

CamPerform CP80-4-M/C-500 CoaxPress Camera



User Manual

Ref. 1887-SU-01-A

Contents

Revision	3
General	4
Declaration of conformity	4
RoHS compliance	4
Scope of delivery	5
Optronis customer service	5
Remark, Attention	6
Precautions	6
Camera Power	6
Environmental Conditions	6
General Precautions	7
Camera	8
Electrical Interface	9
Auxiliary (Aux.) connector pinout	9
Camera Power	12
Indicator Lamp (LED)	13
CoaxPress Data Channels	13
Lens mount and handling	14
Nikon F-Mount adapter	14
C-Mount adapter	16
Important features	16
Frame format	16
Minimum Frame rate (@ internal synchronisation)	16
Maximum Frame rate (@ internal synchronisation)	16
Max. Frame Rate Examples:	18
Frame Rate (@ external synchronisation)	19
Technical Data	20
General	20
Spectral Response / Transmittance	21
Mechanical Dimensions	22
F-Mount Lens (/CM)	22
Synchronisation Input schematics	24
Synchronisation Output schematics	24
Internal Synchronisation Timing	25
Synchronisation Output	25
External Synchronisation Timing	26
Synchronisation Input “level detection”	26
Synchronisation Output “level detection”	26
Focal Length Calculation	27
Full Sensor Resolution	27
Reduced Sensor Resolution	27
Distance Washer	29
Camera firmware update	30
Camera mapping	32

Revision

Cameramodel	Date	Description
CP80-4-M/C-500 SNr. 1887-ST-xxx	30.04.2013	Firmware 6.01

General

Declaration of conformity

Manufacturer: Optronis GmbH
Address: Honsellstr. 8, 77694 Kehl, Germany

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

Product: CP80-4-M-500
CP80-4-C-500

conform with the essential requirements of the EMC Directive 2004/108/EC, based on the following specifications applied:

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

Kehl, 30.04.2013

Optronis GmbH
Dr. Patrick Summ
Managing Director

RoHS compliance



CamPerform CP80-4-M/C-500 cameras are Pb free manufactured.

Scope of delivery

CP80-4-M/C-500 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

Programming cable (USB2) for firmware update

User Manual (CD-ROM)

Optronis customer service

Optronis GmbH
Honsellstrasse 8
77694 Kehl
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: CP80-4-M/C-500
- 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.6.01 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 CP80-4-M/C-500 camera power supply (not included in shipment).

Environmental Conditions

Temperature range during operation: < + 40°C (ambi ent 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.



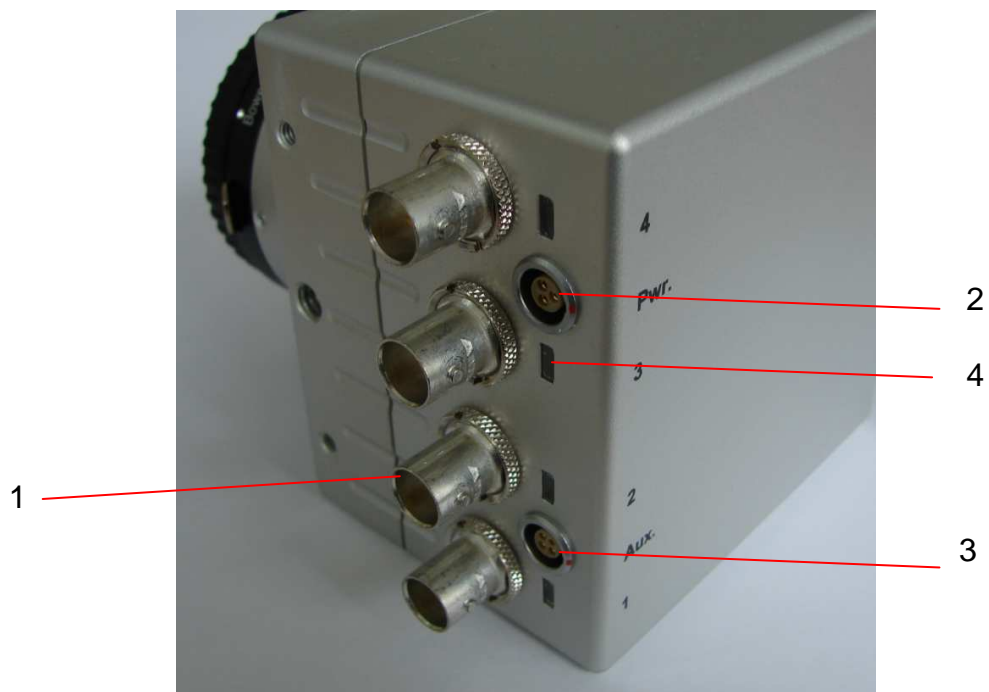
There are no serviceable parts inside the camera. Do not open the housing of the camera.

Warranty becomes void if the camera housing is opened.

