ximea



xiB-64

[ksi-bee:] or [sai-bee:]

- High-Speed PCIe camera series

XIMEA Cameras •
Technical Manual •
Version v261104 •

Introduction

About this manual

Dear customer,

Thank you for purchasing a product from XIMEA.

We hope that this manual can answer your questions, but should you have any further queries or if you wish to claim a service or warranty case, please contact your local dealer or refer to XIMEA Support on our website: www.ximea.com/support

The purpose of this document is to provide a description of XIMEA Cameras and to describe the correct way to install related software, drivers and run it successfully. Please read this manual thoroughly before operating your new XIMEA Cameras for the first time. Please follow all instructions and observe the warnings.

This document is subject to change without notice.

About XIMEA

XIMEA is one of the worldwide leaders for innovative camera solutions with a 30-year history of research, development and production of digital image acquisition systems. Based in Slovakia, Germany and the US, with a global distributor network, XIMEA offers their cameras worldwide. In close collaboration with customers XIMEA has developed a broad spectrum of technologies and cutting-edge, highly competitive products.

XIMEA's camera centric technology portfolio comprises a broad spectrum of digital technologies, from data interfaces such as USB 2.0, USB 3.2 Gen 1 and PCIe to cooled digital cameras with CCD, CMOS and sCMOS sensors, as well as X-ray cameras.

XIMEA has three divisions – generic machine vision and integrated vision systems, scientific imaging and OEM/custom.

Our broad portfolio of cameras includes thermally stabilized astronomy and x-ray cameras, as well as specialty cameras for medical applications, research, surveillance and defense.

Contact XIMEA

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Standard conformity

CE conformity



Figure 1: Standard conformity CE logo

The camera models listed below comply with the requirements of the EC EMC Directive 2014/30/EU regarding the electromagnetic compatibility of equipment.

Certified camera models include

CB262CG-GP-X8G3 CB262MG-GP-X8G3 CB262RG-GP-X8G3 CB654CG-GP-X8G3
CB654MG-GP-X8G3

UKCA conformity



Figure 2: Standard conformity UKCA logo

We declare that the products listed below comply with the requirements of Directive 2014/35/EU (Low Voltage Directive) and Directive 2014/30/EU (Electromagnetic Compatibility).

All tests are based on EU rules and standards valid before January 1, 2021 (Brexit). The harmonized EU product standards were converted into UK designated standards on exit day. Based on that, these products are UKCA compliant.

Certified camera models include

CB262CG-GP-X8G3 CB262MG-GP-X8G3 CB262RG-GP-X8G3 CB654CG-GP-X8G3
CB654MG-GP-X8G3

FCC conformity



Figure 3: Standard conformity FCC logo

The camera models listed below have been tested and found to comply with Part 15 of the FCC rules, which states that:

Operation is subject to the following two conditions:

1. This device may not cause harmful interference.

2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the users will be required to correct the interference at their own expense.

You are cautioned that any changes or modifications not expressly approved in this manual could void your authority to operate this equipment under the above jurisdictions. The shielded interface cable recommended in this manual must be used with this equipment to comply with the limits for a computing device pursuant to Subpart J of Part 15 of FCC Rules.

Certified camera models include

CB262CG-GP-X8G3 CB262MG-GP-X8G3 CB262RG-GP-X8G3 CB654CG-GP-X8G3 CB654MG-GP-X8G3

These models have not been EMC certified, yet: CB013CG-LX-X8G3, CB013MG-LX-X8G3, CB019CG-LX-X8G3, CB019MG-LX-X8G3, CB024CG-GP-X8G3-SFF, CB024MG-GP-X8G3-SFF, CB100CG-GP-X8G3-SFF, CB100MG-GP-X8G3-SFF, CB120CG-CM-X8G3, CB120MG-CM-X8G3, CB120RG-CM-X8G3, CB160CG-LX-X8G3, CB160MG-LX-X8G3, CB209CG-GP-X8G3-SFF and CB209MG-GP-X8G3-SFF.

RoHS conformity

Figure 4: Standard conformity RoHS logo

The products described in this technical manual comply with the RoHS-3 (Restriction of Hazardous Substances) Directive 2015/863/EU.

