

CamPerform CP70-12-M/C-188 CoaxPress Camera



User Manual

Ref. 1874-SU-01-H

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Revision

Cameramodel	Date	Description
CP70-12-M/C-188 SNr. 1874-ST-xxx	30.03.2015	Firmware 1.051 -Add of 'Granularity' mode which allows to set exposure time through register when using external synchronisation of trigger over CoaxPress
CP70-12-M/C-188 SNr. 1874-ST-xxx	16.11.2016	Firmware 11.05 -Add micro-second counter and image counter -Add hot pixel correction -Add CoaXPress 1.1.1 compatibility -Add user flash setup capabilities
		Firmware 11.06 -Add gain x1,x2,x3
		Firmware 11.07 -Add MultiSlope mode (HDR)

General

Declaration of conformity

Manufacturer: Optronis GmbH
Address: Ludwigstr. 2, 77694 Kehl, Germany

We certify and declare under our sole responsibility that the following apparatus

Product: CP70-12-M-188
CP70-12-C-188

conform with the essential requirements of the EMC Directive 2014/30/EU, based on the following specifications applied:

Specifications: EN 61000-6-3 Emission
EN 61000-6-1 Immunity

Kehl, 8.08.2016

Optronis GmbH
Dr. Patrick Summ
Managing Director

RoHS compliance



CamPerform CP70-12-M/C-188 cameras are Pb free manufactured.

Scope of delivery

CP70-12-M/C-188 CoaxPress camera

Options: /C: Color sensor (Bayer Pattern)
 (IR Cutoff Filter, Specification: 1830-SS-10)
 /M: Monochrome sensor

Lens mount: /CM: CMount
 / FM: FMount
 / FMG: FMount for Nikon G-Lens series

CoaxPress: up to 6,25Gbit/channel, 4 channels

Synchronisation Adapter cable (Option)

Programming cable (USB2) for firmware update (Option)

User Manual (CD-ROM)

Optronis customer service

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Ludwigstr. 2
77694 Kehl
Germany
Tel: +49 (0) 7851 9126 0
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E-mail: info@optronis.com

For any questions or problems, please do not hesitate to ask our customer service. Please prepare the following information:

- Camera type: CP70-12-M-188 or CP70-12-C-188
- Serial-Number: see label at the bottom side of the camera
- Frame Grabber
- Operating System (Windows XP/Vista/7/8/32bit/64bit ...)
- Short description of the problem

Remark, Attention

This user manual is compliant with the firmware version v.1.051 of the camera.
The following signs are used in the user manual



Remarks and additional information



Attention

Precautions

Camera Power

Please use Power over CoaxPress or as an option the CP70-12-M/C-188 camera power supply (not included in shipment).

Environmental Conditions

Temperature range during operation: < + 40°C (ambient temperature)
> 0°C (ambient temperature)

Humidity during operation < 80% non-condensed



At high ambient or housing temperatures the camera lifetime will be reduced. Avoid camera operation beyond temperature limits. Please ensure, that the housing temperature will be kept as low as possible by additional heatsinks.

General Precautions

Read the user manual carefully before using the camera.

Do not orientate the optical input of the camera to direct sunlight.

Keep the camera free protected from dirt, dust, grease and water.

Make sure that all the connecting cables are in good condition. Defective cables have to be replaced.

Always unplug the camera before cleaning it. Do not use cleaning liquids or sprays. Instead, use a dry and soft duster.



There are no serviceable parts inside the camera. Do not open the housing of the camera.

Warranty becomes void if the camera housing is opened.

Camera



- | | |
|-------------------------------------|---|
| 1: Camera housing | 2: Mounting holes 2x M4x6mm 1x ¼ ``x6mm |
| 3: Lens mount (Nikon-F) | 4: lens (Nikon-F compatible) |
| 5: electrical interface (back side) | 6: Mounting holes 4x M4x6mm |



1: CoaxPress Channels
3: Auxiliary Connector

2: Power Connector
4: Indicator Lamp (LED)

Electrical Interface



Camera (Pwr.) connector type:
Cable Connector:

Hirose HR10A-7R-6S
Hirose HR10A-7P-6P

Auxiliary (Aux.) connector pinout

Auxiliary (Aux.) connector pinout		
Pin Nr.	Description	
1	Sync. In	External Synchronisation Input TTL level: <0,8Volt (low) > 2 Volt (high)
2	reserved	-
3	Sync. Out	External Synchronisation Output (TTL level @ high impedance, 0 to 2 Volt @ 50 Ohms)
4+5+6	GND	Sync. Ground



To operate SyncIn correctly, a SyncIn driver circuit has to be used.

Minimum Sink Current (TTL Low Level) of the SyncIn Driver has to be 5mA. At 5mA Sink Current the input level at the SyncIn camera input drops below 0,8Volts.

Source Current (TTL High Level).of the SyncIn Driver is negligible (0mA)

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



SyncIn input voltage limit ranges from – 5 Volts to + 30 Volts. Voltages applied beyond these limits may damage the SyncIn Input.



SyncOut has a built in 50 Ohm driver.

At 50 Ohm termination, the driver voltage is in 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).



SyncOut voltage limit ranges from 0 Volt to + 5 Volts. Voltages applied beyond these limits may damage the SyncOut Output.



The Auxiliary connector may also be used to update the firmware of the camera. Please use the USB2 programming adapter cable.

Camera Power



Figure: CP70-12-M/C-188 back view

Camera (Pwr.) connector type: Hirose HR10A-7R-4S

Cable Connector: Hirose HR10A-7P-4P


Power (Pwr.) connector pinout		
Pin Nr.	Description	
1+2	VCC	DC Power +24Volt +/-5% (Ripple < 200mV) Inrush Current ~0,6A
3+4	GND	Power Ground



Alternatively Power over CoaxPress (PoCXP) can be used.

Indicator Lamp (LED)

State	Indication
No power	Off
System booting	Solid orange
Powered, but nothing connected (only for power over power connector)	Slow pulse red
Link detection in progress, PoCXP active	Fast flash green
Link detection in progress, PoCXP not in use	Fast flash orange
Camera / Grabber incompatible, PoCXP active	Slow flash alternate red / green
Camera / Grabber incompatible, PoCXP not in use	Slow flash alternate red / orange
Camera connected, but no data being transferred	Slow pulse green
Camera connected, waiting for event (e.g. trigger, exposure pulse)	Slow pulse orange
Camera connected, transferring frames	Solid green
Error during data transfer	500ms red pulse
System error	Fast flash red


Camera is in calibration mode, when all LEDs are flashing slowly.

CoaxPress Data Channels

To operate the camera, all 4 CoaxPress Channels (Labeling: BNC 4x) have to be used. Channel 1 is Master link. Channel 2, Channel 3 and Channel 4 are Extension links. Channel 1 uses Power over CoaxPress (PoCXP). Speeds of the Downlink are 6,25Gbit/s.