Camera



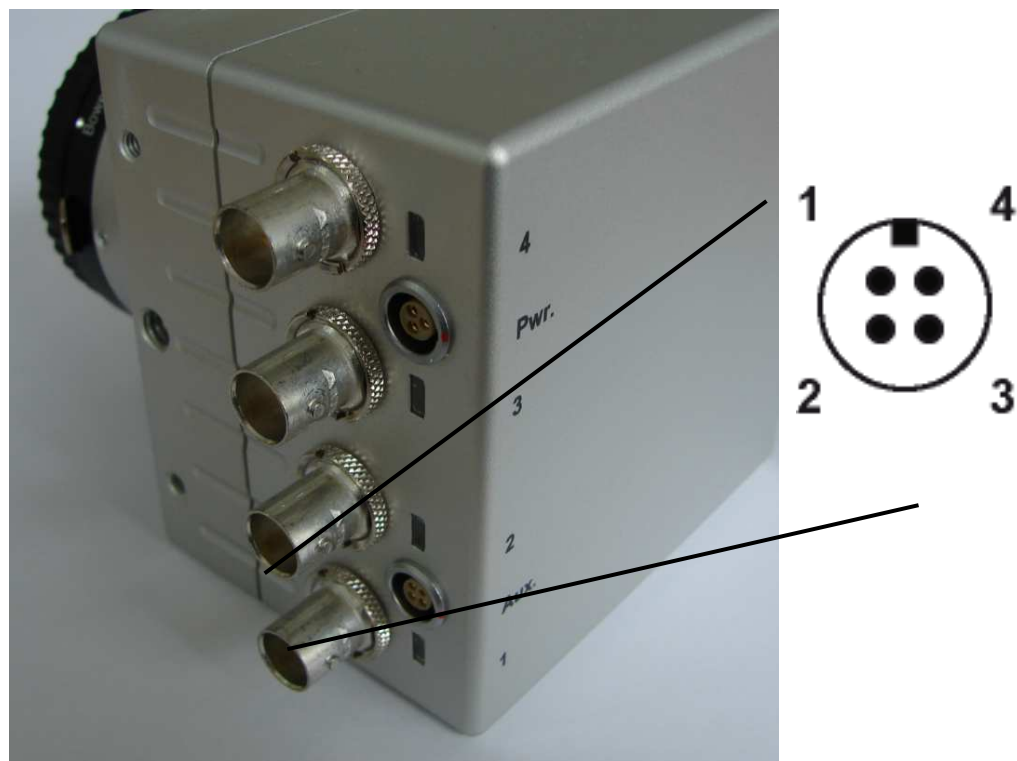
- | | |
|--------------------------------------|---------------------------------------|
| 1: Camera housing | 2: Mounting holes 2x M4x6mm 1x ¼"x6mm |
| 3: Lens mount (Nikon-F) | 4: Nikon lens |
| 5: electrical interface (right side) | 6: Mounting holes 4x M4x6mm |



1: CoaxPress Channel
3: Auxiliary Connector

2: Power Connector
4: Indicator Lamp (LED)

Electrical Interface



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	GND	Sync. Ground
4	Sync. Out	External Synchronisation Output (TTL level @ high impedance, 0 to 2 Volt @ 50 Ohms)



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

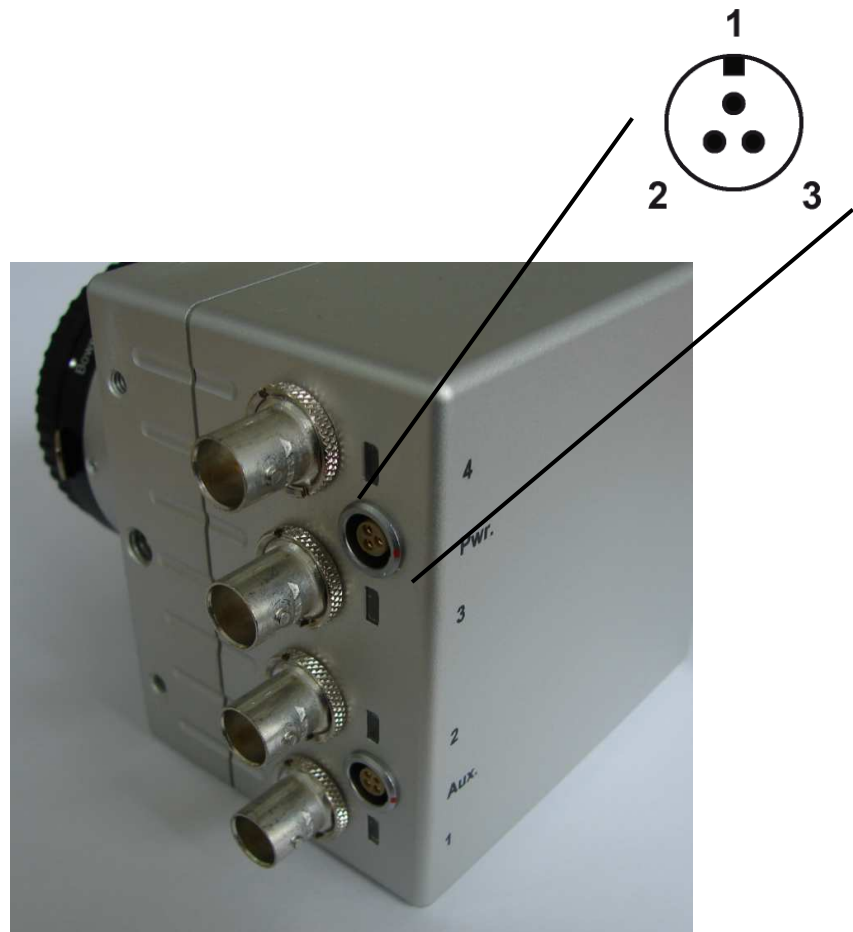


Figure: CP80-4-M/C-500 side view

Camera (Pwr.) connector type: Lemo EGG.0B.303CLL

Cable Connector: Lemo FGG0B303.CLAD56Z

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



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
Linkt 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

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, 5,00Gbit/s or 3,125Gbit/s depending on the speed transfer capabilities of the frame grabber.

