Optronis

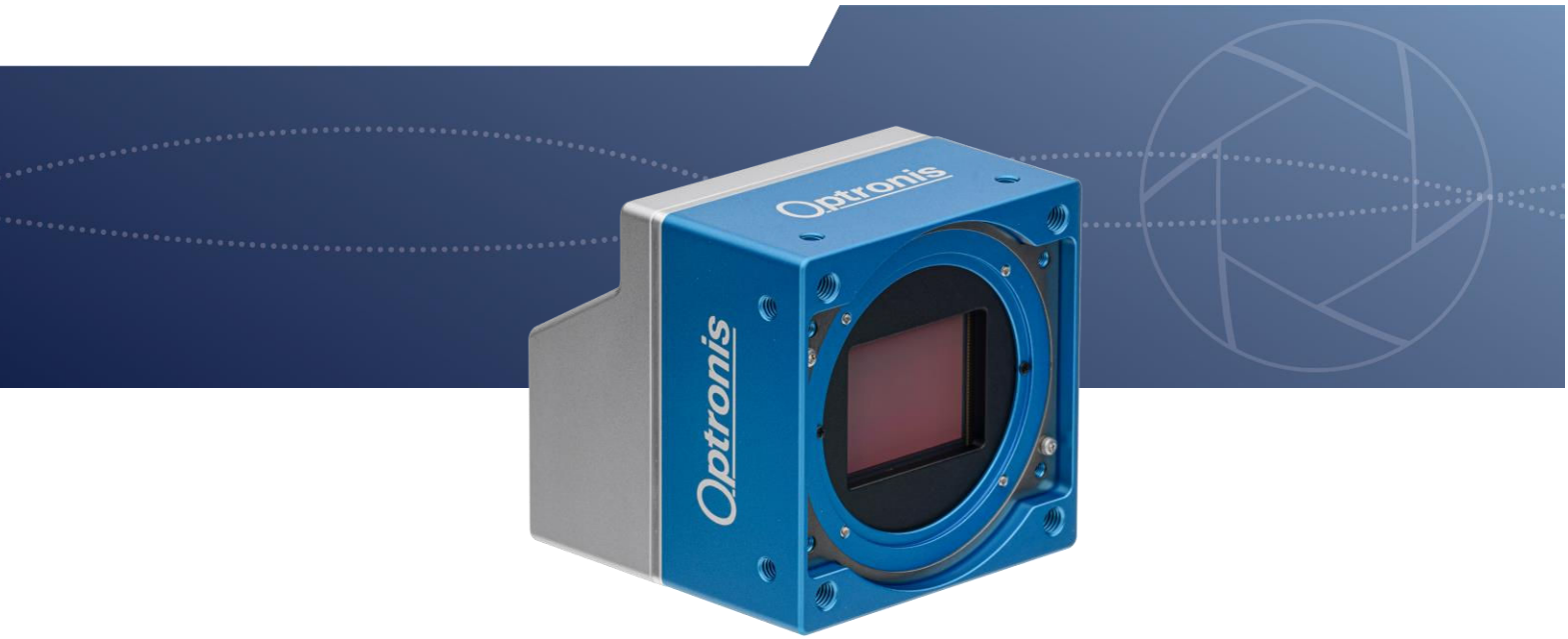
Make time visible

User Manual

CyclonePlus

Series

Rev: -



Example: CyclonePlus-65-M

CoaXPress

Document	1200-SU-06-A
Document Version	A
Release Date	15.09.2025
Language	English

About this manual

The purpose of this document is to provide a description for CyclonePlus series cameras. The manual contains sections with information related to all CyclonePlus cameras and individual sections for each model. Firmware version valid at the time of release of this document is used to describe the camera operation.

On the product page download area latest version of datasheet, manual, firmware and 3D data are available. For older cameras contact Optronis and indicate camera serial number.

Please read this manual thoroughly before operating the camera. Follow all instructions and observe warnings. This document is subject to change without notice.

Support

We hope that this manual can answer your questions, but should you have any further questions or if you wish to claim a service or warranty case, please contact your local dealer or refer to the Optronis support. You can contact our support by using our website or by email at the following address: support@optronis.com.

To process your request efficiently please prepare following information:

Mandatory:

- Camera Model name: CyclonePlus-…. (See label at the bottom side of the camera).
- Serial-Number: 1210-X-X. (See label at the bottom side of the camera).
- Short description of the problem

Useful:

- Camera Firmware version
- Frame Grabber model
- Cable type and length

Contacts

To contact us, please use the information below.

Address	OPTRONIS GMBH Ludwigstr. 2 D-77694 Kehl Germany Tel.: +49 (0) 78 51/91 26-0 / Fax: +49 (0) 78 51/91 26-10
Website	https://optronis.com/en/
Contact Form	https://optronis.com/en/contact/
General Inquiries	info@optronis.com
Sales	sales@optronis.com
Support	support@optronis.com

1 Table of Contents

2 General

2.1 Standards

The camera has been developed according to following standards:

- CoaXPress Standard Version 2.1 - JIIA CXP-001-2021

2.2 Remarks

The following signs are used in this user manual to highlight some information:

Remarks and additional information.

Attention, warnings.

2.3 Scope of Delivery

The camera is delivered together with:

- Brief Introduction

Available accessories are:

- CYP-CM C-Mount lens adapter
- CYP-FM F-Mount lens adapter
- CYP-M42-12 M42 Mount lens adapter
- CYP-M58-11,48 M58 Mount lens adapter
- CYP-HIS Heat Sink
- CYP-FAN Cooling Fan
- CPH6-PTC Pig tail cable for synch
- CPH6-USB Programming Cable
- CPH4-PSA Power Supply

2.4 RoHS Compliance

CyclonePlus series cameras are Pb free manufactured.

2.5 WEEE Symbol Information

Please do not dispose the product together with domestic waste. Use return and collection systems for electrical and electronic waste in your country or return the product to Optronis GmbH.

3 Getting Started

3.1 Camera Handling

Please be careful when using camera. Pay attention especially to:

Temperature and Humidity	Please respect environmental conditions. You may use controlled airflow or heatsinks to keep camera in better temperature conditions.
Dust and Cleaning	The camera is produced in a dust-controlled environment. Please be careful when changing lens, mount or accessing any part close to the sensor. See annex B for cleaning instructions.

Do not open the camera housing.
Warranty becomes void if the camera housing is opened.

3.2 Environmental Conditions

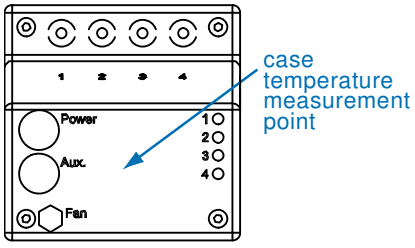
Environmental conditions are:

- Humidity: 20 … 80 % rel. Humidity, not condensing
- Altitude: see level up to 3,000 m (9,800 ft)
- Temperature: see table for each model

Optronis does not guaranty camera operation beyond above conditions and camera lifetime might be reduced.

3.2.1 Thermal conditions

CyclonePlus series cameras are available with accessories for heat dissipation. Depending on heat dissipating accessory, max. ambient temperature is given for each model on the technical data section. Fixing the camera on a heat conductive support can also be consider for heat dissipation. Measuring the case temperature and verifying temperature of camera electronics might be necessary for critical applications to ensure the camera will not operate beyond its limits.



Rear view with measurement point of case temperature

3.3 Camera Operation

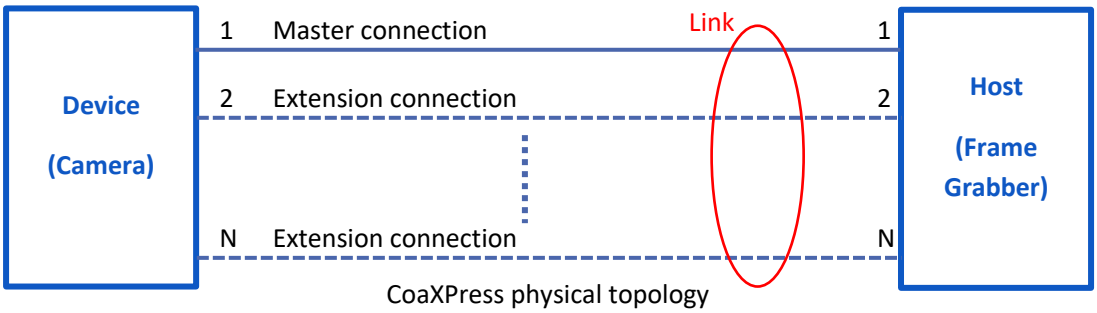
Camera Power	Power to the camera is provide either by CoaXPress (PoCXP) or by an external power supply (option). **Remark:** PoCXP is implemented on all channels and is specified to provide max. 13 W. Depending on camera power requirement more than one channel might need to be connected. Alternatively external power supply must be used. **Remark:** It is not advised to plug or unplug CXP cables while PoCXP is ON.

3.4 Setting Up System

3.4.1 CoaXPress Standard Overview

CoaXPress is an interface to connect Devices (typically cameras) to Hosts (typically frame grabbers). It combines the simplicity of coaxial cable with state-of-the-art high-speed serial data technology, allowing up to 12.5 Gbps data rate per cable, plus device control and power in the same cable. CoaXPress is a point-to-point scalable interface. The physical medium between the Device and Host is 75Ω coaxial cable.

An interface consists of one master connection and optional extension connections, which together form a link. Connections might also be called channels. Each connection is associated with a coax cable. At the Device connections are numbered. 1 for Master, and 2 .. N extension connections as shown in the following figure:

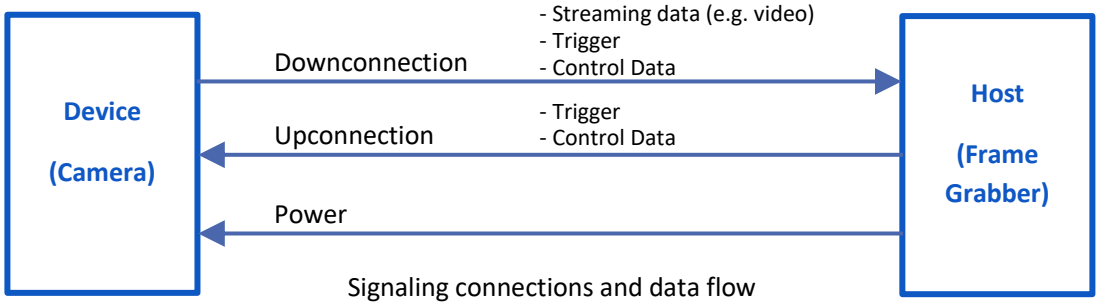


CoaXPress physical topology

CyclonePlus series cameras are typically connected to the host by using 4 connections at max speed. We refer to this setting as 4xCXP12. Each connection provides the following functions:

- High speed serial (usually Device to Host down connection) at up to 12.5 Gbps.
- Low speed serial (usually Host to Device up connection) at up to 41.6 Mbps.
- Power (Host to Device) up to 13W.

The link protocol defines the transfer of high-speed streaming data, control data, and trigger signals. Control data and trigger signals are physically transferred on the master connection only.



Signaling connections and data flow

3.5 About Lenses

3.5.1 Lens handling

Please be careful when installing or removing camera lens. Depending on your lens mount type and lens, pay attention to following points:

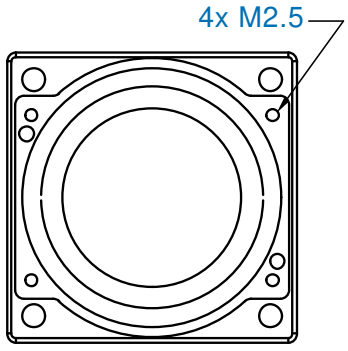
- If your lens has a F-mount flange, first align mounting mark camera mount to lens mounting marks and then rotate anti-clockwise to lock the lens. To remove the lens, unlock the lens-holder silver clip and rotate clockwise until marks are aligned. Then remove the lens.
- If your lens has a screw thread, rotate and clockwise for installation and rotate anti-clockwise to remove it.
- If you have removed the lens from the camera, always use a cap on the camera to avoid dust infiltration. Use also caps on both lens sides.
- Do not forget to remove the front cap of your lens before using the camera.

See Annex A for lens selection.

3.5.2 Lens Mount Installation and Exchange

Lens mount of CyclonePlus cameras can be exchanged. Pay attention not to contaminate sensor or IR filter with dirt while working on the camera front section. Orient camera front vertically or facing down to minimize this risk.

