

CamPerform CP90-25P-M/C-72 CoaxPress Camera



User Manual

Ref. 1896-SU-01-F

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Revision

Manual revision	Date	Comments
1896-SU-C	06.07.2017	First released version
1896-SU-D	24.07.2017	Update layout. Add CXP configuration and Multi ROI paragraphs.

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: CP90-25P-M-72
CP90-25P-C-72

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, 16.08.2016

Optronis GmbH
Dr. Patrick Summ
Managing Director

RoHS compliance



CamPerform CP90-25P-M/C-72 cameras are Pb free manufactured.

Scope of delivery

CP90-25P-M/C-72 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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Germany
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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: CP90-25P-M-72 or CP90-25P-C-72
- Serial-Number: see label at the bottom side of the camera
- Frame Grabber
- Operating System (Windows XP/Vista/32bit/64bit ...)
- Short description of the problem

Remark, Attention

This user manual is compliant with the firmware version v.8.1 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 CP90-25P-M/C-72 camera power supply (not included in shipment).

Environmental Conditions

Temperature range during operation: < + 45°C (housing 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: Nikon lens
- 5: electrical interface (back side)
- 6: Mounting holes 4x M4x6mm



1: CoaxPress Channel
3: Auxiliary Connector

2: Power Connector
4: Indicator Lamp (LED)

Electrical Interface



Camera (Pwr.) connector type: Hirose HR10A-7R-6S

Cable Connector: Hirose HR10A-7R-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



Camera (Pwr.) connector type: Hirose HR10A-7R-4S
 Cable Connector: Hirose HR10A-7R-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
Linkt 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. Calibration mode is directly after start up and can last about 10 seconds.

CoaxPress Data Channels

To operate the camera, all 4 CoaxPress Channels 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

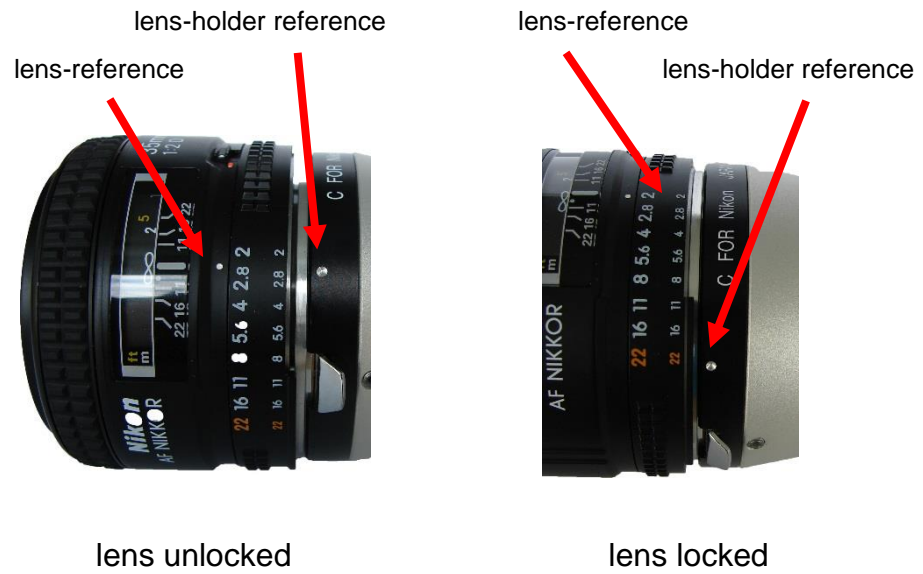
Nikon F-Mount adapter



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.



C-Mount adapter

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 CP90-25P-M/C-72 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 5120 active Pixels in horizontal (x) direction and 5120 active Pixels in vertical (y) direction at full resolution. The frame format can be reduced by factor of 256 Pixel in horizontal direction and factor of 4 Pixel in vertical direction.

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

CoaXPress configuration (speed and cabling)

The default CoaXPress configuration is 4 links/cables working at 6Gbps (CXP6x4).

But the camera can be configured in a 2 links/cables configuration at 6Gbps (CXP6x2). The maximum frame rate is then lower but it allows the user to connect 2 cameras to a 4 link frame grabber.

Allowed configuration are “CXP6x4” and “CXP6x2”, see camera xml entry “ConnectionConfig” to check or modify camera CoaXPress configuration.

Minimum Frame rate (@ internal synchronisation)

Minimum frame rate is limited to 10 fps in free run mode.

Maximum Frame rate (@ internal synchronisation)

The minimum frame interval (maximum frame rate) that can be reached by the camera internal synchronisation mode depends on the CoaxPress Speed (Bit Rate).