Lens mount and handling

Nikon F-Mount adapter

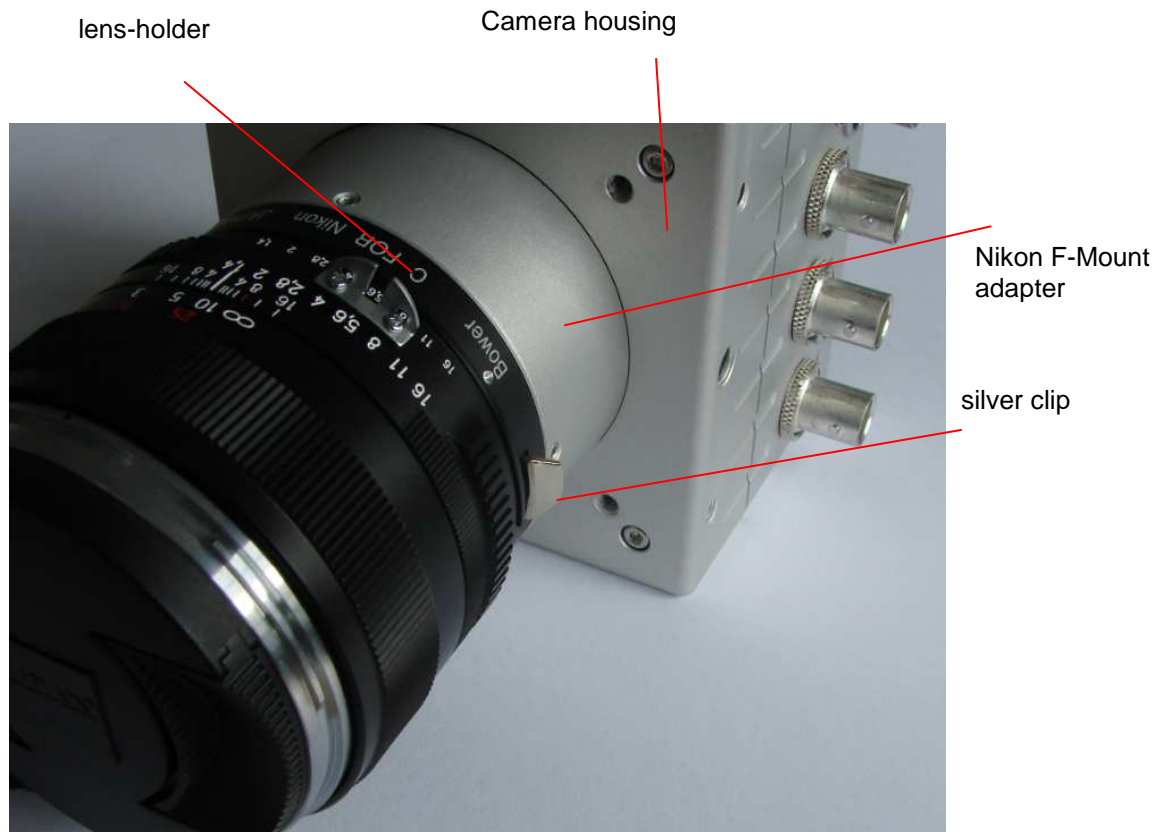
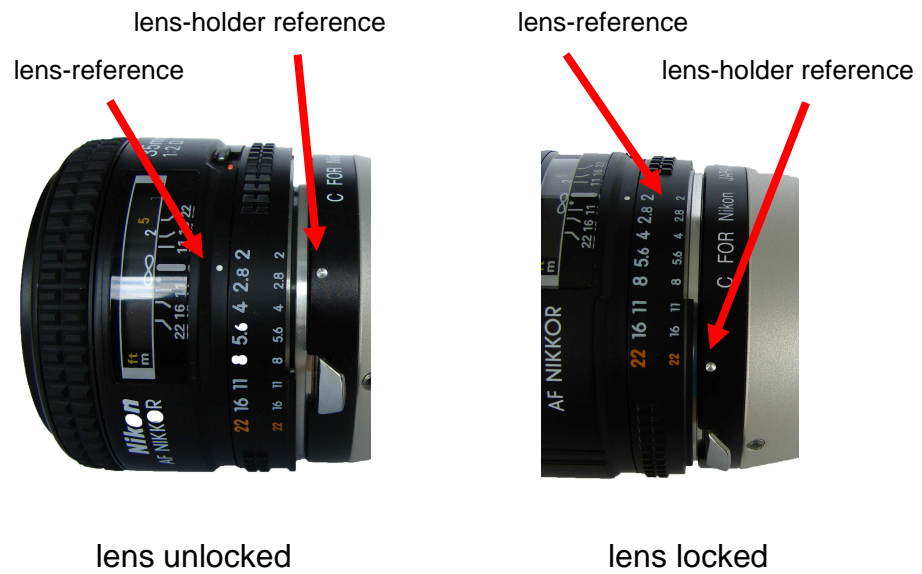


Figure: Camera with Nikon F-Mount adapter

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 CP80-4-M/C-500 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 2304 active Pixels in horizontal (x) direction and 1720 active Pixels in vertical (y) direction at full resolution. The frame format can be reduced by factor of 128 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).