WEEE conformity

Figure 5: Standard conformity WEEE logo

The products described in this technical manual comply with the WEEE (Waste Electrical and Electronic Equipment) Directive 2012/19/EU.

GenICam GenTL API

The GenICam/GenTL standard offers a device-agnostic interface for the acquisition of images and other data types, as well as for communication with devices. This enables each XIMEA camera to function as a GenTL Producer, facilitating the capture of images through a standardized transport layer interface.

Disclaimer

This document and the technical data contained herein are for descriptive purposes only and not binding. They are not to be construed as warranted characteristics or guarantees of properties, quality or durability in the legal sense. Specifications are subject to change without notice. The information contained in this document is provided “as is” without warranty of any kind.

Helpful links

XIMEA Homepage	http://www.ximea.com/
XIMEA Support	https://www.ximea.com/support/wiki/allprod/Contact_Support
Frequently Asked Questions	http://www.ximea.com/support/wiki/allprod/Frequently_Asked_Questions
Knowledge Base	http://www.ximea.com/support/wiki/allprod/Knowledge_Base
XIMEA Software Package	https://www.ximea.com/support/wiki/apis/APIs#Software-packages
Vision Libraries	http://www.ximea.com/support/projects/vision-libraries/wiki
XIMEA General Terms & Conditions	http://www.ximea.com/en/corporate/generaltc

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1 xiB-64 camera series

1.1 What is xiB-64



xiB-64 is a compact PCI express Industrial camera family with outstanding features:

- Small footprint
- High speed computer interface
- Sensors 1 Mpx, 2 Mpx, 2.4 Mpx, 10 Mpx, 12 Mpx, 16 Mpx, 20.9 Mpx, 26 Mpx, 65 Mpx CMOSIS and Luxima and GPixel sensors

The camera line uses a PCI Express (PCI Express (PCIe)) computer interface, eliminating the need for a frame grabber. The xiB-64 cameras stream images to the host computer via 8 lanes on a PCI Express Gen3 bus, boasting a 64 Gbit/s sustainable transfer rate. Due to the underlying technology, there is no additional latency and hardly any CPU load. It features high-speed sensors (1.3 Mpix at > 3500 FPS) all the way to ultra high-res sensors with unmatched framerates (65 Mpix at 72 FPS)

Off-the-shelf hardware can be used for camera-to-computer interfaces, but testing was limited to the items discussed in this manual. Refer to the section Power supply and PCIe host adapter cards for informations needed to interface your camera to the computer.

Additionally, the active EF lens mount adapter enables the combination with a wide array of superb optics, with direct control over the aperture and the focus.

1.2 Advantages

Compact	Periscope like design and a size of mere 60 x 70 x 55 mm simplifies multi-camera setups for 360 panorama applications
Robust	Full metal housing, CNC-machined with precision, no moving parts or sheet metal covers for maximum stability and durability
Unmatched Speed and Bandwidth	The PCIe interface is the primary advantage, allowing these cameras to capture and transfer high-resolution images at speeds that other interfaces cannot match.
High Performance & Low Overhead	The direct data transfer to memory (DMA) and minimal CPU load make them ideal for demanding real-time applications where every millisecond counts.
High Resolution and Frame Rate	The CB209, CB100, and CB024 offer a range of resolutions and frame rates, allowing users to select the best camera for their specific application, from high-resolution inspection to ultra-fast motion analysis.
Flexibility in Multi-Camera Systems	The high bandwidth and synchronization capabilities make them excellent for complex multi-camera setups, such as those used for 3D scanning, volumetric capture, or 360-degree panorama.
No Frame Grabber Required	The PCIe interface eliminates the need for a separate frame grabber card, simplifying the system architecture and reducing costs.

