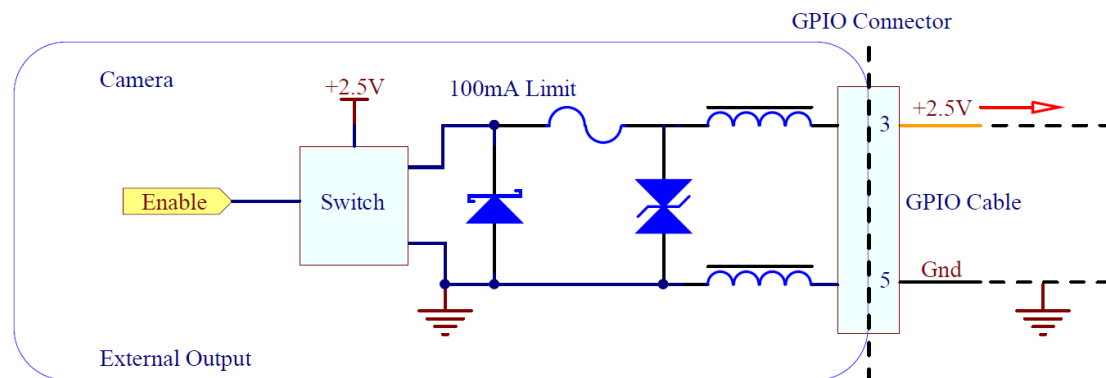
5.4.5 Non-isolated Input - GPIO Line 3

Same as Non-isolated Input – GPIO Line 2 (GPIO_IN is Pin 4, GND is Pin 5)

5.4.6 Non-isolated Output - GPIO Line 3

Same as Non-isolated Output – GPIO Line 2 (GPIO_OUT is Pin 4, GND is Pin 5)

5.4.7 2.5V Output



5.5 LED Status

The CAM-CIC-12-9 camera has an LED that identifies the current state of the camera.

LED Status	Status Information
Flashing red	Camera powered, but no Ethernet link established.
Flashing green	Camera powered, Ethernet link established, but no network traffic.
Solid green	Camera powered, Ethernet link established, and there is network traffic.
Flashing red/green	Firmware update in progress.
Flashing orange	Firmware update in progress.
Solid red	Error. Firmware update failed.

The following LED sequence occurs when the camera is powered up and connected to a network:

1. LED off, plug in the Ethernet cable.
2. LED on, flashing red.
3. After a link is established, the LED starts to flash green.
4. Once you launch the application and start capturing images, the LED changes to solid green. The status LED can also be controlled using the DeviceIndicatorMode property.

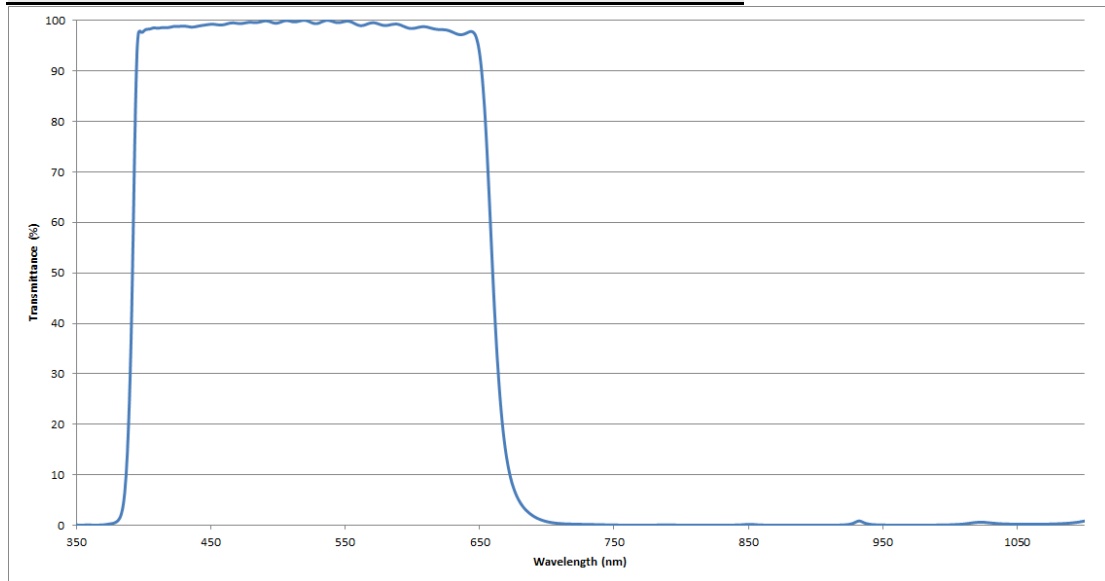
Possible values are:

- Inactive: LED is off.
- Active: LED indicates camera status according to the above table.

5.6 IR Filter

Color cameras from Cognex are equipped with an IR filter that is installed under the gasket of the mount. Mono cameras are equipped with a transparent glass window instead of an IR filter. The dimensions of the IR filter / transparent glass window are as follows:

Model	Size	Thickness
29 x 29 mm IP67 camera C-Mount	18 x 14.5 mm	1 mm



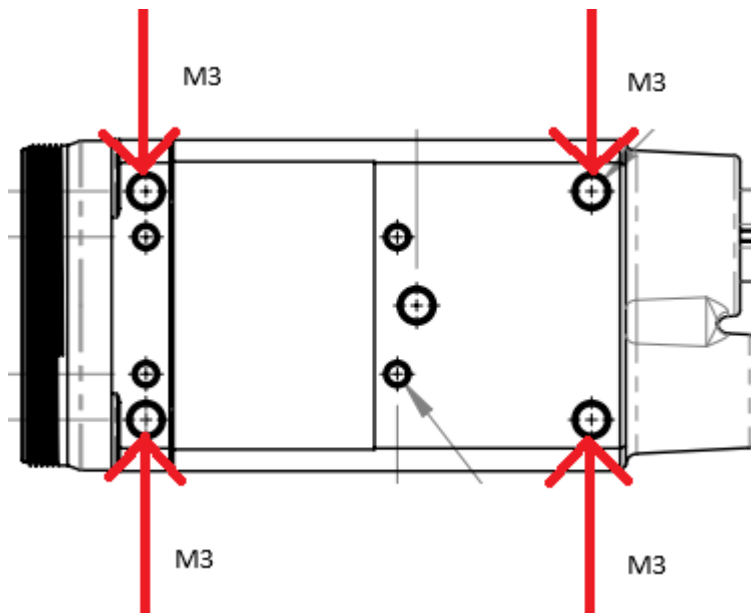
The IR filter and transparent glass window have anti-reflective coating on both sides.

5.7 Shock and Vibration

To ensure the camera's stability, the CAM-CIC-12-9 camera is tested under the following shock/vibration conditions. After the testing, the camera showed no physical damage and could produce normal images during normal operation.

Test	Standard	Parameters
Shock	DIN EN 60068-2-27	Each axis (x/y/z), 20 g, 11 ms, +/- 10 shocks
Bump	DIN EN 60068-2-27	Each axis (x/y/z), 20 g, 11 ms, +/- 100 bumps
Vibration random)	DIN EN 60068-2-27	Each axis (x/y/z), 4.9 g rms, 15-500 Hz, 0.05 g ² /Hz acceleration, 30 min per axis
Vibration sinusoidal)	DIN EN 60068-2-6	Each axis (x/y/z), 10-58 Hz: 1.5 mm, 58-500 Hz: 10 g, 1 oct/min, 1 hour 52 min per axis

During the test, the camera was mounted by securing the four M3 mounting holes on the bottom of the camera as illustrated below.



To mimic a real camera usage scenario, a dummy lens mass is attached to the camera lens mount during the shock and vibration test. The dummy lens has the following properties.

Mass	66 grams
Center of mass from C-mount	16 mm

An IP67 lens tube was then installed outside of the lens mass.

5.8 Specification Tests

5.8.1 FCC

This product has been tested and complies with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Users are advised that any changes or modifications not approved by Cognex will void the FCC compliance. The product is intended to be used as a component of a larger system; hence users are advised that cable and other peripherals may affect overall system FCC compliance.



5.8.2 RoHS, REACH, and WEEE

Cognex declares the CAM-CIC-12-9 camera is in conformity with the following directives:

- RoHS 2015/863/EU
- REACH 1907/2006/EC
- WEEE 2012/19/EC

5.8.3 CE

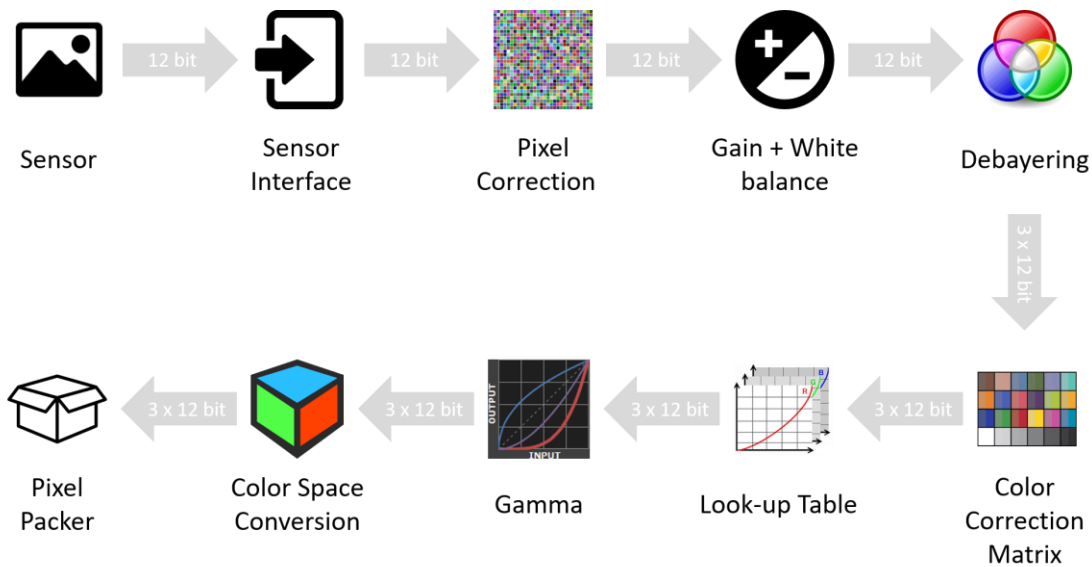
Cognex declares the CAM-CIC-12-9 meets requirements necessary for CE marking. The product complies with the requirements of the directives listed below:

- EN 55032:2012 Electromagnetic compatibility of multimedia equipment - Emission requirements
- EN 61000-3-2:2014 Harmonic Current Emissions
- EN 61000-3-3:2013 Voltage Fluctuations and Flicker
- EN 61000-4-2:2008 Electrostatic Discharge
- EN 61000-4-3:2010 Radiated RF Immunity
- EN 61000-4-4:2012 Electrical Fast Transient/Burst
- EN 61000-4-5:2014 Surge Transient
- EN 61000-4-6:2013 Conducted Immunity
- EN 61000-4-8:2009 Power Frequency Magnetic Field
- EN 61000-4-11:2004 Voltage Dips and Interruptions

6 CAMERA FEATURES

6.1 Image Processing Controls

The following is a typical image processing control flow for cameras like CAM-CIC-12-9. However, the color-related image processing controls (i.e., Debayering, Color Correction Matrix, and Color Space Conversion) are not available for monochrome cameras.