Compliance labelling	Bit Rate (Gbps) per link	Link Number (Coaxpress cables)	Maximum frame rate
CXP6x4	6,250	4	72
CXP6x2	6,250	2	36

Figure: Supported high speed link bit rates

Max. Frame Rate Examples:

CoaxPress labelling	Pixel resolution x (Pixel)	Pixel resolution y (Pixel)	Max. Frame Rate (fps)
CXP6x4	5120	5120	72
CXP6x4	4096	4096	112
CXP6x4	2048	2048	277
CXP6x4	1024	1024	531
CXP6x4	256	256	1688

(Max. Frame Rate values are rounded values)

Calculation of Maximum Frame Rate at CXP6:

$$1000000 / (((\text{Pixel resolution } y + 2) * (A) + 5794 + 4100) / 62)$$

$$A = (\text{Pixel resolution } x / 32 + 4)$$

If $A < 104$ then $A := 104$

Calculation of Exposure Time

Max. Exposure Time = $1/\text{FrameRate}$

Minimum Exposure Time = 100usec

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 10 fps and maximum Frame Rate @ internal synchronisation.

Multi ROI

The camera has a multi ROI output mode with a maximum of 32 ROIs They are named multiroi0 to multiroi31.

Enabling: MultiROI feature is enabled with XML entry “multiroi_number”:

- ‘1’ means no multi ROI (only 1 ROI defined by XML entries “Width” / “OffsetX” and “Height” / “OffsetY”).
- ‘N’ ($1 < N \leq 32$) means N ROI activated.

ROI X_size: When multi ROI is enabled ($N > 1$), all ROIs have the same width parameters defined by XML entries “Width” and “OffsetX”.

ROI Y_size: Every enabled ROI “N” ($0 \leq XX \leq \text{“multiroi_number-1”}$) is defined by 2 XML entries:

- MultiroiN_y_start: 1st line of the ROI XX.
- MultiroiN_y_height: height of the ROI XX

Output frame: The resulting output frame is the concatenation of all activated ROI. Its width is the same as all ROI and its height is the sum of all ROI height.

Be careful and check that there is no overlapping ROIs:

- $\text{Multiroi}(\mathbf{N})_y_start \geq \text{Multiroi}(\mathbf{N-1})_y_start + \text{Multiroi}(\mathbf{N-1})_y_height$, $N \in [0..31]$
- $\text{Multiroi}(\mathbf{N})_y_start + \text{Multiroi}(\mathbf{N})_y_height \leq 5120 = \text{Height_max}$, $N \in [0..31]$

10 bits to 8 bits Look Up Table (LUT)

The camera integrates a 10 bits to 8 bits Look Up Table (LUT) that the user can modify. User can choose between 'Factory' LUT and 'User' LUT using the XML entry 'LUT'.

The camera sensors outputs 10 bits. Let's name the sensor output SENSOR [9..0]. User can select the camera transfer output to 8 bits or 10 bits (by using the XML entry 'PixelFormat'). Let's name camera output OUTP.

- Case 1: PixelFormat is a 10-bits format.
 $\text{OUTP}[9..2] = \text{LUT}(\text{SENSOR}[9..0])$
 $\text{OUTP}[1..0] = \text{SENSOR}[1..0]$
- Case 2: PixelFormat is a 8-bits format.
 $\text{OUTP}[7..0] = \text{LUT}(\text{SENSOR}[9..0])$

The user can change current LUT by using the XML entries LUT_x and LUT_y. Entry 'LUT' must first be set to 'User'. If you want to restore the coefficient to the flash-stored LUT, use entry 'Restore_User_LUT_To_Factory'.

To save the LUT to flash, use entry 'Write_LUT_To_Flash'. After the next power cycle, that LUT will be loaded by the camera.

You can also use 'UCXP_Flash' software to program a LUT. Please refer to 'Customer Procedure' document of 'UCXP_Flash'.