1. Remove any dust protection from the front.



Front view of CyclonePlus camera.

2. Use 4 countersunk head screws M2.5 x 8 provided with the mount to fix the mount.
3. Protect input if no lens is installed.

Do not use longer screws. A thin shim might be installed on the camera front. Do not remove it.

4 Camera Overview

4.1 General Description

4.1.1 Camera Rear Side

Camera rear side

4.1.2 CoaXPress Connectors

CoaXPress Connectors	
Camera connector type:	***Micro-BNC (also known as HD-BNC)***
Number of connectors:	***4***
Impedance:	***75 Ω***

4.1.3 Connection Status Decoding

Each CoaXPress connection has its dedicated LED indicating its status.

State	Indication
No power	Off
System booting	Solid orange
Powered, but nothing connected (not applicable to a device reliant on PoCXP power)	Flash_1 red
Connection detection in progress, PoCXP active	AlternateFlash_12_5 green / orange
Device / Host incompatible, PoCXP active	AlternateFlash_0_5 red / green
Device / Host connected, but no data being transferred	Solid green
Device / Host connected, waiting for event (e.g. trigger, exposure pulse)	Flash_1 orange
Device / Host connected; data being transferred	Flash_12_5 green
Error during data transfer (e.g. CRC error, single bit error detected)	500 ms red pulse
System error	Flash_12_5 red
Connection test packets being sent	AlternateFlash_0_5 green / orange
Firmware Update	Solid red

The connector indicator lamp timings are given in the following table:

Indication	Frequency (±20%)	Duty Cycle (on, ±20%)
Flash_1	1 Hz	25% (200 ms on, 800 ms off)
Flash_12_5	12.5 Hz	25% (20 ms on, 60 ms off)
AlternateFlash_12_5	12.5 Hz	25% (20 ms on color 1, 60 ms off, 20 ms on color 2, 60 ms off)
AlternateFlash_0_5	0.5 Hz	50% (1 s on color 1, 1 s off, 1 s on color 2, 1 s off etc)

4.1.4 CXP Connection Configuration

In default configuration specified by ConnectionConfigDefault, the camera starts with 4 channels at 12.5 GHz (CXP12_X4). If the camera is connected to the frame grabber with 4 cables, this enables regular operation immediately after switching on.

In case the desired number of connections cannot be discovered within a timeout period because maybe less than 4 cables are used, the system behavior will depend on the grabber characteristics. Typically, no image transfer is possible after power cycling but the Host shall maintain the master connection at the discovery speed to allow configuration changes. See information provided by grabber manufacturer to modify configuration and to enable image transfer.

If the cameras should be operated not in default configuration immediately after power cycling, this configuration must be defined and saved once in the camera as UserSetting.

Follow this procedure:
- Set ConnectionConfig to the desired (future) default configuration.
- Set UserSetSelector to the desired User Set.
- Execute UserSetSave which will save the value of ConnectionConfig to ConnectionConfigDefault of the desired User Set.
- Set UserSetDefault to the desired User Set.
- After a (re-)discovery the new ConnectionConfigDefault selected by UserSetDefault will be used.

This procedure allows for example to start the camera in CXP12_X1 configuration.

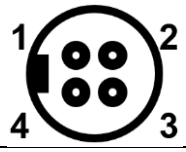
4.1.5 Power over CoaXPress (PoCXP)

The camera can be powered by an external power supply or by the frame grabber via the CoaXPress connections taking advantage of the cameras PoCXP feature. With PoCXP it is advised to connect the camera by at least 2 connections to make sure to provide enough power for each model. One connection can only provide 13 W which will not be enough for some models. In case only one connection can be used and the camera power requirement is above 13 W, an external power supply must be applied. In this case power supply from the frame grabber should be disabled to ensure not to overload the power supply by the CXP.

4.1.6 External Power Supply

The camera can be powered from an external power supply instead of using PoCXP. An external power supply is available as accessory. Alternatively, power can be provided by another supply unit as long bellow characteristics are respected:

Powering the camera via PoCXP in parallel to an external power supply via the “Power” connector is possible, but should be avoided.

Power Connector	
Camera connector type: ***Hirose HR10A-7R-4S*** Cable Connector type: ***Hirose HR10A-7P-4P***	
Connector View: 	
Connector Pinout	
Pin 1 and 2	+24 Volt +/-5 % (Ripple < 200 mV) Inrush Current ~0,6 A
Pin 3 and 4	0V, Power Ground

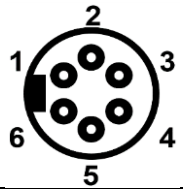
4.1.7 Fan Connector

Coaxial Fan connector can be used to power Optronis optional external fan. It can also be used to power your own cooling solution.

Fan Connector	
Camera connector type: ***Rosenberger 59S601-200L5*** Cable Connector type: ***Rosenberger 59K204-301L5***	
Voltages	**+5 V, 250 mA max.**

4.1.8 Auxiliary Connector

Auxiliary connector is used to access camera Sync In and Sync Out IOs and for firmware updates. The connector is labelled “Aux.”. Camera accessory CPH6-PTC cable gives user 50 Ohm BNC connectors to access Sync IN and Sync Out signals. Camera accessory CPH6-USB cable allows an USB connection to a PC for firmware updates.

Auxiliary (Aux.) Connector	
Camera connector type: ***Hirose HR10A-7R-6S*** Cable Connector type: ***Hirose HR10A-7P-6P***	
Connector View: 	
Connector Pinout (galvanic separated)	
Pin 1	**Sync IN** External Synchronization Input. TTL level: < 0.8 Volt (low) > 2.0 Volt (high)
Pin 2	**Reserved**
Pin 3	**Sync Out** External Synchronization Output. TTL level @ high impedance, 0 to 2 Volt @ 50 Ohm.
Pin 4, 5 and 6	**0 V** Max. voltage difference between 0 V and GND (case): [-50 V ⇔ +50 V]

4.1.8.1 *Sync In*

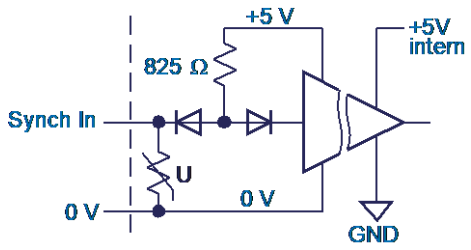
The Synch In signal is used to precisely synchronize start of exposure. The term “Trigger” is used on the GenICam XML file to define how the Synch In signal is processed. The Sync In camera input accepts TTL signals. To operate Sync In correctly, a Sync In driver must be used with a minimum sink current (TTL low level) of 5 mA. Alternatively, it can be driven from a 50 Ohm output if a long cable is used. In this case the cable might need to be terminated by adding an external 50 Ohm resistor near to the camera input.

Pulse width: min. 200 ns

Sync In input voltage limits are: [-5 V ⇔ +30 V]
Voltages beyond these limits may damage camera.

Sync In signal is referred to 0 V of pins 4, 5, and 6. This 0 V signal is floating with respect to GND and case. Difference between 0 V and case must not exceed ±50 V.

A transistor working in open collector configuration can be used as easy solution to drive this input

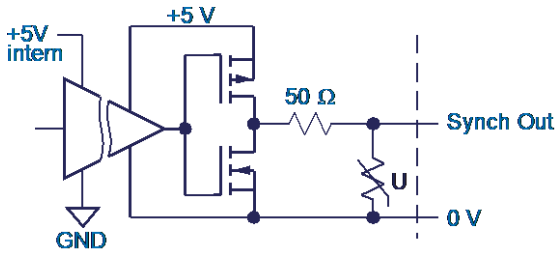


Synch In schematics

4.1.8.2 *Sync Out*

The Synch Out can be used to synchronize external strobe light to the exposure time of the sensor. Voltage output is 0 V (low level) to ~2 V (high level) when driving a 50 Ohm load. At high impedance termination, the driver voltage is 0 V (low level) to ~4 V (high level).

Polarity: Depending on SyncOutEnable and SyncOutPolarity settings.
Pulse width: Following sensor exposure time

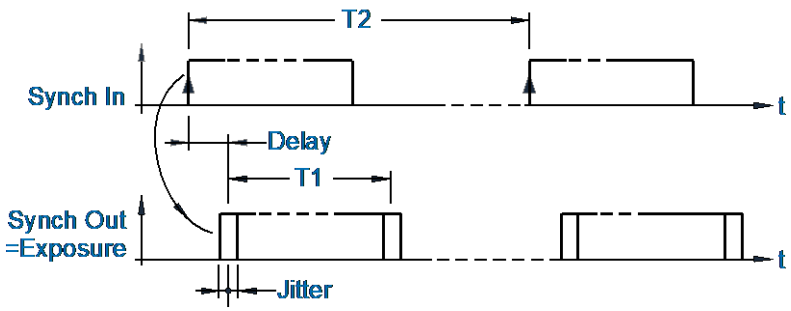


Synch Out schematics

Sync Out signal is referred to 0 V of pins 4, 5, and 6. The 0 V signal is floating with respect to GND and case. Difference between 0 V and case must not exceed ±50 V.

4.1.8.3 *Delay and Jitter*

Timing shows relation between Synch In signal and exposure time. The timing is related to hardware restrictions. Delay related to software definitions of TriggerDelay and OptrInputFilterTime will be added.
Camera is set to:
AcquisitionMode = Continuous
ExposureMode = Timed
TriggerMode = On
TriggerSelector = ExposureStart
TriggerSource = Line1
TriggerActivation = RisingEdge



Definition	Conditions
T1: Exposure Time	T1 min = defined by min . exposure of each model T1 max = T2 – T1 min - Delay
T2: Frame Interval (= 1 / Frame Rate)	T2 min = 1 / (max. Frame Rate) T2 max = 1 / (min. Frame Rate)

Model	Delay	Jitter
CyclonePlus-1HS	1.142 µs	±675 ns
CyclonePlus-2	1.306 µs	±856 ns
CyclonePlus-5	1.239 µs	±760 ns
CyclonePlus-16	1.440 µs	±1006 ns
CyclonePlus-21	8.200 µs	±70 ns
CyclonePlus-25 OptrExposureTimeMode=Ultra Short OptrExposureTimeMode=Standard	 1.100 µs 5.600 µs	 ±20 ns ±50 ns
CyclonePlus-64	9.300 µs	±45 ns
CyclonePlus-65	4.388 µs	±76 ns
CyclonePlus-9	1.015 µs	±655 ns

Values above are given for CXP12_X4 link and camera operation at full resolution. Number of CXP connections, CXP bit rate and width of frame will affect delay and jitter values.

Example: for CyclonePlus-5-700, delay is 1239 ns +/- 760ns, meaning time between rising edge of external Sync In and exposure output (Sync Out) can vary from 479 ns to 1.999 µs

Special case:
For CyclonePlus-25, CyclonePlus-64 and CyclonePlus-65 with activated “TriggerWidth” mode, camera adds an extra-time to the exposure time (sensor related). That means the external pulse width must be shorter than the required exposure time.

Model	Extra-Time added to pulse width in TriggerWidth mode
CyclonePlus-25	7.73 µs
CyclonePlus-64	13.35 µs
CyclonePlus-65	11.87 µs

For example, with a CyclonePlus-65 operated in “TriggerWidth” mode, to achieve an exposure time of EXP the required pulse width is EXP-11.87 µs.

4.1.8.4 *Synch frequency restrictions*

Timing limitations need to be respected if frame rate is defined by the trigger signal applied to the Synch In input or via CXP. If these limitations are not fulfilled, it will result in unexpected behavior. This might be a missing frame with respect to the trigger signal or extended exposure time as well as degraded or degraded image quality.

1. Trigger frequency must remain below 1/ExposureTime and below max. frame rate for the given resolution.
2. Trigger frequency must be higher than min. frame rate.
3. If camera is operated with ExposureMode=TriggerWidth or ExposureMode=SyncControl, end of exposure must NOT appear before transfer of previous frame is completed.
4. Frame rate is defined by the frequency of the trigger signal and might be lower than minimal frame rate specified. If exposure mode is set to “TriggerWidth” or “SyncControl”, maximum exposure time might be longer than period at minimal frame rate. Lower frame rate as well as longer exposure time can be defined by the external trigger signal but might have some impact on the image quality.

5 Camera Control

Camera is controlled through a standard GenICam XML file. For *DeviceControl*, *TransportLayerControl*, *Support* and *CXP* sections, please refer to the CoaXPress Version 2.1 specification. Description below refers to the firmware version programmed at the time this manual was the latest. Contact Optronis to verify whether firmware version programmed in the camera and version of this manual are consistent.