Lens mount and handling

Nikon F-Mount adapter

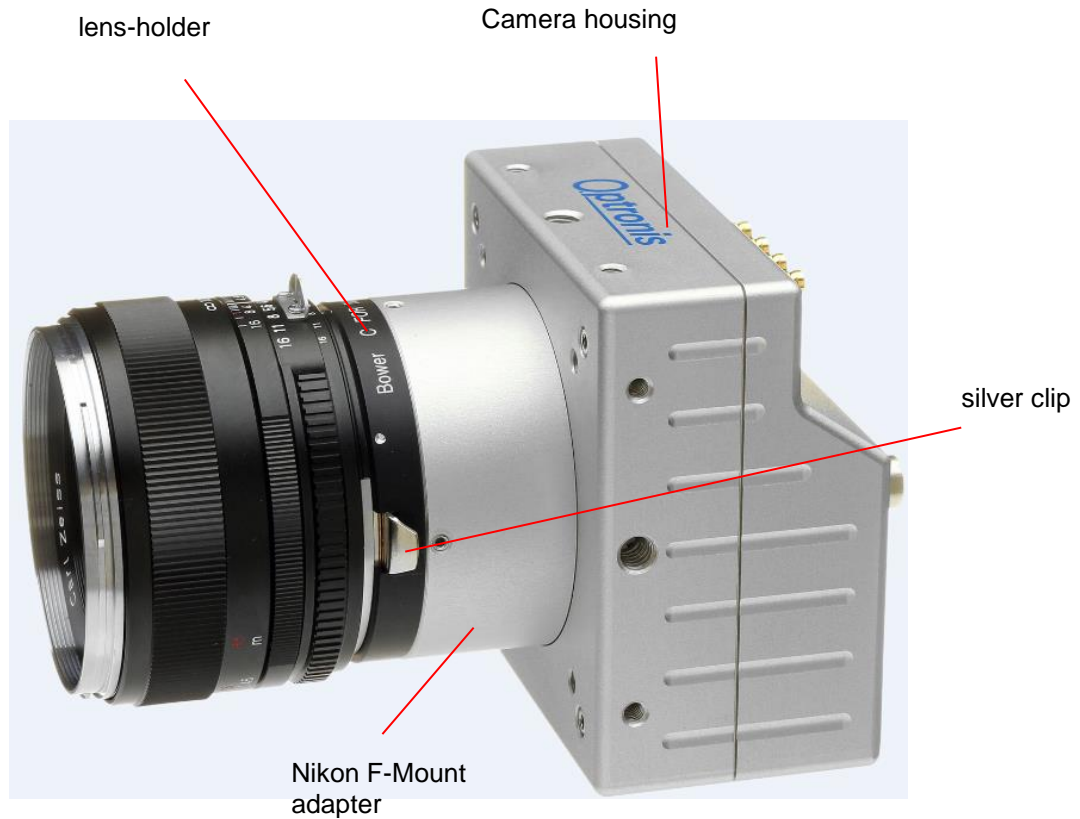
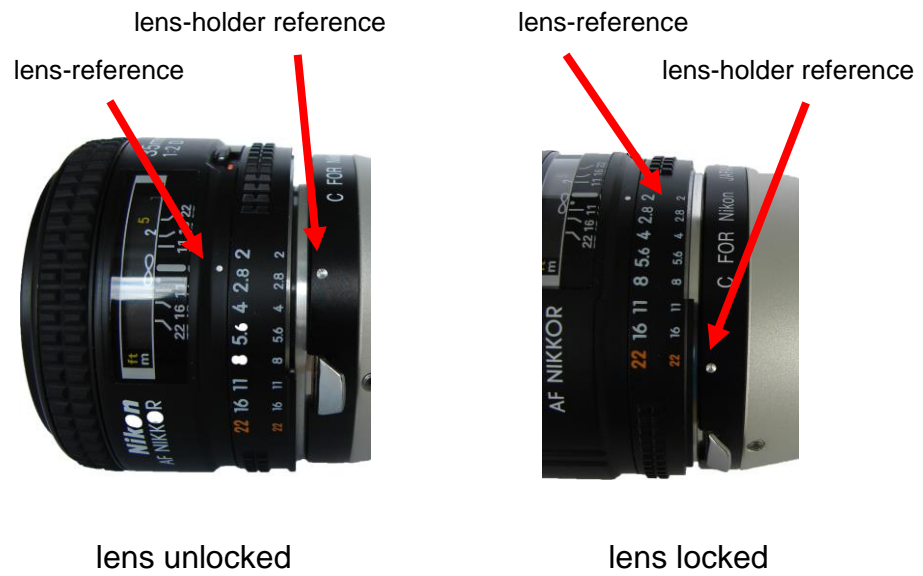


Figure: Camera with Nikon F-Mount adapter

To mount the lens, it has to be positioned on the lens-holder in a way, that the back surface of the lens is completely attached to the surface of the lens-holder.

The lens-reference has to be positioned in face to the lens-holder reference as shown in the figure below. Then, the lens has to be turned anti-clockwise until the silver clip on the lens-holder locks.



To unmount the lens, pull back first the silver clip in order to unlock the lens as shown below. Then (the silver clip has still to be pulled back) turn the lens clockwise until the lens is unmounted completely.



To mount the C-Mount lens, unscrew the protective cover anti-clockwise and mount the C-Mount lens into the lens holder.

To unmount the lens, unscrew the C-Mount lens anti-clockwise.

Important features

The CamPerform CP70-12-M/C-188 CoaxPress cameras are a high resolution, high frame rate CMOS area scan camera that are designed for industrial use. The image sensor and the camera offer exceptional high performance:

- excellent image quality
- excellent sensitivity
- low noise
- monochrome and color
- internal and external synchronisation
- Region of Interest (ROI)

Frame format

The Frame format (frame resolution) of the camera is 4080 active Pixels in horizontal (x) direction and 3072 active Pixels in vertical (y) direction at full resolution. The frame format can be reduced by factor of 16 Pixel in horizontal direction and factor of 8 Pixel in vertical direction.

The frame format can be reduced by selecting a region of interest (ROI).

Minimum Frame rate (@ internal synchronisation)

Minimum frame rate is limited to 20 fps in free run mode.

Maximum Frame rate (@ internal synchronisation)

Max. Frame Rate Examples (8bit):

CoaxPress labeling	Pixel resolution x (Pixel)	Pixel resolution y (Pixel)	Max. Frame Rate (fps)
CXP6, BNC 4x	4080	3072	188
CXP6, BNC 4x	4080	2048	281
CXP6, BNC 4x	4080	1080	527
CXP6, BNC 4x	4080	256	2035

(Max. Frame Rate values are rounded values)

Calculation of Maximum Frame Rate at CXP6 BNC 4x in 8bits mode:

$$1000000/(16+height/2)/3.41234$$

Calculation of Exposure Time in 8 bits mode

Exposure Time Max. = 1/Framerate - 30us

Min. Exposure Time: 30usec

Max. Frame Rate Examples (10bit):

CoaxPress labeling	Pixel resolution x (Pixel)	Pixel resolution y (Pixel)	Max. Frame Rate (fps)
CXP6, BNC 4x	4080	3072	173
CXP6, BNC 4x	4080	2048	258
CXP6, BNC 4x	4080	1080	483
CXP6, BNC 4x	4080	256	1865

(Max. Frame Rate values are rounded values)

Calculation of Maximum Frame Rate at CXP6 BNC 4x in 10bits mode:

$$1000000/(16+height/2)/3,722553$$

Calculation of Maximum Exposure Time in 10bits mode:

1/Framerate - 30 us

Frame Rate (@ external synchronisation)

For external synchronisation please apply a TTL signal to the Sync In and Sync Out BNC adapter of the adapter cable (scope of delivery). External synchronisation may be operated in level detection mode. Please see the external synchronisation timing for more information about resulting frame rates and exposure times.