Technical Data

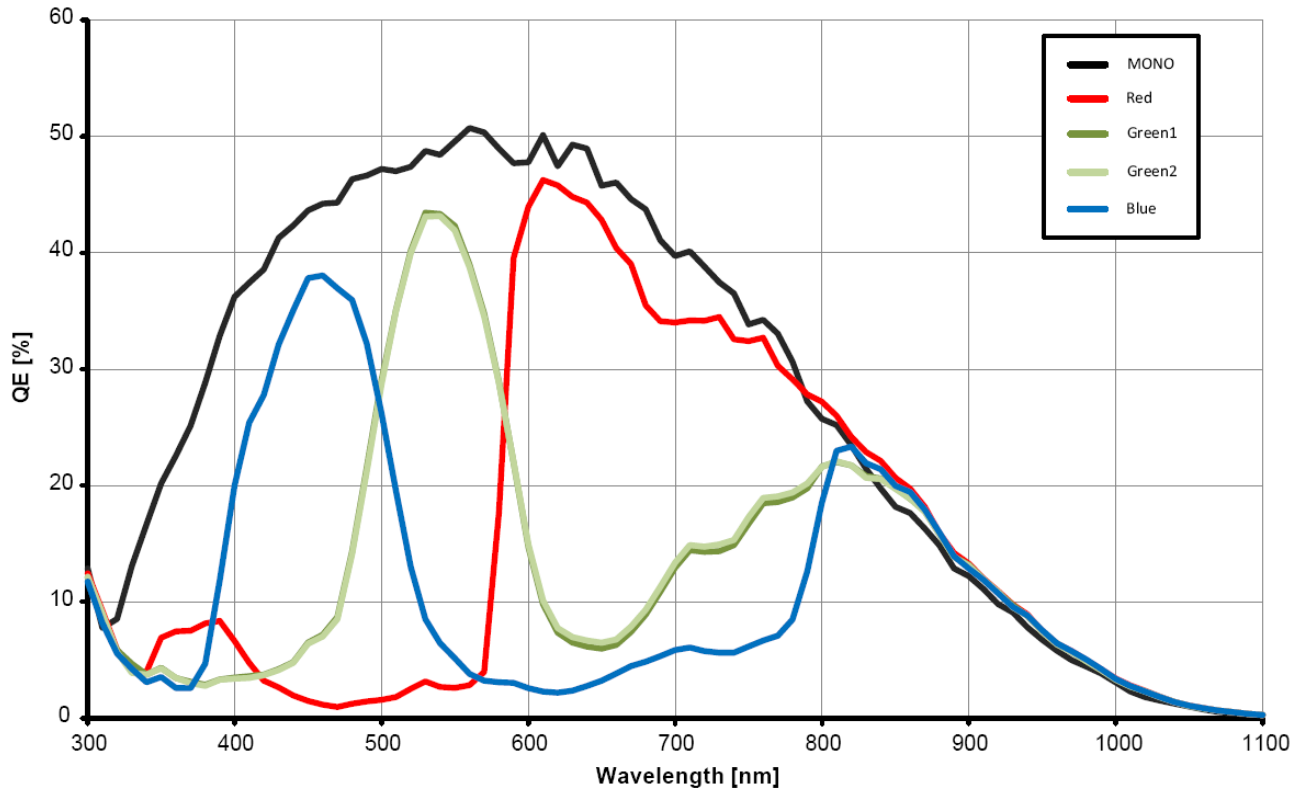
General

Power Source	+ 24 Volt +/- 5% DC < 200mV ripple Alternatively PoCXP
Power	approx. 11 Watt
Pixel Number	5120x5120
Pixel size	4,5 µm x 4,5 µm
Active area	23,04 mm x 23,04 mm
Sensor responsivity	5.8 Volt/lux.s
Sensor S/N ratio	41 dB (Linear)
Shutter	Global, efficiency ~99,9%
Minimum Ambient Temperature	0 °C
Maximum Housing Temperature	+ 45 °C
Humidity	< 80% relative, non-condensed
Interface	CoaxPress DIN1.0/2,3 4 x CXP6
Uplink	Over CoaxPress
Video interface	CoaxPress
Size	85 mm x 85 mm x 99,5 mm (F-Mount)
Weight	approx. 600g without lens