The following tables show all features available. Refer to the Individual Model Data section to see features available for each model.

5.1 Image Format Control

Contains the features related to the format of the transmitted image.

XML entry name	Description
SensorWidth	Effective width of sensor [pixel] Access: Read Only / Visible: Expert
SensorHeight	Effective height of sensor [pixel] Access: Read Only / Visible: Expert
WidthMax	Maximum width of the image (in pixels). The dimension is calculated after horizontal binning, decimation or any other function changing the horizontal dimension of the image. Access: Read Only / Visible: Expert
HeightMax	Maximum height of the image (in pixels). This dimension is calculated after vertical binning, decimation or any other function changing the vertical dimension of the image. Access: Read Only / Visible: Expert
WidthMax	Maximum width (in pixels) of the image. The dimension is calculated after horizontal binning, decimation or any other function changing the horizontal dimension of the image. Access: Read Only / Visible: Expert
Width	Width of the image provided by the device (in pixels). Min, max and incr. see Individual Model Date section. Access: Read Write / Visible: Beginner
Height	Height of the image provided by the device (in pixels). Min, max and incr. see Individual Model Date section. Access: Read Write / Visible: Beginner
OffsetX	Horizontal offset from the origin to the region of interest (in pixels). Access: Read Write / Visible: Beginner
OffsetY	Vertical offset from the origin to the region of interest (in pixels). Access: Read Write / Visible: Beginner
PixelFormat	Format of the pixels provided by the device. Values: Mono 8 – 8 bit monochorme Mono 10 – 10 bit monochrome, packed Mono 12 – 12 bit monochrome, packed BayerGR8 – 8 bit color Access: Read Write / Visible: Beginner

XML entry name	Description
TestPattern	Selects the type of test pattern that is generated by the device as image source. Values: Testimage1: The camera generates a test image with the test image 1 pattern. Pattern is a diagonal pattern and has following format: Line 0: 0, 1, 2,..,255, 0, 1, 2,..,255,… Line 1: 1, 2, 3,.., 255, 0, 1, 2, .., 255,… … Line N: N,N+1,N+2,..,255, 0,1,2,..,255,… Off: No test pattern is generated. The original image is displayed. Access: Read Write / Visible: Beginner
OptrImageStamp	Enables image stamping. If enabled, the first pixels of the image will contain metadata (e.g., an image counter) instead of visual information. Values: On, Off If On, the first pixels of the image will contain the following information: a 16-bits image counter and 24-bits microsecond counter, a trigger counter (counter that increments as soon as the camera has validated an incoming external trigger), OffsetX and OffsetY. a) In 8bits-mode: Pixel 0 contains bits 15..8 of the image counter Pixel 1 contains bits 7..0 of the image counter Pixel 2 contains bits 23..16 of the microsecond counter Pixel 3 contains bits 15..8 of the microsecond counter Pixel 4 contains bits 7..0 of the microsecond counter Pixel 5 contains bits 15..8 of the trigger counter Pixel 6 contains bits 7..0 of the trigger counter Pixel 7 contains bits 15..8 of the horizontal offset OffsetX Pixel 8 contains bits 7..0 of the horizontal offset OffsetX Pixel 9 contains bits 15..8 of the vertical offset OffsetY Pixel 10 contains bits 7..0 of the vertical offset OffsetY a) In 10bits-mode: Pixel 0 contains bits 15..6 of the image counter Pixel 1 contains bits 5..0 of the image counter and bits 23..20 of the microsecond counter Pixel 2 contains bits 19..10 of the microsecond counter Pixel 3 contains bits 9..0 of the microsecond counter Pixel 4 contains bits 15..6 of the trigger counter Pixel 5 contains bits 5..0 of the trigger counter and bits 15..12 of the horizontal offset OffsetX Pixel 6 contains bits 11..2 of the horizontal offset OffsetX Pixel 7 contains bits 1..0 of the horizontal offset OffsetX and bits 15..8 of the vertical offset OffsetY Pixel 8 contains bits 7..0 of the vertical offset OffsetY and 2 bits to ‘0’. Access: Read Write / Visible: Beginner
ReverseX	Flip horizontally the image sent by the device. The pixel values of every line in a captured image will be swapped along the center line. You can use the ROI feature when using the Reverse X feature. The position of the ROI relative to the sensor remains the same. Access: Read Write / Visible: Expert
ReverseY	Flip vertically the image sent by the device. The pixel values of every column in a captured image will be swapped along the center column. You can use the ROI feature when using the Reverse Y feature. The position of the ROI relative to the sensor remains the same. Access: Read Write / Visible: Expert
BinningSelector	Selects which binning engine is controlled by the BinningHorizontal and BinningVertical features. Value: Region1 - FPGA binning can be configured. Access: Read Write / Visible: Expert
BinningHorizontalMode	Sets the mode to use to combine horizontal photo-sensitive cells together when BinningHorizontal is used. Values:

XML entry name	Description
	Sum - The response from the combined cells will be added, resulting in increased sensitivity. Average - The response from the combined cells will be averaged, resulting in increased signal/noise ratio. Access: Read Write / Visible: Expert
BinningHorizontal	Number of horizontal photo-sensitive cells to combined together. This reduces the horizontal resolution(width) of the image. Values: 1 .. 4 Access: Read Write / Visible: Expert
BinningVerticalMode	Sets the mode to use to combine vertical photo-sensitive cells together when BinningVertical is used. Values: Sum - The response from the combined cells will be added, resulting in increased sensitivity. Average - The response from the combined cells will be averaged, resulting in increased signal/noise ratio. Access: Read Write / Visible: Expert
BinningVertical	Number of vertical photo-sensitive cells to combined together. This reduces the vertical resolution(height) of the image. A value of 1 indicates that no vertical binning is performed by the camera. Values: 1 .. 4 Access: Read Write / Visible: Expert

5.1.1 Line Skipping (Vertical Decimation)

If available, line skipping feature allows to transfer only even lines and thus to increase frame transfer speed while keeping the same field of view.

When using dual ROI mode, you can enable line skipping only in one ROI or in both ROIs.

XML entry name	Description
DecimationVertical	Vertical sub-sampling of the image. This reduces the vertical resolution (height) of the image by the specified vertical decimation factor. A value of 1 indicates that the camera performs no vertical decimation. Values: 1, 2 Access: Read Write / Visible: Expert

To enable line skipping:

- Stop acquisition
- Set frame / ROI parameters
- Enable line skipping
  Height is automatically computed (divided by 2 in single ROI or when activated in both ROIs)
- Check entry OptrImageHeightValid to be sure you set valid parameters

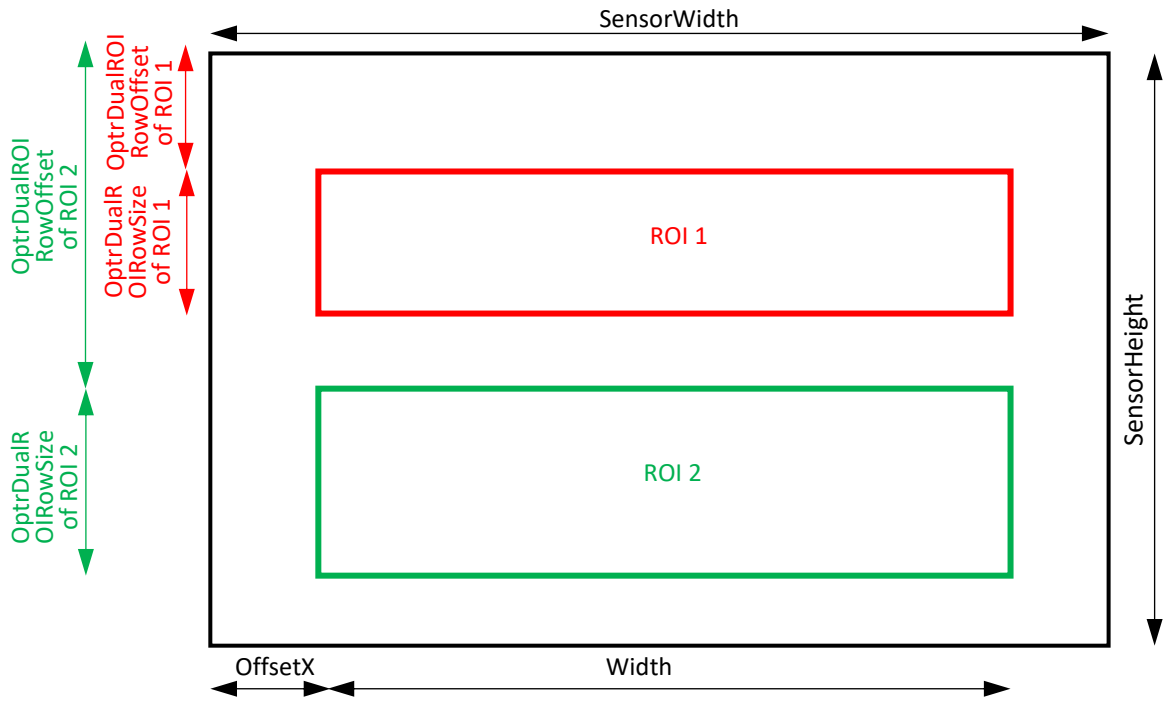
5.1.2 Dual ROI

Instead of reading the complete sensor surface or part of the sensor defined by XML entries Width, Height, OffsetX and OffsetY, the dual ROI mode allows reading two separate regions. They share the same Width and OffsetX values but are defined by entering different heights and OffsetY values.

XML entry name	Description
OptrDualROIRowsEnable	Enables or disables the ability to define dual regions in vertical direction and to read only these regions. When disabled, the height and vertical offset of all regions is

	defined by the Height and OffsetY parameters and the Dual ROI Row Offset and Dual ROI Row Size parameters values are ignored. Value: True, False Access: Read Write / Visible: Expert
OptrDualROIRowSelector	Sets which row can be configured. Values: Row 1, Row 2 Access: Read Write / Visible: Expert
OptrDualROIRowSize	Height of the currently selected row. Access: Read Write / Visible: Expert
OptrDualROIRowOffset	Vertical offset of the currently selected row. Access: Read Write / Visible: Expert
OptrImageHeightValid	Indicates whether the outgoing image is valid. If the value of this parameter is false, change your Dual ROI settings. For example, the regions must not overlap, and the total height of all regions must not exceed the height of the image sensor.

5.1.2.1 *Principle*



5.1.2.2 *Enabling and Configuring dual ROI*

- Stop Acquisition with AcquisitionStop
- Enable dual ROI mode with OptrDualROI = “On”
- Define ROI to be configured OptrDualROIRowSelector
- Set width and offset of ROI1 with OptrDualROIRowOffset
- Define ROI to be configured OptrDualROIRowSelector
- Set width and offset of ROI1 with OptrDualROIRowOffset
- All settings must be consistent with sensor dimensions and restrictions related to min. size and min. increment values given for each sensor. Camera verifies the setting and provides a confirmation with OptrImageHeightValid by using these rules.
  - ⇨ (OffsetX + Width) ≤ WidthMax
  - ⇨ (OptrDualROIRowOffset of ROI1 + OptrDualROIRowSize of ROI1) < OptrDualROIRowOffset of ROI2
  - ⇨ (OptrDualROIRowOffset of ROI1 + OptrDualROIRowSize of ROI1)
    + (OptrDualROIRowOffset of ROI2 + OptrDualROIRowSize of ROI2) ≤ HeightMax

- Image height is automatically computed and updated
- Be sure that computed height respects Height entry parameters (inc, min and max). You can check OptrImageHeightValid entry to be sure that your setup is valid.
- Start Acquisition with AcquisitionStart

5.1.2.3 *Dual ROI output Image*

When using dual ROI mode, output image send to the Frame Grabber is one image composed by the 2 ROIs with:

Output width = Width

Output height = Height = OptrDualROIRowSize of ROI1 + OptrDualROIRowSize of ROI2

It is up to Frame Grabber application to separate ROIs according dual ROI parameters.

Line skipping feature may be used in addition to dual ROI mode, please check Line skipping paragraph for more information.

5.2 Acquisition Control

Contains the features related to image acquisition, including trigger and exposure control.