Alternatively SyncIn can be applied directly between Pin 1 and Pin 3 on the camera power (Pwr.) connector, Sync Out between Pin 4 and Pin 3. The synchronisation output can be used to synchronise other devices as e.g. additional cameras or external light flashes.



The External synchronisation frame rate range can reach any value between 20 fps and maximum Frame Rate @ internal synchronisation.

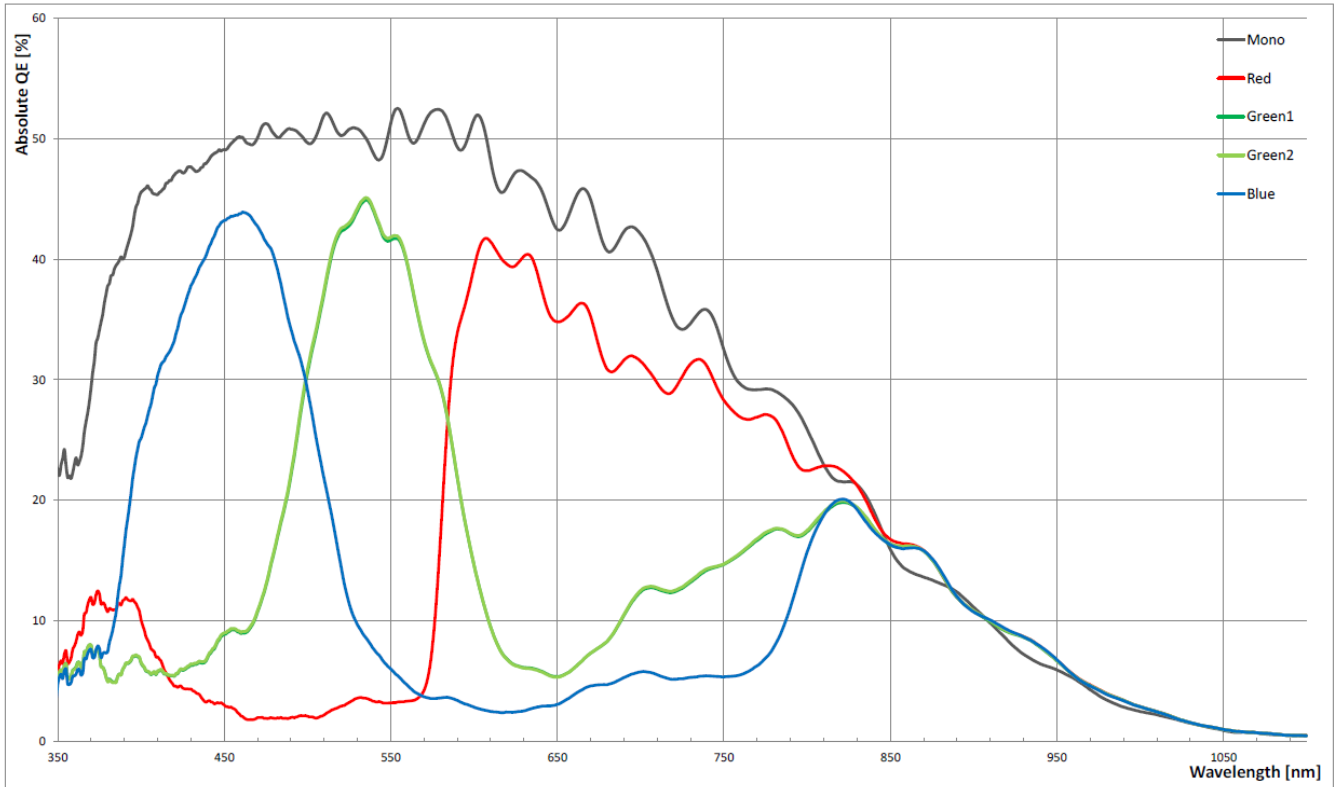
Technical Data

General

Power Source	+ 24 Volt +/- 5% DC < 200mV ripple Alternatively PoCXP
Power	approx. 10 Watt
Pixel Number	4080x3072
Pixel size	5,5 µm x 5,5 µm
Active area	22,528 mm x 16,896 mm
Sensor responsivity	4,64 Volt/lux.s
Shutter	Global
Minimum Ambient Temperature	0 °C
Maximum Housing Temperature	+ 40 °C Ambient Temperature !!! avoid high temperature at camera housing. Please add additional heatsinks at high temperatures !!!
Humidity	< 80% relative, non-condensed
Interface	CoaxPress BNC 4x CXP6
Uplink	Over CoaxPress
Video interface	CoaxPress
Size	85 mm x 85 mm x 84,5 mm (F-Mount)
Weight	approx. 470 g without lens mount

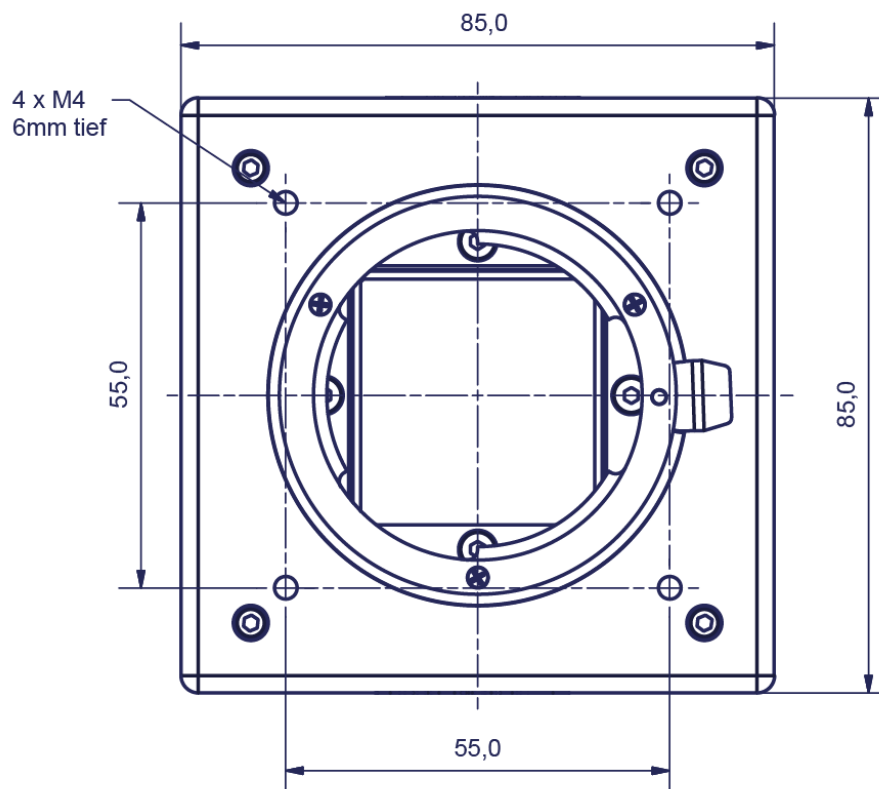
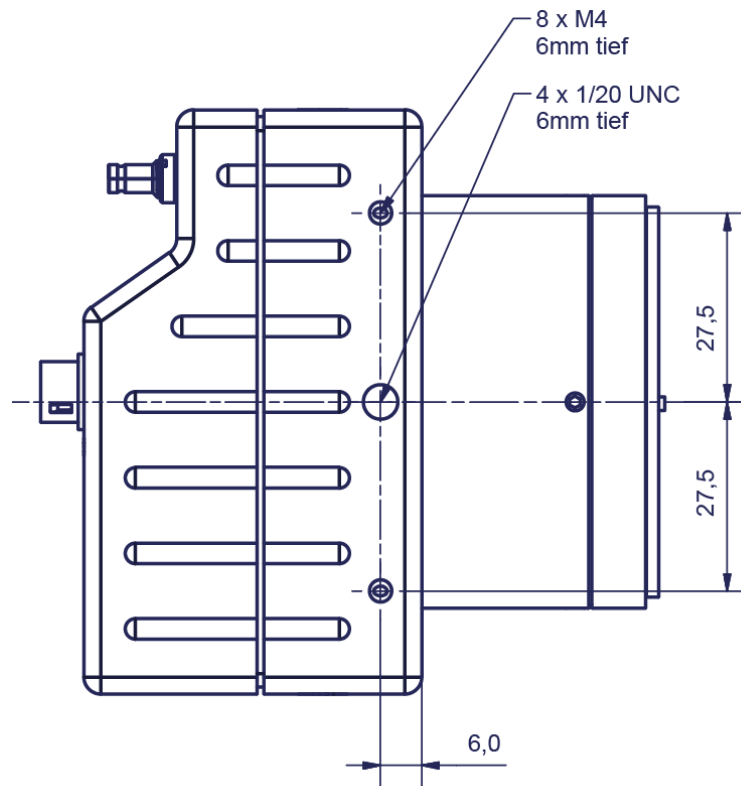
Spectral Response / Transmittance