Spectral Response / Transmittance

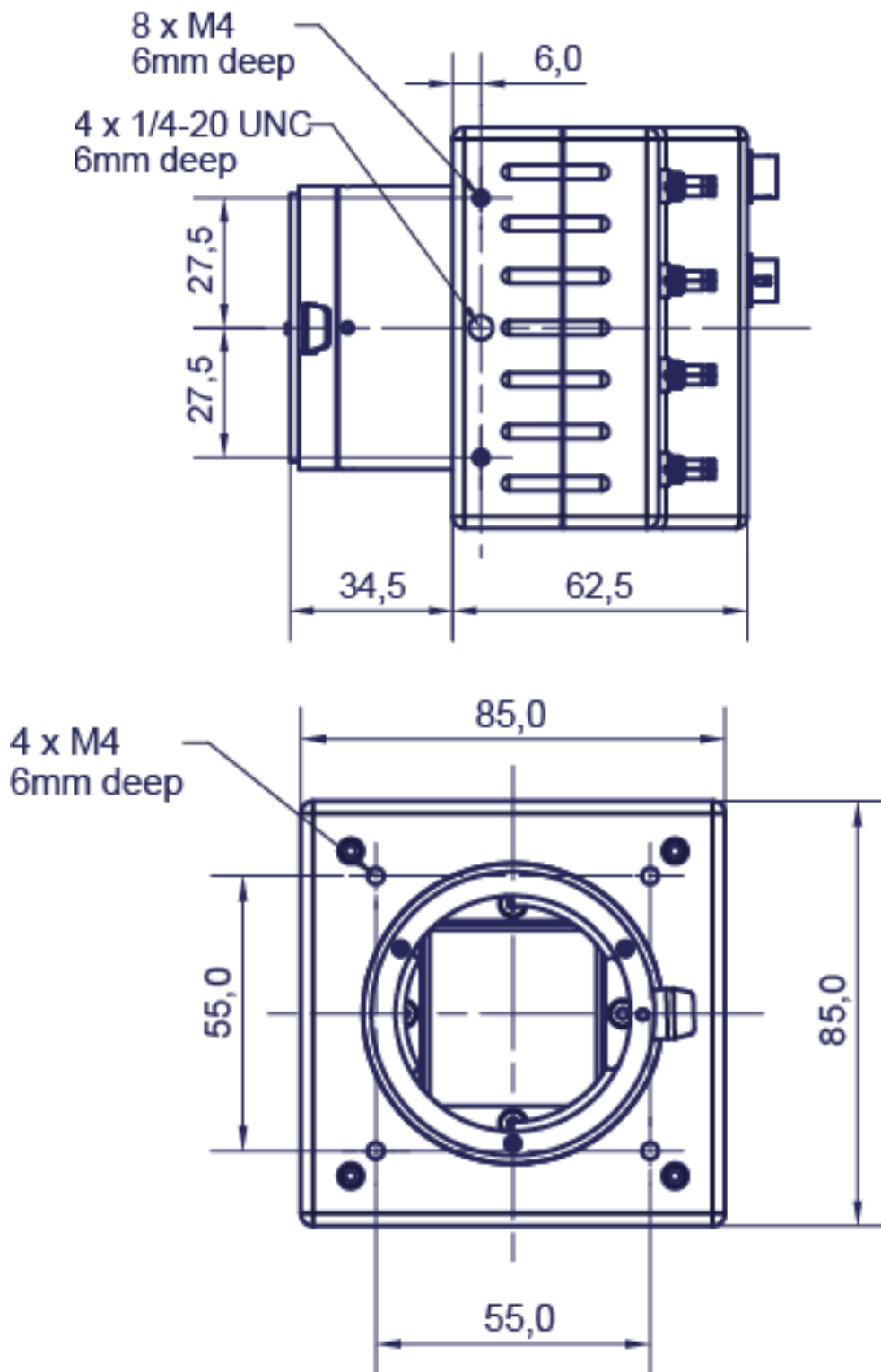
Spectral response (Monochrome / Color Sensor)

Quantum Efficiency



Mechanical Dimensions

F-Mount Lens (/CM)



