Optronis

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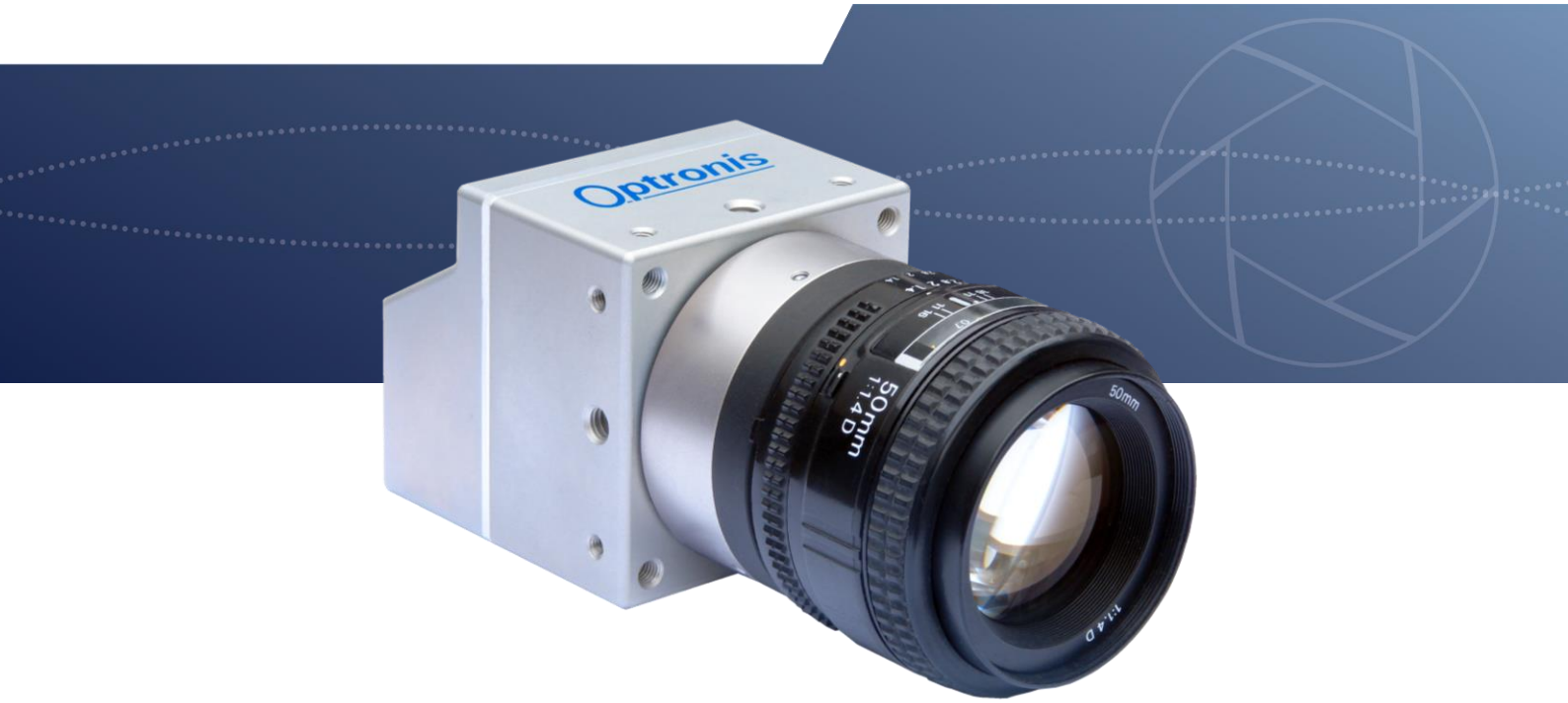
Optronis CoaXPress Cameras
CamPerform-Cyclone Series

User Manual
CamPerform Cyclone Serie

Rev: M



CoaXPress

Document Reference 1200-SU-01-M
Release Date 23/11/2023

About this manual

Thank you for using an Optronis product.

The purpose of this document is to provide a description of Optronis CamPerform-Cyclone series cameras.

Please read this manual thoroughly before operating your new camera for the first time. Please follow all instructions and observe warnings.

This document is subject to change without notice and corresponds to the last camera firmware version.

You can check product page download area to be sure you are using:

- Last Datasheet version
- Last Manual version
- Last Firmware version
- Last Firmware Update software version
- Last CAD data version

https://optronis.com/en/machine-vision-2/

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:

- Camera Model name: Cyclone-XX-M/C-XX. (See label at the bottom side of the camera).
- Serial-Number: 1xxx-X-XXX. (See label at the bottom side of the camera).
- Camera Firmware version (4 numbers, ex: v2.32.2.123)
- Frame Grabber Model
- Cable type (Connector ref, adapter ref…)
- Operating System (Windows 7/10/32bit/64bit …)
- Short description of the problem

Contacts

To contact us, please use the information below.

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1 General

1.1 RoHS Compliance

CamPerform Cyclone-5-700-M/C cameras are Pb free manufactured.

1.2 Standards

The camera has been developed according to following standards:

- CoaXPress Standard Version 2.0 - JIIA CXP-001-2019

1.3 Remarks

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

Remarks and additional information.

Attention, warnings.

1.4 Scope of Delivery

The camera is delivered together with:

- Brief Introduction

Available accessories are:

- CY-CM C-Mount lens adapter
- CY-FM F-Mount lens adapter
- CY-M42 M42 Mount lens adapter
- CPH6-PTC Pig tail cable for synch
- CPH6-USB Programming Cable
- CY-HIS Heat Sink
- CY-FAN Cooling Fan

2 Getting Started

2.1 General Precautions

2.1.1 Environmental Conditions

Recommended environmental conditions are:

- Operation, amb., no cooling 0 .. +30°C / 32 .. 86°F
- Operation, amb., with CY-HIS 0 .. +40°C / 32 .. 104°F
- Operation, amb., with CY-FAN 0 .. +55°C / 32 .. 131°F
- Operation, case temperature 0 .. +70°C / 32 .. 158°F

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

2.1.2 Camera Handling

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

Camera power	Please be careful when powering camera. Use power over Coaxpress (PoCXP) or delivered external power supply (option). **Remark:** PoCXP is implemented on all channels.
Temperature and Humidity	Please respect recommended conditions. You may use controlled airflow or heatsinks to keep camera in better temperature conditions.
Direct sun light	Please avoid direct-sun light, camera sensor may be damaged.
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. Always unplug the camera before cleaning it. Do not use cleaning liquids or sprays. Instead, use a dry and soft duster.

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

2.2 Setting Up System

2.2.1 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. Each connection is associated with a coax cable. At the Device connections are numbered; 0 for Master, and 1 to (*n*-1) for (*n*-1) extension connections as shown in the following figure:

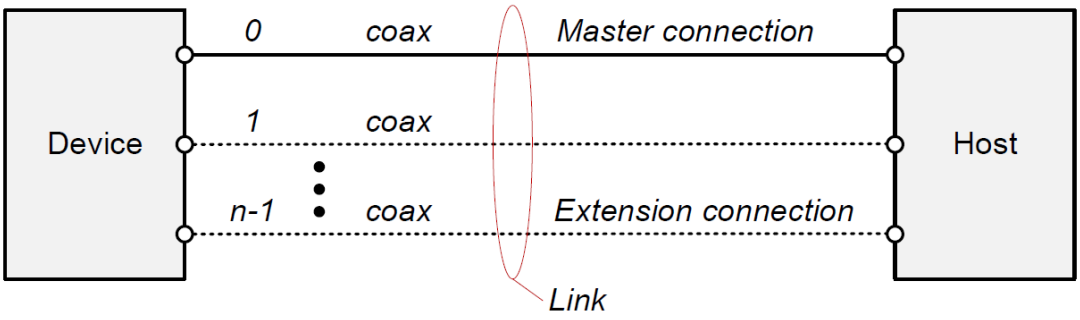


Figure 1: CoaXPress physical topology

Each connection provides the following signaling 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.

A dedicated high speed up connection from the Host to the Device is allowed for high speed triggers and camera control. This connection does not support power.

The link protocol defines the transfer of triggers, general purpose I/O, control data and high-speed streaming data over a link, as shown in the following figure:

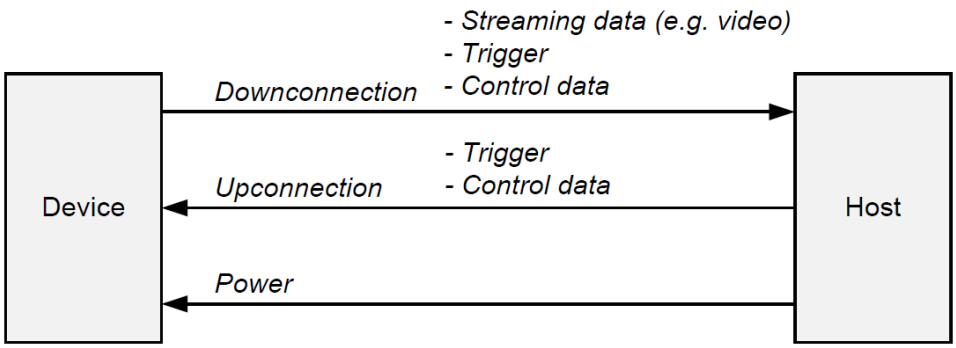


Figure 2: Signaling connections and data flow

2.2.2 Typical System Configuration

A typical system with Optronis CoaXPress camera is composed of:

- An Optronis CoaXPress camera
- CoaXPress cables
- An acquisition and control system (a CoaXPress Frame Grabber in a PC)
- A Control Software based on Frame Grabber features
- Optional features (External power supply, External synchronization system, etc…).