Spectral response (Monochrome / Color Sensor)



Mechanical Dimensions

F-Mount Lens (/FM)



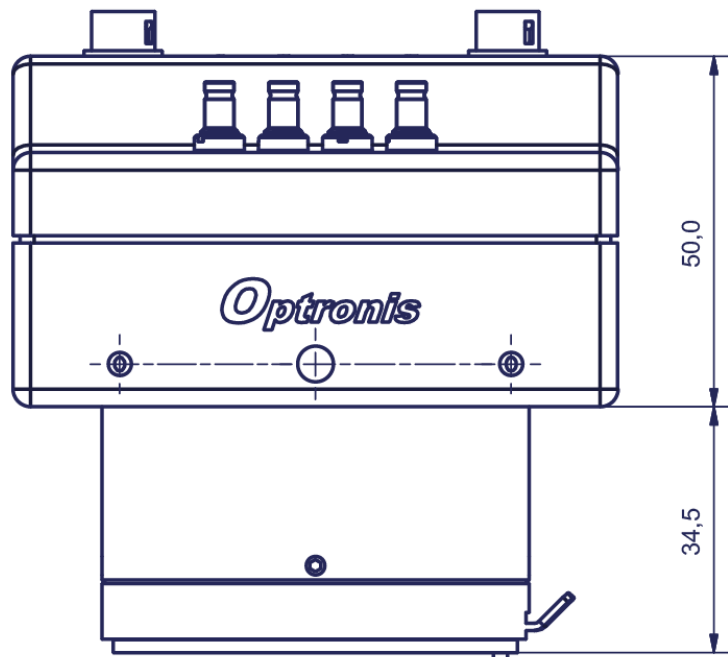
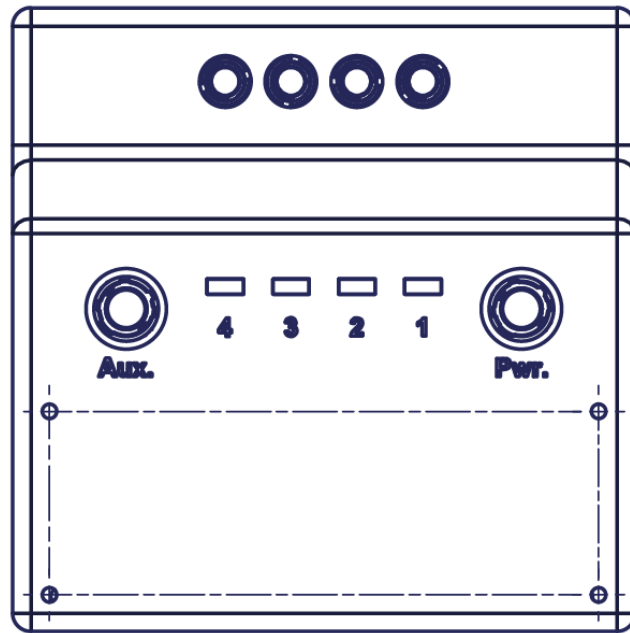


Figure : Side View (all dimensions in mm)

Screw threads in socket:

M4 min. 6 mm depth

1 x ¼ `` min. 6 mm depth (in the middle)

Synchronisation Input schematics

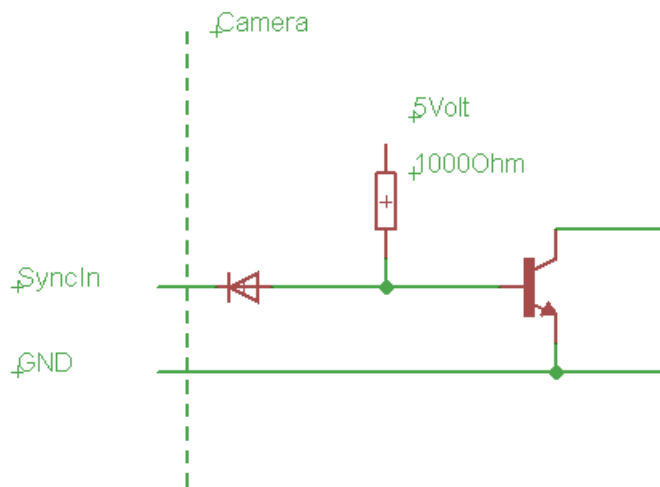


Figure: SyncIn Schematics (for illustration only)