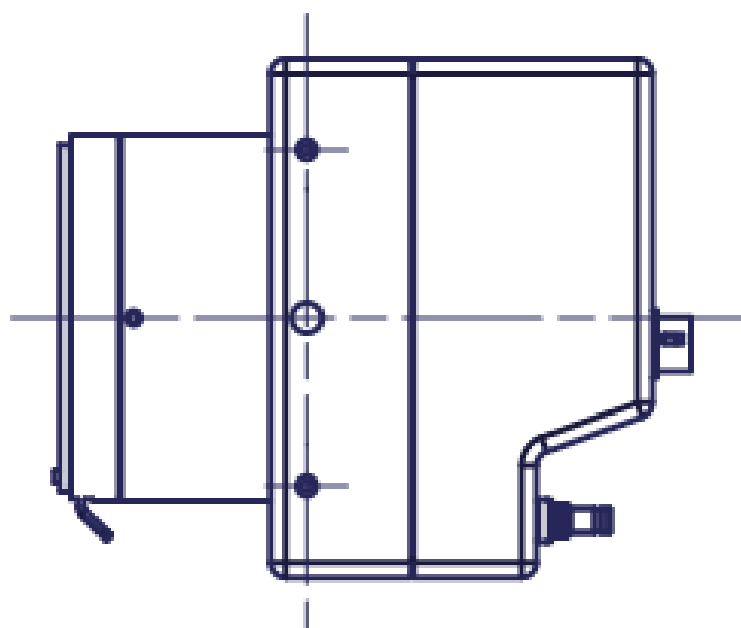
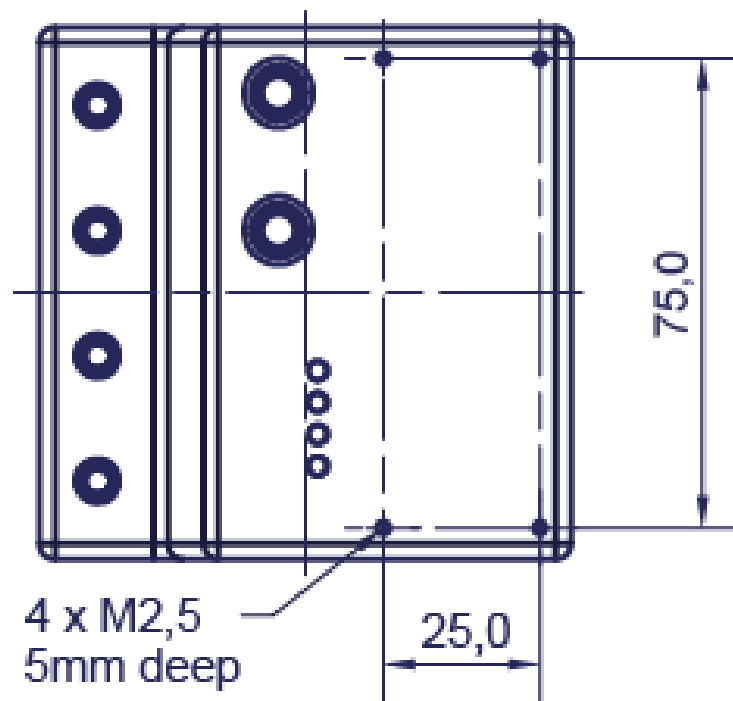


Figure : Side View (all dimensions in mm)

Screw threads in socket:

M4 min. 6 mm depth

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

Synchronisation Input schematics

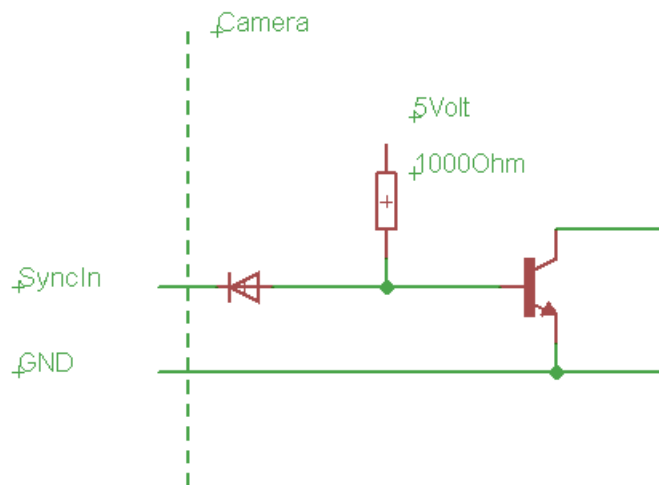


Figure: SyncIn Schematics (for illustration only)

Synchronisation Output schematics

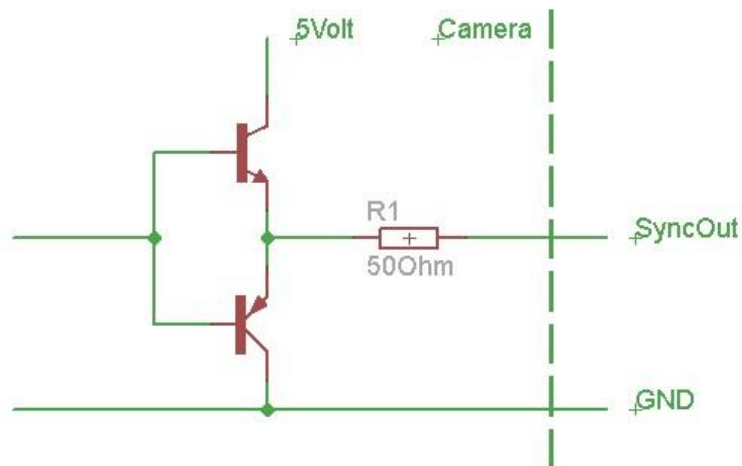
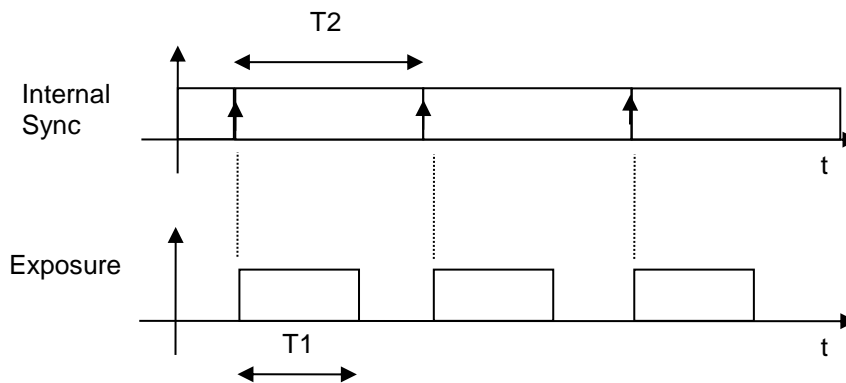