Here is an illustration of such a system:

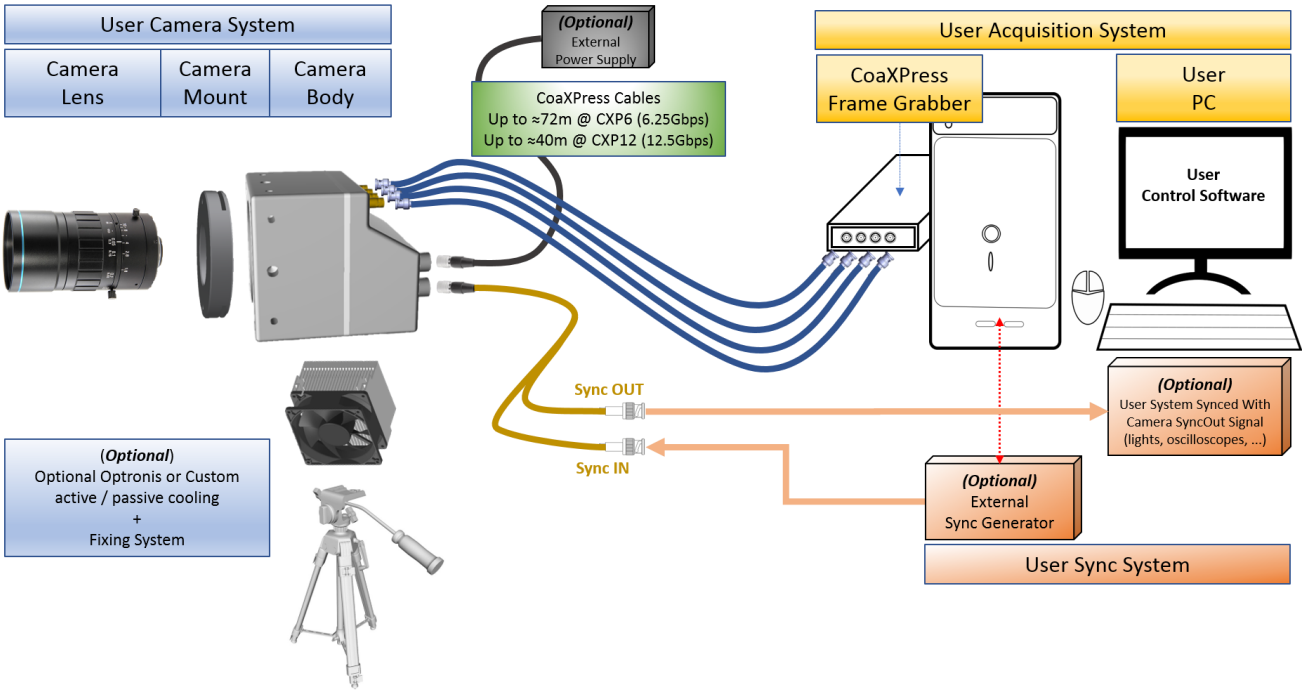


Figure 3: Typical System

2.3 About Lenses

2.3.1 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 mounting mark, first align lens-holder and 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 anti-clockwise to remove it and clockwise to installing it.
- If you are removing the lens from the camera, always use a cap on the camera to avoid dust infiltration. Use also caps on both lens sides for the same reason.
- Do not forget to remove the cap of your lens before using the camera.

2.3.2 Lens Selection / Optical Considerations

A typical optical system can be represented as below.

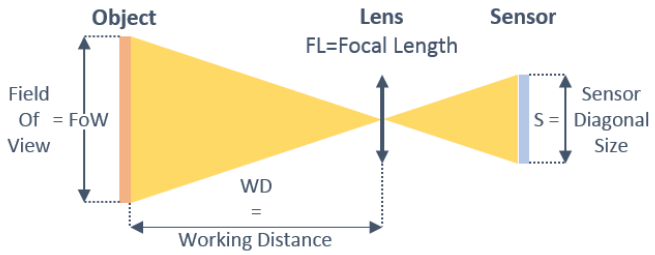


Figure 4: Field of View

Using above notations:

The sensor size depends on frame dimension:

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

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

$$\boldsymbol{Focal\ Length = FL = \frac{WD}{1+\frac{FoW}{S}}} \textit{(distances in millimeters)}$$

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

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

Examples:

- PixelSize = 0.008mm
- Full resolution 1696 x 1708
- FoW = Object size = 100 mm
- WD = 300 mm

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

$$FL = \frac{300}{1 + \frac{100}{19{,}26}} \sim 48{,}5\ mm$$

⇨ Selected focal length = 50 mm.

Same example but using a 35mm lens.

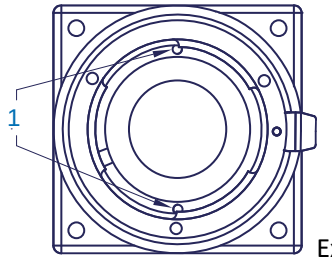
$$WD = 35 \times \left(1 + \frac{100}{19{,}26}\right) \sim 217\ mm$$

⇨ Object must be set at least at WD = 217 mm.

2.3.3 Lens Mount Exchange

Lens mount of CamPerform-Cyclone cameras can be exchanged. Pay attention not to contaminate sensor or IR filter with dirt while working on the camera front section. After exchange, lens mount needs to be adjusted to obtain correct back focal length.

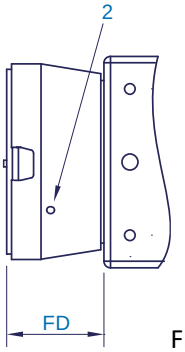
1. Remove the lens and loosen both M3 screws (1) with a 1.5 mm Allen key. Do not remove screws completely.



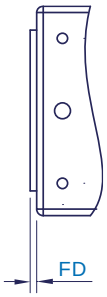
Example showing CY-FM mount, screw (1) position might be rotated.

2. Unscrew mount counterclockwise.

3. Screw in the mount clockwise to adjust flange distance (FD in mm) as shown on the table below. Tighten both screws (1).



Flange distance (FD) for CY-FM



Flange distance (FD) for CY-CM

Camera	CY-CM	CY-FM / CY-FMG	CY-M42
Cyclone-1HS-3500-M	1.4	30.4	29.3
Cyclone-1HS-3500-C	2.1	31.0	30.0
Cyclone-16-300-M	1.1	30.1	29.0
Cyclone-16-300-C	1.8	30.7	29.7
Cyclone-2-2000-M	1.1	30.1	29.0
Cyclone-2-2000-C	1.8	30.7	29.7

Camera	CY-CM	CY-FM / CY-FMG	CY-M42
Cyclone-65-70-M	2.4	31.4	30.3
Cyclone-65-70-C	3.1	32.0	31.0
Cyclone-5-700-M	1.1	30.1	29.1
Cyclone-5-700-C	1.8	30.8	29.7
Cyclone-25-150-M	1.1	30.1	29.1
Cyclone-25-150-C	1.8	30.8	29.7
Cyclone-21-230-M	1.3	30.3	29.3
Cyclone-21-230-C	2.0	30.9	29.9

Hint: When tightening the screws (1), the flange distance increases slightly by ~0.1 mm. Therefore, prior to tighten screws flange distances can be ~0.1 mm less than shown on the table above.

4. Alternatively, to the mechanical measurement of flange distance, back focal distance of lens mount can be adjusted optically while camera is operating. Ideally, the lens finally used with the camera should be used. Prior to tighten screws (1) install lens with open aperture and set focus to infinity. Direct lens on a far distant object and rotate lens together with mount until image is in focus. Remove lens and tighten screws (1).

5. For F-Mount (CY-FM and CY-FMG), release lever might rotated with respect to the position shown above. In his case open 3 screws (2) by using a 1.5 mm Allen key and rotate front part. Tighten screws after this.

3 Camera Overview

3.1 Model Description

3.1.1 Model Name and Options

CamPerform camera series decoding information are illustrated here after. Check camera label on the bottom side to get both:

- Ref.: Camera Model Name (see Figure 5)
- S/N.: Camera Serial Number (see Figure 6)