1.3 Camera applications

- Motion Analysis
- Industrial Automation and Quality Control
- Surveillance and Aerial Mapping
- Scientific Research
- Life Sciences and Medical Imaging
- Cinematography and VR/AR

1.4 Common features

Sensor Technology	CMOS, global shutter
Acquisition Modes	continuous, software and hardware trigger, limited fps, triggered exposure and burst, exposure controlled by trigger length
Partial Image Readout	ROI, decimation and binning modes supported (model specific)
Image data formats	8, 10 or 12 bit RAW pixel data
Color image processing	host based de-Bayering, sharpening, gamma, color matrix, true color CMS
Hot/blemish pixels correction	on camera storage of more than 5000 px coordinates, host assisted correction
Auto adjustments	auto white balance, auto gain, auto exposure
Flat field corrections	host assisted pixel level shading and lens corrections
Image Data and Control Interface	PCIe iPass external PCIe connector (Gen3 x8), PCIe iPass+ Mini-SAS HD
General Purpose I/O	2x opto-isolated input, 2x opto-isolated output, and 4 non-isolated I/O, 4X user configurable LEDs
Signal conditioning	programmable debouncing time
Synchronization	hardware trigger input, software trigger, exposure strobe output, busy output
Housing and lens mount	C-mount, optional Canon EF mount available
Environment	operating 0 to 50 °C on housing, RH 80 % non-condensing, –25 to 60 °C storage
Operating systems	Windows, Linux Ubuntu, MacOS
Software support	xiAPI SDK, adapters and drivers for various image processing packages
Firmware updates	field firmware update through xiCOP tool

1.5 Model nomenclature

xiB-64 CBxxxyT-zz-X8G3(-SFF)

CB = xiB-64 family name

xxx = Resolution
xxx: resolution in 0.1 Mpx, (e.g. 1.3 Mpx: xxx = 013)

y = Color sensing
C: color model
M: black & white model
R: black & white, Infrared-extended model

T = Sensor technology
G: global shutter

zz = Vendor of the sensor
CM: CMOSIS
LX: Luxima
GP: Gpixel

X8G3 = Number of PCIe lanes used, 8 for these cameras
PCIe generation, currently at Gen 3 for these cameras
(-SFF) = Camera with Mini-SAS HD SFF-8644 connector

1.6 Models and sensors overview

Camera model	Sensor model	Sensor type	Filter	Resolution [px]	Pixel size [µm]
CB013CG-LX-X8G3	LUXIMA LUX13HS	Color	BayerGR	1280 × 864	13.7
CB013MG-LX-X8G3	LUXIMA LUX13HS	Monochrome	None	1280 × 864	13.7
CB019CG-LX-X8G3	LUXIMA LUX19HS	Color	BayerGR	1920 × 1080	10
CB019MG-LX-X8G3	LUXIMA LUX19HS	Monochrome	None	1920 × 1080	10
CB024CG-GP-X8G3-SFF	GPixel GSPRINT4502	Color	BayerBG	2048 × 1216	4.5
CB024MG-GP-X8G3-SFF	GPixel GSPRINT4502	Monochrome	None	2048 × 1216	4.5
CB100CG-GP-X8G3-SFF	GPixel GSPRINT4510	Color	BayerBG	4608 × 2176	4.5
CB100MG-GP-X8G3-SFF	GPixel GSPRINT4510	Monochrome	None	4608 × 2176	4.5
CB120CG-CM-X8G3	CMOSIS CMV12000	Color	BayerGB	4096 × 3072	5.5
CB120MG-CM-X8G3	CMOSIS CMV12000	Monochrome	None	4096 × 3072	5.5
CB120RG-CM-X8G3	CMOSIS CMV12000	Monochrome-NIR	None	4096 × 3072	5.5
CB160CG-LX-X8G3	LUXIMA LUX160	Color	BayerRG	4704 × 3424	3.9
CB160MG-LX-X8G3	LUXIMA LUX160	Monochrome	None	4704 × 3424	3.9
CB209CG-GP-X8G3-SFF	GPixel GSPRINT4521	Color	BayerBG	5120 × 4096	4.5
CB209MG-GP-X8G3-SFF	GPixel GSPRINT4521	Monochrome	None	5120 × 4096	4.5
CB262CG-GP-X8G3	GPixel GMAX0505	Color	BayerGB	5120 × 5120	2.5
CB262MG-GP-X8G3	GPixel GMAX0505	Monochrome	None	5120 × 5120	2.5
CB262RG-GP-X8G3	GPixel GMAX0505 Red Fox	Monochrome-NIR	None	5120 × 5120	2.5
CB654CG-GP-X8G3	GPixel GMAX3265	Color	BayerGB	9344 × 7000	3.2
CB654MG-GP-X8G3	GPixel GMAX3265	Monochrome	None	9344 × 7000	3.2