Figure: SyncOut Schematics (for illustration only)

Internal Synchronisation Timing



T1: Exposure time, selected by software

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

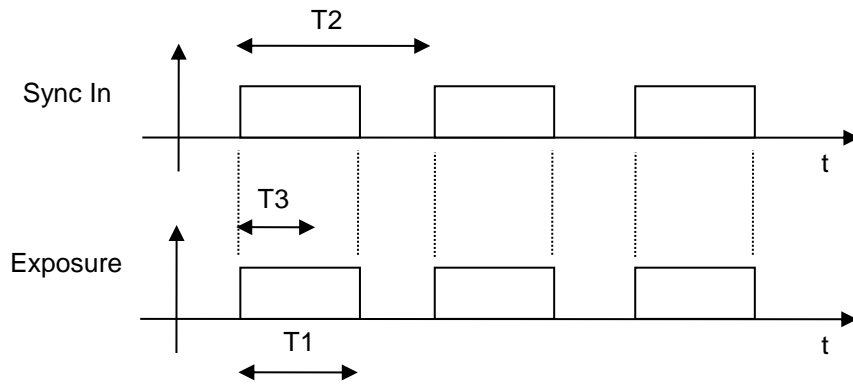
Synchronization Output

Logic 1 during Exposure Time (T1)

External Synchronisation Timing

Synchronization Input “level detection”

positive level:



Sync In rising level to Exposure Delay: ~6,0usec +/- 530nsec typical

T1: Exposure time

T2: 1/Frame Rate

T3: 1/Maximum Frame Rate (limited by readout of the sensor)
depends on frame format and Camera Link® mode

<p>T1 max: : 100msec T1 min: 100usec T2 max: 100msec T2 min: T3</p>
--

Synchronization Output “level detection”

Logic 1 during Exposure Time (T1)

Focal Length Calculation

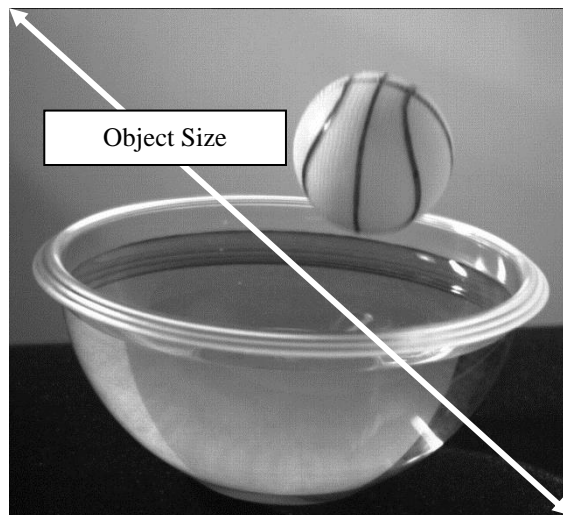
Full Sensor Resolution

The required focal length of the lens at full sensor resolution (5120x5120 Pixel) is calculated as follows:

$$Focal\ Length\ [mm] = \frac{A}{1 + \frac{B}{32,583}}$$

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 = $(300 : (1 + (100 : 32,583))) = 73,7\ mm$

Reduced Sensor Resolution

At reduced sensor resolutions (e.g. 1920 horizontal x 1080 vertical pixels) the focal length is calculated as follows:

$$Sensor\ Size\ [mm] = 0,0045 \cdot \sqrt{C^2 + D^2}$$

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

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 = 1920

D: Number of vertical pixels = 1080

$$Sensor\ Size\ [mm] = 0,0045 \cdot \sqrt{1920^2 + 1080^2} = 9,9$$

A: Distance from lens to object = 300 mm

B: Object size = 100 mm

calculated focal length = $(300 : (1 + (100 : 9,9))) = 27\ mm$

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:

$$35 \cdot (1 + (100 : 9,9)) = 388\ mm$$

The distance from lens to object has to be increased from 300mm to 388mm.