XML entry name	Description
AcquisitionMode	Controls the acquisition mode of the device. Values: Continuous: The camera will acquire images after AcquisitionStart until after AcquisitionStop. SingleFrame: The camera will acquire one image after AcquisitionStart. In both acquisition modes either camera can be operated with internal frame rate (TriggerMode=Off) or camera is triggered (TriggerMode=On). Access: Read Write / Visible: Beginner
AcquisitionStart	Starts the Acquisition of the device. The number of frames captured is specified by AcquisitionMode. Comment: Check that OptrImageHeightValid is valid (1) before starting. If OptrImageHeightValid is false (0), that means that there is an inconsistency with the restrictions of image format or dual ROI. Access: Write Only / Visible: Beginner
AcquisitionStop	Stops the Acquisition of the device at the end of the current frame. It is mainly used when AcquisitionMode is Continuous but can be used in any acquisition mode. Access: Write Only / Visible: Beginner
OptrExposureTimeMode	Sets the exposure time mode. Values: Standard: The exposure time mode is set to Standard. Ultra Short: The exposure time mode is set to Ultra Short. Access: Read Write / Visible: Beginner

XML entry name	Description
AcquisitionFrameRate	Controls the acquisition rate (in Hertz) at which the frames are captured. Maximum rate is limited by the camera specification, CXP link configuration, and image format. Access: Read Write / Visible: Beginner
ExposureTime	Sets the Exposure time (in microseconds) when ExposureMode is Timed. This controls the duration where the photosensitive cells are sensitive to light. Exposure time is limited to the period of the acquisition frame rate. Access: Read Write / Visible: Beginner
ExposureMode	Sets the operation mode of the Exposure. Values: Timed: The exposure duration time is set using the ExposureTime features and the exposure starts with the FrameStart. TriggerWidth: Uses the width of the current trigger signal(s) pulse to control the exposure duration. Note that if the TriggerActivation is LevelHigh, the exposure duration will be the time the trigger stays High. If TriggerActivation is LevelLow, the exposure time will last as long as the trigger stays Low. TriggerControlled: Uses one or more trigger signal(s) to control the exposure duration independently from the current frame triggers. See ExposureStart, ExposureEnd and ExposureActive of the TriggerSelector feature. Typically uses LinkTrigger0 (CoaXPress rising edge) to start the exposure and the LinkTrigger1 (CaoXPress falling edge) to end the exposure. SyncControl: The exposure stops with the specified TriggerActivation of the trigger signal. A new exposure is started automatically and stopped again with the next valid edge of the signal. The framerate corresponds to the trigger frequency. Access: Read Write / Visible: Beginner
TriggerSelector	Selects the type of trigger to configure. Values: ExposureStart: Selects a trigger controlling the start of the exposure of one frame. ExposureEnd: Selects a trigger controlling the end of the exposure of one Frame. Access: Read Write / Visible: Beginner
TriggerMode	Controls if the selected trigger is active. Values: Off: Disables the selected trigger and acquisition is controlled by AcquisitionFrameRate, ON: Enables the selected trigger and a trigger signal must be applied. Access: Read Write / Visible: Beginner
TriggerSource	Specifies the internal signal or physical input line to use as the trigger source. The selected trigger must have its TriggerMode set to On. Values: Software: Specifies that the trigger source will be generated by software using the TriggerSoftware command. Line1: Specifies Line1 (SynchIn) as external source for the trigger signal. Access: Read Write / Visible: Beginner LinkTrigger0: Specifies LinkTrigger0 command as trigger source. The LinkTrigger0 command is transmitted via CXP. Access: Read Write / Visible: Beginner LinkTrigger1: Specifies LinkTrigger1 command as trigger source. The LinkTrigger1 command is transmitted via CXP. It will automatically be related to the end of the exposure. Access: Read Write / Visible: Beginner

XML entry name	Description
TriggerActivation	Specifies the activation mode of the trigger. Values: RisingEdge: Specifies that the trigger is considered valid on the rising edge of the source signal. FallingEdge: Specifies that the trigger is considered valid on the falling edge of the source signal. LevelHigh: Specifies that the trigger is considered valid as long as the level of the source signal is high. Used in combination with ExposureMode=TriggerWidth. LevelLow: Specifies that the trigger is considered valid as long as the level of the source signal is low. Used in combination with ExposureMode=TriggerWidth. AnyEdge: Specifies that the trigger is considered valid on the falling or rising edge of the source signal. Access: Read Write / Visible: Beginner
TriggerSoftware	Generates an internal trigger. TriggerSource must be set to Software. Access: Write Only / Visible: Beginner
TriggerDelay	Specifies the delay in microseconds (us) to apply after the trigger reception before activating it. Access: Write Only / Visible: Expert

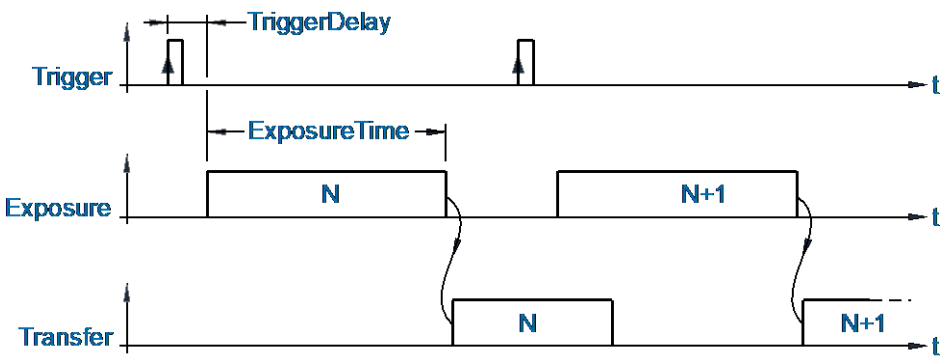
5.2.1 Acquisition Control Examples

Timing for exposure modes when AcquisitionMode is set to Continuous. Schematics below show principial relations. Frame overhead time and hardware related delays are not shown.

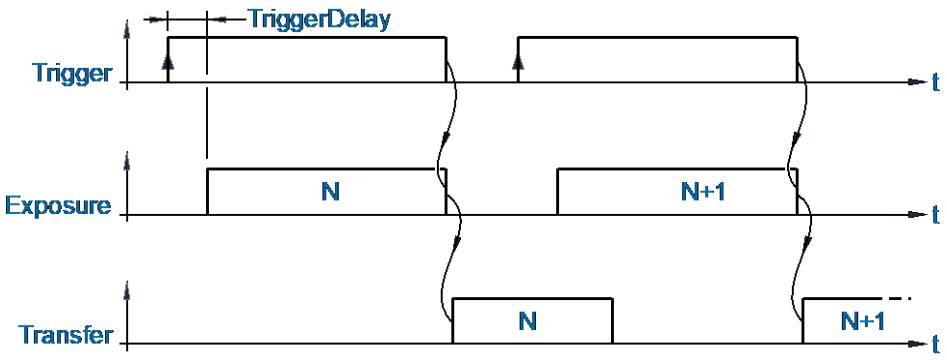
Active frame transfer must be completed before the end of the exposure for the following frame.

- **Camera internal generator (free running)**
  In this mode, the camera uses its own sync generator and generates frames continuously when acquisition is started.
  AcquisitionMode = Continuous
  TriggerMode = Off
  AcquisitionFrameRate = 500 (for example 500 Hz)
  ExposureTime = 1000 (for example 1,000 µs)

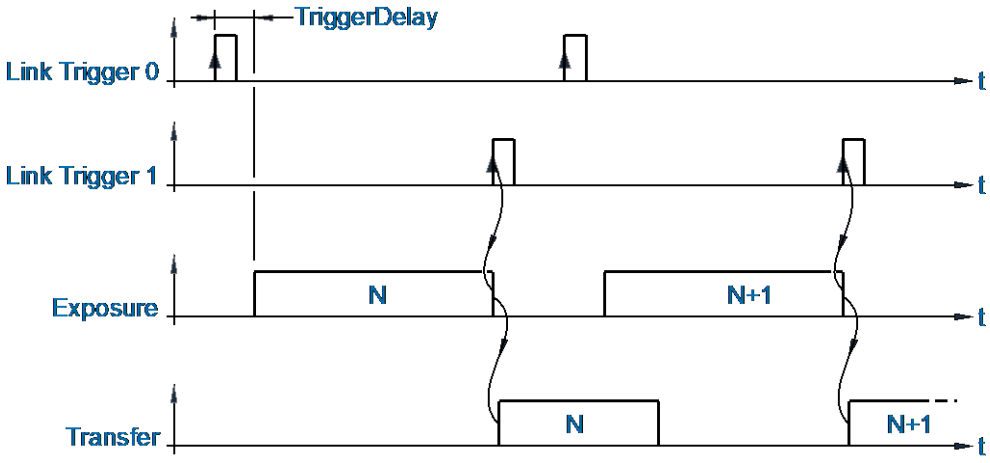
- **Externally triggered with fixed exposure time**
  ExposureMode = Timed
  TriggerMode = On
  TriggerSelector = ExposureStart
  TriggerSource = Line1 (for example)
  TriggerActivation = RisingEdge



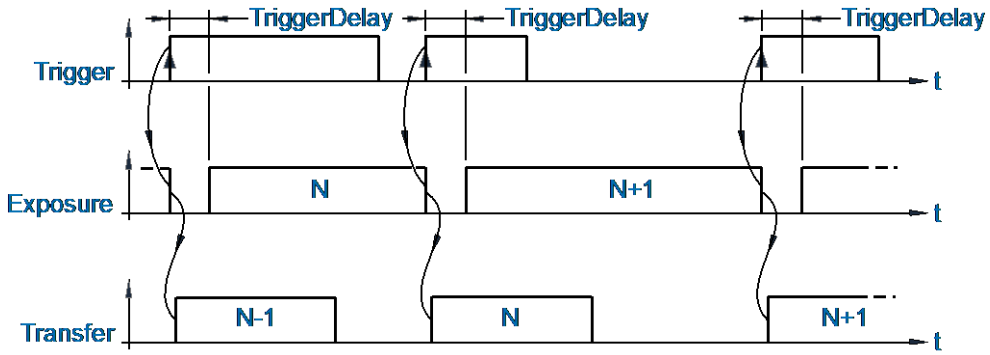
- **Externally triggered with exposure time defined by width of trigger signal**
  ExposureMode = TriggerWidth
  TriggerMode = On
  TriggerSelector = ExposureStart
  TriggerSource = Line1 (for example)
  TriggerActivation = LevelHigh



- **Externally triggered with exposure time defined by two signals**
  Different signals via CXP can be used to control start and stop of exposure. Example below shows LinkTrigger0 to start exposure and LinkTrigger1 to stop exposure.
  ExposureMode = TriggerControlled
  TriggerMode = On
  TriggerSelector = ExposureStart
  TriggerSource = LinkTrigger0
  TriggerActivation = RisingEdge



- **Externally triggered with stop of exposure defined by trigger signal**
  Active trigger signal stops exposure of the current frame and initiates frame transfer as well as start of the exposure for the next frame.
  ExposureMode = SyncControl
  TriggerMode = On
  TriggerSelector = ExposureStart
  TriggerSource = Line1 (for example)
  TriggerActivation = RisingEdge



5.4 Analog Control

Contains the features related to the video signal conditioning in the analog domain.

XML entry name	Description
Gain	Value of the currently selected gain in dB. Access: Read Write / Visible: Beginner
BlackLevel	Black level value to be applied to the currently selected sensor tap. Value: -1023 .. 1023 Access: Read Write / Visible: Expert
OptrAnalogGain	Sets the analog gain in dB. The analog gain is applied before the signal is converted into digital values. Values: -1000 .. 1000 Access: Read Write / Visible: Beginner or Guru Comment: Cameras where analog gain is not visible for Beginners will show artefacts on the image if analog gain is changed.
OptrAnalogOffset	Sets the analog offset. Adjusting this parameter will add an offset to the gray values output by the camera. The analog offset is applied before the signal from the camera sensor is converted into digital values. Values: -4.4 dB, 0 dB, 12 dB Access: Read Write / Visible: Expert

5.5 Image Processing Control

5.5.1 Optr Defect Pixel Correction

Sets the static defect pixel correction mode.