Minimum Frame rate (@ internal synchronisation)

Minimum frame rate is limited to 50 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 labeling	Bit Rate (Gbps)	Maximum frame rate	Discovery Rate
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CXP6	6,250	506	No
CXP5	5,000	452	No
CXP3	3,125	253	Yes

Figure: Supported high speed link bit rates

Max. Frame Rate Examples:

CoaxPress labeling	Pixel resolution x (Pixel)	Pixel resolution y (Pixel)	Max. Frame Rate (fps)
CXP6, BNC 4x	2304	1720	500
CXP6, BNC 4x	2048	1536	560
CXP6, BNC 4x	2048	1152	750
CXP6, BNC 4x	1920	1080	800
CXP6, BNC 4x	2304	4	87000
CXP5, BNC 4x	2304	1720	446
CXP5, BNC 4x	2048	1536	498
CXP5, BNC 4x	2048	1152	667
CXP5, BNC 4x	1920	1080	712
CXP5, BNC 4x	2304	4	77430
CXP3, BNC 4x	2304	1720	250
CXP3, BNC 4x	2048	1536	280
CXP3, BNC 4x	2048	1152	375
CXP3, BNC 4x	1920	1080	400
CXP3, BNC 4x	2304	4	43500

(Max. Frame Rate values are rounded values)

Calculation of Maximum Frame Rate at CXP6 BNC 4x:

$$\text{readout time (us)} = (151/132) * (\text{SizeY} + 6)$$

(SizeY = number of lines, Pixel resolution y)

$$\text{Max. Framerate} = 1000000 / \text{readout time(us)}$$


Calculation of Maximum Exposure Time:

$$\text{expo max} = \text{readout time} - 4 * 151 / 132$$

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 50 fps and maximum Frame Rate @ internal synchronisation.

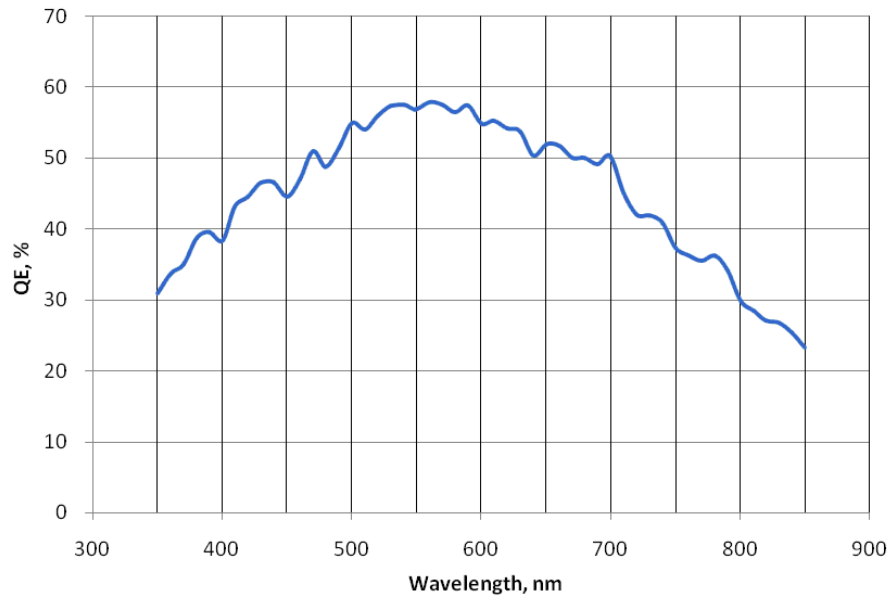
Technical Data

General

Power Source	+ 24 Volt +/- 5% DC < 200mV ripple Alternatively PoCXP
Power	approx. 10 Watt
Pixel Number	1304 x 1720
Pixel size	7 µm x 7 µm
Active area	16,13 mm x 12,04 mm
Sensor responsivity	9000 bits/lux.s
Sensor S/N ratio	48 dB (Linear)
Shutter	Global, efficiency ~99,9%
Minimum Ambient Temperature	0 °C
Maximum Ambient Temperature	+ 40 °C
Humidity	< 80% relative, non-condensed
Interface	CoaxPress BNC 4x CXP6, CXP5, CXP3
Uplink	Over CoaxPress
Video interface	CoaxPress
Size	145 mm x 95 mm x 78,5 mm (F-Mount)
Weight	approx. 1050g without lens