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 be 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 = 9,9mm

required Object Size=9,9mm

(The required magnification factor is = 1 : 1)

focal length of the lens = 35mm

calculated Length of the Distance Washer = $35 \cdot (9,9 : 9,9) = 35\text{mm}$

Camera firmware update

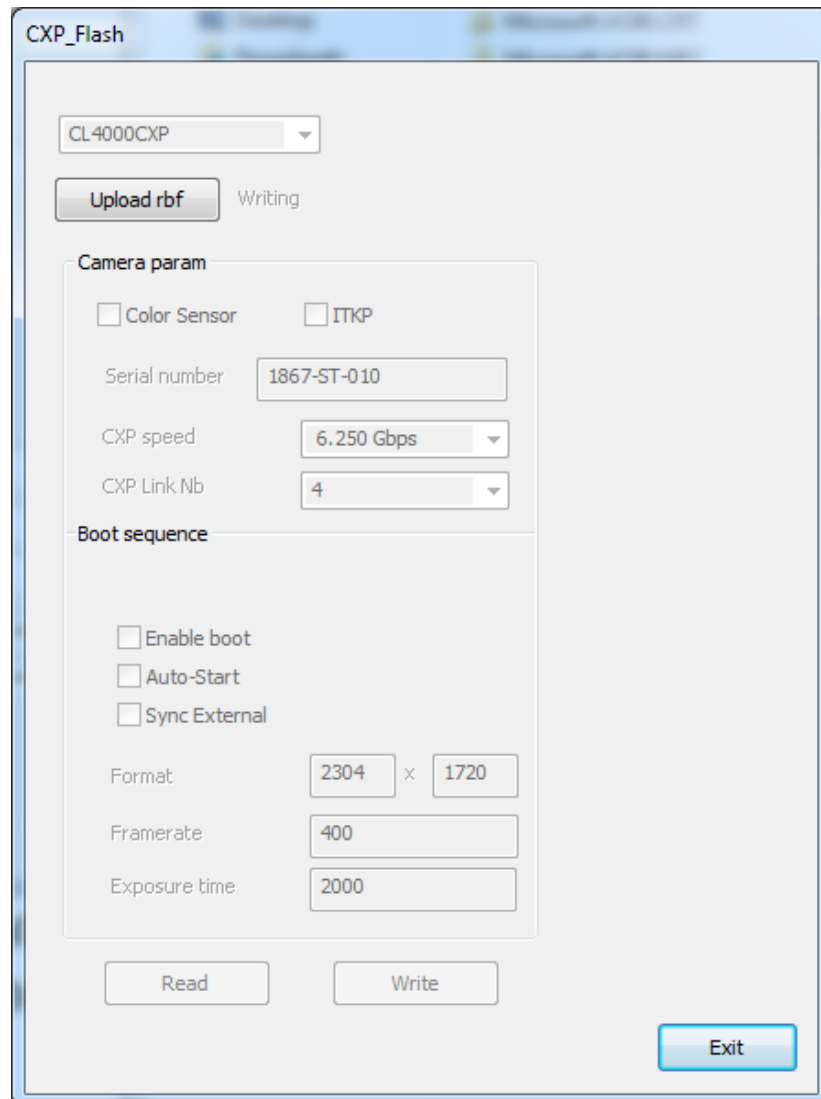
Camera firmware update is available through the USB programming cable and the UCXP_Flash software delivered with the camera.

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 and then Reboot PC.

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



Click on "Upload rbf" and select the file cyp9xxx.rbf.

Wait until finished.

6) Click on Exit.

7) Switch OFF camera and switch ON camera.

Camera Control

The camera can be controlled using its GenICam XML file.

The XML file is organized in several categories:

- **DeviceControl**
- **ImageFormatControl**
- **AcquisitionControl**
- **TransportLayerControl**
- **Support**
- **CXP**
- **Optronis**

The most important entries to control the camera are detailed below.

Please check camera XML to have get more information and get camera mapping to control camera using a register accesses instead of the GenICam XML.

DeviceVendorName

Description: Name of the manufacturer of the device.

Length: 32

Access Mode: RO

DeviceModelName

Description: This feature provides the model of the device.

Length: 32

Access Mode: RO

DeviceManufacturerInfo

Description: This feature provides extended manufacturer information about the device.

Length: 48

Access Mode: RO

DeviceVersion

Description: This feature provides the version of the device.

Length: 32

Access Mode: RO

DeviceFirmwareVersion

Description: Version of the firmware in the device.

Length: 32

Access Mode: RO

DeviceID

Description: This feature stores a camera identifier.

Length: 16

Access Mode: RO

DeviceReset

Description: Resets the device to its power up state.

Length: 4

Access Mode: WO

WidthMax

Description: 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.