The details of each of the image processing controls are described below.

6.1.1 Defect Pixel Correction

The CAM-CIC-12-9 supports a list of pixel coordinates to be corrected via firmware. For the list of pixel coordinates, their actual pixel values are replaced by interpolation of their neighboring pixel values. The camera has a preloaded pixel correction list and these pixels are loaded during the camera manufacturing process. Defective pixels are an inevitable part of the semiconductor manufacturing process. As the camera operates for extended periods at elevated temperatures or is exposed to radiation, more defective pixels may appear. You can update the pixel correction list at any time.

Steps to add a new pixel to the correction list

1. Set OffsetX and OffsetY to zero. Set Width and Height to the maximum allowed value.
2. Set Gain to zero and note the coordinates of any bright pixels in the image. Ensure the

camera is not exposed to light by covering it with a lens cap and placing in a dark box.

3. Fire the DefectCorrectionGetNewDefect command.
4. Enter the X-coordinate noted in step 2 into DefectCorrectionPositionX.
5. Enter the Y-coordinate noted in step 2 into DefectCorrectionPositionY.
6. Fire the DefectCorrectionApply command.
7. Repeat steps 3-6 as needed and fire the DefectCorrectionSave command when done.



Pixel correction is still applied if the image geometry changes (e.g. applying ReverseX, ReverseY, a region of interest, or binning).

The following pseudocode demonstrates how to add a defective pixel to the correction list:

```
// Connect to camera
// Get device node map
// Set maximum width and height
OffsetX = 0;
OffsetY = 0;
Width = Max Width;
Height = Max Height;
// Set constant ExposureTime and Gain

DefectCorrectionGetNewDefect();
DefectCorrectionPositionX = 25; // The X-coordinate of the blemish pixel
DefectCorrectionPositionY = 150; // The Y-coordinate of the blemish pixel
DefectCorrectionApply();

// Repeat the above four steps as needed. When complete:
DefectCorrectionSave();
```

6.1.2 Gain

Gain refers to a multiplication factor applied to a signal to increase the strength of that signal. On the CAM-CIC-12-9 camera, gain can be either manually adjusted or automatically controlled. Some cameras feature gain that is purely digital while others allow for analog gain control up to a certain value, beyond which the gain becomes digital. Depending on the camera family and sensor model, the specific gain control can vary.

Analog Gain

Analog Gain refers to amplification of the sensor signal prior to A/D conversion.

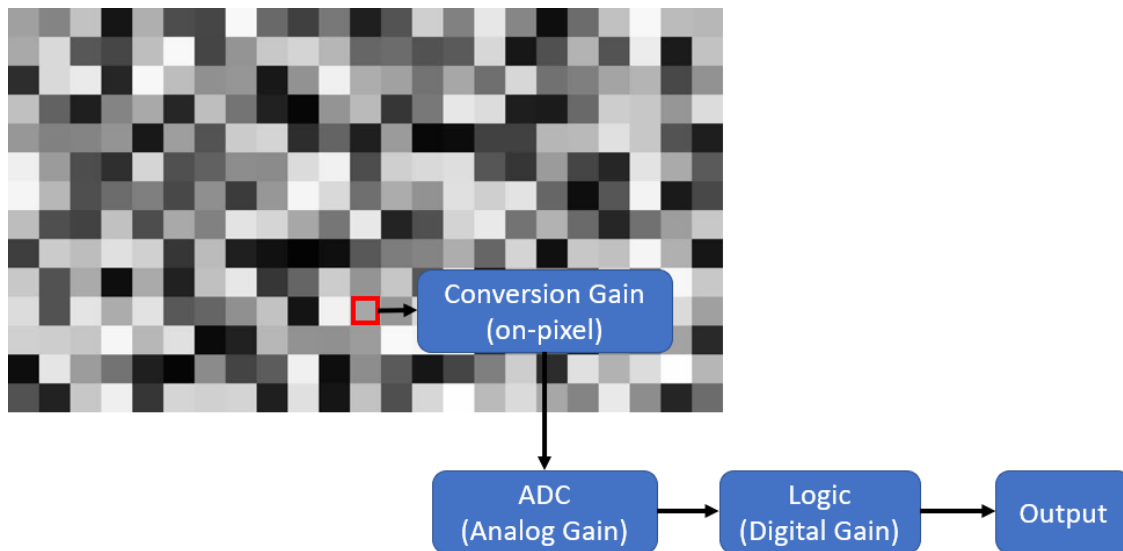
Digital Gain

Digital Gain refers to amplification of the signal after digitization. The following pseudocode demonstrates how to set Gain to 12dB:

```
// Connect to camera
// Get device node map
GainAuto = Off;
Gain = 12;
```

Conversion Gain Switching

Sony's third-generation Pregius sensor line offers a feature called Conversion Gain Switching. The Conversion Gain Switching feature lets you select between High Conversion Gain (HCG) for maximum sensitivity and minimum read noise in low light, and Low Conversion Gain (LCG) for greatly increased saturation capacity and higher dynamic range under bright light.



Conversion gain (HCG or LCG) only allows the pixel to be applied once; you will not get the same pixel with both HCG and LCG in two images.

6.1.3 Color Processing

The Debayering core in the image processing pipeline is a color processing core that enables the camera to output a color processed image format in addition to the unprocessed Bayer-tiled image. The camera supports the RGB8 pixel format, which outputs 8 bits of data per color channel for a total of 24 bits per pixel. Due to the number of bits per pixel, the total image size for RGB8 is three times larger than an 8-bit image. This increase in image data size per frame reduces the average frame rate of the camera.

The following pseudocode demonstrates how to configure the camera to RGB8 pixel format:

```
// Connect to camera
// Get device node map
PixelFormat = PixelFormat_RGB8;
```

6.1.4 White Balance

The White Balance module aims to change the balance between the Red, Green, and Blue channels such that a white object appears white in the acquired images. Cognex cameras allow for manual white balance adjustment by the user, or automatic white balance adjustment based on statistics of previously acquired frames. Different external illuminations and different sensors may render acquired images with color shift. The White Balance module allows the user to correct for the color shift by adjusting gain value of each color channel.

Cognex offers two types of white balance algorithms as described below. Each algorithm below allow for user controlled anchor points or reference points, from which multipliers are computed for each channel. The different anchor points are summarized below.

Anchors	Information
Min	The lowest luminance channel is used as reference while other channels are adjusted to match it. There is no chance of overflowing the pixels, but the image is darkened.
Max	The highest luminance channel is used as reference while other channels are adjusted to match it. There is a chance of overflowing the pixels.
Mean	The mean value of all channels is used as reference while all channels are adjusted to match the mean. There is a smaller chance of overflowing.
Green	Green channel is used as the reference while the Red and Blue are adjusted.

Grey World

The Grey World algorithm assumes that the average of all colors in an image is a neutral grey.

White Patch

The White Patch algorithm has the same idea as Grey World, but only considers a section of the image (i.e. the section being the white patches). A simple way to determine such section(s) of the image is to indicate a pixel as white when $R+G+B$ is greater than the threshold pixel value. Determining the threshold can be done using a 90% percentile of

previous image. There is also a need for an additional threshold to exclude saturated pixels for better white balance adjustment.

6.1.5 Look-Up Table (LUT)

A Look-Up Table (LUT) maps 12-bit raw sensor pixel values to 12-bit user-specified pixel values. Users input values for the even indices including the last index 4095 while averaging is used to calculate the rest of the odd indices. This results in a total of 2049 effective input entries: 2048

even (e.g., 0, 2, 4, . . . , 4092, 4094) + 1 odd (4095). Index value 0 corresponds to black while the index value 4095 corresponds to white.

To build a LUT, users input index values (e.g., 0, 2, 4, . . . , 4092, 4094, 4095) that need to be replaced in the LUTIndex field and the corresponding new value in the LUTValue field. For the odd index values in the gap (e.g., 1,3,5 . . . ,4089, 4091, 4093), their mapped value is calculated by taking the average of their neighbor mapped values (e.g., If the input mappings are LUTIndex = 1090 -> LUTValue = 10 and LUTIndex = 1092 -> LUTValue = 20, then the mapped value of LUTIndex = 1091 will be LUTValue = 15)



To reset Look-Up Table, please execute the **LUTReset** command.

The following pseudocode demonstrates how to replace black pixel values with white pixel values:

```
// Connect to camera
// Get device node map

LUTEnable = true;
LUTIndex = 0; //Pixel value to be replaced, in this
case black
LUTValue = 4095; //New pixel value, in this case
white
LUTSave();
```

6.1.6 Gamma

The gamma control allows the optimization of brightness for display. Cognex implements Gamma using the GenICam standard as shown below.

$$X = Y^{\text{Gamma}}$$

- X = New pixel value; $0 \leq X \leq 1$
- Y = Old pixel value; $0 \leq Y \leq 1$
- Gamma = Pixel intensity; $0.2 \leq \text{Gamma} \leq 2$

Y in the Gamma formula is scaled down to [0-1] from the original pixel range, which results in a pixel range of [0-1] for X. Thus, for 12-bit pixel formats, this means scaling down the pixel range from [0-4095] to [0-1] and for 16-bit pixel formats, this means scaling down the pixel range from [0-65535] to [0-1].

The camera applies gamma correction values to the intensity of each pixel. In general, gamma values can be summarized as follows:

- Gamma = 1: brightness is unchanged.
- $1 \leq \text{Gamma} \leq 2$: brightness decreases.
- $0.2 \leq \text{Gamma} \leq 1$: brightness increases.