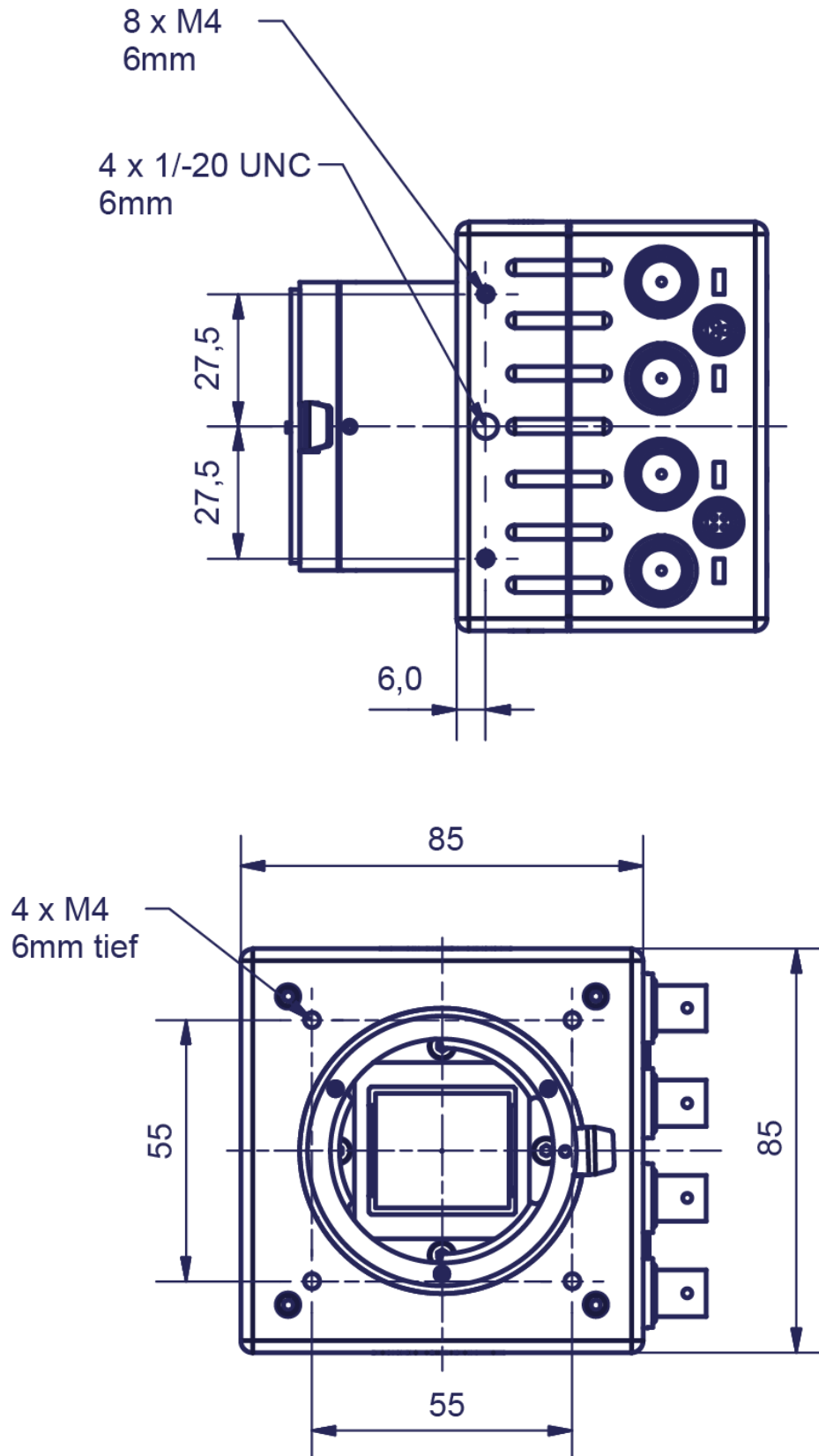
Spectral Response / Transmittance

Spectral response (Monochrome Sensor)



Mechanical Dimensions

F-Mount Lens (/CM)



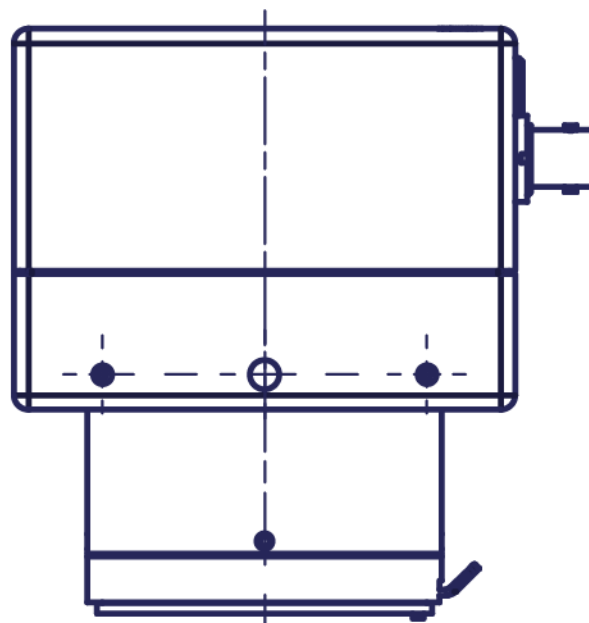
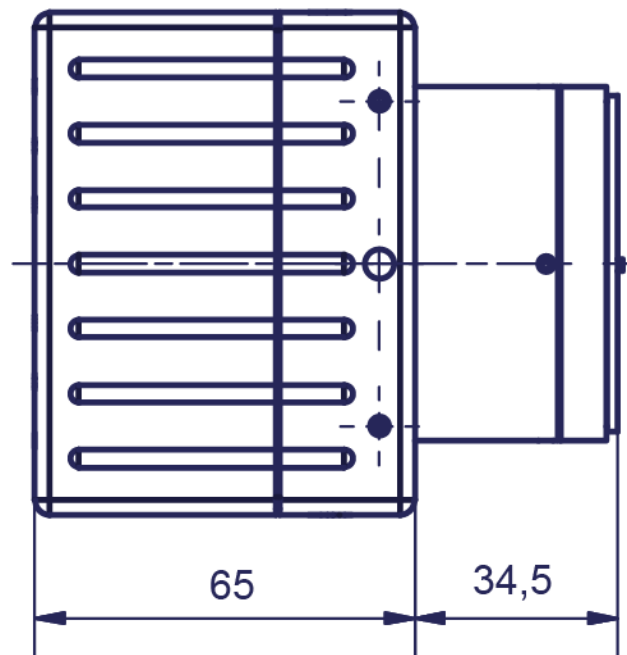


Figure : Side View (all dimensions in mm)

Screw threads in socket:

M4 min. 6 mm depth

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

Synchronisation Input schematics

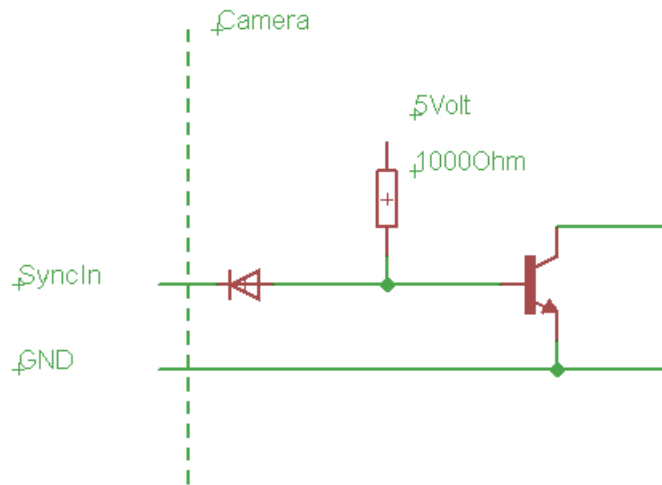


Figure: SyncIn Schematics (for illustration only)

Synchronisation Output schematics

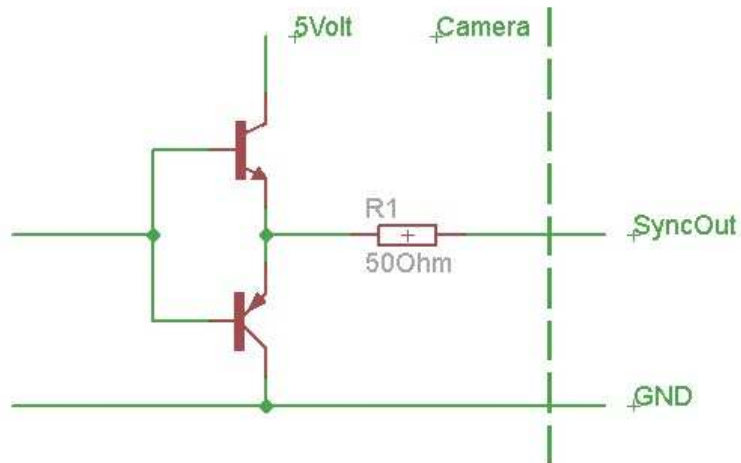
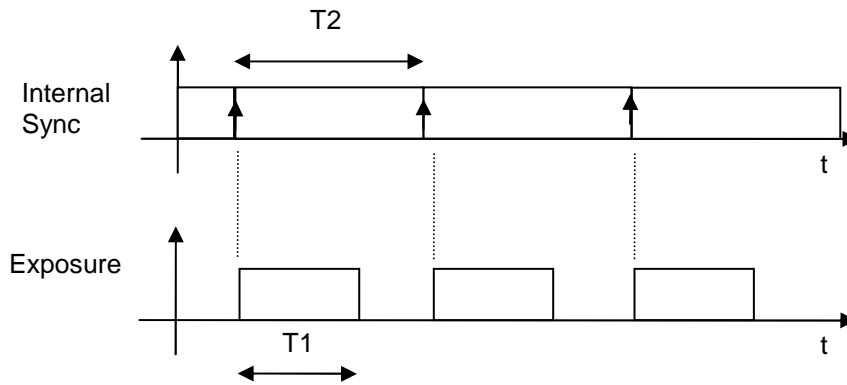


Figure: SyncOut Schematics (for illustration only)

Internal Synchronisation Timing



T1: Exposure time, selected by software

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

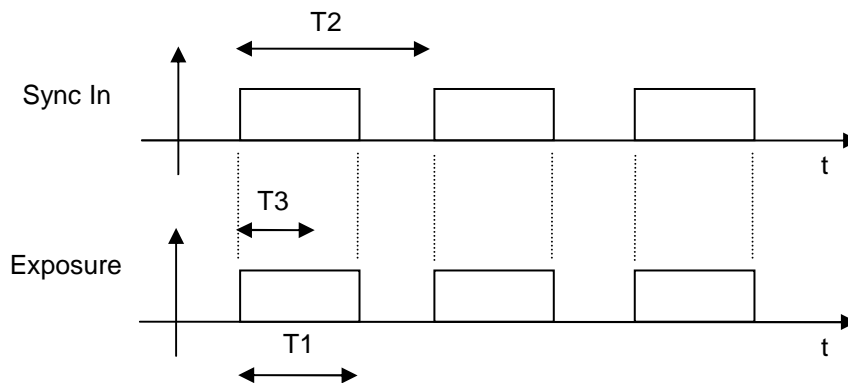
Synchronisation Output

Logic 1 during Exposure Time (T1)

External Synchronisation Timing

Synchronisation 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

<u>T1>T3:</u>	<u>T1<T3:</u>
T1 max: : no limit < 1sec recommended due to shutter T2 max: no limit < 1sec recommended due to shutter efficiency and thermal noise T2 min: T1	T1 max: : no limit < 1sec recommended due to shutter efficiency and thermal noise T2 max: no limit < 1sec recommended due to shutter efficiency and thermal noise T2 min: T3

Synchronisation Output “level detection”

Logic 1 during Exposure Time (T1)