Synchronisation Output schematics

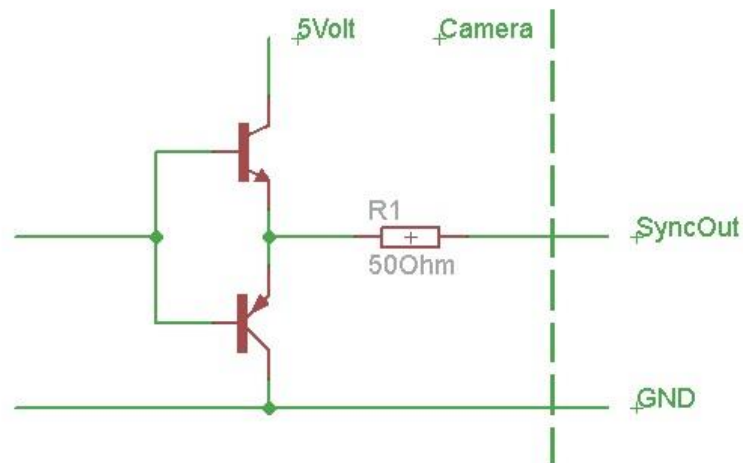
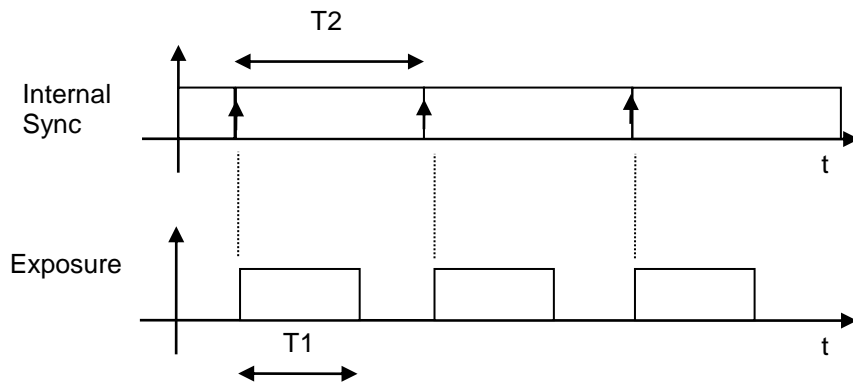


Figure: SyncOut Schematics (for illustration only)

Internal Synchronisation Timing



T1: Exposure time, selected by software

T2: Frame Interval (1/Frame Rate), selected by software

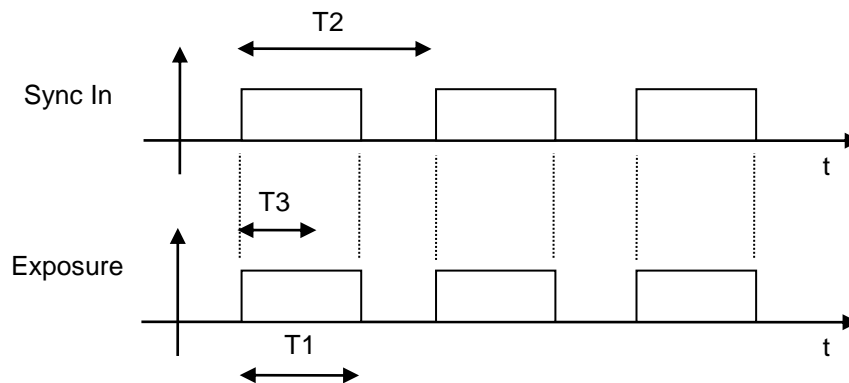
Synchronisation Output

Logic 1 during Exposure Time (T1)

External Synchronisation Timing

Synchronisation Input “level detection”

positive level:



Sync In rising level to Exposure Delay: ~ 4.3 usec +/- 100 nsec typical

T1: Exposure time

T2: 1/Frame Rate

T3: 1/maximum Frame Rate (limited by readout of the sensor)
 Depends on Frame Format

1/T2 has to be larger than 20 fps

Synchronisation Output “level detection”

Logic 1 during Exposure Time (T1)

Focal Length Calculation

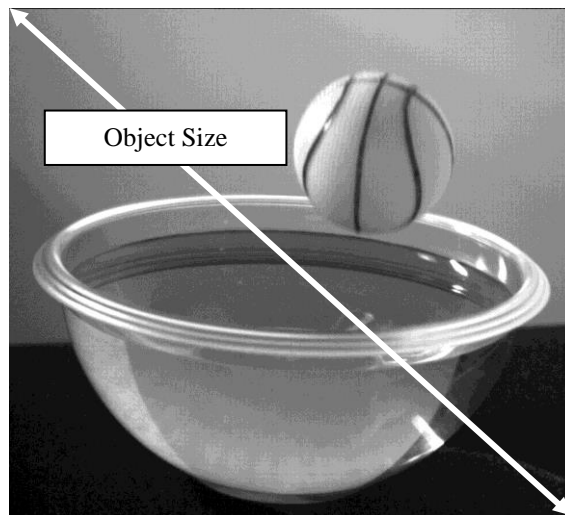
Full Sensor Resolution

The required focal length of the lens at full sensor resolution (4080 x 3072 Pixel) is calculated as follows:

$$Focal\ Length\ [mm] = \frac{A}{1 + \frac{B}{28,16}}$$

A: Distance from lens to object in mm

B: Size of the object in mm



Example:

A: Distance from lens to object = 300 mm

B: Object Size = 100 mm

calculated focal length = $(300 : (1 + (100 : 28,16))) = 66\ mm$

selected focal length = 50 mm

Reduced Sensor Resolution

At reduced sensor resolutions (e.g. 2048 horizontal x 2048 vertical pixels) the focal length is calculated as follows:

$$Sensor\ Size\ [mm] = 0,0055 \cdot \sqrt{C^2 + D^2}$$

$$Focal\ Length\ [mm] = \frac{A}{1 + \frac{B}{Sensor\ Size\ [mm]}}$$

A: Distance from lens to object in mm

B: Object size in mm

C: Number of horizontal pixels

D: Number of vertical pixels

Example:

C: Number of horizontal pixels = 2048

D: Number of vertical pixels = 2048

$$Sensor\ Size\ [mm] = 0,0055 \cdot \sqrt{2048^2 + 2048^2} = 16$$

A: Distance from lens to object = 300 mm

B: Object size = 100 mm

calculated focal length = (300 : (1 + (100 : 16))) = 41 mm

when a lens with focal length of 35 mm has to be used, and the object size has to be kept at 100 mm, the distance from lens to object has to be changed as follows:

$$Distance\ to\ Object\ [mm] = Focal\ Length \cdot \left(1 + \frac{Object\ Size}{Sensor\ Size} \right)$$

at a focal length of 35mm, an object size of 100mm and a sensor size of 15,4mm the new distance from lens to object is calculated as:

$$35 \cdot (1 + (100 : 16)) = 250\ mm$$

The distance from lens to object has to be reduced from 300mm to 250mm.

Vice versa, when the distance from lens to object has to be reduced, the focus of the lens will come to its limit. and the required magnification factor can no more performed by the lens itself. In this case, a distance washer has to be placed between the lens interface of the camera and the lens.