Table 1: List of camera models and their respective sensor models and filters

1.7 Accessories overview

The following accessories are available:

Item P/N	Description
MECH-60MM-BRACKET-T	xiB series tripod mounting bracket
CBL-MT-PWR-SYNC-3M0	3 m xiB-64 series I/O Sync and AUX power cable
CBL-PCI-X8G3-COP-3M0	3 m PCIe Gen.3 x8, copper cable[1]
CBL-SFF-X4G3-10M0	10 m PCIe Gen.3 x4 fiber SFF cable[2]
CBL-SFF-X4G3-COP-5M0	5 m PCIe Gen.3 x4 copper SFF cable
CBL-MTP-X8G3-FF-5M0	5 m MTP fiber optic trunk cables Gen3 x8 lanes[3]
CB-X8G3-FAN-COOLER-KIT	Fan Cooler with Screws Kit[4]
CB-X8G3-WAT-COOLER-KIT	Water Cooler with Screws Kit[4]
XC-X8G3-MTP-X8G3-IPASS	PCIe Gen.3 x8 iPass to MTP converter
XC-X8G3-SFF-X8G3-IPASS	PCIe Gen.3 x8 SFF converter
HA-1P-X8G3-MTP-X8G3	Host adapter with 1 port for PCIe Gen.3 x8 MTP cables
HA-2P-X4G3-SFF-X8G3	PCIe SFF x8 Host Adapter Dual
HA-2P-X4G3-FF-X8G3	Host adapter with 2 ports for PCIe Gen.3 x4 Firefly cables
HA-8P-X4G3-FF-X16G3	Host adapter with 8 ports for PCIe Gen.3 x4 Firefly cables
PEX8-G3-X1-DOL	PCIe Gen.3 x8 extender host adapter for copper and fiber optics cables
PEX8-G3-X2-OSS	PCIe Gen.3 x8 dual port extender host adapter for copper and fiber optics cables
PEX8-G3-X1-IOI	PCIe Gen.3 x8 dual port extender host adapter for fiber and copper PCIe Gen.3 x8 cables
ADPT-MX-X8G3-FF-X8G3-SFF	Firefly to SFF adapter x8 lanes
MECH-60MM-EF-ADAPTER-KIT	Canon EF-Mount Adapter[4]
LA-C-MNT-60MM-BK7-KIT	C-mount lens adapter kit with BK7 filter glass
LA-C-MNT-60MM-IR650-KIT	C-mount lens adapter kit with IR650 filter glass
LA-E-MNT-60MM-KIT	Sony passive lens E-mount
PSU-GSM60B24-P1J	Desktop power supply (60 W, 24 V)
MECH-OPA-S-ALIGNED	Optical MTP patch cable adapter

[1]Also available in 5 and 7 meter lengths.
[2]Also available in 30 and 50 meter lengths.
[3]Also available in 10/20/30/40/50 and 100 meter lengths.
[4]These assemblies are sold separately. Additional assemblies purchased along with a camera can be added to the order at time of purchase for assembly with camera head, see table below.

Table 2: List of accessories available for xiB-64 cameras

Item P/N	Description
A-CB-X8G3-FAN-COOLER-KIT	Assembly service for CB-X8G3-FAN-COOLER-KIT
A-CB-X8G3-WAT-COOLER-KIT	Assembly service for CB-X8G3-WAT-COOLER-KIT
A-MECH-60MM-EF-ADAPTER-KIT	Assembly service for MECH-60MM-EF-ADAPTER-KIT
A-LA-C-MNT-60MM-KIT	Assembly service for LA-C-MNT-60MM-xxx-KIT

Table 3: xiB-64 assembly options

1.8 Camera connection diagram

The diagram below shows the basic relationships between cameras and accessories based on their connectors and features. For detailed information about the products shown, visit our webpage, where the diagram includes reference links to the individual product pages:

XIMEA diagram

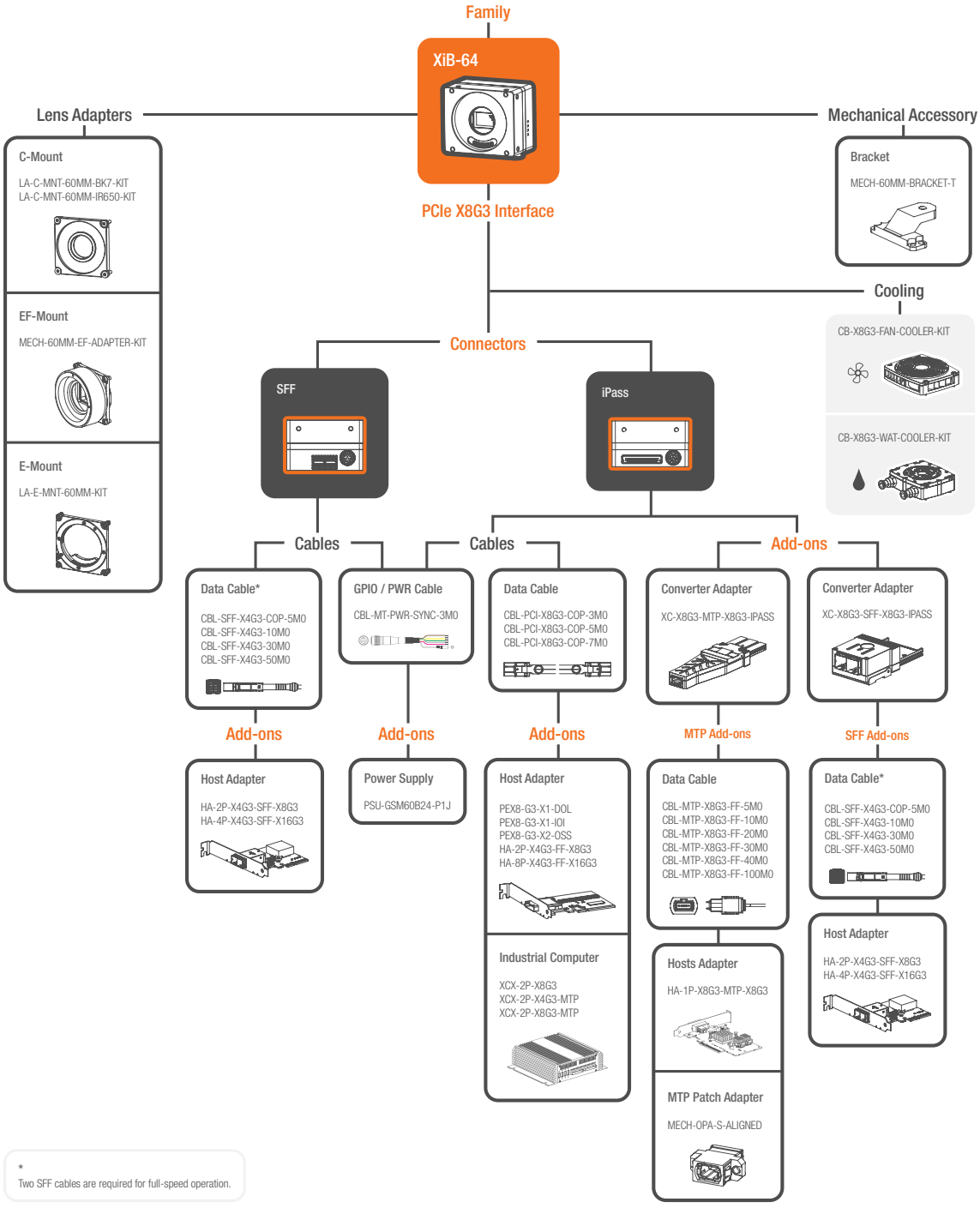


Figure 6: Diagram of accessories and specific connections for the xiB-64 camera family

2 Hardware specification

2.1 Power supply

The power consumption table can consist of several values:

Supply voltage: Voltage used for measuring the power consumption.