Focal Length Calculation

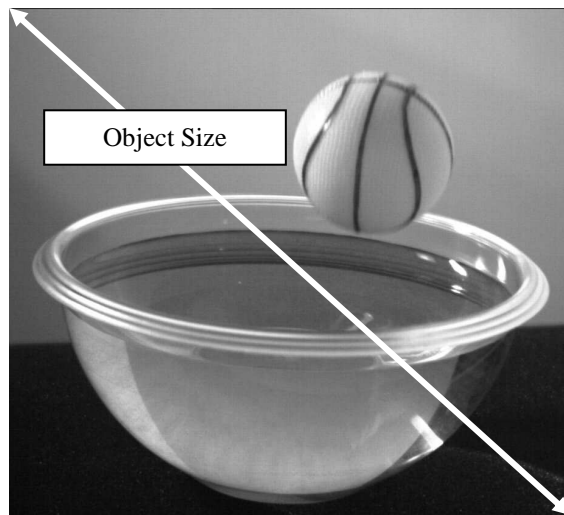
Full Sensor Resolution

The required focal length of the lens at full sensor resolution (2304 x 1720 Pixel) is calculated as follows:

$$Focal\ Length\ [mm] = \frac{A}{1 + \frac{B}{20,126}}$$

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 = $(300 : (1 + (100 : 20,126))) = 50\ mm$

selected focal length = 50 mm

Reduced Sensor Resolution

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

$$Sensor\ Size\ [mm] = 0,007 \cdot \sqrt{C^2 + D^2}$$

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

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

$$Sensor\ Size\ [mm] = 0,007 \cdot \sqrt{1920^2 + 1080^2} = 15,4$$

A: Distance from lens to object = 300 mm

B: Object size = 100 mm

calculated focal length = $(300 : (1 + (100 : 15,4))) = 40\ mm$

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:

$$35 \cdot (1 + (100 : 15,4)) = 262\ mm$$

The distance from lens to object has to be reduced from 300mm to 262mm.

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 = 15,4mm

required Object Size=15,4mm

(The required magnification factor is = 1 : 1)

focal length of the lens = 35mm

calculated Length of the Distance Washer = $35 \cdot (15,4 : 15,4) = 35\text{mm}$

Camera firmware update

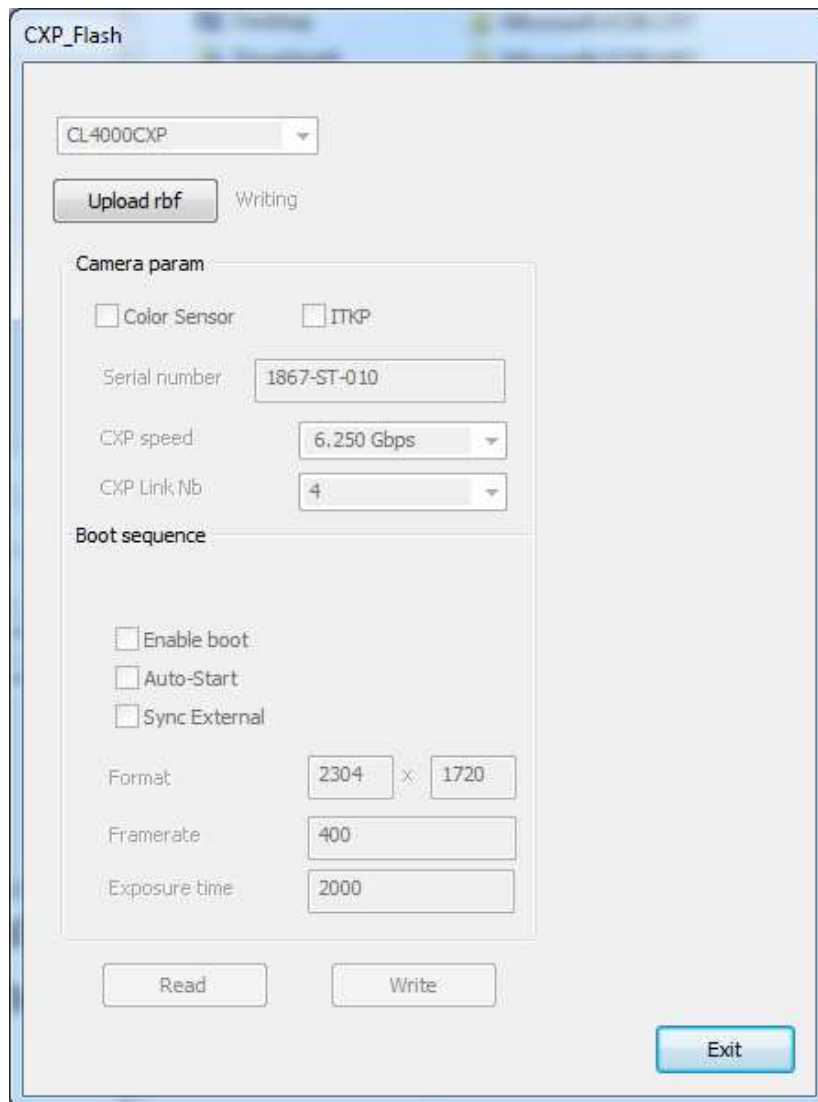
Camera firmware update is available through the USB programming cable and the CXP_Flash_Consumer software (located in the CXPFlash_Setup folder) delivered with the camera.

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 cxp7_xxx.rbf.
Wait until finished.