Distance Washer

The length of the distance washer can be calculated as follows:

$$\text{Length of the Distance Washer [mm]} = \text{Focal Length} \cdot \frac{\text{Sensor Size}}{\text{Object Size}}$$

Example:

Sensor Size as calculated above = 16mm

required Object Size=16mm

(The required magnification factor is = 1 : 1)

focal length of the lens = 35mm

calculated Length of the Distance Washer = $35 \cdot (16 : 16) = 35\text{mm}$

Camera firmware update

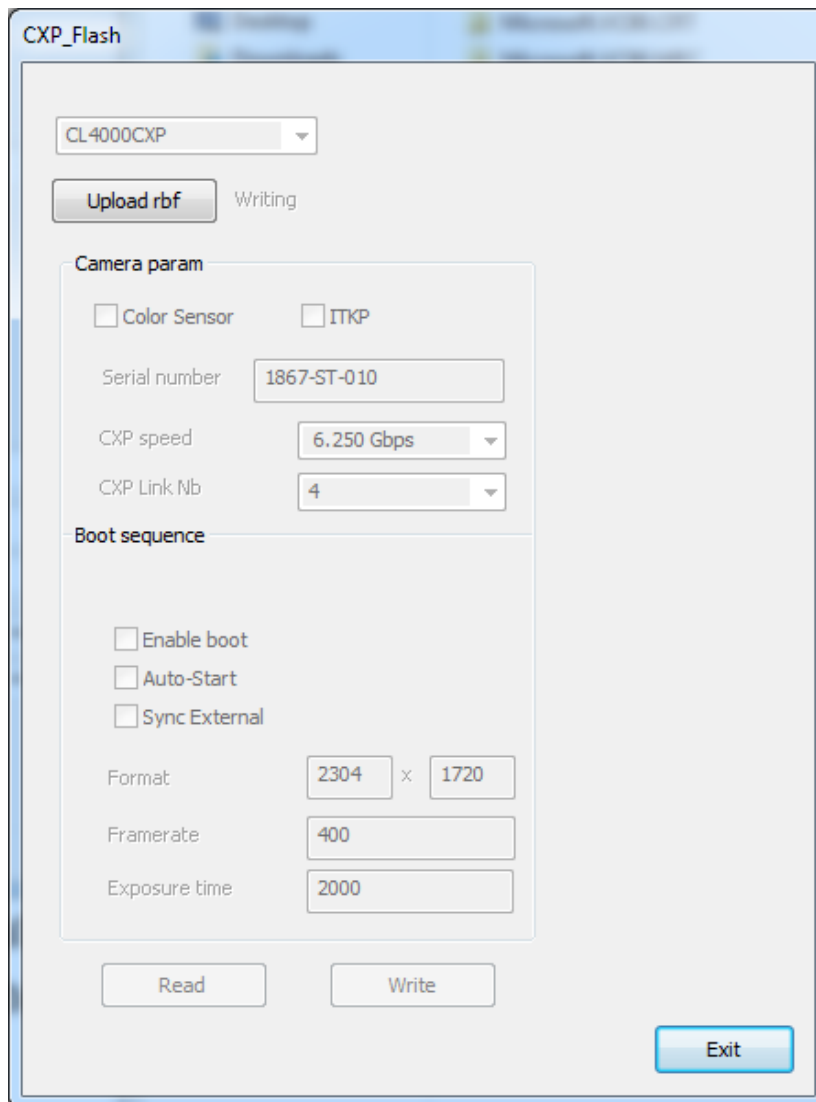
Camera firmware update is available through the USB programming cable and the CXP_Flash_Consumer software (located in the CXPFlash_Setup folder) delivered with the camera.

Please go through the following steps :

- 1) Switch OFF camera
- 2) Connect USB cable to PC and camera Aux. input.
- 3) Install USB driver on PC if it is not already done.

To install USB driver, launch USB_Setup.exe (located in the CXPFlash_Setup folder) and then Reboot PC.

- 4) Switch ON camera
- 5) Launch CXP_Flash_Consumer.exe



Click on "Upload rbf" and select the file cxp4xxx.rbf.
Wait until finished.

- 6) Click on Exit.
- 7) Switch OFF camera and switch ON camera.

Camera mapping

This part is an extract of the GenICam xml file.

DeviceVendorName

Name of the manufacturer of the device.

DeviceModelName

This feature provides the model of the device

DeviceManufacturerInfo

This feature provides extended manufacturer information about the device

DeviceVersion

This feature provides the version of the device

DeviceFirmwareVersion

Version of the firmware in the device

DeviceID

This feature stores a camera identifier

DeviceReset

Resets the device to its power up state. Write 0x1 to reset the device.

WidthMax

Maximum width (in pixels) of the image

Width

This feature represents the actual image width expelled by the camera (in pixels).

HeightMax

Maximum height (in pixels) of the image

Height

This feature 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

This feature indicates the format of the pixel to use during the acquisition

AcquisitionMode

This feature controls the acquisition mode of the device

AcquisitionStart

This feature starts the Acquisition of the device

AcquisitionFrameRate

Frame rate in Hz

AcquisitionFrameRateMax

Maximum frame rate in Hz

ExposureTime

Sets the Exposure time (in microseconds) when ExposureMode is Timed

ExposureTimeMax

Maximum Exposure time (in microseconds) when ExposureMode is Timed

Gain

Sets the gain to x1,x2 or x3

GranularityMode

When 'ON', exposure time is set by register (ExposureTime) when using external triggering or trigger over CoaxPress

When 'OFF', exposure time is set by external or CXP trigger pulse width.

IndicatorLamps

Switch ON/OFF indicator lamps.

ColorSensor

Has camera a color sensor.

Return 0x1 for a color sensor and 0x0 for a monochrom sensor

AddCounterInformation

When set to 'Yes', counter informations are integrated in the first pixels of every transferred frame:

- 16 first bits contain an image counter (incrementing with every frame transferred)
- 24 next bits contain a micro-second precision counter that indicates the time when exposure has started.

When set to 'No', no information is integrated in the transferred frames.

HotPixelCorrection

When set to 'On', hot pixel correction is activated.

When set to 'Off', hot pixel correction is deactivated.

FactoryFlash

When called, factory settings are restored to flash and at the next camera boot.

SaveToFlashWithRebootAndWithoutAutoStart

When called, camera saves its current parameters to flash. These parameters are restored at next camera boot.

SaveToFlashWithRebootAndWithAutoStart

When called, camera saves its current parameters to flash. These parameters are restored at next camera boot. And also the camera starts transferring frames automatically.

YSize_1

Sets the height of ROI1 in dual ROI mode (dual ROI mode is auto-activated if YSize_1 and YSize_2 are different from 0; to switch to single ROI, you have to call Disable_DUAL_ROI).

YSize_2

Sets the height of ROI2 in dual ROI mode (dual ROI mode is auto-activated if YSize_1 and YSize_2 are different from 0; to switch to single ROI, you have to call Disable_DUAL_ROI).

YStart_1

Sets the vertical offset of ROI1 in dual ROI mode (dual ROI mode is auto-activated if YSize_1 and YSize_2 are different from 0; to switch to single ROI, you have to call Disable_DUAL_ROI).

YStart_2

Sets the vertical offset of ROI2 in dual ROI mode (dual ROI mode is auto-activated if YSize_1 and YSize_2 are different from 0; to switch to single ROI, you have to call Disable_DUAL_ROI).

Disable_DUAL_ROI

This feature resets DUAL ROI settings to switch to single ROI mode (dual ROI mode is auto-activated if YSize_1 and YSize_2 are different from 0; to switch to single ROI, you have to call Disable_DUAL_ROI).

NumberSlopes

Sets the number of slopes (between 1 and 3, default value is 1)

ExpKp1

Sets exposure time (in % of the total exposure time) of kneepoint 1

ExpKp2

Sets exposure time (in % of the total exposure time) of kneepoint 2

Vtf12

Sets voltage (between 1 and 64) of kneepoint 1

Vtf13

Sets voltage (between 1 and 64) of kneepoint 2

Single / dual ROI management

Single ROI mode

To use the camera in single ROI mode the user has to set these parameters in the same order as bellow:

- Height
- Width
- Offset Y
- Offset X

Parameters YStart_1, Ystart_2, YSize_1 and YSize_2 must not be modified and keep there '0' default value.