Length: 4

Access Mode: RO

Width

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

Minimum: 256

Maximum: WidthMax

Increment: 256

Length: 4

Access Mode: RW

HeightMax

Description: 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.

Length: 4

Access Mode: RO

Height

Description: This feature represents the actual image height expelled by the camera (in pixels).

Minimum: 4

Maximum: HeightMax

Increment: 4

Length: 4

Access Mode: RW

OffsetX

Description: Horizontal offset from the origin to the area of interest (in pixels).

Minimum: 0

Maximum: OffsetXMax

Increment: 256

Length: 4

Access Mode: RW

OffsetY

Description: Vertical offset from the origin to the area of interest (in pixels).

Minimum: 0

Maximum: OffsetYMax

Increment: 4

Length: 4

Access Mode: RW

PixelFormat

Description: This feature indicates the format of the pixel to use during the acquisition.

Value: Mono8

Value: Mono10Packed

Value: BayerRG8

Value: BayerRG10

Length: 4

Access Mode: RW

AcquisitionMode

Description: This feature controls the acquisition mode of the device.

Value: Continuous

Value: SingleFrame

Value: CoaxPress

Length: 4

Access Mode: RW

AcquisitionStart

Description: This feature starts the Acquisition of the device.

Length: 4

Access Mode: RW

AcquisitionStop

Description: This feature stops the Acquisition of the device at the end of the current Frame.

Length: 4

Access Mode: RW

Maximum: AcquisitionFrameRate

Description: Frame rate in Hz.

Minimum: 16

Maximum: 72

Unit: Hz

Length: 4

Access Mode: RW

Maximum: ExposureTime

Description: Sets the Exposure time (in microseconds) when ExposureMode is Timed. This controls the duration where the photosensitive cells are exposed to light.

Minimum: 98

Maximum: Depends on Frame rate

Unit: us

Length: 4

Access Mode: RW

Granularity

Description: Granularity mode.

Value: On

Value: Off

Length: 4

Access Mode: RW

ConnectionReset

Description: Bootstrap register ConnectionReset.

Length: 4

Access Mode: RW

ConnectionConfig

Description: Bootstrap register ConnectionConfig.

Value: CXP6_X2

Value: CXP6_X4

Length: 4

Access Mode: RW

Calibration

Description: Calibration

Value: On

Value: Black

Length: 4

Access Mode: RW

FlashSaveWithAutoStart

Description: This feature saves the current configuration into flash. After reboot, the camera loads the saved configuration and starts the acquisition automatically.

Length: 4

Access Mode: RW

FlashSaveWithoutAutoStart

Description: This feature saves the current configuration into flash. After reboot, the camera loads the saved configuration without starting the acquisition automatically.

Length: 4

Access Mode: RW

DisableFlashLoad

Description: This feature disables the flash configuration load at the camera boot.

Length: 4

Access Mode: RW

IndicatorLamps

Description: Switch ON/OFF indicator lamps.

Value: On

Value: Off

Length: 4

Access Mode: RW

ColorSensor

Description: Has camera a color sensor.

Minimum: 0

Maximum: 1

Increment: 1

Length: 4

Access Mode: RO

multiroi_number

Description: multiroi_number

Length: 4

Access Mode: RW

The maximum number of multi ROI is 32. There are named multiroi0 to multiroi31.

Once a multiroi is enabled (ie. number multiroi_number > 1), each multiroi is controlled by 2 XML entries: start and height.

For example for multiroi0:

Multiroi0_y_start

Description: multiroiN_y_start

Minimum: 0

Maximum: HeightMax

Increment: 4

Length: 4

Access Mode: RW

multiroiN_y_height

Description: multiroiN_y_height

Minimum: 0

Maximum: HeightMax

Increment: 4

Length: 4

Access Mode: RW

LUT

Description: Select current LUT (Factory or User LUT). User LUT can be programmed and saved to camera flash (see next entries).

Value: Factory

Value: User

Length: 4

Access Mode: RW

Restore_User_LUT_To_Factory

Description: Restore current User LUT to its factory coefficients.

Length: 4

Access Mode: RW

Write_LUT_To_Flash

Description: Writes current User LUT to the camera flash. At the next power cycle, the camera will start with the saved User LUT.

Length: 4

Access Mode: RW

LUT_x

Description: x-entry of the current User LUT

Minimum: 0

Maximum: 1023

Increment: 1

Length: 4

Access Mode: RW

LUT_y

Description: y-entry of the current User LUT

Minimum: 0

Maximum: 255

Increment: 1

Length: 4

Access Mode: RW

Gen<i>Cam

Optronis ships together with the CP90-25P-M/C-72 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.