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

Camera mapping

Camera mapping for firmware version $\geq v4.1$

0x6000	Width_Max/Width	R/W	4
Bits [31..16]	Maximal frame width		
Bits [15..0]	Current frame width (must be a multiple of 128)		
0x60D0	OffsetX	R/W	4
Bits [15..0]	Frame Horizontal Offset (must be a multiple of 16)		
0x6004	Height_Max/Height	R/W	4
Bits [31..16]	Maximal frame height		
Bits [15..0]	current frame height (must be a multiple of 4)		
0x60D4	OffsetY	R/W	4
Bits [15..0]	Frame Vertical Offset (must be a multiple of 4)		
0x60D8	Special Modes	R/W	4
Bits [31..24]	0x01 to enable dual ROI mode else 0x00		
Bits [23..16]	0x01 to enable SubSampling mode for ROI1 else 0x0		
Bits [15..8]	0x01 to enable SubSampling mode for ROI2 else 0x00		
Bits [7..0]	0x01 to enable Shading Correction else 0x00		
0x60DC	Height_ROI1/Height_ROI2	R/W	4
Bits [31..16]	ROI1 frame height (must be a multiple of 4)		
Bits [15..0]	ROI2 frame height (must be a multiple of 4)		
0x60E0	ROI1 Offset Y/ROI2 OffsetY	R/W	4
Bits [31..16]	ROI1 Vertical Offset (must be a multiple of 4)		
Bits [15..0]	ROI2 Vertical Offset (must be a multiple of 4)		
0x6008	Framerate	R/W	4
Bits [31..0]	Current framerate (0x60C0 for floating value)		
0x600C	Framerate_Max	R	4
Bits [31..0]	Maximal framerate for the current frame format (0x60C4 for floating value)		
0x6010	Exposure_Time	R/W	4
Bits [31..0]	Current exposure time (unit = us) (0x60C8 for floating value)		
0x60BC	Exposure_Time_Max	R/W	4
Bits [31..0]	Maximal exposure time for the current framerate (unit = us) (0x60CC for floating value)		
0x6018	Synchronization	R/W	4
Bits [31..0]	0x0000 for internal synchronization 0x0001 for external synchronization (Aux. input) 0x0002 to use trigger over CoaXPress		
0x601C	Stream_Start	R/W	4
Bits [31..24]	Not used		
Bits [23..16]	0x00 to switch ON indicator lamps 0x01 to switch OFF indicator lamps		
Bits [15..8]	0x01 to send pattern frame else 0x00		
Bits [7..0]	0x00 to stop streaming (only idle packets are sent) 0x01 to enable streaming (sensor data packets are sent)		
0x6024	Save_User_Boot_To_Flash	W	4

Bits [31..0]	Write 0x00000001 to save current camera configuration to flash (frame format, framerate, exposure time, synchronization, CXP transfer rates, CXP link number). After power up, the camera starts streaming IDLE packets. Write 0x00000101 to save current camera configuration to flash (frame format, framerate, exposure time, synchronization, CXP transfer rates, CXP link number). After power up, the camera directly starts streaming image data.
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0x6028	Camera_Serial_Number	R	16
Bits [127..0]	Camera serial number		

0x6038	Color_Sensor	R	4
Bits [31..0]	Returns 0x00000001 if camera has a color sensor Returns 0x00000000 if camera has a monochrome sensor		

What's new for firmware version ≥ 4.1

Special Modes :

- dual ROI
- subsampling

Dual ROI :

Dual ROI allows to define two not-overlapping ROIs (Region Of Interest).

The option is selected by writing 0x01 to the bits 31..24 of the 'Special Modes' (0x60D8) register.

ROI1 is always the top ROI and ROI2 the bottom ROI.

By default, vertical offset of ROI1 is 0 and vertical offset of ROI2 is equal to the height of ROI1.

Streaming has to be stopped before changing the 'Special Modes' (0x60D8) register.

Streaming can be stopped by writing 0x01 to the bits 7..0 of the 'Stream_Start' (0x601C) register.

Vertical offsets and heights of the 2 ROIs are defined in the 0x60E0 and 0x60DC register.

Width of ROIs are the same and can be defined in the register 0x6000.

Horizontal offset of ROIs are the same and can be defined in the register 0x60D0.

When special mode is used, the register 0x6004 is reserved and is automatically calculated by the camera.

For example, if 0x60DC contains the hexadecimal value 0x02000100, the bits 15..0 of register 0x6004 will automatically contain the value $0x0300 = 0x0200 + 0x0100$.

Subsampling :

Subsampling mode allows to transfer only the even lines of the ROI or ROIs.

The option is selected for ROI1 by writing 0x01 to the bits 23..16 of the 'Special Modes' (0x60D8) register.

The option is selected for ROI2 by writing 0x01 to the bits 15..8 of the 'Special Modes' (0x60D8) register.

Streaming has to be stopped before changing the 'Special Modes' (0x60D8) register.

Streaming can be stopped by writing 0x01 to the bits 7..0 of the 'Stream_Start' (0x601C) register.

Vertical offset and height of the ROI or ROIs are defined in the 0x60E0 and 0x60DC register.

When special mode is used, the register 0x6004 is reserved and is automatically calculated by the camera.

For example, if 0x60DC contains the hexadecimal value 0x02000000 and 0x60D8 contains the hexadecimal value 0x00010000, the bits 15..0 of register 0x6004 will automatically contain the value $0x0100 = 0x0200/2$.

If dual ROI mode is activated, each ROI can be configured with or without subsampling mode.

Setup to follow when using 'Special Modes' :

- 1) Ensure that streaming is stopped (bits 7..0 of 0x601C must be set to 0x00).
- 2) Setup the register 0x60D8 to the desired value
- 3) Modify heights and offsets manually via the registers 0x60DC and 0x60E0.
- 4) Start streaming (bits 7..0 of 0x601C must be set to 0x01)
- 5) After streaming is started, the user can change the offset values of the ROI or ROIs (0x60E0).

All these parameters are also defined in the internal XML file of the camera.

Gen<i>Cam

Optronis ships together with the CP80-4-M/C-500 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.