6.1.7 Color Space Conversion and Correction

The Color Space Conversion control allows you to convert from RGB color space to another color space such as YUV. The conversion is done in a linear manner as shown in the following equation.

$$\begin{bmatrix} Y \\ C_1 \\ C_2 \end{bmatrix} = \begin{bmatrix} Gain_{00} & Gain_{01} & Gain_{02} & Offset_0 \\ Gain_{10} & Gain_{11} & Gain_{12} & Offset_1 \\ Gain_{20} & Gain_{21} & Gain_{22} & Offset_2 \end{bmatrix} \cdot \begin{bmatrix} R \\ G \\ B \\ 1 \end{bmatrix}$$

The color correction function lets you select from several preset values or configure your own matrix values. The color correction enables the multiplication of a 3x3 matrix to the 3x1 matrix containing R, G and B pixel values to achieve more desirable R', G' and B' values. The specific mathematical procedure can be represented by the following.

$$\begin{bmatrix} Gain_{00} & Gain_{01} & Gain_{02} \\ Gain_{10} & Gain_{11} & Gain_{12} \\ Gain_{20} & Gain_{21} & Gain_{22} \end{bmatrix} \begin{bmatrix} R_{in} \\ G_{in} \\ B_{in} \end{bmatrix} + \begin{bmatrix} Offset_0 \\ Offset_1 \\ Offset_2 \end{bmatrix} = \begin{bmatrix} R_{out} \\ G_{out} \\ B_{out} \end{bmatrix}$$

- The ColorTransformationEnable node indicates whether the conversion matrix of the color space conversion module is used or bypassed.
- When the pixel format is YUV or YCbCr, ColorTransformationSelector is displayed as RGBtoYUV. When the pixel format is Mono, ColorTransformationSelector is displayed as RGBtoY.
- ColorTransformationValueSelector configures which coefficient in the conversion matrix and the coefficient value is shown in ColorTransformationValue. In Mono, YUV or YCbCr pixel formats, ColorTransformation- Value is read only.

6.2 Image Format Controls

The CAM-CIC-12-9 camera is equipped with the following image format control capabilities.

6.2.1 Region of Interest (ROI)

The Region of Interest feature allows you to specify which region of the sensor is used for image acquisition. This feature allows a custom width and height for image size and a custom X and Y offset for image position. The width and height must be a multiple of the minimum width and height values allowed by the camera.

The following pseudocode demonstrates how to configure the camera to use a region of interest of 200x200 at offset (250,150):

```
// Connect to camera
// Get device node map
OffsetX = 250;
OffsetY = 150;
Width = 200;
Height = 200;
```



If the camera is acquiring images, AcquisitionStop must be called before changing region of interest settings.

6.2.2 Binning

The CAM-CIC-12-9 camera supports binning, which is a feature that combines columns and/or rows of pixels to reduce the overall image size without changing the image's field of view. This feature may increase the camera's frame rate.

The binning factor indicates how many pixels in the horizontal and vertical axes are combined. For example, when applying 2x2 binning, which is two pixels in the horizontal axis and two pixels in the vertical axis, 4 pixels combine to form one pixel. The resultant pixel values can be summed or averaged.

Binning affects the settings for the image width and height. For example, if you are using a camera with sensor resolution of 2448 x 2048 and apply 2x2 binning, the effective resolution of the resultant image is reduced to 1224 x 1024. You can verify this by checking the Width and Height nodes.

The following pseudocode demonstrates how to configure binning on the camera:

```
// Connect to camera
// Get device node map

BinningSelector = Digital; // Digital binning is performed by FPGA; some cameras will
support BinningSelector = Sensor
BinningHorizontalMode = Sum; // Binned horizontal pixels will be summed
                             (additive binning)
BinningVerticalMode = Sum; // Binned vertical pixels will be summed
                             (additive binning)

BinningHorizontal = 2; // Set Horizontal Binning to a factor of 2
BinningVertical = 2; // Set Vertical Binning to a factor of 2

// Resulting image is 1/4 of original size
```



When horizontal binning is used, horizontal decimation (if supported) is not available. When vertical binning is used, vertical decimation (if supported) is not available.



If the camera is acquiring images, AcquisitionStop must be called before adjusting binning settings.

6.2.3 Decimation

The CAM-CIC-12-9 camera supports decimation, which is a feature that skips columns and/or rows of pixels to reduce the overall image size without changing the image's field of view. This feature is also known as "subsampling" due to the smaller sample size of pixels the camera transmits. This feature may result in an increase of camera's frame rate.

Decimation affects the settings for the image width and height. For example, suppose that you are using a camera with sensor resolution of 2448 x 2048. When horizontal and vertical decimation are both set to 2, the effective resolution of the resultant image is reduced to 1224 x 1024. You can verify this by checking the Width and Height nodes.

The following pseudocode demonstrates how to configure decimation on the camera:

```
// Connect to camera
// Get device node map

DecimationHorizontal = 2; //Set Horizontal Decimation to 2
DecimationVertical = 2; //Set Vertical Decimation to 2

// Resulting image is 1/4 of original size
```



When horizontal decimation is used, horizontal binning (if supported) is not available. When vertical decimation is used, vertical binning (if supported) is not available.



If the camera is acquiring images, AcquisitionStop must be called before adjusting decimation settings.

6.2.4 Horizontal and Vertical Flip

This feature allows the camera to flip the image horizontally and vertically. The flip action occurs on the camera before transmitting the image to the host.

The following pseudocode demonstrates how to configure the camera to flip both horizontal and vertical axes:

```
// Connect to camera
// Get device node map

ReverseX = True;
ReverseY = True;
```



If the camera is acquiring images, AcquisitionStop must be called before changing horizontal or vertical flip.

6.2.5 Test Pattern

The camera is able to output one of several FPGA-generated test patterns that you can choose.



6.3 Digital IO

The CAM-CIC-12-9's Digital IO controls input and output lines that can be utilized with external circuitry for synchronization with other devices. An example use of an input line is to allow the camera to take an image upon receipt of an internal software signal or an external pulse (rising or falling edge). An example use of an output line is to fire a pulse when the camera starts integration for the duration of the current ExposureTime value.

The Digital IO lines correspond to the CAM-CIC-12-9's GPIO pins. Please consult the GPIO Cable section for more information on the required cable for the GPIO connector and the GPIO Characteristics section for a GPIO pinout diagram.

6.3.1 Configuring an Input Line

When a Digital IO line is set to Input, the line can accept external pulses. To trigger the camera upon receipt of an external pulse, the camera must also have trigger mode enabled.

The following pseudocode demonstrates how to enable trigger mode and setting Line0 as the trigger input source.

```
// Connect to camera
// Get device node map
// Choose Line0 and set it to Input

LineSelector = Line0;
LineMode = Input;

TriggerMode = On;
TriggerSelector = FrameStart; // Trigger signal starts a frame capture
TriggerSource = Line0;       // External signal to be expected on Line0
```

```
TriggerActivation = FallingEdge; // Camera will trigger on the falling  
edge of the input signal
```

```
AcquisitionStart();
```

```
// Acquire images by sending pulses to line0
```

It is also possible to set software as the input source. This will enable the camera to trigger upon a software signal. Note this mechanism may not be as accurate as using an external trigger source.

The following pseudocode demonstrates how to enable trigger mode and set a software trigger source.

```
// Connect to camera
```

```
// Get device node map
```

```
TriggerMode = On;
```

```
TriggerSelector = FrameStart; // Trigger signal starts a frame  
capture
```

```
TriggerSource = Software; // Software signal will trigger camera
```

```
AcquisitionStart();
```

```
TriggerSoftware(); // Execute TriggerSoftware to signal  
the camera to acquire an image
```



Some Digital IO lines may be Input only (e.g., an opto-isolated input). Consult the GPIO Characteristics section for a GPIO pinout diagram.



When a rolling shutter sensor is triggered, the sensor needs to take and read out an extra frame to reset the sensor. This typically reduces the maximum achievable trigger frequency to about half of the maximum value of the AcquisitionFrameRate node on most rolling shutter cameras.

6.3.2 TriggerOverlap

By default, the CAM-CIC-12-9 rejects input pulses until the last triggered image has completed the readout step on the sensor. This may limit the maximum achievable trigger frequency on some cameras when compared to the maximum non-triggered FrameRate.

To address this situation, the CAM-CIC-12-9 also supports TriggerOverlap functionality. When TriggerOverlap is enabled, the camera is able to accept an input pulse before the readout step is complete. This allows the camera to be triggered at frequencies closer to the maximum non-triggered FrameRate.

6.3.3 Configuring an Output Line

When a Digital IO line is set to Output, the line can fire pulses.

The following pseudocode demonstrates how to set Line1 as the output source. This sets up the camera to fire a pulse when the camera is acquiring an image.

```
// Connect to camera
// Get device node map

// Choose Line1 and set it to Output
LineSelector = Line1;
LineMode = Output;
LineSource = ExposureActive; // The output pulse will match the duration of
ExposureTime

AcquisitionStart();

// Acquire images and process signal from Line1
```



Opto-isolated outputs will require external circuitry to be properly signaled. Some Digital IO lines may be Output only (e.g., an opto-isolated output). Consult the GPIO Characteristics section for a GPIO pinout diagram.

6.3.4 Turning on GPIO Voltage Output

The CAM-CIC-12-9 is capable of supplying external circuits with power through the V_{DD} line. By default this line is turned off. The following pseudocode demonstrates how to enable the GPIO V_{DD} line to output voltage.

```
// Connect to camera
// Get device node map

// Choose Line4 and set it to output external voltage
LineSelector = Line4;
VoltageExternalEnable = True;

// Continue with the rest of the program...
```



Consult the GPIO Characteristics section for a GPIO pinout diagram.

6.4 Chunk Data

Chunk data is additional tagged data that can be used to identify individual images. The chunk data is appended after the image data.

For more details on chunk data, see the [Device Nodes](#) section.

6.4.1 Extracting the Image CRC checksum with ChunkCRC

When the CRC chunk data property is enabled, the camera tags a cyclic-redundancy check (CRC) checksum that is calculated against the image payload, which is useful for error detection.

The following pseudocode demonstrates how to enable the CRC property in chunk data and extracting the ChunkCRC chunk from acquired images:

```
// Connect to camera
// Get device node map
ChunkModeActive = True;
ChunkSelector   = CRC;
ChunkEnable     = True;

AcquisitionStart();

// Acquire image into buffer
// Read chunk data from received buffer
bufferCRC = ChunkCRC;      // CRC checksum for image payload
```



If the camera is acquiring images, AcquisitionStop must be called before enabling or disabling chunk data.

6.5 Transfer Control

Transfer Control allows the device to accumulate images on the on-camera buffer in a queue. The data stored in the queue, referred to as blocks, can be transmitted to the host application at a later time. The host application will be able to request the device to transmit one or more blocks. By default, this control is disabled on the CAM-CIC-12-9 and acquired images are automatically transmitted.

6.5.1 Automatic Transfer Control

When using Automatic Transfer Control mode, the transfer of blocks to the host is controlled by the device's acquisition controls.

In Automatic Transfer Control mode, the TransferOperationMode is read only and set to Continuous.

Using Continuous TransferOperationMode is similar to when Transfer Control is not enabled, except the host application can stop data transmission without stopping image acquisition on the device.