XML entry name	Description
OptrDefectPixelCorrectionMode	Sets the static defect pixel correction mode. Values:

	Factory: Static defect pixel correction is based on the defect pixels stored in the factory correction file. User: Static defect pixel correction is based on the defect pixels stored in the user correction file. Off: Disables static defect pixel correction. Access: Read Write / Visible: Expert
OptrDefectPixelCorrectionCount	Indicates how many defect pixels are being corrected. Access: Read Only / Visible: Expert
OptrDefectPixelCorrectionYCoordinate	Y coordinate of the defect pixel to be corrected. See control section below for details. Access: Read Write / Visible: Expert
OptrDefectPixelCorrectionXSelector	Sets which x coordinate entry can be configured. Use the Static Defect Pixel Correction X Coordinate parameter to assign an x coordinate to this entry. Value: X0 .. X7 Access: Read Only / Visible: Expert
OptrDefectPixelCorrectionXCoordinate	X coordinate of the defect pixel to be corrected. Access: Read Write / Visible: Expert
OptrDefectPixelCorrectionSave	Saves changes to the defect pixel coordinates to flash memory. Access: Write Only / Visible: Expert
OptrDefectPixelCorrectionClearAll	Clears all custom defect pixel coordinates. Access: Write Only / Visible: Expert
OptrDefectPixelCorrectionTestMode	Enables or disables the static defect pixel correction test mode. In test mode, all corrected pixels are set to completely white. This helps to find pixels that are being corrected in your images. When “Off” sensor pixels are used and will be corrected depending on setting of OptrDefectPixelCorrectionMode. Values: On, Off Access: Read Write / Visible: Expert

5.5.1.1 *Principle*

A defect pixel correction can be applied to correct some pixel values using its neighbors. At camera power up, defect pixel correction stored in camera flash memory is loaded and used in real time.

By default, a defect pixel correction is written in camera flash during camera production and used at power up. This is the “**Factory**” correction.

User can use this Factory correction or program its own correction by indicating dynamically which pixels must be corrected in XML interface. This is the “**User**” correction. Then, this User configuration can be saved in flash and used at next power up. User modifications are not automatically saved and will be lost at next power cycle if they are not saved.

User correction has boot priority over Factory correction. If user has saved a correction in flash, it will be used until User correction is erased from flash. Then Factory correction will be used again. The number of defect pixel per line is 8 but reduces for some camera models.

5.5.1.2 *Control*

For CyclonePlus-2, CyclonePlus-5, CyclonePlus-1HS and CyclonePlus-16, OptrDefectPixelCorrectionYCoordinate selects a line (i.e. Y pixel coordinate) and OptrDefectPixelCorrectionXSelector = X0..X7 are the X pixel coordinates which can be corrected. To correct a pixel, a valid X coordinate must be set in the entry OptrDefectPixelCorrectionXCoordinate with valid values are 0 .. image_width. If 65535 (0xFFFF) is set as coordinate, no pixel is corrected. X and Y coordinate are absolute and based on full image size even if a smaller ROI is used.

For CyclonePlus-25, CyclonePlus-64 and CyclponePlus-65 selected line address used for OptrDefectPixelCorrectionYCoordinate is equal to Y pixel coordinate divided by 2. OptrDefectPixelCorrectionXSelector = X0..X3 are 4 pixel columns (i.e. X pixel coordinates) which can be corrected for the line Y/2 and OptrDefectPixelCorrectionXSelector = X4..X7 are 4 pixel columns which can be corrected for the line Y/2 + 1.

For CyclonePlus-21 selected line address used for OptrDefectPixelCorrectionYCoordinate is equal to Y pixel coordinate divided by 4.
OptrDefectPixelCorrectionXSelector = X0 and X1 are 2 pixel columns which can be corrected for the line Y/4.
OptrDefectPixelCorrectionXSelector = X2 and X3 are 2 pixel columns which can be corrected for the line Y/4 + 1.
OptrDefectPixelCorrectionXSelector = X4 and X5 are 2 pixel columns which can be corrected for the line Y/4 + 2.
OptrDefectPixelCorrectionXSelector = X6 and X7 are 2 pixel columns which can be corrected for the line Y/4 + 3.

5.5.2 Flat Field Correction

Flat field correction (FFC) is separated in a column-based correction and a block-based correction. Both methods are independent and can be used separately or in combination.

Column-based correction compensates fixed pattern noise (FPN) of the dark level and photo response non-uniformity (PRNU) per column. Typically, sensor related imperfections are corrected with this method.

Block-based correction compensates photo response non-uniformity of larger sensor areas (blocks). It is intended to compensate non-uniform object illumination or vignetting related to the lens or non-uniform illumination. The correction applies to the global image.

5.5.2.1 *Column-Based FFC*

XML entry name	Description
OptrFlatFieldCorrectionSelector	Sets which type of flat-field correction can be configured. When FFC is enabled Dark Signal Non-Uniformity (DSNU) and Photo Response Non-Uniformity (PRNU) are corrected. Values: ColumnBased, BlockBased Select ColumnBased for the following configuration entries Access: Read Write / Visible: Expert
OptrFlatFieldCorrectionMode	Activates the flat-field correction mode. This entry is also used for column-based correction. Values: On, Off, DSNUOnly Access: Read Write / Visible: Expert
OptrFlatFieldCorrectionCoeffX	Column used for flat-field correction. Values: 0 .. SensorWidth-1 Access: Read Write / Visible: Expert
OptrFlatFieldCorrectionCoeffDSNU	Dark Signal Non-Uniformity (DSNU) coefficient of the column specified by the OptrFlatFieldCorrectionCoeffX parameter. Values: 0 .. 127 Access: Read Write / Visible: Expert
OptrFlatFieldCorrectionCoeffPRNU	Dark Signal Non-Uniformity (PRNU) coefficient of the column specified by the OptrFlatFieldCorrectionCoeffX parameter. Values: 0 .. 511 Access: Read Write / Visible: Expert
OptrFlatFieldCorrectionUserGD	User-defined global dark offset used for flat-field correction. Access: Read Write / Visible: Beginner
OptrFlatFieldCorrectionDMean	The mean gray value of all pixels in the dark field image. This is the sum of the gray values of all pixels of all acquired images divided by the total number of pixels.

	Access: Read Write / Visible: Expert
OptrFlatFieldCorrectionSaveToFlash	Saves current flat-field correction values to flash memory. Access: Write Only / Visible: Expert

5.5.2.2 *Column-Based FFC Principle*

At power up, camera loads column-based correction data from camera flash memory (= FPN and PRNU column coefficients) to RAM. User can dynamically modify column parameters using XML interface. Then, this new configuration can be saved in non-volatile camera flash to be used at next power up. If it is not saved, all user modifications will be lost after next power cycle.

When enabled, each pixel is corrected using its column parameters:

- OptrFlatFieldCorrectionCoeffPRNU: photon response non-uniformity coefficient
- OptrFlatFieldCorrectionCoeffDSNU: dark signal non-uniformity offset
- OptrFlatFieldCorrectionUserGD: user defined global dark offset
- OptrFlatFieldCorrectionDMean: dark image calibration mean value

Following steps must be done by the user to calculate these coefficients and to load them into the camera. Block-based correction should be deactivated:

- First, a sequence is taken in the dark. An average image is built from that sequence. The overall mean value of that image is called *DMean_Offset*. *UserGD_Offset* is a global dark offset that the customer can optionally add to the calculation.
- For every column x, an average value is calculated, leading to *D(x)*.
- Then a sequence is taken with a 70% saturation well uniform light. An average image is built from that sequence. The overall mean value of that image is called *GMean*. For every column, an average value is calculated, leading to *G(x)*.
- Then we can calculate the missing OptrFlatFieldCorrectionCoeffPRNU and OptrFlatFieldCorrectionCoeffDSNU:

$$OptrFlatFieldCorrectionCoeffDSNU = round\big(D(x)\big)$$
$$OptrFlatFieldCorrectionCoeffPRNU = round\left(128 \times \frac{GMean}{G(x) - D(x) + 1}\right)$$

In the camera, for every pixel with value PixIn(x,y) read from the sensor, the following correction is applied before sending the value to the frame grabber:

$$\begin{aligned}&(PixIn(x,y) - OptrFlatFieldCorrectionCoeffDSNU(x))\\ &\times \big(OptrFlatFieldCorrectionCoeffPRNU(x)\\ &+ 128 \times (\mathrm{OptrFlatFieldCorrectionDMean} + \mathrm{OptrFlatFieldCorrectionUserGD})\big) \ll 7\end{aligned}$$

5.5.2.3 *Block-Based FFC*

XML entry name	Description
OptrFlatFieldCorrectionSetCreate	Creates a flat-field correction set. Access: Write Only / Visible: Beginner
OptrFlatFieldCorrectionSelector	Sets which type of flat-field correction can be configured. Values: ColumnBased, BlockBased Select BlockBased for the following configuration entries Access: Read Write / Visible: Expert
OptrFlatFieldCorrectionMode	Activates the flat-field correction mode. This entry is also used for column-based correction. Values: On, Off, DSNUOnly

	Access: Read Write / Visible: Expert
OptrFlatFieldCorrectionSetStatus	Status of the flat-field correction set. Values: FileEmpty: Storage file does not contain any sets. FileFormatInvalid: Storage file is invalid. SetOk: Correction set is ok. SetEmpty: Correction set does not contain data. SetInvalid: Correction set is invalid. Unknown: Status is unknown. Access: Read Write / Visible: Expert
OptrFlatFieldCorrectionSetLoad	Loads the flat-field correction set from the camera's flash memory. Access: Write Only / Visible: Beginner
OptrFlatFieldCorrectionSetSave	Saves the flat-field correction set to the camera's flash memory. Access: Write Only / Visible: Beginner
OptrFlatFieldCorrectionVersionMajor	Flat-Field Correction Version Major Access: Read Only / Visible: Expert
OptrFlatFieldCorrectionSetIndex	Index number under which the current flat-field correction set is active. Value: 0 .. 15 Access: Read Write / Visible: Beginner

5.5.2.4 *Block-Based FFC Principle*

A flat field reference image needs to be acquired. Lighting conditions and lens configuration must be identical to the conditions used to acquire the images to be corrected later.

The processing to create correction data is done inside the camera and the correction data are saved inside the camera also. The correction data is obtained by calculating mean values with consequent subsampling. Resulting data is scaled to 1 for the maximum value followed by calculating the inverted value.

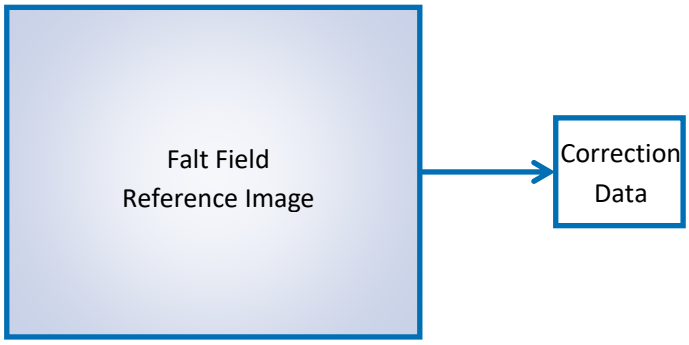
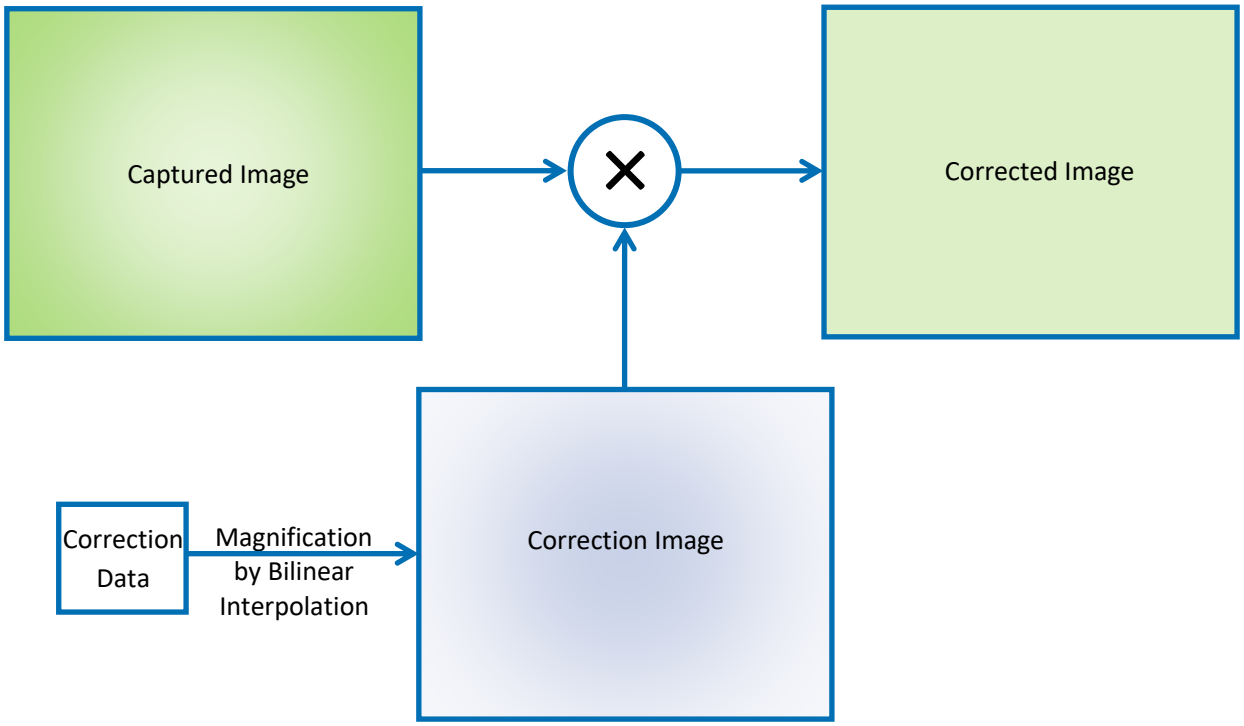


Image processing if block-based FFC correction is activated.