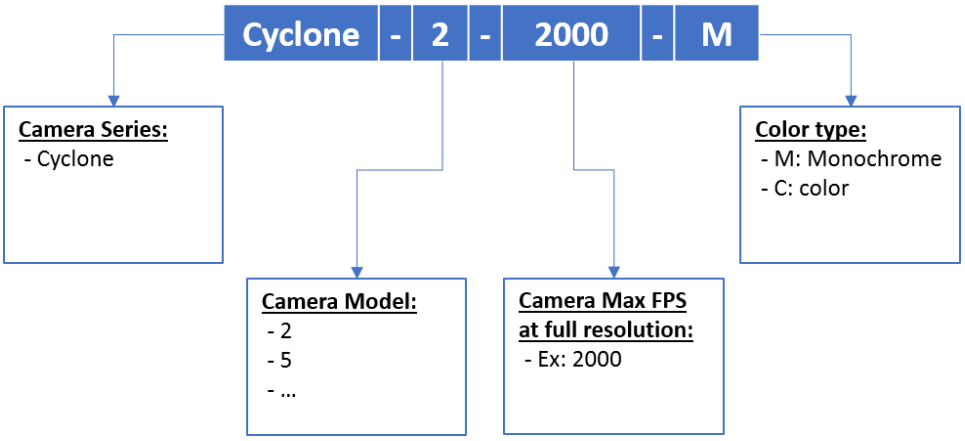


Figure 5: Camera Model Name Decoder

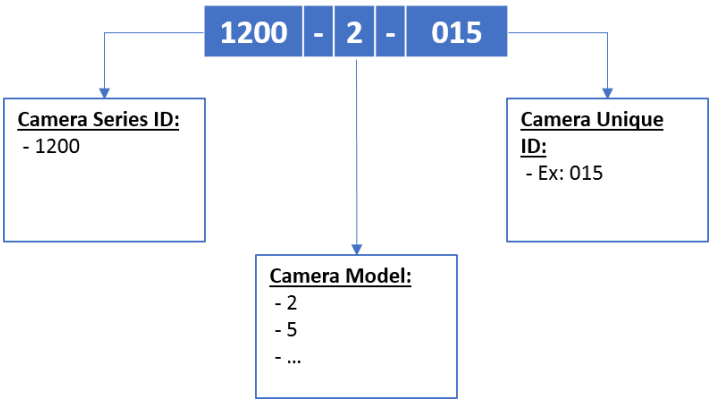
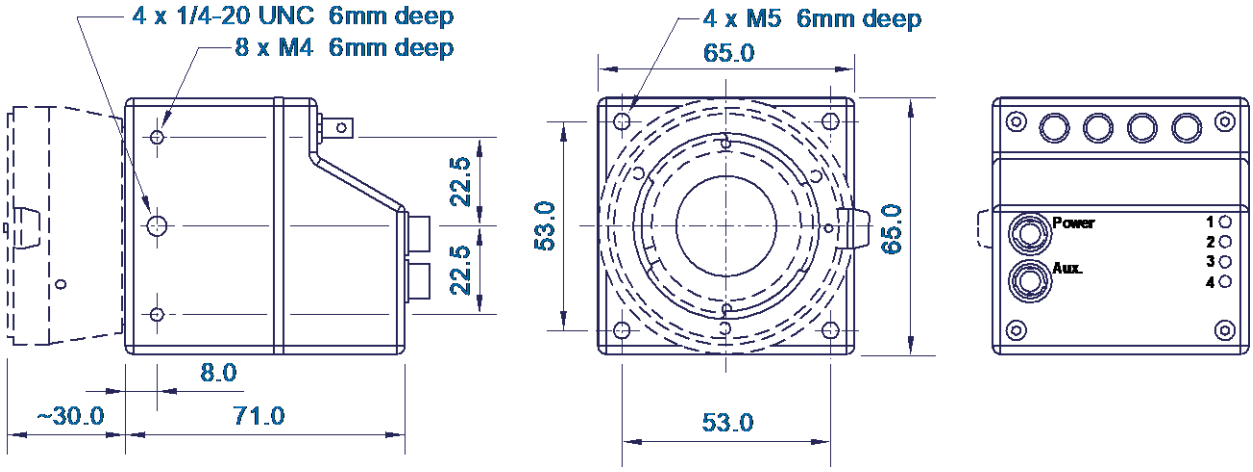


Figure 6: Camera Serial Number Decoder

3.1.2 Mechanical Drawings - Dimensions and Mounting Points



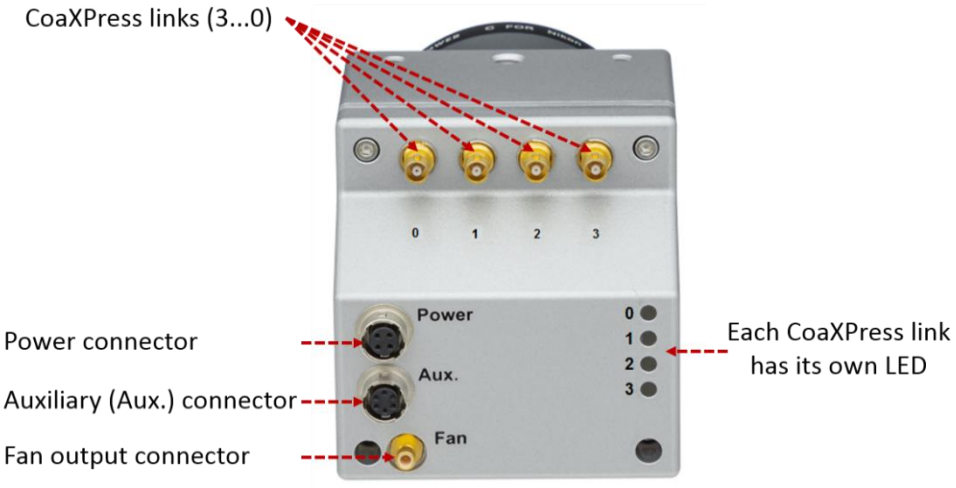
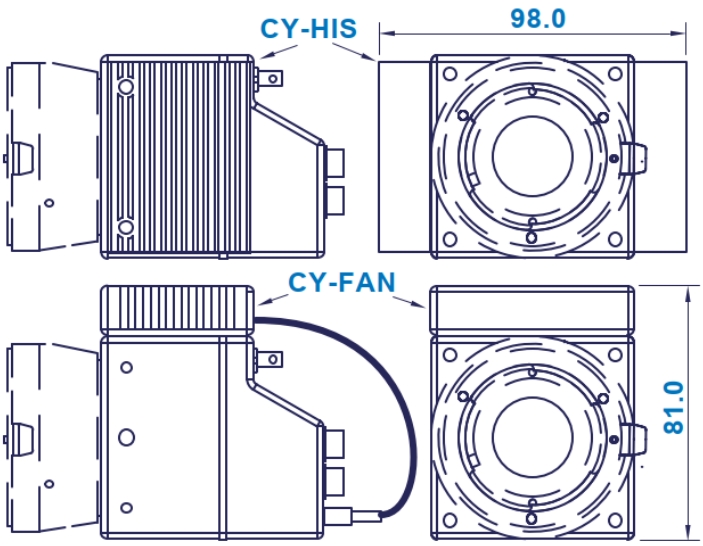


Figure 7: Cyclone HW Identification



Each 4 CoaXPress links / connector has its dedicated LED indicating its status. The table here after describes camera link status for every possible LED state.

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:

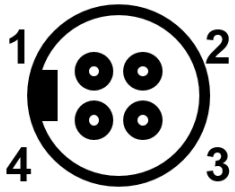
Indication	Frequency (±20%)	Duty Cycle (on) (±20%)
Flash_12_5	12.5 Hz	25% (20 ms on, 60 ms off)
Flash_1	1 Hz	25% (200 ms on, 800 ms off)
AlternateFlash_12_5	12.5 Hz	25% (20 ms on color 1, 60 ms off, 20 ms on color 2, 60 ms off)
AlternateFlash_0_5	0.5 Hz	50% (1 s on color 1, 1 s off, 1 s on color 2, 1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

3.1.2.1 *External Power Supply Connector*

Power connector is used to power camera when using an external power supply instead of power over CoaXPress feature (PoCXP).

The connector is labelled “Power”.

Optronis Camera accessory “Power supply” is recommended when using an external power supply. Alternatively, your power supply must respect bellow characteristics:

CamPerfrom-Cyclone Series	
Connector info: Camera (Pwr) connector type: • ***Hirose HR10A-7R-4S*** Cable Connector: • ***Hirose HR10A-7P-4P***	
Connector View:  Figure 8: Cyclone Power Connector	
Connector Pinout:	
Pin 1, 2: VCC	+24 Volt +/-5 % (Ripple < 200 mV) Inrush Current ~0,6 A
Pin 3, 4: GND	Power Ground

3.1.2.2 *CoaXPress Connectors*

CamPerform-Cyclone Series
Connector info: 4 x 75 Ω Micro-BNC (also known as HD-BNC™).
Remark: Connectors are labelled from 1 to 4

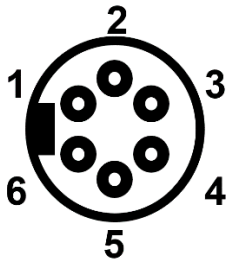
3.1.2.3 *Auxiliary Connector*

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.

CamPerform-Cyclone Series	
Connector info: Camera (Aux) connector type: • ***Hirose HR10A-7R-6S*** Cable Connector: • ***Hirose HR10A-7P-6P***	
Connector View:  Figure 9: Cyclone Auxiliary Connector	
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 4,5,6:	**0 V** Max. voltage difference between 0 V and GND (case): [-50 V ⇔ +50 V]

3.1.2.3.1 Sync In schematic

The Sync In camera input is TTL adapted (high impedance). To adapt to 50 Ohm, please add an external 50 Ohm termination.

To operate Sync In correctly, a Sync In driver has to be used with a minimum sink current (TTL low level) of 5 mA.

Polarity: rising edge, minimum pulse width 200 ns

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

Easiest driver circuit is a transistor working in open collector configuration.

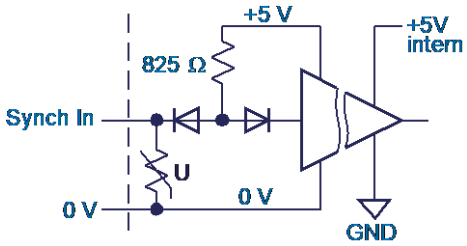


Figure 10: Sync In Input Schematics

3.1.2.3.2 Sync Out schematic

Sync Out has a built in 50 Ohm driver.

At 50 Ohm termination, the driver voltage is between 0 (low level) to ≈2 Volts (high level).

At high impedance termination, the driver voltage is in between 0 (low level) to ~4 Volts (high level).