The following pseudocode demonstrates how to enable Automatic Transfer Control mode on the camera.

```
// Connect to camera
// Get device node map

// Set desired Pixel Format, Width, Height

// Optional: Read TransferQueueMaxBlockCount to determine the number of blocks
// that can be stored in the on-camera buffer with the current device settings

TransferControlMode = Automatic;
TransferQueueMode = FirstInFirstOut;
AcquisitionStart(); // When in Automatic Transfer Control Mode, the
// AcquisitionStart command automatically executes the TransferStart command

// Acquire images
// Images will be accumulating into the on-camera buffer
// Blocks will be transmitted to the host system automatically until TransferPause or AcquisitionStop is
// executed

// Retrieve images on host system
```



In Automatic Transfer Control mode, the following commands are available:

- **TransferPause** pauses the transfer of blocks without executing TransferStop or AcquisitionStop.
- **TransferResume** resumes the transfer of blocks after TransferPause has been called.
- **TransferAbort** aborts the transfer of blocks.
- **TransferStop** stops the transfer of blocks.



When blocks are not transmitted from the on-camera buffer to the host quickly enough and the number of blocks to be stored in the buffer exceeds TransferQueueMaxBlockCount, the new images will be dropped.

Set TransferStatusSelector to **QueueOverflow** and read TransferStatus to determine if a block is lost.

6.5.2 UserControlled Transfer Control

When using UserControlled Transfer Control mode, the transfer of blocks to the host is controlled by the host application. Using MultiBlock TransferOperationMode with UserControlled Transfer Control allows the host application to specify when to transmit data from the device.

The following pseudocode demonstrates how to enable UserControlled Transfer Control mode with MultiBlock TransferOperationMode on the camera. It also demonstrates transferring 2 blocks from the on-camera buffer for each transmission operation.

```
// Connect to camera
// Get device node map

// Set desired PixelFormat, Width, Height

// Optional: Read TransferQueueMaxBlockCount to determine the number of blocks
// that can be stored in the on-camera buffer with the current device settings

TransferControlMode = UserControlled;
TransferQueueMode = FirstInFirstOut;

TransferOperationMode = MultiBlock; // Transmit the number of blocks in
TransferBlockCount    = 2; // This should be less than or equal to
                           TransferQueueMaxBlockCount

AcquisitionStart();

// Acquire images
// Images will be accumulating into the on-camera buffer

// Read TransferQueueCurrentBlockCount
If (TransferQueueCurrentBlockCount > 0)
{
    // Transmit blocks to host system
    TransferStart();

    // Retrieve block 1 on host system
    // Retrieve block 2 on host system

    TransferStop();
}
```



In UserControlled Transfer Control mode, the following commands are available:

- **TransferPause** to pause transfer of blocks without executing TransferStop or AcquisitionStop.
- **TransferResume** to resume transfer of blocks after TransferPause has been called.
- **TransferAbort** to abort transfer of blocks.
- **TransferStop** to stop transfer of blocks.



When blocks are not transmitted from the on-camera buffer to the host quickly enough and the amount of blocks to be stored in the buffer exceeds TransferQueueMaxBlockCount, the new images are dropped.

Set TransferStatusSelector to QueueOverflow and read TransferStatus to determine if a block is lost.



To turn off the Transfer Control mechanism, set the TransferControlMode to Basic.



If the camera is acquiring images, AcquisitionStop must be executed before changing Transfer Control properties.

6.6 Event Control

Events are notifications generated by the camera to inform the host application about internal updates. Event Control is a mechanism used to synchronize the camera with host application using these events.

EventSelector can be used to select the event for turning notifications on or off. By default, EventNotification for all the events are set to Off except for Test events. This is because EventNotification for Test events is always set to On and cannot be changed.

The following pseudocode demonstrates how to enable Event Control on the camera.

```
// Connect to camera
// Get device node map

// Initialize host software to receive events

// Register event callback within host software

// Wait on event
```



```
// Encounter event from camera
```

```
// De-register event callback within host software
```

Events available on CAM-CIC-12-9 are as follows:

6.6.1 Exposure Start

The Exposure Start event occurs when the camera starts exposing the sensor to capture a frame. When this event occurs, the following data is sent by the camera in an Exposure Start event:

- **EventExposureStart:** Unique identifier of the Exposure Start type of Event.
- **EventExposureStartTimestamp:** Unique timestamp of the Exposure Start Event.
- **EventExposureStartFrameID:** Unique Frame ID related to Exposure Start Event.

6.6.2 Exposure End

The Exposure End event occurs when the camera has finished exposing the sensor. The following data is sent by the camera in an Exposure End event:

- **EventExposureEnd:** Unique identifier of the Exposure End type of Event.
- **EventExposureEndTimestamp:** Unique timestamp of the Exposure End Event.
- **EventExposureEndFrameID:** Unique Frame ID related to Exposure End Event.

6.6.3 Test

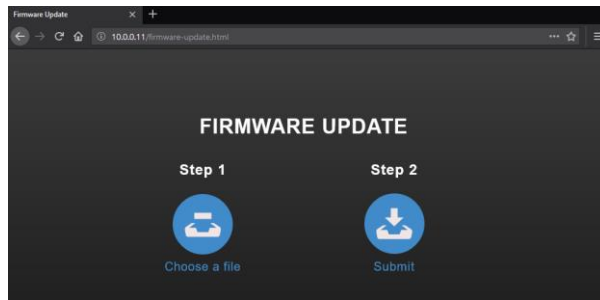
The Test event occurs when TestEventGenerate node is executed. Test event is mainly used to confirm that camera is generating events. The following data is sent by the camera in a Test event:

- **EventTest:** Unique identifier of the Test type of Event.
- **EventTestTimestamp:** Unique timestamp of the Test Event.

6.7 Firmware Update

Use the camera's Firmware Update page to update your camera's firmware. Updating your camera's firmware is easy with our firmware (fwa) file. Contact us to obtain the latest fwa file.

The camera comes with an onboard firmware update page that you can directly access in a web browser. If you already know your camera's IP address, you can access it at <http://{your-camera-ip-address}/firmware-update.html>.



6.7.1 Updating your Camera Firmware

1. Navigate to your camera's firmware update page in your web browser (<http://{your-camera-ip-address}/firmware-update.html>).
2. Click **Choose a file** on the Firmware Update page and select your fwa file.
3. Click **Submit** on the Firmware Update page. This will start the firmware update process.

The Firmware Update page will show the progress of the update. During the update, the camera will not be accessible for control or image capture. The update may take a few minutes to complete. Please refrain from turning off power to the camera during the update.

When the firmware update is complete, the camera will reboot. Once the update is finished, you can close the Firmware Update page and access the camera again.

7 DEVICE NODES

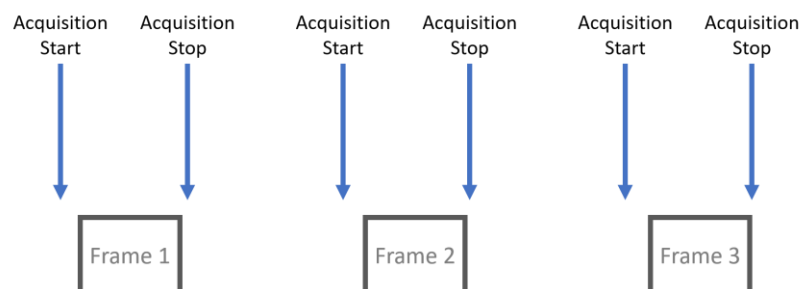
7.1 Acquisition Control

Acquisition Control contains features related to image acquisition. Triggering and exposure control functionalities are included in this section.

7.1.1 Acquisition Modes

There are 3 main types of acquisition modes - SingleFrame acquisition, MultiFrame acquisition, and Continuous acquisition.

SingleFrame Acquisition



In SingleFrame acquisition mode, one frame is acquired after AcquisitionStart is called. AcquisitionStop is an optional call as the acquisition process automatically stops after the single frame is acquired. During the acquisition process, all Transport Layer parameters are locked and cannot be modified.

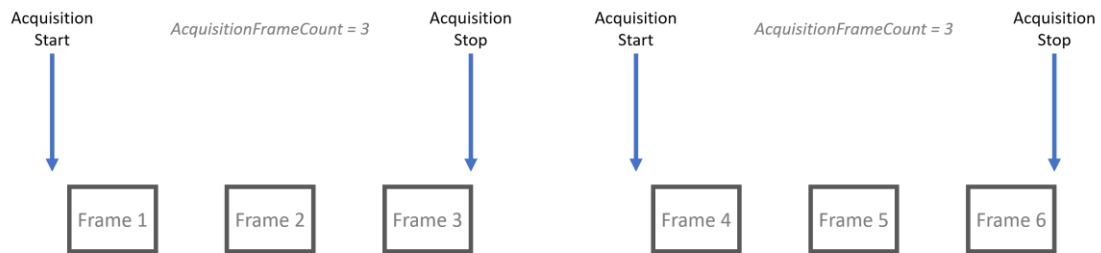


If “Acquisition Stop” is executed after “Acquisition Start” but prior to when a frame is available, it is possible that no frame is acquired.

The following code block demonstrates configuring camera to single frame acquisition mode.

```
// Connect to camera
// Get device node map
AcquisitionMode = SingleFrame;
```

MultiFrame Acquisition



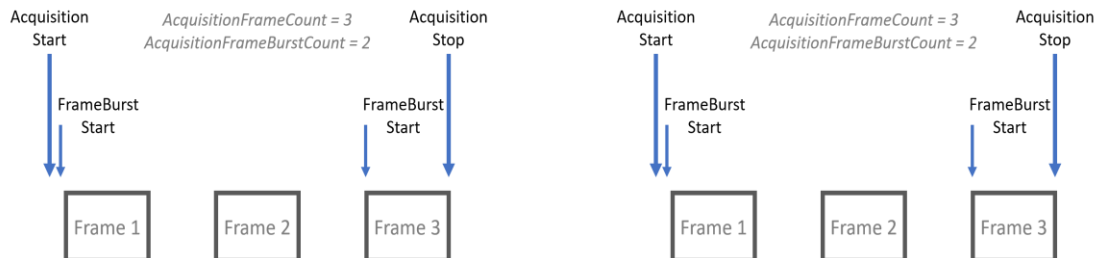
In MultiFrame acquisition mode, frames are acquired once AcquisitionStart is called. The number of frames acquired is dictated by the parameter AcquisitionFrameCount. During the acquisition process, all Transport Layer parameters are locked and cannot be modified.



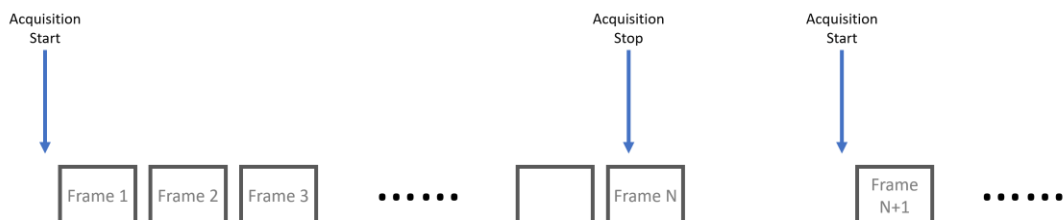
AcquisitionStop is optional in MultiFrame acquisition mode.