Operating Conditions:

To acquire the flat field reference image the camera must be operated in full frame mode. Line skipping, partial readout or binning must be deactivated. Reverse X or revers Y must be set as for later camera operation.

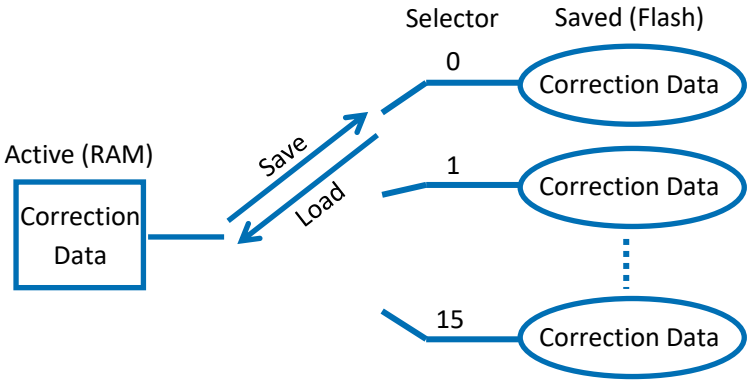
Following steps must be done to achieve a block-based FFC calibration:

- Start video live in full frame with the non-uniform illumination and lens vignetting to be compensate.
- Execute the OptrFlatFieldCorrectionSetCreate command.
- Block-based correction data are calculated and saved to camera RAM.
- OptrFlatFieldCorrectionMode parameter automatically changes to 'On' and the correction is applied to each frame from now on.
- Block-based FFC can be disabled by setting OptrFlatFieldCorrectionMode to 'Off'.

The block-based FFC correction data hold in the camera RAM and must to be saved in non-volatile camera flash if they need to be used after camera power cycling. 16 different sets of correction data can be saved to flash.

- Set OptrFlatFieldCorrectionSelector parameter (between 0 and 15) to specify a location to store correction data

- Execute the OptrFlatFieldCorrectionSetSave command to save correction data from RAM to flash location pointed by OptrFlatFieldCorrectionSelector.
- Execute the OptrFlatFieldCorrectionSetLoad command to load the block-based FFC correction data from flash location pointed by OptrFlatFieldCorrectionSelector to RAM.
- To enable FFC correction OptrFlatFieldCorrectionMode must be set to 'On'. If no valid correction date had been saved to the selected flash location before, OptrFlatFieldCorrectionMode be set to 'On'.



5.6 Digital IO Control

Contains the features related to the control of the input and output pins of the device.

XML entry name	Description
LineSelector	Selects the physical line of the Aux. connector to configure. Values: Line 1, Line 2 Access: Read Write / Visible: Expert
LineFormat	Controls the current electrical format of the selected physical input or output Line of the Aux. connector. Values: Opto-coupled Access: Read Only / Visible: Expert
LineMode	Controls if the physical Line is used to Input or Output a signal. Values: Input (only for Line 1), Output (only for Line 2) Access: Read Write / Visible: Expert
OptrInputFilterTime	Time period during which the camera evaluates all variations and durations of logical states of the input signal. Throughout this period, the camera calculates the mean value over time and applies a threshold function to the result to reconstruct the digital signal. This removes noise, interference, etc. as well as signal with durations shorter than the configured filter time. Larger values will affect trigger delay. Values: 0 .. 100,000 corresponding to 0 .. 1 ms Access: Read Write / Visible: Expert
OptrInputHoldOffTime	The duration following the receipt of an input trigger signal during which the camera ignores any subsequent trigger signals or changes in signal state. This mechanism helps prevent false triggering due to rapid successive signals, such as those caused by contact bounce. Note that longer inhibit periods may reduce the effective frame rate when operating with external triggering. Values: 0 … 2,000,000 corresponding to 0 .. 20 ms Access: Read Write / Visible: Expert

XML entry name	Description
LineSource	Selects which internal acquisition or I/O source signal to output on the selected Line. Available only when LineMode is configured as Output. Values: Off – no signal is provided ExposureActive – outputs the exposure active signal UserOutput0 – outputs the state of bit0 of the User Output register UserOutput1 – outputs the state of bit1 of the User Output register Access: Read Write / Visible: Beginner
UserOutputSelector	Selects which bit of the User Output register will be set by UserOutputValue. Values: User Output 0, User Output 1 Access: Read Write / Visible: Expert
UserOutputValue	Sets the value of the bit selected by User Output Selector. Values: True, False Access: Read Write / Visible: Expert
OptrEnableFan	Activates the power supply used for the external cooling fan. Values: On, Off Access: Read Write / Visible: Beginner

5.7 UserSetControl

Contains parameters for creating user sets, also known as configuration sets. Groups of factory settings or user-defined settings can be saved in these sets and loaded again at a later stage or on a different camera.

XML entry name	Description
UserSetSelector	Selects the feature User Set to load, save or configure. Values: Default - The factory set can be loaded. This set configures the camera to provide good camera performance in many common applications under normal conditions. Values: UserSet1 - User set 1 can be saved, loaded, or configured. Access: Read Write / Visible: Beginner
UserSetLoad	Loads the User Set specified by UserSetSelector to the device and makes it active. Access: Write Only / Visible: Beginner
UserSetSave	Save the User Set specified by UserSetSelector to the non-volatile memory of the device. Access: Write Only / Visible: Beginner
UserSetDefault	Selects the feature User Set to load and make active by default when the device is reset. Values: Default - The Default User Set factory set is set as the default startup set. UserSet1 - User set 1 is set as the default startup set. Access: Read Write / Visible: Beginner

This category allows to load or save a custom configuration to the camera.

To save camera parameters:

- Set all parameters needed in the different XML entries (Size, Framerate, Exposure, Gain, …)

5.8 FileAccessControl

This section enables uploading and downloading of user data to and from the camera using GenICam File Access Control features.

XML entry name	Description
FileSelector	Selects the target file name in the camera Values: CustomUserFile Access: Read Write / Visible: Guru

- Any type of data can be transferred.
- File size should be a multiple of 256 bytes.
  If not, it will be automatically padded with arbitrary data. When reading a file, the size will be rounded up to the nearest multiple of 256 bytes. Arbitrary data might be padded.
- Maximum file size: ≤ 3 MB
- The host's ControlPacketSizeMax must be at least 288 bytes.

5.9 Event Control

This section allows to define how the camera might send information data about particular events.

XML entry name	Description
EventSelector	Selects which Event will be send to the host application. Values: OverTemperature, Test Access: Read Write / Visible: Expert
EventNotification	Activate or deactivate the notification of the occurrence of the selected Event Values: On, Off (always On for the Test event) Access: Read Write / Visible: Expert
EventOverTemperature	Returns the unique identifier of the OverTemperature type of Event. Access: Read Only / Visible: Expert
EventOverTemperatureTimestamp	Returns the Timestamp when the OverTemperature Event occured. Values: Access: Read Only / Visible: Expert
EventTest	Returns the unique identifier of the Test type of Event Values: Access: Read Only / Visible: Expert
EventTestTimestamp	Returns the Timestamp of the Test Event. Values: Access: Read Only / Visible: Expert
EventTestGenerate	Generates a Test Event. Values: Access: Write Only / Visible: Expert

5.10 Counter And Timer Control

Contains the features related to the use of counters particularly to trigger and event counters

XML entry name	Description
CounterSelector	Selects the counter to be configured. Values: Counter 1, Counter 2 Access: Read Write / Visible: Expert
CounterEventSource	Selects the events that will be the source to increment the selected Counter. Values: Line 1, Line 2, Acquisition Active, Exposure Active, Exposure Start, Exposure Trigger Wait, Software Signal 1, Software Signal 2, Software Signal 3, Cxp Trigger 0, Cxp Trigger 1 Access: Read Write / Visible: Expert
CounterEventActivation	Selects the Activation mode of the Event Source signal. Values: Rising Edge, Falling Edge, Any Edge Access: Read Write / Visible: Expert
CounterResetSource	Selects the signals that will be the source to reset the Counter. Values: Line 1, Line 2, Acquisition Active, Exposure Active, Exposure Start, Exposure Trigger Wait, Software Signal 1, Software Signal 2, Software Signal 3, Cxp Trigger 0, Cxp Trigger 1

XML entry name	Description
	Access: Read Write / Visible: Expert
CounterResetActivation	Selects the Activation mode of the Counter Reset Source signal. Values: Rising Edge, Falling Edge, Any Edge Access: Read Write / Visible: Expert
CounterTriggerSource	Selects the source to start the Counter. Values: Line 1, Line 2, Acquisition Active, Exposure Active, Exposure Start, Exposure Trigger Wait, Software Signal 1, Software Signal 2, Software Signal 3, Cxp Trigger 0, Cxp Trigger 1 Access: Read Write / Visible: Expert
CounterTriggerActivation	Selects the activation mode of the trigger to start the Counter. Values: Rising Edge, Falling Edge, Any Edge, Level High, Low High Access: Read Write / Visible: Expert
CounterDuration	Sets the duration (i.e. the counter's maximum value) or number of events after which the counter stops counting. Values: 0 .. 2^{32}-1 Access: Read Write / Visible: Expert
CounterValue	Reads the current value of the selected Counter. Values: 0 .. 2^{32}-1 Access: Read Only / Visible: Expert
CounterStatus	Returns the current status of the Counter. Values: Counter Idle, Counter Trigger Wait, Counter Active, Counter Completed, CounterOverflow Access: Write Only / Visible: Expert
CounterReset	Does a software reset of the selected Counter and starts it. Values: - Access: Write Only / Visible: Expert

5.10.1 Counter And Timer Control Example

- To count the number of triggers during an Acquisition, this setting can be used
  CounterSelector = Counter 1
  CounterEventSource = Exposure Start
  CounterEventActivation = Rising Edge
  CounterTriggerSource = Acquisition Active
  CounterTriggerActivation = Level High
  CounterResetSource = Acquisition Active
  CounterResetActivation = Rising Edge

Software Signal Control

Allows the configuration of software signals that can be used with the counters.

XML entry name	Description
SoftwareSignalSelector	Selects which Software Signal features to control Values: Software Signal 1, Software Signal 2, Software Signal 3 Access: Read Write / Visible: Beginner
SoftwareSignalPulse	Generates a pulse on the selected signal Values: - Access: Write Only / Visible: Beginner

5.11 Device Control

Contains the features related to the control and information of the device.

XML entry name	Description
DeviceScanType	Scan type of the sensor of the device. Values: Areascan Access: Read Only / Visible: Expert
DeviceVendorName	Name of the manufacturer of the device. Access: Read Only / Visible: Beginner
DeviceModelName	Model of the device Access: Read Only / Visible: Expert
DeviceFamilyName	Identifier of the product family of the device. Value: CyclonePlus Access: Read Only / Visible: Beginner
DeviceManufacturerInfo	Manufacturer information about the device. Access: Read Only / Visible: Expert
DeviceVersion	Version of the device. Access: Read Only / Visible: Beginner
DeviceFirmwareVersion	Version of the firmware in the device. Access: Read Only / Visible: Beginner
DeviceSerialNumber	Device's serial number. This string is a unique identifier of the device. Access: Read Only / Visible: Expert
DeviceUserID	User-programmable device identifier. Access: Read Write / Visible: Beginner
DeviceIndicatorMode	Sets the behavior of the camera's status LED. Values: Active, Inactive Access: Read Write / Visible: Expert
DeviceReset	Immediately resets and restarts the camera. Access: Write Only / Visible: Guru

5.11.1 Device Control Temperature

Camera returns temperature information to help monitoring system temperature stability and to prevent permanent hardware defects.