Polarity: positiv, pulse width following exposure time

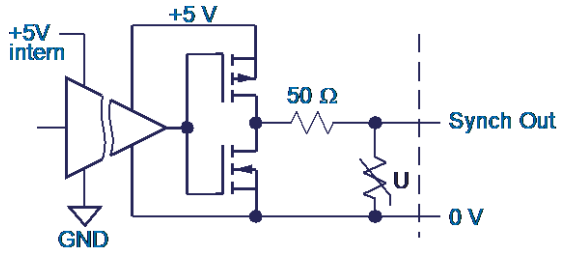
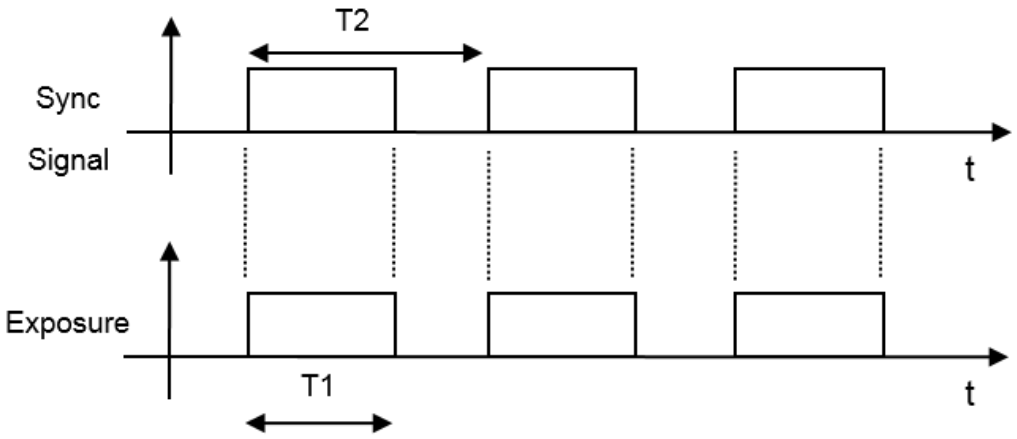


Figure 11: Sync Out Output Schematics

3.1.2.3.3 Typical Delay and Jitter values



T1: Exposure time T2: Frame Interval = (1 / Fps)	T2min = Frame Interval min = (1 / fps_min) T2max = Frame Interval max = (1 / fps_max) T1max = T2 - T1min T1min = see “Max & Min Exposure Time” paragraph

Model	Delay (ns)	Jitter +/- (ns)
Cyclone-1HS	**1142**	**675**
Cyclone-5	**1239**	**760**
Cyclone-2	**1306**	**856**
Cyclone-16	**1440**	**1006**
Cyclone-21	**8200**	**70**
Cyclone-25 MinimalExposure ON MinimamExposure OFF	 **1100** **5600**	 **20** **50**
Cyclone-64	**9300**	**45**
Cyclone-65	**4388**	**76**
Cyclone-9	**1015**	**655**

Example: for Cyclone-5, delay is 1306 ns +/- 760ns, meaning time between rising edge of external sync input and exposure output (SyncOut) can vary from 564 ns to 2066 ns.

Special case:
For Cyclone-25, Cyclone-64 and Cyclone-65 with activated TriggerWidth mode, camera adds an extra-time to the exposure time (sensor related). That means the value must be subtract from its external pulse width to achieve the required exposure time.

For Cyclone-25, that extra-time is 7.73 us.
For Cyclone-64, that extra-time is 13.35 us.
For Cyclone-65, that extra-time is 11.87 us.

For example, with a Cyclone-65 and TriggerWidth mode, to achieve an exposure time of EXP, the pulse width is EXP-11.87 us.

3.1.2.4 *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.

CamPerform-Cyclone Series
Connector info: Camera (Fan) connector type: • ***Rosenberger 59S601-200L5*** Cable Connector: • ***Rosenberger 59K204-301L5***
+5 V 250 mA maximum

3.2 CamPerform-Cyclone series technical data

To use camera with only one CXP link, external power supply must be applied as one CXP link can only provide 13W of power.

3.2.1 Cyclone-5-700

Sensor	Cyclone-5-700
Image sensor	LUX51 (Alexima) Global Shutter CMOS
Sensor resolution	2560x1916
Width inc,min,max	64,256,2560
Height inc,min,max	4,4,1916
Framerate @ max. sensor resolution	693 fps
Framerate min	20 fps
Frame rate increase	in Y
Exposure Time min,max (in µs)	2, 1/framerate
Active Area	12.8 mm x 9.580 mm
Sensor diagonal dimension	15.988 mm
Pixel size	5.0 um
A/D conversion	8 bit / 10 bit
Trigger signal (Sync In, Sync Out)	ttl, 3.3 - 5 V, 10 mA, optically isolated
Trigger modes	Internal free-run, external, CXP
CXP revision	2.0
CXP Interface	4xCXP12,2xCXP12,1xCXP12,4xCXP6,2xCXP6
Power	<10W, External and Power over CXP
Lens mount	F-Mount, C-Mount, M42 and custom
Weight	400 g without mount
Dimensions	65 mm x 65 mm x 71.0 mm
Housing	lightweight anodised aluminium
Factory hot pixel correction	Yes
System Gain*	52 e-/DN
Temporal dark noise*	21 e-
Signal-to-Noise Ratio*	41 dB
Absolute sensitivity threshold*	37 e-
Saturation Capacity*	25500 ph
Dynamic Range*	56.8 dB
DSNU*	71.3 e-
PRNU*	2.56%
Linearity error (LE,EMVA1288_v3.0)*	1.22%
DualROI**	Yes, up to 2 ROIs
LineSkipping** (only for monochrom sensor)	Yes
Pattern**	Yes
User Hot Pixel Correction	Yes
User column-based Offset Correction**	Yes
User column-based Gain Correction**	Yes

Sensor	Cyclone-5-700
Counter information in frame**	Yes
Horizontal mirroring** (only for monochrom sensor)	No
Vertical mirroring** (only for monochrom sensor)	No
User global analog offset**	Yes
User global analog gain**	Yes
Save setup to flash and load on power-on**	Yes
Digital Binning 2x2** (only for monochrom sensor)	Yes
RGB Gain **	Yes
Exposure modes	Timed

* EMVA 1288

** Optronis features

** A frame rate calculator is available at https://optronis.com/calculator/

Important:

1) StreamPacketSizeMax set by frame-grabber must be ≥3KBytes

3.2.2 Cyclone-2-2000

Sensor	Cyclone-2-2000
Image sensor	LUX19HS (Alexima) Global Shutter CMOS
Sensor resolution	1920 x 1080
Width inc,min,max	64,256,1920
Height inc,min,max	4,4,1080
Framerate @ max. sensor resolution	2155 fps
Framerate min	20 fps
Frame rate increase	in Y
Exposure Time min,max (in µs)	2, 1/framerate
Active Area	19.2 mm x 10.80 mm
Sensor diagonal dimension	22.029 mm
Pixel size	10.0 um
A/D conversion	8 bit / 10 bit
Trigger signal (Sync In, Sync Out)	ttl, 3.3 - 5 V, 10 mA, optically isolated
Trigger modes	Internal free-run, external, CXP
CXP revision	2.0
CXP Interface	4xCXP12,2xCXP12,1xCXP12,4xCXP6,2xCXP6
Power	<10W, External and Power over CXP
Lens mount	F-Mount, C-Mount, M42 and custom
Weight	400 g without mount
Dimensions	65 mm x 65 mm x 71.0 mm
Housing	lightweight anodised aluminium
Factory hot pixel correction	Yes
System Gain*	68 e-/DN
Temporal dark noise*	32 e-
Signal-to-Noise Ratio*	42 dB
Absolute sensitivity threshold*	38 e-
Saturation Capacity*	43700 ph
Dynamic Range*	52 dB
DSNU*	109 e-
PRNU*	1.95%
Linearity error (LE,EMVA1288_v3.0)*	0.23%
ISO_SNRsat (monochrom sensor)	5000
DualROI**	Yes, up to 2 ROIs
LineSkipping** (only for monochrom sensor)	No
Pattern**	Yes
User Hot Pixel Correction	Yes
User column-based Offset Correction**	Yes
User column-based Gain Correction**	Yes
Counter information in frame**	Yes
Horizontal mirroring** (only for monochrom sensor)	No
Vertical mirroring** (only for monochrom sensor)	No
User global analog offset**	Yes
User global analog gain**	Yes
Save setup to flash and load on power-on**	Yes

Sensor	Cyclone-2-2000
Digital Binning 2x2** (only for monochrom sensor)	Yes
RGB Gain **	Yes
Exposure modes	Timed

* EMVA 1288

** Optronis features

** A frame rate calculator is available at https://optronis.com/calculator/

Important:

1) StreamPacketSizeMax set by frame-grabber must be ≥2Kbytes

3.2.3 Cyclone-1HS-3500

Sensor	Cyclone-1HS-3500
Image sensor	LUX13HS (Alexima) Global Shutter CMOS
Sensor resolution	1280 x 860
Width inc,min,max	64,256,1280
Height inc,min,max	4,4,860
Framerate @ max. sensor resolution	3367 fps
Framerate min	20 fps
Frame rate increase	in Y
Exposure Time min,max (in µs)	2, 1/framerate
Active Area	17.536 mm x 11.782 mm
Sensor diagonal dimension	21.126 mm
Pixel size	13.7 um
A/D conversion	8 bit / 10 bit
Trigger signal (Sync In, Sync Out)	ttl, 3.3 - 5 V, 10 mA, optically isolated
Trigger modes	Internal free-run, external, CXP
CXP revision	2.0
CXP Interface	4xCXP12,2xCXP12,1xCXP12,4xCXP6,2xCXP6
Power	<10W, External and Power over CXP
Lens mount	F-Mount, C-Mount, M42 and custom
Weight	400 g without mount
Dimensions	65 mm x 65 mm x 71.0 mm
Housing	lightweight anodised aluminium
Factory hot pixel correction	Yes
System Gain*	66.4 e-/DN
Temporal dark noise*	34.5 e-
Signal-to-Noise Ratio*	42.3 dB
Absolute sensitivity threshold*	35 e-
Saturation Capacity*	16938 ph
Dynamic Range*	53.7 dB
DSNU*	57.5 e-
PRNU*	1.266%
Linearity error (LE,EMVA1288_v3.0)*	<0.5%
ISO_SNRsat (monochrom sensor)	2000
DualROI**	Yes, up to 2 ROIs
LineSkipping** (only for monochrom sensor)	No
Pattern**	Yes
User Hot Pixel Correction	Yes
User column-based Offset Correction**	Yes
User column-based Gain Correction**	Yes
Counter information in frame**	Yes
Horizontal mirroring** (only for monochrome sensor)	No
Vertical mirroring** (only for monochrom sensor)	No
User global analog offset**	Yes
User global analog gain**	Yes
Save setup to flash and load on power-on**	Yes