MultiFrame with FrameBurstStart

A burst of frames is defined as a capture of a group of one or many frames within an acquisition. This can be achieved with MultiFrame acquisition mode as demonstrated in the diagram below. Note that in the diagram, the second Frame- BurstStart in each acquisition sequence only results in one frame acquired because AcquisitionFrameCount is set to a value of 3.



Continuous Acquisition



In Continuous acquisition mode, frames are acquired once AcquisitionStart is called. Frames are acquired until AcquisitionStop is called. During the acquisition process, all Transport Layer parameters are locked and cannot be modified.



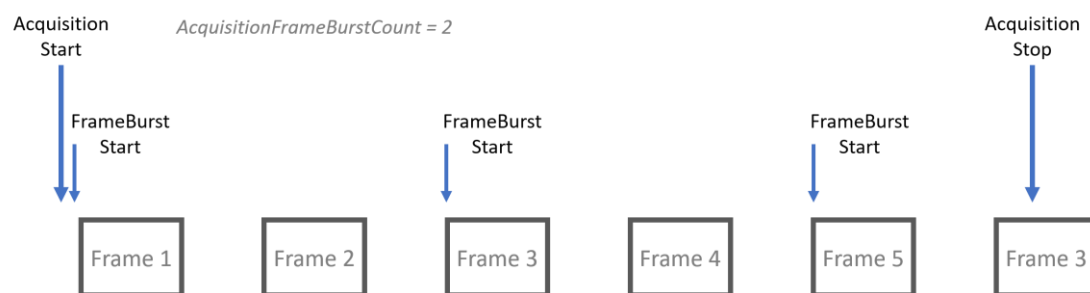
If AcquisitionStop is called during the last frame then the acquisition sequence will stop after the current frame finishes.

The following pseudocode demonstrates how to configure the camera to Continuous acquisition mode:

```
// Connect to camera
// Get device node map
AcquisitionMode = Continuous;
```

Continuous Acquisition with FrameBurstStart

A burst of frames is defined as a capture of a group of one or many frames within an acquisition. This can be achieved with Continuous acquisition mode as below. Note that when AcquisitionStop is called, the current frame will need to be finished.



Node Name	Description
AcquisitionMode	Specifies the acquisition mode of the current device. It helps determine the number of frames to acquire during each acquisition sequence.
AcquisitionStartMode	Specifies the acquisition start mode.
AcquisitionStart	Start the acquisition sequence for the current device.
AcquisitionStop	Stop the acquisition sequence for the current device.
AcquisitionFrameCount	This node specifies the number of frames to be acquired under MultiFrame AcquisitionMode.
AcquisitionBurstFrameCount	This parameter is ignored if AcquisitionMode is set to SingleFrame. This feature is also constrained by AcquisitionFrameCount if AcquisitionMode is MultiFrame.
AcquisitionFrameRate	Controls the acquisition rate (in Hertz) at which the frames are captured.

Node Name	Description
TransmissionFrameRate	Specifies the rate (in Hertz) at which frames are transmitted.
AcquisitionFrameRateEnable	Controls if the AcquisitionFrameRate feature is writable and used to control the acquisition rate.
AcquisitionLineRate	Controls the rate (in Hertz) at which the Lines in a Frame are captured.
PTPSyncFrameRate	Specifies the rate (in Hertz) at which frames are triggered in PTPSync AcquisitionStartMode.
TriggerSelector	This node selects the specific trigger type to configure.
TriggerMode	Controls the On/Off status of the current trigger.
TriggerSoftware	Executing this will generate a software trigger signal. Note that current TriggerSource must be set to Software.
TriggerSource	This node specifies the source of the trigger. It can be a software internal signal of a physical input hardware signal.
TriggerActivation	This node specifies the state in which trigger is activated.
TriggerOverlap	Specifies the type of trigger overlap permitted with the previous frame or line. This defines when a valid trigger will be accepted (or latched) for a new frame or a new line.
TriggerLatency	Enables low latency trigger mode.
TriggerDelay	Specifies the delay in microseconds (us) to apply after the trigger reception before activating it.
TriggerArmed	Specifies whether the trigger is armed. If the trigger is not armed, triggers will be ignored.
ISPClockSpeed	Speed of the ISP clock.
ExposureTimeSelector	Selects which exposure time is controlled by the Exposure Time feature. This allows for independent control over the exposure components.
ExposureTime	Controls the device exposure time in microseconds (us).

Node Name	Description
ExposureTimeRaw	Reports the device raw exposure time value.
ShortExposureEnable	Sets to Short Exposure Mode.
ExposureAuto	Sets the automatic exposure mode.
ExposureAutoLimitAuto	Specifies usage of ExposureAutoLowerLimit and ExposureAutoUpperLimit.
ExposureAutoLowerLimit	Specifies the lower limit of ExposureAuto algorithm.
ExposureAutoUpperLimit	Specifies the upper limit of ExposureAuto algorithm.
TargetBrightness	Sets the target brightness in 8-bit.
ExposureAutoAlgorithm	Controls the auto exposure algorithm.
ExposureAutoDamping	Controls the auto exposure damping factor in percent. Bigger values converge faster but have higher chance of oscillating.
ExposureAutoDampingRaw	Controls the auto exposure damping factor raw value. Bigger values converge faster but have higher chance of oscillating.
CalculatedMedian	Reports the current image exposure median value.
CalculatedMean	Reports the current image exposure average value.
AutoExposureAOI	Category for auto exposure AOI features.

7.1.2 Auto Exposure AOI

Node Name	Description
AutoExposureAOIEnable	Controls auto exposure AOI enable (1) or disable (0).
AutoExposureAOIWidth	Controls auto exposure AOI width relative to user AOI.
AutoExposureAOIHeight	Controls auto exposure AOI height relative to user AOI.
AutoExposureAOIOffsetX	Controls auto exposure AOI offset X relative to user AOI.
AutoExposureAOIOffsetY	Controls auto exposure AOI offset Y relative to user

Node Name	Description
	AOI.

7.2 Action Control

Node Name	Description
ActionUnconditionalMode	Enables the unconditional action command mode where action commands are processed even when the primary control channel is closed.
ActionPTPSyncRequired	Determines whether or not PTP needs to be synchronized to launch an action command.
ActionQueueSize	Indicates the size of the scheduled action commands queue.
ActionDeviceKey	Provides the device key that allows the device to check the validity of action commands.
ActionSelector	Selects to which Action Signal further Action settings apply.
ActionGroupKey	Provides the key that the device will use to validate the action on reception of the action protocol message.
ActionGroupMask	Provides the mask that the device will use to validate the action on reception of the action protocol message.

7.3 Analog Control

Analog Control contains features that describe how to influence the analog features of an image, such as gain, black level, and gamma. Features related to white balance are not available on monochrome cameras.

Node Name	Description
GainSelector	Selects which Gain is controlled by the various Gain features.
Gain	Controls the selected Gain as an absolute physical value.
GainRaw	Reports the gain raw value.

Node Name	Description
GainAuto	Sets the automatic gain control mode.
GainAutoLowerLimit	Specifies the lower limit of GainAuto algorithm.
GainAutoUpperLimit	Specifies the upper limit of GainAuto algorithm.
BlackLevelSelector	Selects which BlackLevel is controlled by the various Black Level features.
BlackLevel	Controls the BlackLevel as an absolute physical value.
BlackLevelRaw	Controls the raw BlackLevel value.
BalanceRatioSelector	Selects which BalanceRatio is controlled by the various Balance Ratio features.
BalanceRatio	Controls the selected BalanceRatio as an absolute physical value. This is an amplification factor applied to the video signal.
BalanceWhiteAuto	Controls the mode for automatic white balancing between the color channels. The white balancing ratios are automatically adjusted.
BalanceWhiteEnable	Activates balance white features.
BalanceWhiteAutoAnchorSelector	Controls which type of statistics are used for BalanceWhiteAuto.
AwbDamping	Controls the auto white balance damping factor in percent.
AwbDampingRaw	Controls the auto white balance damping factor raw value.
AwbWhitePatchEnable	Controls if the white patch algorithm is used for BalanceWhiteAuto.
AwbStatsFrameCount	Controls how many frames are used for collecting statistics for BalanceWhiteAuto.
AwbAOI	Category for auto white balance AOI features.
GammaEnable	Controls the selected balance ratio as an absolute physical value. This is an amplification factor applied to the video signal.
Gamma	Controls the gamma correction of pixel intensity.

Node Name	Description
SharpeningEnable	Controls if the sharpening feature is enabled.
SharpeningAmount	Controls the sharpening amount.
SharpeningThreshold	Controls the minimal brightness change that will be sharpened. The threshold setting can be used to sharpen more pronounced edges, while leaving subtler edges untouched.

7.4 Chunk Data Control

Node Name	Description
ChunkModeActive	Activates the inclusion of Chunk data in the payload of the image.
ChunkSelector	Selects which Chunk to enable or control.
ChunkEnable	Enables the inclusion of the selected Chunk data in the payload of the image.
ChunkCRC	CRC chunk data.
ChunkTriggerLine	Trigger line chunk data.
ChunkHistogramStats	Histogram stats chunk data.
ChunkDeepNeuralNetworkLength	The length of the deep neural network chunk data.
ChunkDeepNeuralNetwork	Deep neural network chunk data.
ChunkTimestamp	Chunk Timestamp chunk data.
ChunkSequencerSetActive	Chunk Sequencer Set Active chunk data.
ChunkLineStatusAll	Chunk Line Status All chunk data.
ChunkPixelFormat	Chunk Pixel Format chunk data.
ChunkWidth	Chunk Width chunk data.
ChunkHeight	Chunk Height chunk data.
ChunkOffsetX	Chunk Offset X chunk data.
ChunkOffsetY	Chunk Offset Y chunk data.

Node Name	Description
ChunkPixelDynamicRangeMin	Chunk Pixel Dynamic Range Min chunk data.
ChunkPixelDynamicRangeMax	Chunk Pixel Dynamic Range Max chunk data.
ChunkGain	Chunk Gain chunk data.
ChunkBlackLevel	Chunk Black Level chunk data.
ChunkExposureTime	Chunk Exposure Time chunk data.

7.5 Color Transformation Control

Color Transformation Control contains features that describe how to color transformation features of an image, such as RGB to YUV conversion. This feature is not available on monochrome cameras.

Node Name	Description
ColorTransformationEnable	Controls if the selected color transformation module is activated.
ColorTransformationSelector	Selects which Color Transformation module is controlled by the various Color Transformation features.
ColorTransformationValueSelector	Selects the Gain factor or Offset of the Transformation matrix to access in the selected Color Transformation module.
ColorTransformationValue	Represents the value of the selected Gain factor or Offset inside the Transformation matrix.

7.6 Counter and Timer Control

Node Name	Description
CounterSelector	Selects which Counter to configure.
CounterEventSource	Select the events that will be the source to increment the Counter.
CounterEventActivation	Selects the Activation mode Event Source signal.