XML entry name	Description
DeviceTemperatureSelector	Selects the location within the device, where the temperature will be measured. Value: FPGA Access: Read Only / Visible: Beginner
DeviceTemperature	Device temperature measured at the location selected by DeviceTemperatureSelector. Value: Temperature in °C Access: Read Only / Visible: Expert
OptrTemperatureStatus	Indicates the temperature state. Value: OK The temperature is within the normal operating temperature range Value: Critical The temperature is close to or at the allowed maximum. Provide cooling. Value: Error The temperature is above the allowed maximum. Provide cooling immediately. Access: Read Only / Visible: Beginner

Note: Case temperature will be lower than reported device temperature but still might be beyond acceptable values given by the application.

5.11.2 Over-Temperature Protection

The camera continuously monitors its internal temperature to ensure safe operation. When the temperature reaches a predefined threshold, the temperature status transitions to “Error”. In response, the device automatically reduces its power consumption. Consequently, image acquisition is halted, and an OverTemperature event will be sent to the host system if the OverTemperatureEvent notification is enabled. Acquisition must be manually restarted after the temperature decreases and the temperature status returns to “Ok.”.

Note: While this protective mechanism helps mitigate thermal risks, it does not guarantee that the temperature will decrease or prevent potential hardware failure. Any unexpected acquisition interruption should prompt immediate temperature assessment and cooling intervention.

5.12 Transport Layer Control

Contains the features related to the Transport Layer Control.

XML entry name	Description
PayloadSize	Provides the number of bytes transferred for each data buffer or chunk on the stream channel. Values: Image Height x Image Width in Byte Access: Read Only / Visible: Expert
DeviceTapGeometry	Describes the geometrical properties characterizing the taps of a camera as presented at the output of the device. Values: 1X-1Y, 1X-2YE, Access: Read Only / Visible: Beginner
Image1StreamID	Stream ID of the first image stream. Values: Image 1 Stream ID Access: Read Only / Visible: Expert
Image2StreamID	Stream ID of the second image stream. Values: Image 2 Stream ID Access: Read Only / Visible: Expert
CxpLinkConfiguration	This feature allows specifying the Link configuration for the communication between the Receiver and Transmitter Device. Values: CXP12_X4, CXP12_X2, CXP12_X1, CXP6_X4, CXP6_X2 Access: Read Write / Visible: Beginner
CxpLinkConfiguration-Preferred	Provides the Link configuration that allows the camera to operate in its default mode. Values: CXP12_X4, CXP12_X2, CXP12_X1, CXP6_X4, CXP6_X2 Access: Read Write / Visible: Expert
CxpConnectionSelector	Sets the CoaXPress physical connection to control. Values: - Access: Read Write / Visible: Expert
CxpConnectionTestMode	Enables the test mode for an individual physical connection of the Device. Values: Off, Mode 1 Access: Read Write / Visible: Expert
CxpConnectionTestError-Count	Reports the current connection error count for test packets received by the device on the connection selected by CxpConnectionSelector Values: Access: Read Write / Visible: Expert
CxpSendReceiveSelector	Selects which one of the send or receive features to control Values: Send, Receive Access: Read Write / Visible: Expert

XML entry name	Description
CxpConnectionTest-PacketCount	Reports the current count for the test packets on the connection selected by CxpConnectionSelector. Values: Access: Read Write / Visible: Expert

5.13 Optronis

Contains features implemented by Optronis and have XML entry names beginning with “Optr”. Some of them are explained above, the remaining Optronis features are explained in this section

6 Firmware Update

Latest firmware is available on Optronis website and can be loaded onto the camera via USB using the camera Aux connector or via CoaXPress (CXP) interface.

Note: Cameras provided by Optronis with firmware versions 5-x-x-x released in 2025 or later versions allow update via USP or CXP at any time. These cameras appear as CXP device even after an update failed. Cameras provided with firmware versions earlier than 5-x-x-x support updates via USB only. They can be updated via USB to versions 5-x-x-x or higher to allow subsequent update via CXP. In case a firmware update might have failed, these cameras again require update via USB only.

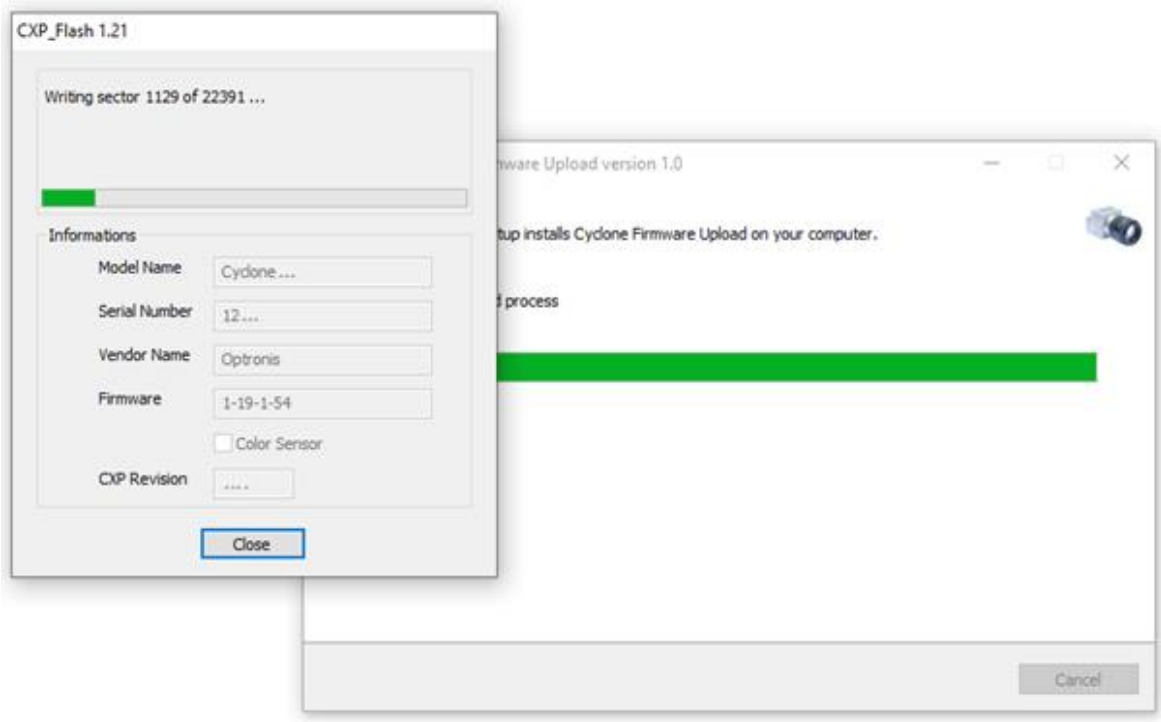
For model-specific update instructions consult Optronis with your camera's model and serial number.

6.1 Firmware Update via USB

Before updating camera firmware, please make sure you have:

- The last firmware version as "CFU_CXXXX.exe" file
- Camera accessory "CPH6-USB"
- Driver for "CPH6-USB" cable.

1) If your update the first time from your computer or if your driver software is outdated execute last version of "CyclonePlus_Driver_VCRedist_Install.exe" to install driver for "CPH6-USB".
   Restart computer.
2) Connect USB cable to PC and camera Aux input.
   Use PC rear USB ports as front ports are often not working.
3) Power cycle the camera.
4) Start CFU_CXXXX.exe



5) Wait end of process (5 to 10 minutes, depending on camera and firmware size)'
Power cycle camera when programming is finished.

If remaining time is higher than 20 min, it often means that the cable is not well detected.

- Close software and make sure it is terminated.
- Choose another USB port, power cycle camera and restart software.

6.2 Firmware Update via CoaXPress

Before updating camera firmware, please make sure you have:

- Firmware update software “CFUX.exe”
- The last firmware version as .GUF file

Update must be supported by the CXP frame grabber.

1) Connect camera to frame grabber by using at least 1 CXP connection.
2) Power cycle the camera.
3) Start CFUX.exe
4) Select appropriate .GUF file and start update.

7 Individual Model Data

7.3 CyclonePlus-1HS

Parameter	CyclonePlus-1HS
Image sensor	LUX13HS Global Shutter
Sensor resolution	1 280 x 860
Width inc, min, max	64, 256, 1280
Height inc, min, max	4, 4, 8604
Framerate max. @ full sensor resolution	3 518 fps
Framerate min	20 fps
Exposure Time min, max	2 µs, 1/framerate
Active Area	17.5462 mm x 11.78 mm
Sensor diagonal dimension	21.13 mm
Pixel size	13.7 µm x 13.7 µm
Quantum efficiency (sensor)	30% @550 nm
A/D conversion	8/10 bit
Trigger	Internal, External (SynchIn), CoaXPress, software
Trigger signal (SyncIn, SyncOut)	TTL, 3.3 - 5 V, 10 mA, electrically isolated
CXP revision	2.1
CXP Interface Configuration	4 × CXP12, 2 × CXP12, 1 × CXP12, 4 × CXP6, 2 × CXP6
Power (typ.)	12 W, PoCXP, external
Weight	~340 g without mount
Dimensions	65 mm x 65 mm x 65.5 mm
Housing	lightweight anodized aluminum

EMVA1288 (v4.0, typical)	8 bit	10 bit
Dynamic Range	56 dB	TBD dB
Saturation Capacity	21,000 e^-	21,000 e^-
Temporal dark noise	33 e^-	TBD e^-
System Gain	90 e^-/DN	TBD e^-/DN
Signal-to-Noise Ratio	43 dB	TBD dB
Dark Signal Non-Uniformity (DSNU)	85 e^-	TBD e^-
Photo Response Non-Uniformity (PRNU)	2.7%	TBD%
Linearity error (LE,EMVA1288_v3.0)	2.3%	TBD%

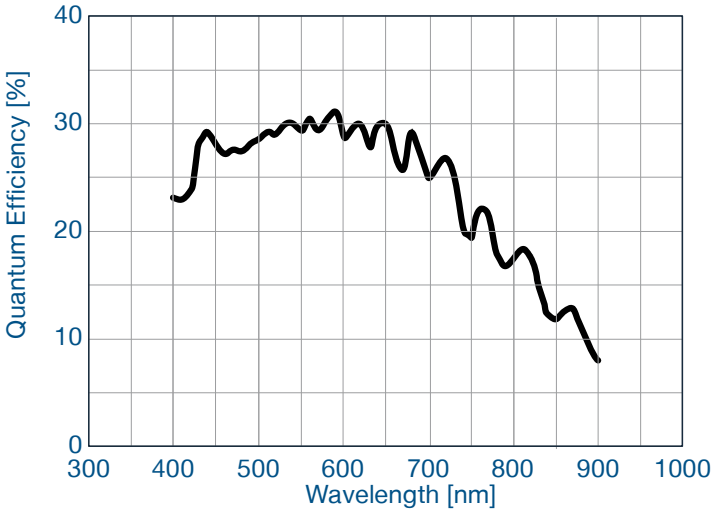
Temperatures (to limit case temperature to 65°C)	CyclonePlus-1HS
Operating Ambient Temperature	
- without additional cooling	0 .. +25°C / 32 .. 77°F
- with CYP-HIS	0 .. +35°C / 32 .. 95°F
- with CYP-FAN	0 .. +45°C / 32 .. 113°F
Storage Temperature	-10 .. +40°C / 14 .. 104°F
Transport Temperature	-25 .. +65°C / -13 .. 149°F

Firmware Features	Version: CP1_1200-IX-09_v6-0-3-4
Exposure modes	Timed
Trigger Activation	Rising Edge, Falling Edge, Any Edge
Trigger Sources	External (SynchIn), CoaXPress, software
Trigger Filter and Trigger Hold-Foo Time*	Yes, for external trigger source
Trigger Delay*	Adjustable
Flat Field Correction (FFC)*	Block-based with up to 16 reference data in camera, auto calibration Column-based
Defect Pixel Correction	Yes, factory setting or customer configuration, 0 .., 8 pixel/line
Digital Binning Modes	Average, Sum
Digital Binning horizontal/vertical	×1, ×2, ×4 / ×1, ×2, ×4
DualROI*	Yes
LineSkipping (Vertical Decimation)*	No
Image Mirroring*	No
User Global Adjustments *	Offset analog and digital / Gain analog and digital
Programmable User Output	Yes
White Balance	Yes, with auto function ROI control, manual RGB gain
Counter and Timer Control*	Yes
Image Stamp (Counter information in frame)*	Yes
Save setup to flash and load on power-on*	Yes
Over Temperature Monitoring*	Yes
Firmware Update	via USB (CPH6-USB) and CXP
File Access Control	Yes, up to 3 Myte user data
Test Pattern Generation*	Yes