Idle: The average power consumption when the camera is powered, but not opened/initialized in software.

Typical: The average power consumption during streaming in the most power-intensive mode, (typically the one with the highest frame rate).

Maximum: The highest power consumption peak recorded during streaming in the most power-intensive mode, (measured using a current probe).

Power consumption of:
CB013CG-LX-X8G3 CB013MG-LX-X8G3

Supply Voltage[1]	Consumption typical	Consumption maximum
12 V	13.8 W	17.8 W

[1]Supported voltage 9 - 24 V

Table 4: Power consumption of the specific models

Power consumption of:
CB019CG-LX-X8G3 CB019MG-LX-X8G3

Supply Voltage[1]	Consumption typical	Consumption maximum
24 V	13.9 W	18.0 W

[1]Supported voltage 12 - 24 V

Table 5: Power consumption of the specific models

Power consumption of:
CB024CG-GP-X8G3-SFF CB024MG-GP-X8G3-SFF

Supply Voltage[1]	Consumption idle	Consumption typical	Consumption maximum
24 V	9.3 W	18.3 W	19.2 W

[1]Supported voltage 12 - 24 V

Table 6: Power consumption of the specific models

Power consumption of:
CB100CG-GP-X8G3-SFF CB100MG-GP-X8G3-SFF

Supply Voltage[1]	Consumption idle	Consumption typical	Consumption maximum
24 V	9.3 W	23.0 W	24.3 W

[1]Supported voltage 12 - 24 V

Table 7: Power consumption of the specific models

Power consumption of:
CB120CG-CM-X8G3 CB120MG-CM-X8G3 CB120RG-CM-X8G3

Supply Voltage[1]	Consumption typical	Consumption maximum
24 V	17.8 W	20.4 W

[1]Supported voltage 12 - 24 V

Table 8: Power consumption of the specific models

Power consumption of:
CB160CG-LX-X8G3 CB160MG-LX-X8G3

Supply Voltage[1]	Consumption typical	Consumption maximum
24 V	13.4 W	17.6 W

[1]Supported voltage 12 - 24 V

Table 9: Power consumption of the specific models

Power consumption of:
CB209CG-GP-X8G3-SFF CB209MG-GP-X8G3-SFF

Supply Voltage[1]	Consumption idle	Consumption typical	Consumption maximum
24 V	9.3 W	24.0 W	26.2 W

[1]Supported voltage 12 - 24 V

Table 10: Power consumption of the specific models

Power consumption of:
CB262CG-GP-X8G3 CB262MG-GP-X8G3 CB262RG-GP-X8G3

Supply Voltage[1]	Consumption typical	Consumption maximum
24 V	13.6 W	14 W

[1]Supported voltage 12 - 24 V

Table 11: Power consumption of the specific models

Power consumption of:
CB654CG-GP-X8G3 CB654MG-GP-X8G3

Supply Voltage[1]	Consumption typical	Consumption maximum
24 V	16.7 W	17.3 W

[1]Supported voltage 12 - 24 V

Table 12: Power consumption of the specific models

2.1.1 Power input

The cameras require a DC input of +12 to +24 V with a maximum of about 29 W without lens control. Ximea offers a power supply which can plug into the CBL-MT-PWR-SYNC-3M0 (power/sync cable) and provide DC power to the camera from an AC 120 V - 230 V source. Recommended power supply for cameras is 60 W or more.

2.2 General specification

2.2.1 Environment

Description	Symbol	Value
Optimal ambient temperature operation	T_{opt}	10 to 25 °C
Ambient temperature operation	T_{max}	0 to 50 °C
Ambient temperature for storage and transportation	$T_{storage}$	–25 to 60 °C
Relative Humidity, non-condensing	RH	80 %

Table 13: Environment

Housing temperature must not exceed 65 °C.