Node Name	Description
CounterTriggerSource	Selects the source to start the Counter.
CounterTriggerActivation	Selects the Activation mode of the trigger to start the Counter.
CounterResetSource	Select the signals that will be the source to reset the Counter.
CounterResetActivation	Selects the Activation mode of the Counter Reset Source signal.
CounterReset	Does a software reset of the selected Counter and starts it.
CounterValue	Reads or writes the current value of the selected Counter.
CounterValueAtReset	Reads value of the selected Counter when it was reset by a trigger or by an explicit CounterReset command.
CounterDuration	Sets the duration (or number of events) before the Counter End event is generated.
CounterStatus	Returns the current status of the Counter.
TimerSelector	Selects which Timer to configure.
TimerTriggerSource	Selects the source to start the Timer.
TimerTriggerActivation	Selects the Activation mode of the trigger to start the Timer.
TimerDuration	Sets the duration (in microseconds) of the Timer pulse.
TimerDelay	Sets the duration (in microseconds) of the delay to apply at the reception of a trigger before starting the Timer.
TimerReset	Does a software reset of the selected Timer and starts it.
TimerValue	Reads or writes the current value of the selected Timer.
TimerStatus	Returns the current status of the Timer.

7.7 Defect Correction Control

Node Name	Description
DefectCorrectionEnable	Activates the defect correction feature.

Node Name	Description
DefectCorrectionCount	The number of defect corrected pixels.
DefectCorrectionIndex	The index of the defect corrected pixel to access.
DefectCorrectionPositionX	The column index of the defect corrected pixel selected by DefectCorrectionIndex.
DefectCorrectionPositionY	The row index of the defect corrected pixel selected by DefectCorrectionIndex.
DefectCorrectionGetNewDefect	Get a new defect corrected pixel to be entered.
DefectCorrectionApply	Apply the new defect corrected pixel.
DefectCorrectionRemove	Remove the defect corrected pixel selected by DefectCorrectionIndex.
DefectCorrectionSave	Save the defect corrected pixels to non-volatile memory.
DefectCorrectionRestoreDefault	Reset the defect correction to factory default.

7.8 Device Control

Device Control contains features that provide information of the capabilities of the device. There are also features that describe the particular device in detail. These features can be used in applications to query the capabilities of the device and report them to the end user if needed.

Below is a list of the available features that are contained in the specific category.

Node Name	Description
DeviceType	Returns the device type.
DeviceScanType	Scan type of the sensor of the device.
DeviceVendorName	Name of the manufacturer of the device.
DeviceModelName	Model of the device.
DeviceFamilyName	Identifier of the product family of the device.
DeviceManufacturerInfo	Provides additional information from the vendor about the device.
DeviceVersion	Version of the device.

Node Name	Description
DeviceFirmwareVersion	Version of the firmware in the device.
DeviceSerialNumber	Device's unique serial number.
DeviceUserID	A device ID string that is user-programmable.
DeviceSFNCVersionMajor	Major version of the Standard Features Naming Convention (SFNC) that was used to create the device's GenICam XML.
DeviceSFNCVersionMinor	Minor version of the Standard Features Naming Convention (SFNC) that was used to create the device's GenICam XML.
DeviceSFNCVersionSubMinor	Sub minor version of the Standard Features Naming Convention (SFNC) that was used to create the device's GenICam XML.
DeviceManifestEntrySelector	Manifest entry selector.
DeviceManifestXMLMajorVersion	Indicates the major version number of the GenICam XML file of the selected manifest entry.
DeviceManifestXMLMinorVersion	Indicates the minor version number of the GenICam XML file of the selected manifest entry.
DeviceManifestXMLSubMinorVersion	Indicates the sub minor version number of the GenICam XML file of the selected manifest entry.
DeviceManifestSchemaMajorVersion	Indicates the major version number of the schema file of the selected manifest entry.
DeviceManifestSchemaMinorVersion	Indicates the minor version number of the schema file of the selected manifest entry.
DeviceManifestPrimaryURL	Indicates the first URL to the GenICam XML device description file of the selected manifest entry.
DeviceTLType	Transport Layer type of the device.
DeviceTLVersionMajor	Major version of the Transport Layer of the device.
DeviceTLVersionMinor	Minor version of the Transport Layer of the device.

Node Name	Description
DeviceTLVersionSubMinor	Sub minor version of the Transport Layer of the device.
DeviceMaxThroughput	Maximum bandwidth of the data that can be streamed out of the device.
DeviceLinkSelector	Selects which Link of the device to control. In general, the device only has one link.
DeviceLinkSpeed	Indicates the speed of transmission negotiated on the specified Link selected by DeviceLinkSelector.
DeviceLinkThroughputLimitMode	Controls if the DeviceLinkThroughputLimit is active.
DeviceLinkThroughputLimit	Limits the maximum bandwidth of the data that will be streamed out by the device on the selected Link.
DeviceLinkThroughputReserve	Allocates the maximum percentage of bandwidth reserved for re-transmissions.
DeviceLinkHeartbeatMode	Activate or deactivate the selected Link's heartbeat.
DeviceLinkHeartbeatTimeout	Controls the current heartbeat timeout of the specific Link in microseconds.
DeviceLinkCommandTimeout	Indicates the command timeout of the specified Link in microseconds.
DeviceStreamChannelCount	Indicates the number of stream channels supported by the device.
DeviceStreamChannelSelector	Selects the stream channel to control.
DeviceStreamChannelType	Reports the type of the stream channel.
DeviceStreamChannelEndianness	Endianness of multi-byte pixel data for this stream.
DeviceStreamChannelPacketSize	Specifies the stream packet size, in bytes, to send on the selected channel for the device.
DeviceEventChannelCount	Indicates the number of event channels supported by the device.
DeviceCharacterSet	Character set used by all the strings of the

Node Name	Description
	device.
DeviceReset	Resets the device to its power up state.
DeviceFactoryReset	Resets device to factory defaults.
FirmwareUpdate	Starts a firmware update.
DeviceFeaturePersistenceStart	Indicate to the device and GenICam XML to get ready for persisting of all streamable features.
DeviceFeaturePersistenceEnd	Indicate to the device the end of feature persistence.
DeviceRegistersStreamingStart	Prepare the device for registers streaming without checking for consistency.
DeviceRegistersStreamingEnd	Announce the end of registers streaming.
DeviceIndicatorMode	Controls the behavior of the indicator LED showing the status of the Device.
DeviceTemperatureSelector	Selects the temperature sensor to read from.
DeviceTemperature	Device temperature in degrees Celsius.
DevicePressure	The internal device pressure in kilopascals.
DevicePower	Device power in Watts.
DeviceClockSelector	Selects the clock frequency to access from the device.
DeviceClockFrequency	Returns the frequency of the selected Clock.
Timestamp	Reports the current value of the device timestamp counter.
TimestampReset	Resets the current value of the device timestamp counter. Executing this command causes the timestamp counter to restart automatically.
TimestampLatch	Latches the current timestamp counter into TimestampLatchValue.
TimestampLatchValue	Returns the latched value of the timestamp counter.

Node Name	Description
DeviceUpTime	Time the device has been powered in seconds.
LinkUpTime	Time the device link has been established in seconds.
ChipID	Chip ID of the device.

7.9 Digital IO Control

Node Name	Description
LineConfiguration	Reports the configuration of the Digital IO Lines.
LineSelector	Selects the physical line (or pin) of the external device connector to configure.
LineMode	Controls if the physical Line is used to Input or Output a signal.
LineInverter	Controls the inversion of the signal of the selected input or output Line.
LineStatus	Returns the current status of the selected input or output Line.
LineStatusAll	Returns the current status of all available Line signals at time of polling.
LineSource	Selects which internal acquisition or I/O source signal to output on the selected Line. LineMode must be set to Output.
LineFormat	Controls the current electrical format of the selected physical input or output Line.
LineFilterSelector	Selects the input filter to configure. LineMode must be Input.
LineFilterWidth	Width of the filter in microseconds.
LineActivationVoltage	The voltage level to activate the line.
VoltageExternalEnable	Controls if the external voltage is enabled.
ExposureActiveOutputSignalMode	Selects the output signal mode of the

Node Name	Description
	ExposureActive LineSource.
UserOutputSelector	Selects which bit of the User Output register will be set by UserOutputValue.
UserOutputValue	Sets the value of the bit selected by UserOutputSelector.
UserOutputValueAll	Sets the value of all the bits of the User Output register. It is subject to the UserOutputValueAllMask.
UserOutputValueAllMask	Sets the write mask to apply to the value specified by UserOutputValueAll before writing it in the User Output register. If the UserOutputValueAllMask feature is present, setting the user Output register using UserOutputValueAll will only change the bits that have a corresponding bit in the mask set to one.

7.10 Event Control

Event Control has the device inform the host application that an event has occurred. Below is a list of the available features that are contained in the specific category.

Node Name	Description
EventSelector	Selects which Event to signal to the host application.
EventNotification	Activate or deactivate the notification to the host application of the occurrence of the selected Event.
EventDestinationAddress	Controls the destination IP address for events.
EventExposureStartData	Category that contains all the data features related to the ExposureStart Event.
EventExposureEndData	Category that contains all the data features related to the ExposureEnd Event.
EventTestData	Category that contains all the data features related to the Event Test generated using the TestEventGenerate command.

Node Name	Description
EventEncoder0StoppedData	Category that contains all the data features related to the Encoder0Stopped Event.
EventEncoder0RestartedData	Category that contains all the data features related to the Encoder0Restarted Event.
EventFrameDroppedData	Category that contains all the data features related to the FrameDropped Event.
EventTemperatureOutOfRangeData	Category that contains all the data features related to the TemperatureOutOfRange Event.
EventAcquisitionTriggerMissedData	Category that contains all the data features related to the EventAcquisitionTriggerMissed Event.
EventFrameTriggerMissedData	Category that contains all the data features related to the EventFrameTriggerMissed Event.

7.10.1 Event Acquisition Trigger Missed Data

Node Name	Description
EventAcquisitionTriggerMissed	Returns the unique identifier of the EventAcquisitionTriggerMissed type of Event.
EventAcquisitionTriggerMissedTimestamp	Returns the Timestamp of the EventAcquisitionTriggerMissed Event.

7.10.2 Event Encoder 0 Restarted Data

Node Name	Description
EventEncoder0Restarted	Returns the unique identifier of the Encoder0Restarted type of Event.
EventEncoder0RestartedTimestamp	Returns the Timestamp of the Encoder0Restarted Event.

7.10.3 Event Encoder 0 Stopped Data

Node Name	Description
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Node Name	Description
EventEncoder0Stopped	Returns the unique identifier of the Encoder0Stopped type of Event.
EventEncoder0StoppedTimestamp	Returns the Timestamp of the Encoder0Stopped Event.