Sensor	Cyclone-1HS-3500
Digital Binning 2x2** (only for monochrom sensor)	No
RGB Gain **	Yes
Exposure modes	Timed

* EMVA 1288

** Optronis features

** A frame rate calculator is available at https://optronis.com/calculator/

Important:

1) StreamPacketSizeMax set by frame-grabber must be ≥2Kbytes

3.2.4 Cyclone-16-300

Sensor	Cyclone-16-300
Image sensor	LUX160 (Alexima) Global Shutter CMOS
Sensor resolution	4672 x 3416
Width inc,min,max	64,256,4672
Height inc,min,max	4,4,3416
Framerate @ max. sensor resolution	284 fps
Framerate min	20 fps
Frame rate increase	in Y
Exposure Time min,max (in µs)	2, 1/framerate
Active Area	18.221 mm x 13.322 mm
Sensor diagonal dimension	22.572 mm
Pixel size	3.9 um
A/D conversion	8 bit / 10 bit
Trigger signal (Sync In, Sync Out)	ttl, 3.3 - 5 V, 10 mA, optically isolated
Trigger modes	Internal free-run, external, CXP
CXP revision	2.0
CXP Interface	4xCXP12,2xCXP12,1xCXP12,4xCXP6,2xCXP6
Power	<10W, External and Power over CXP
Lens mount	F-Mount, C-Mount, M42 and custom
Weight	400 g without mount
Dimensions	65 mm x 65 mm x 71.0 mm
Housing	lightweight anodised aluminium
Factory hot pixel correction	Yes
System Gain*	34 e-/DN
Temporal dark noise*	10 e-
Signal-to-Noise Ratio*	39 dB
Absolute sensitivity threshold*	15 e-
Saturation Capacity*	22700 ph
Dynamic Range*	55 dB
DSNU*	135 e-
PRNU*	2.13%
Linearity error (LE,EMVA1288_v3.0)*	0.5%
ISO_SNRsat (monochrom sensor)	1250
DualROI**	Yes, up to 2 ROIs
LineSkipping** (only for monochrom sensor)	No
Pattern**	Yes
User Hot Pixel Correction	Yes
User column-based Offset Correction**	Yes
User column-based Gain Correction**	Yes
Counter information in frame**	Yes
Horizontal mirroring** (only for monochrom sensor)	No
Vertical mirroring** (only for monochrom sensor)	No
User global analog offset**	Yes
User global analog gain**	Yes
Save setup to flash and load on power-on**	Yes

Sensor	Cyclone-16-300
Digital Binning 2x2** (only for monochrom sensor)	No
RGB Gain **	Yes
Exposure modes	Timed

* EMVA 1288

** Optronis features

** A frame rate calculator is available at https://optronis.com/calculator/

Important:

1) StreamPacketSizeMax set by frame-grabber must be ≥8 Kbytes

3.2.5 Cyclone-65-70

Sensor	Cyclone-65-70
Image sensor	GMAX3265 (GPixel) Global Shutter CMOS
Sensor resolution	9344 x 7000
Width inc,min,max	64,256,9344
Height inc,min,max	4,4,7000
Framerate @ max. sensor resolution	71 fps
Framerate min	1 fps
Frame rate increase	in Y
Exposure Time min,max (in µs)	12, 1/framerate
Active Area	29.901 mm x 22.400 mm
Sensor diagonal dimension	37.361 mm
Pixel size	3.2 um
A/D conversion	8 bit / 10 bit
Trigger signal (Sync In, Sync Out)	ttl, 3.3 - 5 V, 10 mA, optically isolated
Trigger modes	Internal free-run, external, CXP
CXP revision	2.0
CXP Interface	4xCXP12,2xCXP12,1xCXP12,4xCXP6,2xCXP6
Power	<14W, External and Power over CXP
Lens mount	F-Mount, C-Mount, M42 and custom
Weight	400 g without mount
Dimensions	65 mm x 65 mm x 71.0 mm
Housing	lightweight anodised aluminium
Factory hot pixel correction	Yes
System Gain*	46 e-/DN
Temporal dark noise*	18 e-
Signal-to-Noise Ratio*	40 dB
Absolute sensitivity threshold*	18 e-
Saturation Capacity*	20246 ph
Dynamic Range*	55 dB
DSNU*	72 e-
PRNU*	2.1%
Linearity error (LE,EMVA1288_v3.0)*	0.31%
DualROI**	Yes, up to 2 ROIs
LineSkipping** (only for monochrom sensor)	Yes
Pattern**	Yes
User Hot Pixel Correction	Yes
User column-based Offset Correction**	Yes
User column-based Gain Correction**	Yes
Counter information in frame**	Yes
Horizontal mirroring** (only for monochrom sensor)	No
Vertical mirroring** (only for monochrom sensor)	No
User global analog offset**	Yes
User global analog gain**	Yes
Save setup to flash and load on power-on**	Yes
Digital Binning 2x2** (only for monochrom sensor)	Yes

Sensor	Cyclone-65-70
RGB Gain **	Yes
Exposure modes	Timed and TriggerWidth

* EMVA 1288

** Optronis features

** A frame rate calculator is available at https://optronis.com/calculator/

Important:

1) StreamPacketSizeMax set by frame-grabber must be ≥256 Bytes. 16KBytes is recommended to reach maximal framerates

3.2.6 Cyclone-25-150

Sensor	Cyclone-25
Image sensor	GMAX0505 (Gpixel) Global Shutter CMOS
Sensor resolution	5120 x 5120
Width inc,min,max	64, 256, 2560
Height inc,min,max	4, 4, 1916
Framerate @ max. sensor resolution	150
Framerate min	20 fps
Frame rate increase	in Y
Exposure Time min,max (in µs)	8, 1/framerate
Active Area	12.8 mm x 12.8 mm
Sensor diagonal dimension	18.102 mm
Pixel size	2.5 um
A/D conversion	8 bit / 10 bit
Trigger signal (Sync In, Sync Out)	ttl, 3.3 - 5 V, 10 mA, optically isolated
Trigger modes	Internal free-run, external, CXP
CXP revision	2.0
CXP Interface	4xCXP12, 2xCXP12, 1xCXP12, 4xCXP6, 2xCXP6
Power	~13,5 W, External and Power over CXP
Lens mount	F-Mount, C-Mount, M42 and custom
Weight	400 g without mount
Dimensions	65 mm x 65 mm x 71.0 mm
Housing	lightweight anodised aluminium
Factory hot pixel correction	Yes
System Gain*	17 e-/DN
Temporal dark noise*	7 e-
Signal-to-Noise Ratio*	36 dB
Absolute sensitivity threshold*	6 e-
Saturation Capacity*	3880 ph
Dynamic Range*	56.1 dB
DSNU*	17.9 e-
PRNU*	1.72%
Linearity error (LEmin,LEmax)*	<2%
Linearity error (LE,EMVA1288_v3.0)*	0.59%
DualROI**	Yes, up to 2 ROIs
LineSkipping** (only for monochrom sensor)	Yes
Pattern**	Yes
User Hot Pixel Correction	Yes
User column-based Offset Correction**	Yes
User column-based Gain Correction**	Yes
Counter information in frame**	Yes
Horizontal mirroring** (only for monochrom sensor)	Yes
Vertical mirroring** (only for monochrom sensor)	Yes
User global analog offset**	Yes
User global analog gain**	Yes

Sensor	Cyclone-25
Save setup to flash and load on power-on**	Yes
Digital Binning 2x2** (only for monochrom sensor)	Yes
RGB Gain **	Yes
Exposure modes	Timed and TriggerWidth

* EMVA 1288

** Optronis features

** A frame rate calculator is available at https://optronis.com/calculator/

Important:

1) StreamPacketSizeMax set by frame-grabber must be ≥8KBytes

3.2.7 Cyclone-21-230

EMVA1288 measurements (v3.1 typ. 10 bit)

Sensor	Cyclone-21
Image sensor	GSPRINT4521(Gpixel) Global Shutter CMOS
Sensor resolution	5120 x 4096
Width inc,min,max	64,256,5120
Height inc,min,max	32,32,4096
Framerate @ max. sensor resolution	230
Framerate min	1 fps
Frame rate increase	in Y
Exposure Time min,max (in µs)	4, 1/framerate
Active Area	23.04 mm x 18.432 mm
Sensor diagonal dimension	29.506 mm
Pixel size	4.5 um
A/D conversion	8 bit / 10 bit
Trigger signal (Sync In, Sync Out)	ttl, 3.3 - 5 V, 10 mA, optically isolated
Trigger modes	Internal free-run, external, CXP
CXP revision	2.0
CXP Interface	4xCXP12,2xCXP12,4xCXP6,2xCXP6
Power	~16 W, External and Power over CXP
Lens mount	F-Mount, C-Mount, M42 and custom
Weight	400 g without mount
Dimensions	65 mm x 65 mm x 71.0 mm
Housing	lightweight anodised aluminium
Factory hot pixel correction	Yes
System Gain*	32 e-/DN
Temporal dark noise*	35 e-
Signal-to-Noise Ratio*	45 dB
Absolute sensitivity threshold*	38 e-
Saturation Capacity*	31000 e-
Dynamic Range*	59 dB
DSNU*	18 e-
PRNU*	1.6%
Linearity error (LEmin,LEmax)*	<4%
Linearity error (LE,EMVA1288_v3.0)*	0.54%
DualROI**	No
LineSkipping** (only for monochrom sensor)	No
Pattern**	Yes
User Hot Pixel Correction	Yes
User column-based Offset Correction**	Yes
User column-based Gain Correction**	Yes
Counter information in frame**	Yes
Horizontal mirroring** (only for monochrom sensor)	No
Vertical mirroring** (only for monochrom sensor)	No
User global analog offset**	Yes