Remarks:

The user must follow these rules:

- $(\text{Width} + \text{Offset X}) \leq \text{Max Width}$
- $(\text{Height} + \text{Offset Y}) \leq \text{Max Height}$

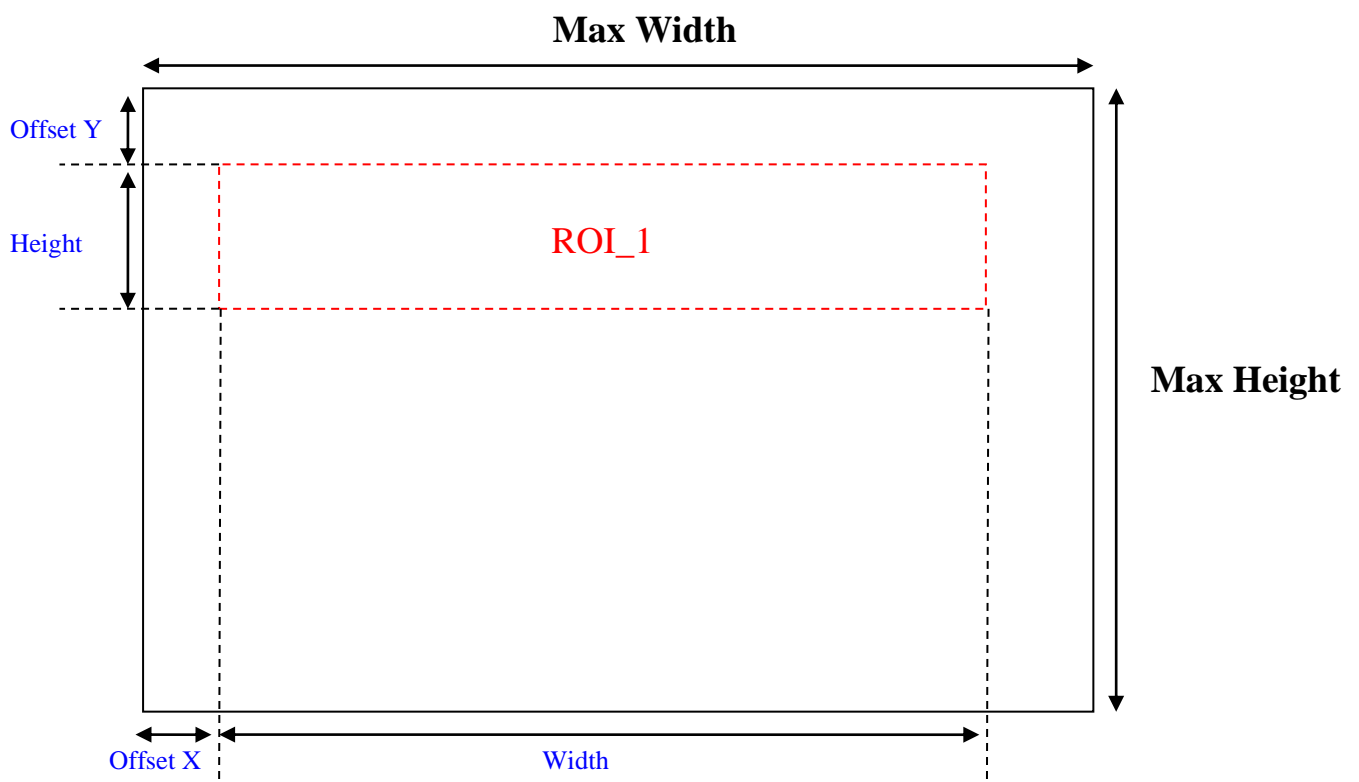


Image size when using single ROI mode. XML parameters are written in blue.

Dual ROI mode

To use the camera in dual ROI mode the user has to set these values in the same order as below:

- Height = YSize_1 + YSize_2
- Width
- Offset Y = 0
- Offset X
- YStart_1
- YSize_1
- YStart_2
- YSize_2

Remarks:

The user must follow these rules:

- (Width + Offset X) <= Max Width
- (YStart_1+ YSize_1) < YStart_2
- (YStart_1+ YSize_1) + (YStart_2+ YSize_2) <= Max Height

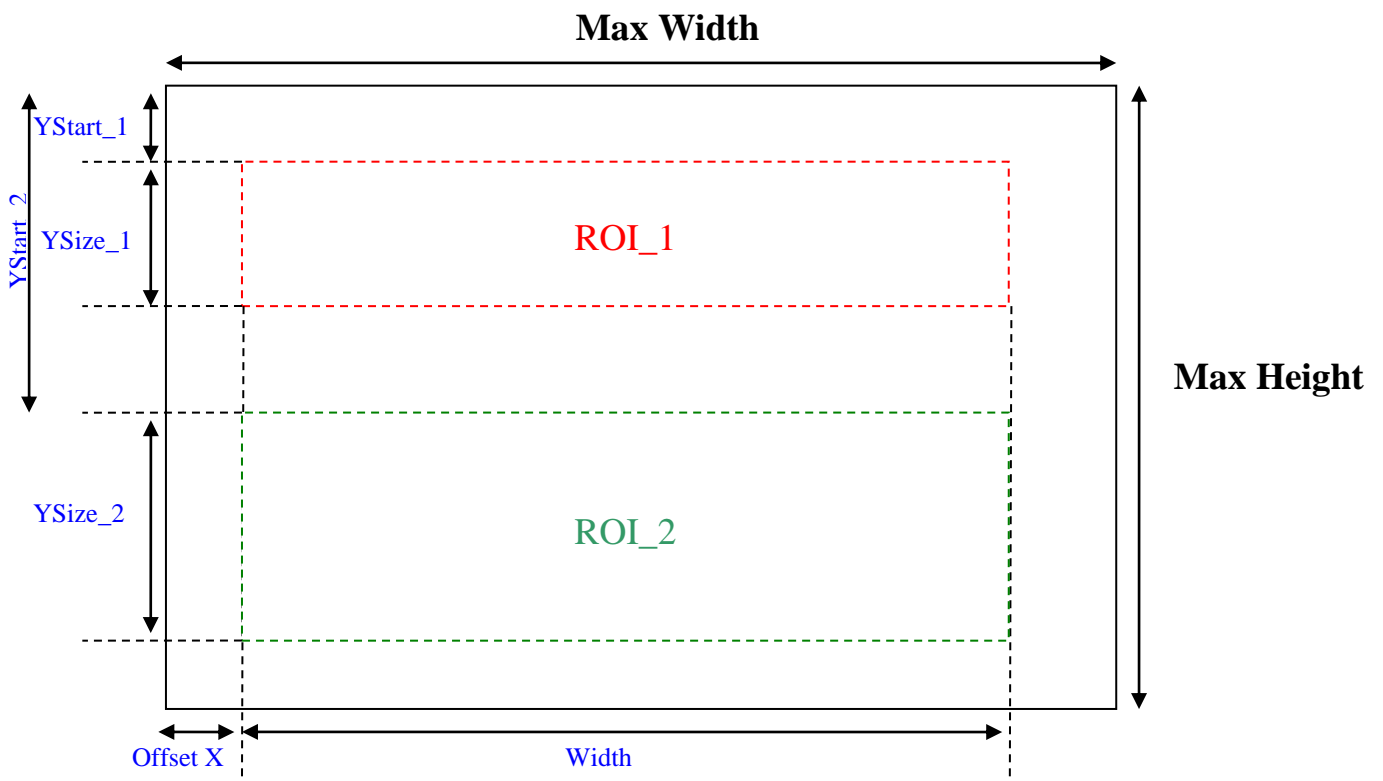
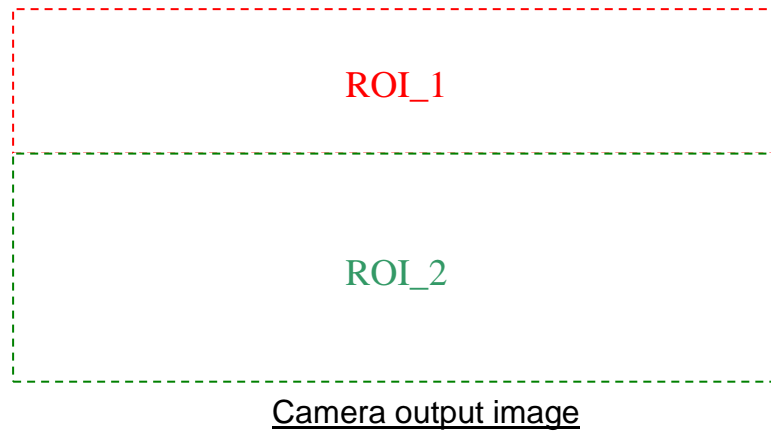