7.10.4 Event Exposure End Data

Node Name	Description
EventExposureEnd	Returns the unique identifier of the ExposureEnd type of Event.
EventExposureEndTimestamp	Returns the Timestamp of the ExposureEnd Event.
EventExposureEndFrameID	Returns the unique Identifier of the Frame (or image) that generated the ExposureEnd Event.

7.10.5 Event Exposure Start Data

Node Name	Description
EventExposureStart	Returns the unique identifier of the ExposureStart type of Event.
EventExposureStartTimestamp	Returns the Timestamp of the ExposureStart Event.
EventExposureStartFrameID	Returns the unique Identifier of the Frame (or image) that generated the ExposureStart Event.

7.10.6 Event Frame Dropped Data

Node Name	Description
EventFrameDropped	Returns the unique identifier of the FrameDropped type of Event.
EventFrameDroppedTimestamp	Returns the Timestamp of the FrameDropped Event.

7.10.7 Event Frame Trigger Missed Data

Node Name	Description
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Node Name	Description
EventFrameTriggerMissed	Returns the unique identifier of the EventFrameTriggerMissed type of Event.
EventFrameTriggerMissedTimestamp	Returns the Timestamp of the EventFrameTriggerMissed Event.

7.10.8 Event Temperature Out Of Range Data

Node Name	Description
EventTemperatureOutOfRange	Returns the unique identifier of the TemperatureOutOfRange type of Event.
EventTemperatureOutOfRangeTimestamp	Returns the Timestamp of the TemperatureOutOfRange Event.

7.10.9 Event Test Data

Node Name	Description
EventTest	Returns the unique identifier of the Event Test type of event generated using the TestEventGenerate command.
EventTestTimestamp	Returns the Timestamp of the Event Test event.

7.11 File Access Control

Node Name	Description
FileSelector	Selects the target file in the device.
FileOperationSelector	Selects the target operation for the selected file in the device. This operation is executed when the FileOperationExecute feature is called.
FileOperationExecute	Executes the operation selected by FileOperationSelector on the selected file.
FileOpenMode	Selects the access mode in which a file is opened in the device.

Node Name	Description
FileAccessBuffer	Defines the intermediate access buffer that allows the exchange of data between the device file storage and the application.
FileAccessOffset	Controls the offset of the mapping between the device file storage and the FileAccessBuffer.
FileAccessLength	Controls the length of the mapping between the device file storage and the FileAccessBuffer.
FileOperationStatus	Represents the FileOperationExecute status.
FileOperationResult	Represents the file operation result. For Read or Write operations, the number of successfully read/written bytes is returned.
FileSize	Represents the size of the selected file in bytes.
FileStorageSize	Represents the total size of the file storage selected by FileSelector in bytes.
FileStorageUsedSize	Represents the used size of the file storage selected by FileSelector in bytes.
FileStorageFreeSize	Represents the free size of the file storage selected by FileSelector in bytes.

7.12 I2C Access Control

Node Name	Description
I2COperationSelector	Selects the target operation for the I2C communication on the device. This operation is executed when the I2COperationExecute feature is called.
I2COperationExecute	Executes the operations selected by I2COperationSelector on the I2C communication.
I2CAccessBuffer	Defines the intermediate access buffer that allows the exchange of data between the device's I2C communication and the application.
I2CRegisterAddress	Controls the register address for the operation selected by the I2COperationSelector.
I2CRegisterAddressLength	Controls the register address length used for the I2C communication.

Node Name	Description
I2CRegisterDataLength	Controls the register data length used for the I2C communication.
I2CAccessLength	Controls the number of words to transfer to or from the I2CAccessBuffer.
I2COperationStatus	Represents the I2COperationExecute status.
I2COperationResult	Represents the number of successfully read/written bytes for the I2C operation.
I2CSlaveDeviceAddress	Controls the device address for the slave.
I2CSlaveDeviceAddressLength	Controls the slave device address length used for the I2C communication.
I2CSclSource	Selects the physical line to use for the I2C SCL source.
I2CSdaSource	Selects the physical line to use for the I2C SDA source.

7.13 Image Format Control

Node Name	Description
PixelFormat	Format of the pixels provided by the device.
PixelSize	Total size in bits of a pixel of the image.
PixelFormatMappingSelector	Selects the pixel format mapping.
PixelFormatMappingEnable	Enables the pixel format mapping selected by PixelFormatMappingSelector.
PolarizedAngleSelector	Selects the polarized angle for the PolarizedDolpAngle_* pixel formats.
PixelColorFilter	Type of color filter that is applied to the image.
IspBayerPattern	Reports the image Bayer pattern in the ISP.
SensorWidth	Effective width of the sensor in pixels.
SensorHeight	Effective height of the sensor in pixels.
SensorShutterMode	Specifies the shutter mode.

Node Name	Description
WidthMax	Maximum width of the image in pixels.
HeightMax	Maximum height of the image in pixels.
PhysicalPixelSize	Reports the physical size of an individual pixel on the sensor.
ADCBitDepth	Reports the bit depth of the sensor's ADC.
ImagerWidth	Width of the sensor image after binning and decimation.
ImagerHeight	Height of the sensor image after binning and decimation.
ImagerOffsetX	Horizontal offset from the origin of the sensor region.
ImagerOffsetY	Vertical offset from the origin of the sensor region.
ISPWidth	Width of the image in the image processing pipeline before multi ROI.
ISPHeight	Height of the image in the image processing pipeline before multi ROI.
Width	Width of the image provided by the device in pixels.
Height	Height of the image provided by the device in pixels.
OffsetX	Horizontal offset from the origin to the region of interest in pixels.
OffsetY	Vertical offset from the origin to the region of interest in pixels.
MultipleROIRowsEnable	Enables multiple ROI rows mode.
MultipleROIRowSelector	Selects the index of the row to configure.
MultipleROIRowEnable	Enables the selected row.
MultipleROIRowSize	Configures the Height of the selector row.
MultipleROIRowOffset	Configures the OffsetY of the selected row.
ReverseX	Flip horizontally the image sent by the device.
ReverseY	Flip vertically the image sent by the device.

Node Name	Description
PixelDynamicRangeMin	Minimum value that can be returned during the digitization process.
PixelDynamicRangeMax	Maximum value that can be returned during the digitization process.
BinningSelector	Selects which binning engine is controlled by the BinningHorizontal and BinningVertical features.
BinningHorizontalMode	Selects how to combine the horizontal pixels together.
BinningVerticalMode	Selects how to combine the vertical pixels together.
BinningHorizontal	Number of horizontal pixels to combine together. This reduces the horizontal resolution (width) of the image. A value of 1 indicates that no horizontal binning is performed by the camera.
BinningVertical	Number of vertical pixels to combine together. This reduces the vertical resolution (height) of the image. A value of 1 indicates that no vertical binning is performed by the camera.
DecimationSelector	Selects which decimation engine is controlled by the DecimationHorizontal and DecimationVertical features.
DecimationHorizontalMode	Selects how to decimate the horizontal pixels.
DecimationVerticalMode	Selects how to decimate the vertical pixels.
DecimationHorizontal	Number of horizontal pixels to decimate. This reduces the horizontal resolution (width) of the image. A value of 1 indicates that no horizontal decimation is performed by the camera.
DecimationVertical	Number of vertical pixels to decimate. This reduces the vertical resolution (height) of the image. A value of 1 indicates that no vertical decimation is performed by the camera.
TestPattern	Selects the type of test pattern that is generated by the device as image source.

7.14 LUT Control

Node Name	Description
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Node Name	Description
LUTEnable	Activates the saved LUT.
LUTToneMapping	Selects which tone mapping curve to apply.
LUTSelector	Selects which LUT to control.
LUTIndex	Control the index (offset) of the coefficient to access in the selected LUT.
LUTValue	Access the value at entry LUT Index of the LUT selected by LUT Selector.
LUTValueAll	Accesses all the LUT coefficients in a single access without using individual LUT Index.
LUTSave	Save the values set through LUT Values or LUT Value All.
LUTReset	Reset the LUT Values to be linear mapping.

7.15 Sequencer Control

Sequencer Control allows acquisition of images with varying settings without stopping stream. A total of 8 different sets can be defined in Sequencer with each set maintaining unique values for the supported features. When Sequencer Mode is enabled, the camera will cycle through these 8 sets and grab images. For example, the sets could have different gain and exposure times. For each cycle, 8 different paths can be defined; in each path, one set can point to any of other 7 sets for the upcoming frame.

7.15.1 Supported Features:

The following features are supported in a sequencer set:

- Gain
- Exposure Time

7.15.2 Configuring a Sequencer Set

The following instructions explain how to configure a sequencer with two sets of Exposure Time where set 0 goes to set 1 and set 1 goes back to set 0, all being triggered on Frame Start.

Configuring first set of the sequencer:

To start the configuration process, set SequencerConfigurationMode to “On” under the Sequencer Control group.

Ensure that SequencerFeatureSelector is set to "ExposureTime".

By default, SequencerSetSelector is set to "0". This means that we can set a exposure time for set "0" under AcquisitionControl (the ExposureAuto node is already forced Off at this point). Under the Acquisition Control group, set an ExposureTime of 100 us.

Set SequencerSetStart to "0". This means that every cycle starts from set "0".

SequencerPathSelector can be "0".

Set SequencerSetNext to "1".

Set SequencerTriggerSource to "FrameStart". This allows the sequencer to change the set at each Frame Start signal.

Click "SequencerSetSave" to save your first set of sequencer settings with an exposure time of 100 us.

Configuring the second set of the sequencer:

1. Change SequencerSetSelector from "0" to "1" in order to start configuring set 2.
2. Set SequencerSetNext to "0".
3. Go under the Acquisition Control group and set ExposureTime to another value like 50000 us.
4. Leave SequencerTriggerSource to "FrameStart". This allows the sequencer to change at each Frame Start signal.
5. Click on "SequencerSetSave" to save your second set of sequencer settings with exposure time 50000 us.

Turn SequencerConfigurationMode to "Off"; the firmware validates your sequencer setting to ensure it is valid. SequencerMode should now be writable, which allows you to set it to "On". If it's not writable, this means that the sequencer set configured is invalid. After setting SequencerMode to "On" and streaming the camera, you should see flashing of images with two exposure times.



For the SingleFrame and MultiFrame acquisition modes, AcquisitionStop must be executed before executing AcquisitionStart again.