Note: The following parameters are not guaranteed if the cameras are operated outside the optimum range:

- Dark current
- Dynamic Range
- Linearity
- Acquisition
- Readout noise
- S/N ratio
- Durability

2.3 Lens mount

2.3.1 C-mount

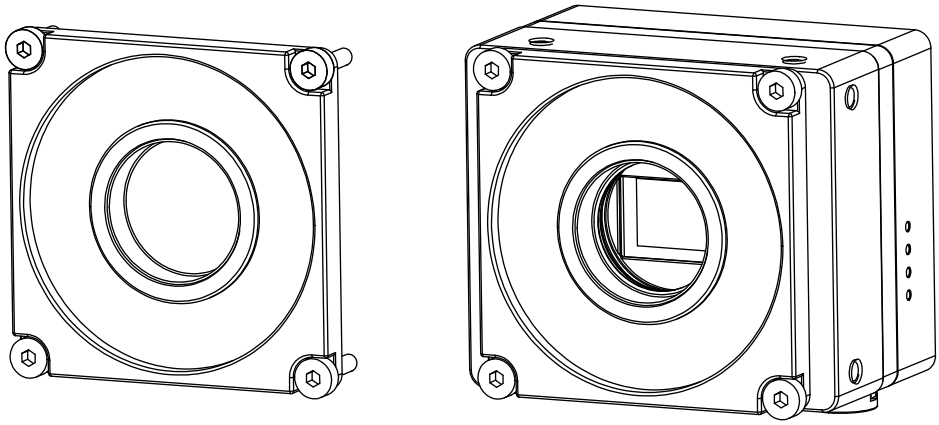


Figure 7: Lens mount adapter C-Mount 60mm (left) , camera with adapter (right)

Camera models, featuring a 4/3" or smaller sensor format, are compatible with a C-mount lens adapter, which is securely fastened in the front mount holes using four M4 screws. For further details, please refer to section LA-C-MNT-60MM-xxx-KIT.

The mentioned lens adapter can optionally be included in:
all models in this manual (refer to the table Models and sensors overview)

2.3.2 EF-mount

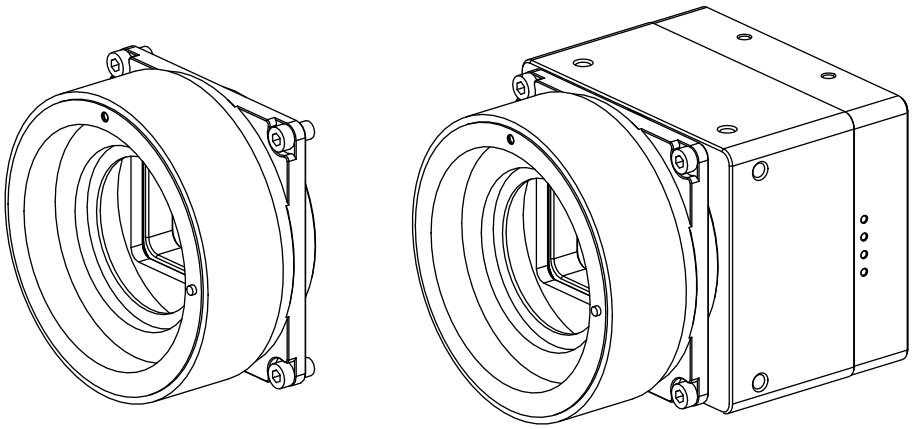


Figure 8: Lens mount adapter EF-mount (left) , camera with adapter (right)

The cameras are optionally delivered with or without an outer EF-Mount Adapter. This adapter, when active, enables remote control over aperture, focus, and image stabilization, and is securely mounted to the camera using four M4x6 screws. The distance between the outer EF-Mount Adapter and the active sensor surface is 44 mm, and when no EF-Mount Adapter is included, it is 13.78 mm. Refer to MECH-60MM-EF-ADAPTER for more information.

The mentioned lens adapter can be optionaly included in:
all models in this manual (refer to the table Models and sensors overview)

2.4 Mounting points

The mounting points available to the customer are shown below. Use only the designated threaded holes for mounting the camera. Utilize only the specified screws and torques when fastening.

Specific mounting information can be found in the dimensional drawings of the camera models located in section Dimensional drawings.