User global analog gain**	Yes
Save setup to flash and load on power-on**	Yes
Digital Binning 2x2** (only for monochrom sensor)	No
RGB Gain **	Yes
Exposure modes	Timed and TriggerWidth

* EMVA 1288

** Optronis features

** A frame rate calculator is available at https://optronis.com/calculator/

Important:

2) **The ROI height can be adjusted in the Cyclone-21-230, but be aware that vertical offset cannot be set. ROI is always vertically centered.**
3) **The frame-grabber used in association with the Cyclone-21-230 must support the CoaXPress 1X-2YE DeviceTapGeometry.**
4) **StreamPacketSizeMax set by frame-grabber must be ≥8KBytes**

4 Camera Control Interface

Camera is controlled through a standard GenICam XML file. For *DeviceControl*, *TransportLayerControl*, *Support* and *CXP* sections, please refer to the CoaxPress Version 2.0 specification.

4.1 ImageFormatControl

Xml entry Name Address	Description
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.
HeightMax	Maximum height (in pixels) of the image. This dimension is calculated after vertical binning, decimation or any other function changing the vertical dimension of the image.
Width	Represents the actual image width expelled by the camera (in pixels).
Height	Represents the actual image height expelled by the camera (in pixels).
OffsetX	Horizontal offset from the origin to the area of interest (in pixels).
OffsetY	Vertical offset from the origin to the area of interest (in pixels).
PixelFormat	Indicates the format of the pixel to use during the acquisition. Mono10 uses packed data and corresponds to Genicam Mono10Packed.

4.2 AcquisitionControl

Xml entry Name Address	Description
AcquisitionMode	Controls the acquisition mode of the device. • Continuous: Camera internal trig • SingleFrame: Camera ext. IO trig • CoaxPress: trigger over CXP
AcquisitionStart	Starts the Acquisition of the device. Check that ImageHeightValid is set to 1 before starting. If ImageHeightValid is 0, that means that the transferred frame height is not a multiple of 4, and in that case, acquisition will not start.
AcquisitionStop	Stops the Acquisition of the device at the end of the current Frame.
AcquisitionFrameRate	Frame rate in Hz.
ExposureTime	Sets the Exposure time (in microseconds) when ExposureMode is Timed. This controls the duration where the photosensitive cells are exposed to light.
ExposureMode	Sets the Exposure mode. • Timed: exposure time is defined by ExposureTime entry • TriggerWidth: exposure time is defined by external or CXP trigger pulse positive width. TriggerWidth is not available for all camera models. Please refer to section 3.2 for more details about your camera model.

The camera frame acquisition is controlled by using camera XML AcquisitionStart and AcquisitionStop commands.

The camera frame acquisition can be synchronized by 3 different ways:

- **Camera Internal Generator:** (*AcquisitionMode* = “Continuous”)
  In this mode, the camera uses its own sync generator and generates frames continuously when acquisition is started. Frames are generated according to *AcquisitionFrameRate* value.

- **External Synchronization Generator:** (*AcquisitionMode* = “Single Frame”)

In this mode, the camera uses an external signal to generate frames. You must apply a TTL signal the Sync In input of the camera. Please respect signal limits (current and voltage) and use the Aux. to BNC adapter or respect Aux. connector pinout.

- **Synchronization over CoaXPress by Frame Grabber:** (*AcquisitionMode* = "CoaxPress")

CoaXPress standard allows Frame Grabber synchronizing camera frame generation using specific packets called *trigger packets* sent on "CoaXPress uplink".

4.3 Optronis

Xml entry Name Address	Description
IndicatorLamps	Enables or disables indicator lamps.
EnableFan	Enables or disables camera Fan power output. Fan can be disabled during frame acquisition to avoid vibrations and enabled to stabilize temperature when not capturing frames.
ColorSensor	Indicates if camera has camera a color sensor. '0' means mono sensor. '1' means color sensor.
Pattern	Enables or disables a frame Pattern. When disabled, sensor pixels are sent. 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,…
Binning	Enables or disables digital binning 2x2. If set to 'On', binning is activated. If set to 'Off', binning is disactivated.
Flipping	Sets the Flipping (or Mirroring) mode. If set to 'Off', no flipping is applied to the camera. If set to 'Horizontal', horizontal flipping is applied to the camera. If set to 'Vertical', vertical flipping is applied to the camera. If set to 'Horizontal_And_Vertical', horizontal AND vertical flipping are applied to the camera.
LineSkipping	Enables or disables line skipping feature. If dual ROI mode is used, it can be applied on all ROIs ("On") on only a specific ROI ("ROI1_Only" or "ROI2_Only")
DualROI	Enables or disables dual ROI mode.
Height_ROI1	Height of ROI1 when dual ROI mode is enabled.
Height_ROI2	Height of ROI2 when dual ROI mode is enabled.
ROI1_OffsetY	Offset of ROI1 when dual ROI mode is enabled.
ROI2_OffsetY	Offset of ROI2 when dual ROI mode is enabled.
ImageHeightValid	Indicates if output frame height is valid with current setup (Binning, dual ROI, line skipping are impacting this result).
DefectPixelCorrectionEnable	Enables or disables defect pixel correction.
DefectPixelTestMode	When enabled, this test mode eases defect pixel coordinates by showing corrected pixels in white and non-corrected pixels in black.
DefectPixelSource	Returns the source of defect pixel correction (Factory programmed or User saved).
DefectPixelTotal	Returns the number of corrected pixels in the frame.
DefectPixelLineSelect	For Cyclone-5-700, Cyclone-2-2000, Cyclone-1HS-3500 and Cyclone-16-300, DefectPixelLineSelect selects a defect pixel list to display or modify for a physical sensor line of ordinate DefectPixelLineSelect. For Cyclone-65-70 and Cyclone-25-150, DefectPixelLineSelect selects a defect pixel list to display or modify for two physical sensor line of ordinate 2*DefectPixelLineSelect and 1+2*DefectPixelLineSelect.

DefectPixelX0 DefectPixelX1 DefectPixelX2 DefectPixelX3 DefectPixelX4 DefectPixelX5 DefectPixelX6 DefectPixelX7	For Cyclone-5-700, Cyclone-2-2000, Cyclone-1HS-3500 and Cyclone-16-300, DefectPixelXi is the abscissa of the defect pixel Pi(DefectPixelXi, DefectPixelLineSelect). For Cyclone-65-70 and Cyclone-25-150, DefectPixelXi is the abscissa of the defect pixel Pi(DefectPixelXi, 2*DefectPixelLineSelect) if i is in the range [0..3] and the abscissa of the defect pixel Pi(DefectPixelXi, 1+2*DefectPixelLineSelect) if i is in the range [4..7] Set DefectPixelXi = 0xFFFF to disable correction for pixel Pi. Set DefectPixelXi = [0 .. ImageWidth-1] to enable correction for pixel Pi. It modifies only RAM value. Call DefectPixelUserFlashSave() to save current defect pixel configuration.
DefectPixelClearAll	Clears all RAM values (0xFFFF) and set DefectPixelTotal to '0'. Flash data is not impacted. If camera is power cycled, the same flash configuration will be loaded again.
DefectPixelUserFlashSave	Saves current RAM values to User flash area. Previous user values in flash are lost. Current values will be used at next power cycle.
DefectPixelUserFlashErase	Erases current user flash values. Previous user values in flash are lost. No user correction will be loaded after a power cycle until new values are saved using DefectPixelUserFlashSave.
Correction	Enables or disables FFC correction.
Correction_Coeff_X	Selects a column **X** in the frame (0 … Width_Max-1).
Correction_Coeff_V	FPN & PRNU Coefficients of column **X** = Correction_Coeff_X. 16b integer with: - Bit8..0 = PRNU_Coeff (valid values are 0..511) - Bit15..9 = FPN_Coeff (valid values are 0..127) Ex: Correction_Coeff_X = 50 & Correction_Coeff_V = 0x0280. It means that for column n° 50: - FPN_Coeff(column=50) = 0x1 PRNU_Coeff(column=50) = 0x80 (PRNU_coeff/128=1)
Correction_UserGD	UserGD offset value of selected column **X** = Correction_Coeff_X.
Correction_DMean	DMean offset value of selected column **X** = Correction_Coeff_X.
FFCSaveToFlash	Saves current FFC parameters from RAM to flash. Erases previous user FFC correction. This new saved FFC correction will be used after next power cycle.
CXP_Trigger_Period	Reference period (in µs) used to detect missing trigger packets.
CXP_Trigger_Counter_Error	Returns the number of missing trigger packets. This counter is incremented until reset by XML entry CXP_Trigger_Counter_Reset.
CXP_Trigger_Counter_Reset	Resets CXP_Trigger_Counter_Error counters.
Temperature	Returns camera internal temperature.
MaxFrameRateExtended	If set to "Default", the calculation of the maximal frame rate is based on sensor size. If set to "Extended", the calculation of the maximal frame rate is based on exposure time (approximately 1/exposure time)
AGain	Analog gain
AOffset	Analog offset applied to the sensor in mV
DGain	Digital gain Set value between 0 and 16383 with steps of 1, corresponding to floating gains between 0 and 16383/1024 with steps of 1/1024. A value of 1024 corresponds to a gain of 1.0
DOffset	Digital offset between 0 and 1023. When using 8 bits pixel format, image offset is increased by DOffset/4. When using 10 bits pixel format, image offset is increased by DOffset.
CounterInformation	If enabled, the first pixels of the image will contain the following informations 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'.
RGB_Gain_Enable	Only available for color cameras. Activates separate gains for red (RGB_Gain_R), green (RGB_Gain_G) and blue (RGB_Gain_B) pixels on color sensors. Set to "On" to activate, "Off" to disactivate.
RGB_Gain_R	Only available for color cameras. Gain for red pixels. Set value between 0 and 4095 with steps of 1, corresponding to floating gains between 0 and 4095/1024 with steps of 1/1024. A value of 1024 corresponds to a gain of 1.0
RGB_Gain_G	Only available for color cameras. Gain for green pixels. Set value between 0 and 4095 with steps of 1, corresponding to floating gains between 0 and 4095/1024 with steps of 1/1024. A value of 1024 corresponds to a gain of 1.0
RGB_Gain_B	Only available for color cameras. Gain for blue pixels. Set value between 0 and 4095 with steps of 1, corresponding to floating gains between 0 and 4095/1024 with steps of 1/1024. A value of 1024 corresponds to a gain of 1.0
BalanceWhiteAuto_Highlight	Highligths the ROI used by BalanceWhiteAuto.
BalanceWhiteAuto_OffsetX	Horizontal offset from the origin to the area of interest (in pixels) used for white balance.
BalanceWhiteAuto_OffsetY	Vertical offset from the origin to the area of interest (in pixels) used for white balance.
BalanceWhiteAuto_Width	Width of the area of interest (in pixels) used for white balance.
BalanceWhiteAuto_Height	Height of the area of interest (in pixels) used for white balance.
BalanceWhiteReset	Reset all RGB_Gain_x to 1024.
BalanceWhiteAuto	Controls the mode for automatic white balancing between the color channels. The white balancing ratios are automatically adjusted. Possible values are: • Off: White balancing is user controlled using RGB_Gain_x and RGB_Gain_Enable. • Once: White balancing is automatically adjusted once by the device. Once it has converged, it automatically returns to the Off state. • Continuous: White balancing is constantly adjusted by the device.
SyncOutEnable	Defines the way the camera output SyncOut is generated.