The following pseudocode summarizes the above instructions and demonstrates how to configure two sets (0 and 1) with varying ExposureTime so they loop 0-1-0-1.

```
// Connect to camera
// Get device node map
ExposureAuto = "Off";
GainAuto = "Off";
SequencerMode = "Off";
SequencerConfigurationMode = "On";
```

```

// Configuring set 1
SequencerSetSelector = 0;
SequencerFeatureSelector = "ExposureTime";
ExposureTime = 100;
SequencerPathSelector = 0;
SequencerSetNext = 1;
SequencerTriggerSource = FrameStart;
SequencerSetSave;

// Configuring set 2
SequencerSetSelector = 1;
SequencerFeatureSelector = "ExposureTime";
ExposureTime = 50000;
SequencerPathSelector = 0;
SequencerSetNext = 0;
SequencerTriggerSource = FrameStart;
SequencerSetSave;

SequencerSetStart = 0
SequencerConfigurationMode = "Off"

SequencerMode = "On"

```

Node Name	Description
SequencerMode	Controls if the sequencer mechanism is active.
SequencerConfigurationMode	Controls if the sequencer configuration mode is active.
SequencerFeatureSelector	Selects which sequencer features to control.
SequencerFeatureEnable	Enables the selected feature and make it active in all the sequencer sets.
SequencerSetSelector	Selects the sequencer set to which further feature settings applies.
SequencerSetSave	Saves the current device state to the sequencer set selected by the SequencerSetSelector.
SequencerSetLoad	Loads the sequencer set selected by SequencerSetSelector in the device.
SequencerSetActive	Contains the currently active sequencer set.
SequencerSetStart	Sets the initial/start sequencer set, which is the first set used within a sequencer.
SequencerPathSelector	Selects to which branching path further path settings

Node Name	Description
	applies.
SequencerSetNext	Specifies the next sequencer set.
SequencerTriggerSource	Specifies the internal signal or physical input line to use as the sequencer trigger source.
SequencerTriggerActivation	Specifies the activation mode of the sequencer trigger.
SequencerSetFrameCount	Specifies the number of frames a particular sequencer set will apply.

7.16 Serial Access Control

Node Name	Description
SerialOperationSelector	Selects the target operation for the serial communication on the device. This operation is executed when the SerialOperationExecute feature is called.
SerialOperationExecute	Executes the operation selected by SerialOperationSelector on the serial communication.
SerialAccessBuffer	Defines the intermediate access buffer that allows the exchange of data between the device's serial communication and the application.
SerialAccessLength	Controls the number of bytes to transfer to or from the SerialAccessBuffer.
SerialOperationStatus	Represents the SerialOperationExecute status.
SerialOperationResult	Represents the Serial operation result. For Read or Write operations, the number of successfully read/written bytes is returned.
SerialReceivedSize	Represents the number of bytes received from or transferred to the serial communication.
SerialReceiveSource	Selects the physical line to use for the serial communication receive source.
SerialBaudRate	This feature controls the baud rate used for serial communication.

Node Name	Description
SerialParity	This feature controls the parity used for serial communication.
SerialStopBits	This feature controls the number of stop bits used for serial communication.
SerialDataBits	This feature controls the number of data bits used for serial communication.
SerialFlowControl	This feature controls the flow control used for serial communication.

7.17 Software Signal Control

Node Name	Description
SoftwareSignalSelector	Selects which Software Signal features to control.
SoftwareSignalPulse	Generates a pulse signal that can be used as a software trigger.

7.18 Test Control

Node Name	Description
TestEventGenerate	Generates a Test Event.
TestPendingAck	Tests the device's pending acknowledge feature.
TestMode	None

7.19 Transfer Control

Transfer Control allows the device to accumulate on the on-camera buffer in a queue. The data stored in the queue, referred to as blocks, can be transmitted to the host application at a later time. The host application will be able to request the device to transmit one or more blocks. By default, this control is disabled on the CPN0466-001/CPN0466-002 and acquired images are automatically transmitted.

Node Name	Description
TransferSelector	Selects which stream transfers are currently controlled by the selected Transfer features.
TransferControlMode	Selects the control method for the transfers.
TransferOperationMode	Selects the operation mode of the transfer.
TransferBlockCount	Specifies the number of data Blocks that the device should stream before stopping.
TransferQueueMaxBlockCount	Controls the maximum number of data blocks that can be stored in the block queue of the selected stream.
TransferQueueCurrentBlockCount	Returns the number of Block(s) currently in the transfer queue.
TransferQueueMode	Specifies the operation mode of the transfer queue.
TransferStart	Starts the streaming of data blocks out of the device.
TransferStop	Stops the streaming of data Block(s).
TransferAbort	Immediately abort the streaming of data block(s).
TransferPause	Pauses the streaming of data Block(s).
TransferResume	Resumes a data Blocks streaming that was previously paused by a TransferPause command.
TransferStatusSelector	Selects which status of the transfer module to read.
TransferStatus	Reads the status of the Transfer module signal selected by TransferStatusSelector.

7.20 Transport Layer Control

Transport Layer Control includes a list of features related to the GigE Vision bootstrap registers and GigE Vision transport medium.

Node Name	Description
PayloadSize	Provides the number of bytes transferred for each image or chunk on the stream channel.

Node Name	Description
GigEVision	Category that contains the features pertaining to the GigE Vision transport layer of the device.
PacketResendWindowFrameCount	Number of frames in the packet resend window used to calculate the total number of packets that can be resent in that period.
ReceivedPacketResendCount	Returns the number of received packet resend commands.
ValidPacketResendCount	Returns the number of valid packet resends handled by the device.
UnavailablePacketResendCount	Returns the number of unavailable packet resends handled by the device.
ShortReachModeEnable	Enables short reach mode for Ethernet. Setting takes effect after reboot of camera.
PtpControl	Category that contains the features related to the Precision Time Protocol (PTP) of the device.

7.20.1 GigE Vision

Node Name	Description
GevPhysicalLinkConfiguration	Controls the principal physical link configuration to use on next restart/power-up of the device.
GevCurrentPhysicalLinkConfiguration	Indicates the current physical link configuration of the device.
GevSupportedOptionSelector	Selects the GEV option to interrogate for existing support.
GevSupportedOption	Returns if the selected GEV option is supported.
GevInterfaceSelector	Selects which logical link to control.
GevMACAddress	MAC address of the logical link.
GevPAUSEFrameReception	Controls whether incoming PAUSE Frames are handled on the given logical link.
GevPAUSEFrameTransmission	Controls whether PAUSE Frames can be

Node Name	Description
	generated on the given logical link.
GevCurrentIPConfigurationLLA	Controls whether the Link Local Address IP configuration scheme is activated on the given logical link.
GevCurrentIPConfigurationDHCP	Controls whether the DHCP IP configuration scheme is activated on the given logical link.
GevCurrentIPConfigurationPersistentIP	Controls whether the Persistent IP configuration scheme is activated on the given logical link.
GevCurrentIPAddress	Reports the IP address for the given logical link.
GevCurrentSubnetMask	Reports the subnet mask of the given logical link.
GevCurrentDefaultGateway	Reports the default gateway IP address to be used on the given logical link.
GevIPConfigurationStatus	Reports the current IP configuration status.
GevPersistentIPAddress	Controls the Persistent IP address for this logical link.
GevPersistentSubnetMask	Controls the persistent subnet mask associated with the Persistent IP address on this logical link.
GevPersistentDefaultGateway	Controls the persistent default gateway for this logical link.
GevPersistentARPConflictDetectionEnable	Enables ARP Conflict Detection for persistent IP addresses. Warning: Disabling may result in the inability to communicate with the device!
GevDiscoveryAckDelay	Indicates the maximum randomized delay the device will wait to acknowledge a discovery command.
GevGVCPExtendedStatusCodesSelector	Selects the GigE Vision version to control extended status codes for.
GevGVCPExtendedStatusCodes	Enables the generation of extended status codes.

Node Name	Description
GevGVCPPendingAck	Enables the generation of PENDING_ACK.
GevPrimaryApplicationSwitchoverKey	Controls the key to use to authenticate primary application switchover requests.
GevGVSPExtendedIDMode	Enables the extended IDs mode.
GevCCP	Controls the device access privilege of an application.
GevPrimaryApplicationSocket	Returns the UDP source port of the primary application.
GevPrimaryApplicationIPAddress	Returns the address of the primary application.
GevMCPHostPort	Controls the port to which the device must send messages.
GevMCDA	Controls the destination IP address for the message channel.
GevMCTT	Provides the transmission timeout value.
GevMCRC	Controls the number of retransmissions allowed when a message channel message times out.
GevMCSP	This features indicates the source port for the message channel.
GevStreamChannelSelector	Selects the stream channel to control.
GevSCPIInterfaceIndex	Index of the logical link to use.
GevSCPHostPort	Controls the port of the selected channel to which a GVSP transmitter must send data stream or the port from which a GVSP receiver may receive data stream.
GevSCPSFireTestPacket	Sends a test packet. When this feature is set, the device will fire one test packet.
GevSCPSDoNotFragment	The state of this feature is copied into the 'do not fragment' bit of IP header of each stream packet.
GevSCPSPacketSize	It specifies the stream packet size, in bytes, to send on the selected channel for

Node Name	Description
	a GVSP transmitter or specifies the maximum packet size supported by a GVSP receiver.
GevSCPD	Controls the delay (in GEV timestamp counter unit) to insert between each packet for this stream channel.
GevSCDA	Controls the destination IP address of the selected stream channel to which a GVSP transmitter must send data stream or the destination IP address from which a GVSP receiver may receive data stream.
GevSCSP	Indicates the source port of the stream channel.
GevSCFTD	Indicates the transmission delay before transmission occurs.
TransportStreamProtocol	Controls the the protocol of device streaming.
GevSCTCPMTS	Indicates the TCP maximum transfer size.

7.20.2 PTP Control

Node Name	Description
PtpEnable	Enables the Precision Time Protocol (PTP).
PtpStatus	Returns the latched state of the PTP clock.
PtpSlaveOnly	Enables slave only operation of the PTP.
PtpClockAccuracy	Indicates the expected accuracy of the device PTP clock when it is the grandmaster, or in the event it becomes the grandmaster.
PtpServoStatus	Returns the latched state of the clock servo.
PtpDataSet	Reports the current value of the PTP's timestamp.
PtpDataSetLatch	Latches the current values from the device's PTP clock data set.
PtpDataSetLatchValue	Returns the latched value of the PTP clock.

Node Name	Description
PtpOffsetFromMaster	Returns the latched offset from the PTP master clock in nanoseconds. If PtpOffsetFromMaster returns -1 then the synchronization has not started.
PtpClockID	Returns the latched clock ID of the PTP device.
PtpParentClockID	Returns the latched parent clock ID of the PTP device.
PtpGrandmasterClockID	Returns the latched grandmaster clock ID of the PTP device.

7.21 User Set Control

Node Name	Description
UserSetSelector	Selects the feature set to load, save, or configure.
UserSetLoad	Loads the User Set specified by UserSetSelector to the device and makes it active.
UserSetSave	Save the User Set specified by UserSetSelector to the non-volatile memory of the device.
UserSetDefault	Selects the feature User Set to load and make active by default when the device is reset.
UserSetFeatureSelector	Selects which individual User Set feature to control.
UserSetFeatureEnable	Enables the selected feature and make it active in all the User Sets.