Image size when using DUAL ROI mode. [XML parameters](#) are written in blue.



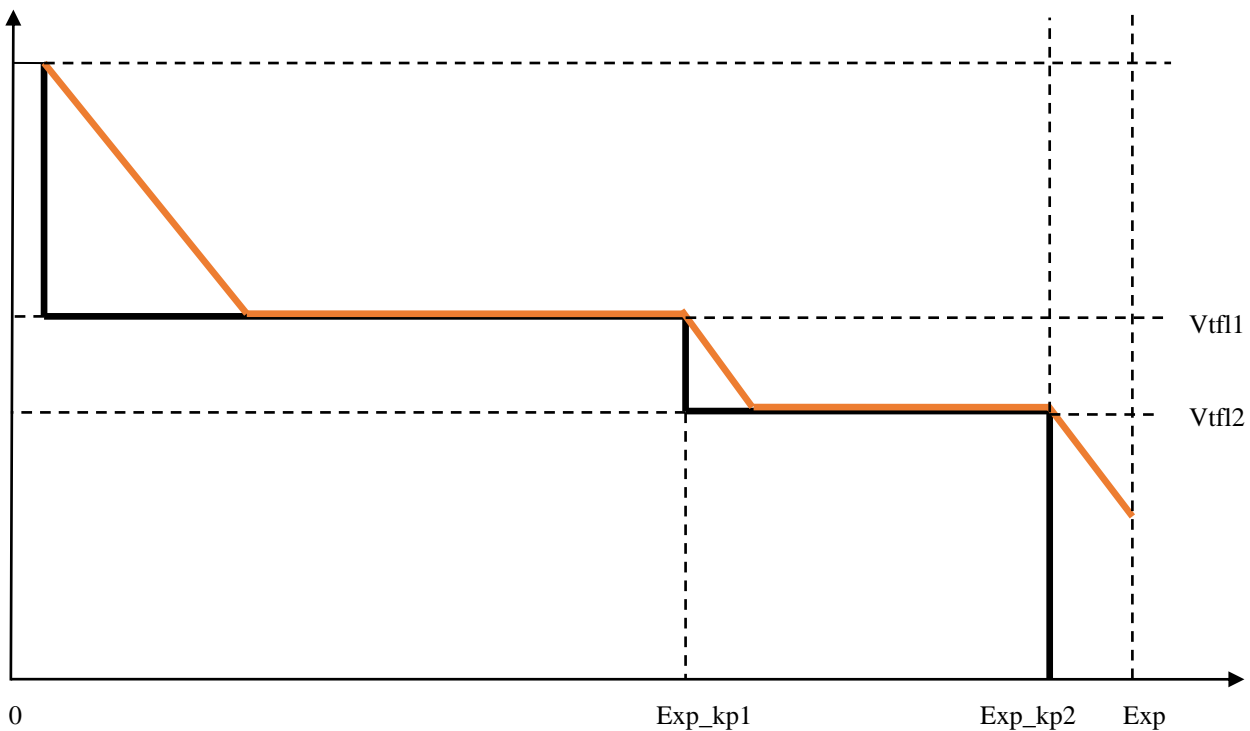
Switch from dual ROI to single ROI mode

To switch from dual ROI to single ROI mode the user must:

- Call “Disable_DUAL_ROI” to reset dual ROI parameters
- Set single ROI parameters as defined in the previous section “**Single ROI mode**”

MultiSlope (HDR) mode

The camera has the possibility to achieve a high optical dynamic range by using a multiple slope feature. This feature will partially reset those pixels which reach a programmable voltage, while leaving the other pixels untouched. This can be done 2 times within one exposure time to achieve a maximum of 3 exposure slopes. More details can be found in the figure below.



In the figure above, the red lines represent a pixel on which a large amount of light is falling. The blue line represents a pixel on which less light is falling. As shown in the figure, the bright pixel is held to a programmable voltage for a programmable time during the exposure time. This happens two times to make sure that at the end of the exposure time the pixel is not saturated. The darker pixel is not influenced by this multiple slope and will have a normal response. The Vtfl voltages and different exposure times are programmable. Using this feature, a response as detailed in the figure below can be achieved. The placement of the kneepoints in X is controlled by the Vtfl programming, while the slope of the segments is controlled by the programmed exposure times.

Default values of Exp_kp1 and Exp_kp2 are 50% and 70% of the total exposure time. Vtfl2 is set to 45 and Vtfl3 is set to 55 (corresponding to the figure above). Vtfl1 corresponds to Exp_kp1, Vtfl2 corresponds to Exp_kp2.

Vtfl1 and Vtfl2 range: 0 to 63 (0 equals 0% level, 63 equals 100%level)

Exp_kp1 and Exp_kp2 range 1 to 100 (1 equals 1%, 100 equals 100%)



It is suggested to operate as follow:

Select single slope and look to image (oversaturated)

Select double slope (2 slopes) and check with adapting Vtfl1 if dark regions keep clearly visible.

Increase Exp_kp1 until oversaturated regions become visible. Go from 1 to maximum range.

Remark: 100 should be maximum range but can be reached at smaller values (e.g. 29).

If still oversaturation, then go to triple slope (3 slopes) and check with adapting Vtfl2 if some former oversaturated regions keep visible.

Increase Exp_kp2 from 1 to maximum range to adjust visibility further.

Remark: 100 should be maximum range but can be reached at smaller values (e.g 29).

Gen<i>Cam

Optronis ships together with the CP70-12-M/C-188 camera a XML file that is Gen<i>Cam compatible. The XML file follows the SNFC (Standard Features Naming Convention).

Please ask, if needed, the Optronis customer service for the availability of this XML file.