	When set to 'AlwaysOn', SyncOut is always ON if acquisition is stopped or not. In that case, SyncOut is high when exposure is running and low when there is no exposure. When set to 'AlwaysOff', SyncOut is set to low level (i.e. physical output is set to ground). When set to 'OnAcquisitionOnly', SyncOut follows exposure when an acquisition is running. When acquisition is stopped, SyncOut is set to low level (i.e. physical output is set to ground).
SyncOutPolarity	Defines the polarity of the camera output SyncOut. When set to 'High', SyncOut is active high, i.e. SyncOut is high when exposure is running and low when there is no exposure. When set to 'Low', SyncOut is active low, i.e. SyncOut is low when exposure is running and high when there is no exposure.
Hold_Offset_X_Y	Defines the behavior of OffsetX and OffsetY when changing Width or Height of the frame. When Hold_Offset_X_Y is set to 'Off' and user changes the Width, OffsetX is reset to center horizontally the ROI. When Hold_Offset_X_Y is set to 'Off' and user changes the Height, OffsetY is reset to center vertically the ROI. When Hold_Offset_X_Y is set to 'On', OffsetX and OffsetY always remain unchanged and: - if user changes Width and OffsetX+Width>WidthMax, Width is restored to previous value. - if user changes Height and OffsetY+Height>HeightMax, Height is restored to previous value (and OffsetY remains unchanged).

4.3.1 Dual ROI

4.3.1.1 *Dual ROI control*

Dual ROI mode is controlled by XML entries:

- *DualROI*
- *Height_ROI1*
- *Height_ROI2*
- *ROI1_OffsetY*
- *ROI2_OffsetY*
- *ImageHeightValid*
- *Width / OffsetX*
- *Height = Height_ROI1 + Height_ROI2, is updated automatically after setting an acquisition start. You can choose to update it manually.*

The figure here after (Figure 12) shows how to use these entries.

Figure 12: Camera Dual ROI control

4.3.1.2 *Enabling and Configuring dual ROI*

To enable and use multi ROI:

- Stop Acquisition
- Enable dual ROI mode (*DualROI* = “On”)
- Set *Width / OffsetX* according your needs. All ROIs share the same *Width / OffsetX* and ROIs parameters *Height_ROI1 / ROI1_OffsetY* and *Height_ROI2 / ROI2_OffsetY*, following these rules
  - ⇨ (Width + Offset X) ≤ WidthMax
  - ⇨ (ROI1_OffsetY + Height_ROI1) < ROI2_OffsetY
  - ⇨ (ROI1_OffsetY + Height_ROI1) + (ROI2_OffsetY + Height_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 *ImageHeightValid* entry to be sure that your setup is valid.
- Start Acquisition

4.3.1.3 *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 = Height_ROI1 + Height_ROI2*.

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

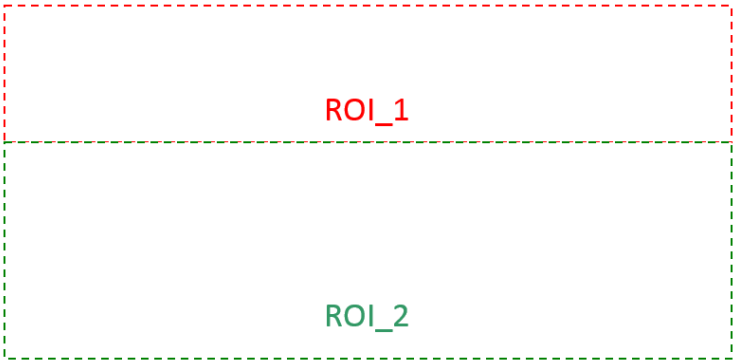


Figure 13: Camera output image when using multi ROI

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

4.3.2 Line Skipping

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.

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 *ImageHeightValid* to be sure you set valid parameters

Line skipping is controlled by XML entries:

- *LineSkipping*
- *ImageHeightValid*

4.3.3 Defect Pixel Correction

4.3.3.1 *Principle*

A defect pixel correction can be applied to correct some pixel values using its neighbors. 8 pixels per line can be corrected, except for Cyclone-65-70 and Cyclone-25-150 where only 4 pixels per line can be corrected.

At camera power up, defect pixel correction stored in camera flash memory is loaded and use 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.

4.3.3.2 *Control*

DefectPixelCorrectionEnable enables "On" or disables "Off" defect pixel correction.

DefectPixelSource indicates the source of correction (User or Factory).

DefectPixelTotal indicates how many pixels are corrected. (Maximum number is total number of lines x 8).

DefectPixelTestMode enables "On" or disables "Off" a defect pixel test mode. This test mode purpose is to ease corrected pixel visualization. When enabled, all corrected pixels are shown in white and non-corrected pixels are shown in black. When disabled, sensor pixels are used, corrected or not, depending on *DefectPixelCorrectionEnable* value.

For Cyclone-5-700, Cyclone-2-2000, Cyclone-1HS-3500 and Cyclone-16-300, *DefectPixelLineSelect* selects a line (i.e. Y pixel coordinate) and *DefectPixelX0..X7* are the 8 pixel columns (i.e. X pixel coordinates) which can be

corrected. If 65535 (0xFFFF) is set as coordinate, no pixel is corrected. To correct a pixel, a valid X coordinate must be set in one of *DefectPixelX0..X7* entry (valid values are 0 .. image_width). X and Y coordinate are absolute and based on full image size even if a smaller ROI is used.

For Cyclone-65-70 and Cyclone-25-150, *DefectPixelLineSelect* selects a line address (equal to Y pixel coordinate divided by 2) and *DefectPixelX0..X3* are the 4 pixel columns (i.e. X pixel coordinates) which can be corrected for the line 2**DefectPixelLineSelect*. *DefectPixelX4..X7* are the 4 pixel columns (i.e. X pixel coordinates) which can be corrected for the line 1+2**DefectPixelLineSelect*.

If 65535 (0xFFFF) is set as coordinate, no pixel is corrected. To correct a pixel, a valid X coordinate must be set in one of *DefectPixelX0..X7* entry (valid values are 0 .. image_width-1). X and Y coordinate are absolute and based on full image size even if a smaller ROI is used.

To save current correction values (i.e. pixel coordinates set in *DefectPixelX0..X7* fields), user must call *DefectPixelUserFlashSave* command to save all values in flash. These values will be used at next power cycle and *DefectPixelSource* will return “User” as source.

To delete from flash any user data, user must call *DefectPixelUserFlashErase* command. Then all user correction values are erased and *DefectPixelSource* will return Factory as source at next power cycle.

Defect pixel correction is controlled by XML entries:

- *DefectPixelCorrectionEnable*
- *DefectPixelTestMode*
- *DefectPixelSource*
- *DefectPixelTotal*
- *DefectPixelLineSelect*
- *DefectPixelX0*
- *DefectPixelX1*
- *DefectPixelX2*
- *DefectPixelX3*
- *DefectPixelX4*
- *DefectPixelX5*
- *DefectPixelX6*
- *DefectPixelX7*
- *DefectPixelClearAll*
- *DefectPixelUserFlashSave*
- *DefectPixelUserFlashErase*

4.3.4 Flat Field Correction (FFC)

FFC correction is a column-based correction applied on all pixels. FFC correction consists in an FPN and a PRNU correction.