* Optronis features

Important:

7.3.2 Spectral Sensitivity



7.8 CyclonePlus-9

Parameter	CyclonePlus-9
Image sensor	LUX9506 Global Shutter
Sensor resolution	4 096 x 2 304
Width inc, min, max	256, 256, 4096
Height inc, min, max	4, 4, 2304
Framerate max. @ full sensor resolution	509 fps
Framerate min	20 fps
Exposure Time min, max	4 µs, 1/framerate
Active Area	26.62 mm x 14.98 mm
Sensor diagonal dimension	30.55 mm
Pixel size	6.5 µm x 6.5 µm
Quantum efficiency (sensor)	38% @550 nm
A/D conversion	8 bit
Trigger	Internal, External (SynchIn), CoaXPress, software
Trigger signal (SyncIn, SyncOut)	TTL, 3.3 - 5 V, 10 mA, electrically isolated
CXP revision	2.1
CXP Interface Configuration	4 × CXP12, 2 × CXP12, 1 × CXP12, 4 × CXP6, 2 × CXP6
Power (typ.)	18W, PoCXP (min. 2 connections), external
Weight	~370 g without mount
Dimensions	65 mm x 65 mm x 65.5 mm
Housing	lightweight anodized aluminum

EMVA1288 (v4.0, typical)	CyclonePlus-9
Dynamic Range	57 dB
Saturation Capacity	10,600 e^-
Temporal dark noise	19 e^-
System Gain	46 e^-/DN
Signal-to-Noise Ratio	40 dB
Absolute sensitivity threshold	15 e-
Dark Signal Non-Uniformity (DSNU)	64 e^-
Photo Response Non-Uniformity (PRNU)	2.4%
Linearity error (LE,EMVA1288_v3.0)	1%

Temperatures	CyclonePlus-9
Operating Case Temperature	0 .. +65°C / 32 .. 149°F
Operating Electronics Temperature	0 .. +90°C / 32 .. 194°F
Operating Ambient Temperature	
- without additional cooling	0 .. +15°C / 32 .. 59°F
- with CYP-HIS	0 .. +20°C / 32 .. 68°F
- with CYP-FAN	0 .. +40°C / 32 .. 104°F
Storage Temperature	-10 .. +40°C / 14 .. 104°F
Transport Temperature	-25 .. +65°C / -13 .. 149°F

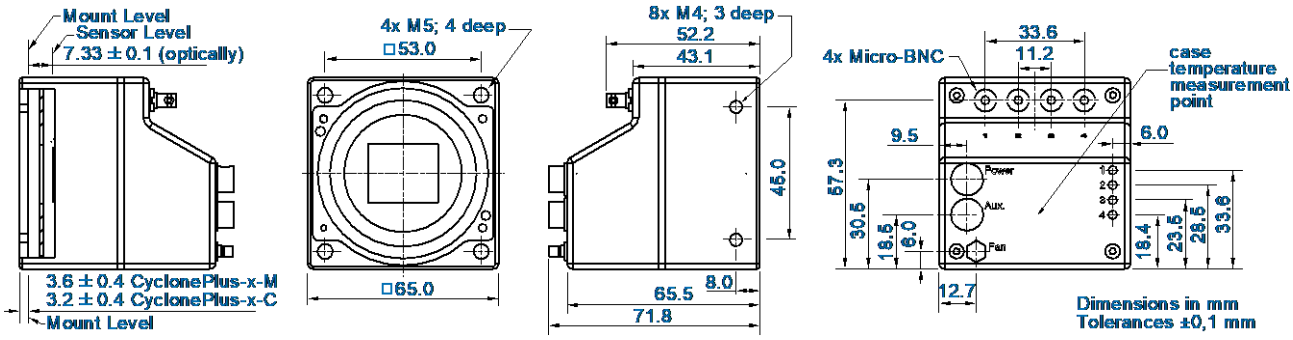
Firmware Features	Version: CP9_1200-IX-13_v3-906-1-15
Exposure modes	Timed
Trigger Activation	Rising Edge, Falling Edge, Any Edge
Trigger Sources	External (SynchIn), CoaXPress, software
Trigger Filter and Trigger Hold-Foo Time*	Yes, for external trigger source
Trigger Delay*	Adjustable
Flat Field Correction (FFC)*	Block-based with up to 16 reference data in camera, auto calibration Column-based
Defect Pixel Correction	Yes, factory setting or customer configuration
Digital Binning Modes	Average, Sum
Digital Binning horizontal/vertical	×1, ×2, ×4 / ×1, ×2, ×4
DualROI*	Yes
LineSkipping (Vertical Decimation)*	Yes
Image Mirroring*	Horizontal and Vertical
User Global Adjustments *	Offset analog and digital / Gain analog and digital
Programmable User Output	Yes
White Balance	Yes, with auto function ROI control, manual RGB gain
Counter and Timer Control*	Yes
Image Stamp (Counter information in frame)*	Yes
Save setup to flash and load on power-on*	Yes
Over Temperature Monitoring*	Yes
Firmware Update	via USB (CPH6-USB) and CXP
File Access Control	Yes, up to 3 Myte user data
Test Pattern Generation*	Yes

* Optronis features

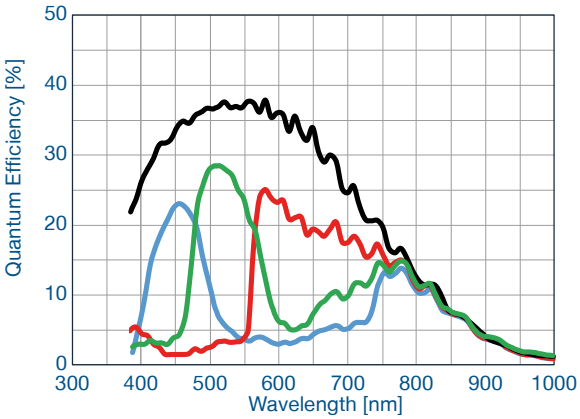
Important:

2) StreamPacketSizeMax set by frame-grabber must be ≥8 kByte

7.8.1 Dimensions

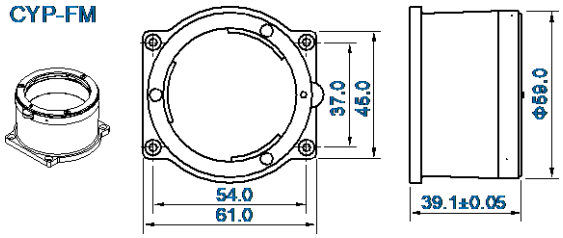


7.8.2 Spectral Sensitivity

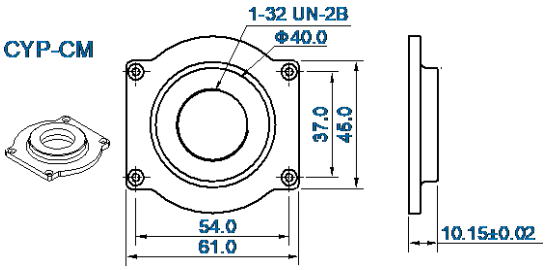


8 Accessories

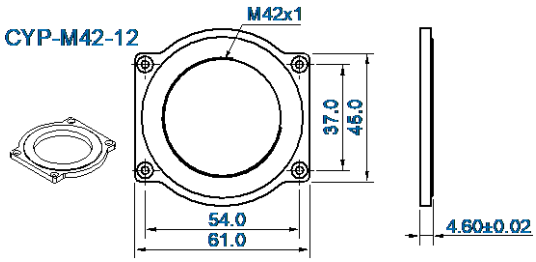
8.1 Mounts



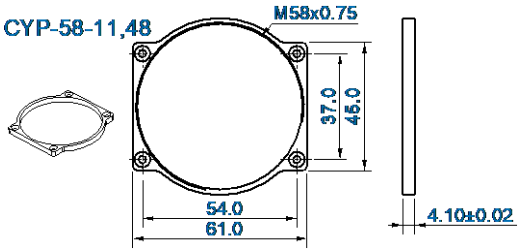
Weight: 130 g



Weight: 45 g

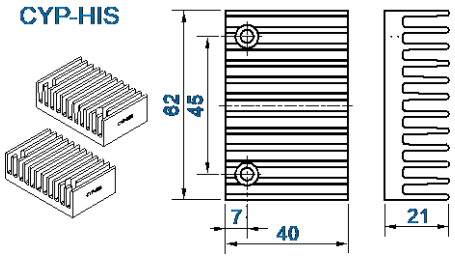


Weight: 25 g

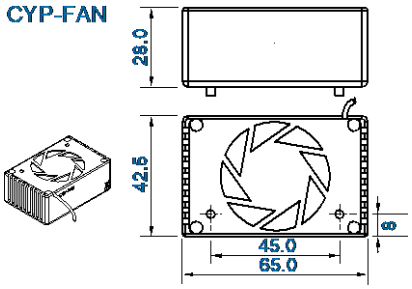


Weight: 10 g

8.2 Cooling



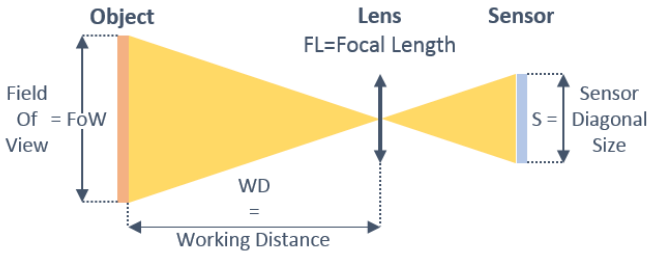
Weight: 160 g



Weight: 95 g

Annex A – Lens selection

A typical optical system can be represented as below.



Using above notations:

The sensor diagonal S is given with the technical data of the sensor or can be calculated based on pixel resolution and pixel size.:

$$\boldsymbol{Sensor\ Diagonal\ Size = S = PixelSize \times \sqrt{Resolution\_X^2 + Resolution\_Y^2}}$$

To select a lens, you can use the following formula:

$$\boldsymbol{Focal\ Length = FL = \frac{WD}{1 + \frac{FoW}{S}}}$$

Alternatively, if you already have a lens, you can compute working distance using the following formula:

$$\boldsymbol{Working\ Distance = WD = FL \times \left(1 + \frac{FoW}{S}\right)}$$

Examples:

- PixelSize = 0.008 mm
- Full resolution 1696 x 1708
- FoW = Object size = 200 mm
- WD = 600 mm

$$S = 0{,}008 \times \sqrt{1696^2 + 1708^2} = 19{,}26\ mm$$

$$FL = \frac{600}{1 + \frac{200}{19{,}26}} \sim 48{,}5\ mm$$

⇨ Selected focal length = 50 mm.

Same example but using a 35mm lens.

$$WD = 35 \times \left(1 + \frac{200}{19{,}26}\right) \sim 398\ mm$$

⇨ Object must be set at least at WD = 389 mm.

Annex B - Cleaning

Contaminations on the sensor cover glass or IR filter glass might affect image quality particularly when optical systems with high F-numbers are used. The camera is produced in a dust-controlled environment and sensor cleanliness is verified prior the camera is packed in a dust free plastic bag. Contaminations should be avoided but might occur during handling or operation. If sensor cleaning is needed, the following instructions must be observed:

- Only trained personal familiar with handling of optical equipment should clean the camera.
- The work should be done on a clean bench ideally in a durst free environment.
- ESD precautions must be respected.
- Removing the lens mount might simplify cleaning.
- First use dry and clean air to blow off particles from the sensor or IR filter.
  Avoid blowing on the mechanical parts or threads, as this might release particles contaminating the sensor.
- Only if blowing off does not result in a clean sensor cover glass, use lint free cotton buds soaked with clean alcohol (Ethanol or Isopropyl alcohol) and gently wipe on the glass. Wiping should always be in one direction and cotton bud should be used once only. Do not use cotton bud after they touched camera housing.
- When lens mount is installed again, camera should be oriented with the sensor facing down. This reduces the risk of sensor contamination from particles that are released when the mount is screwed onto the camera.