At power up, camera loads FFC flash data (= FPN and PRNU column coefficients) to RAM. User can dynamically modify column parameters using XML interface. Then, this new configuration can be saved in 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:

- *FPN_Coeff(x)*: fixed pattern noise coefficient

- *PRNU_Coeff(x)*: photon response non-uniformity coefficient
- *UserGD_Offset*: user defined global dark offset
- *DMean_Offset*: dark image calibration mean value

where x is the column index.

Following steps can be done by the customer to calculate these coefficients:

- 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 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 *FPN_Coeff(x)* and *PRNU_Coeff(x)*:

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

In the camera, for every *(x,y)* coordonate pixel with value *PixIn(x,y)*, the following correction is applied:

$$\big(PRNU\_Coeff(x) \times (PixIn(x,y) - FPN\_Coeff(x)) + 128 \times (DMean\_Offset + UserGD\_Offset)\big) \ll 7$$

FFC is controlled by XML entries:

- *Correction*
- *Correction_Coeff_X*
- *Correction_Coeff_V*
- *Correction_UserGD*
- *Correction_DMean*
- *FFCSaveToFlash*

4.3.5 Missing CoaXPress trigger packet detection

This feature allows to detect missing CXP trigger packets.

Camera is measuring CXP trigger packets (rising edge packets) period and compare it to a reference period set by user. If measured trigger packet period is **x1.5** higher than expected period, error counter is incremented.

To use this feature:

- Set camera and acquisition system in coaxpress synchronization mode
- Set *CXP_trigger_ Period*
- Start sending CXP trigger packets and start camera acquisition
- Reset *CXP_Trigger_Counter_Reset*
- You can now poll *CXP_Trigger_Counter_Error* entry to detect missing CXP trigger packets.

Missing CXP trigger packet detection is controlled by XML entries:

- *CXP_Trigger_Period*
- *CXP_Trigger_Counter_Error*
- *CXP_Trigger_Counter_Reset*

4.3.6 Temperature

Camera returns FPGA die temperature using a temperature sensing diode (TSD). It helps you to monitor your system temperature stability and evolution.

Temperature is returned is Celsius degrees.

Temperature is controlled by XML entry:

- *Temperature*

4.4 UserSetControl

Xml entry Name Address	Description
UserSetSelector	Selects the feature User Set to load
UserSetLoad	Loads the User Set specified by UserSetSelector to the device and makes it active
UserSetDefault	Selects the feature User Set to load and make active by default when the device is reset
UserSetSave	Save the User Set to the non-volatile memory of the device

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, …)
- Set UserSetSave: your configuration will be saved to the non-volatile memory of the camera.

UserSetDefault allows to start the camera in either factory settings of customed settings saved by the customer.

To load camera parameters:

- Set UserSetSelector to either default (for factory settings) or USerSet0 for custom settings (configuration saved using USerSetSave command)
- Execute UserSetLoad command

UserSetControl is controlled by XML entries:

- *UserSetSelector*
- *UserSetLoad*
- *UserSetDefault*
- *UserSetSave*

5 Firmware Update

Camera firmware update is available through camera Aux connector by using the camera accessory “Programming cable”. This cable allows an USB connection to a PC and must be used together with Optronis Windows update software “CFU_CXXXX.exe”.

Before updating camera firmware, please check product website page (download tab) to be sure that you have:

- The last firmware version
- The driver setup

Please find below a quick description of the updating process:

1) If your software is out of date or if this is the first use:
   Execute last version of “Cyclone_Driver_VCRedist_Install.exe” to install Firmware Update Software and Programming cable Drivers.
   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

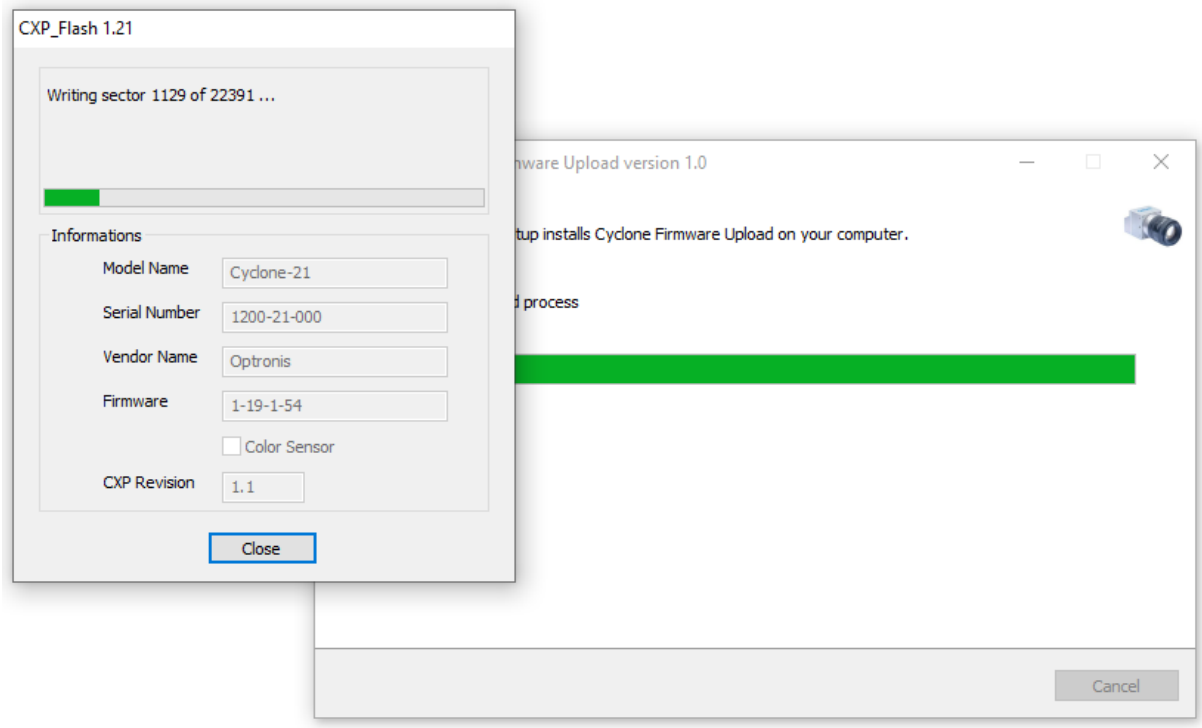


Figure 14 : Cyclone Firmware Upload

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

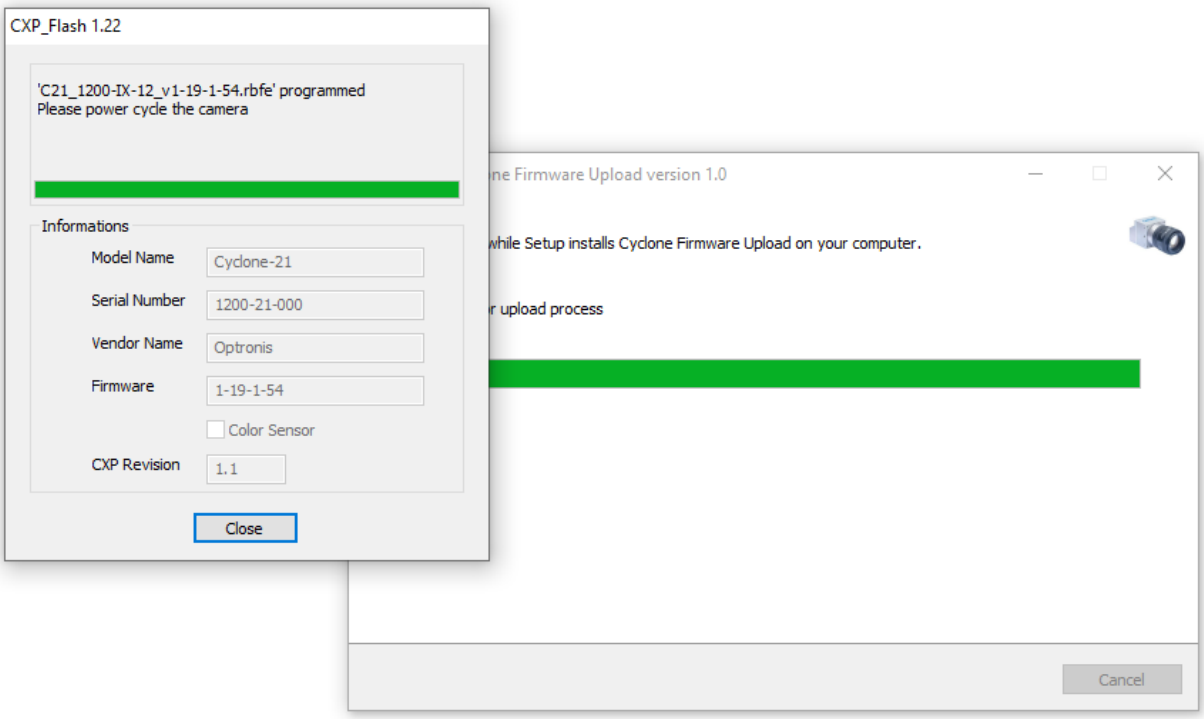


Figure 15 : Cyclone Firmware Upload Finished

If remaining time is higher than 20min, it often means that the cable is not well detected. Close software and end “CFU_CXXXX.exe ” process if it is still running. Choose another USB port, power cycle camera and restart software.