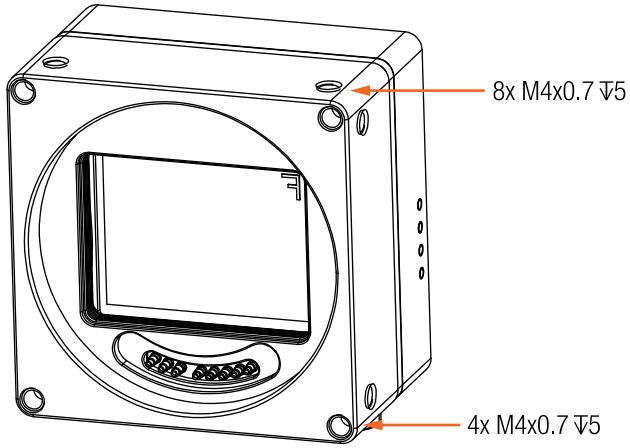


Figure 9: Camera mounting points

2.4.1 M4 Mounting screws

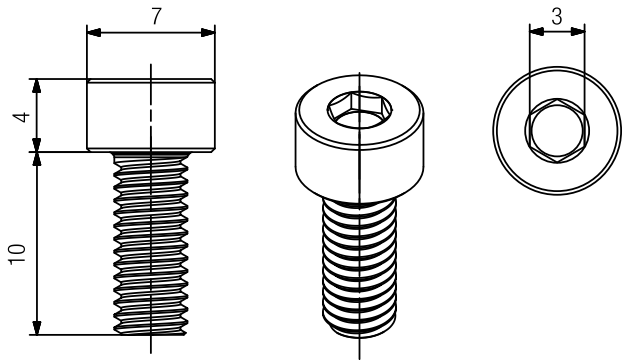


Figure 10: M4 mounting screws

Item	Material	Surface	Thread	Driver	Avail. lengths
Value	Stainless steel	Polished	M4 Full thread	INBUS 3.0	6 to 40 mm

Table 14: M4 screw description

2.5 Optical path

The optical path in cameras defines the course traversed by light from the observed object to the image captured by the sensor. It involves complex interactions with components (e.g. lenses).

The flange focal distance (FFD) or optical distance is the distance between a lens's mounting flange and a camera's sensor plane. In standard setups, it assumes that only air fills the space between the lens and the sensor. However, the introduction of additional elements like windows or filters can alter the focal plane through refraction, requiring an adjusted FFD for proper alignment.

The presence or absence of a filter or sensor window in the camera depends on the camera model. The distance from the flange to the sensor is designed (refer to the camera cross-section image below for visual information).

Do not use compressed air to clean the camera as this could push dust particles into the camera or potentially cause damage (e.g.scratches).

Cross-section corresponding to:

CB013CG-LX-X8G3 CB013MG-LX-X8G3 CB019CG-LX-X8G3 CB019MG-LX-X8G3

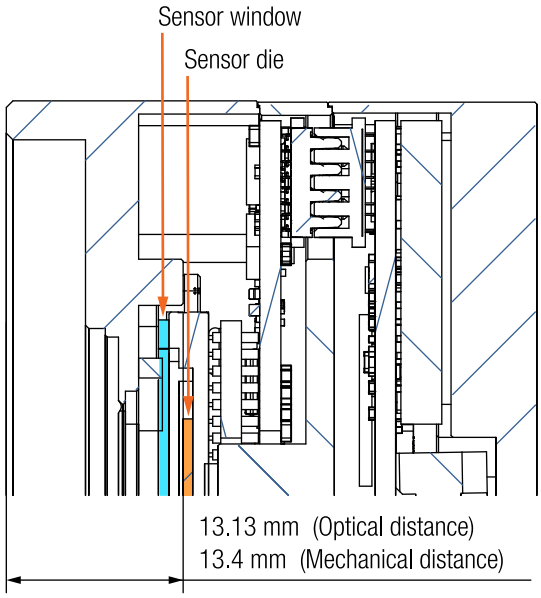


Figure 11: Cross section of CB013/019/160xG-LX-X8G3 camera models

Sensor window	Value
Thickness	0.8 mm

Table 15: Sensor window details

Cross-section corresponding to:
CB024CG-GP-X8G3-SFF CB024MG-GP-X8G3-SFF

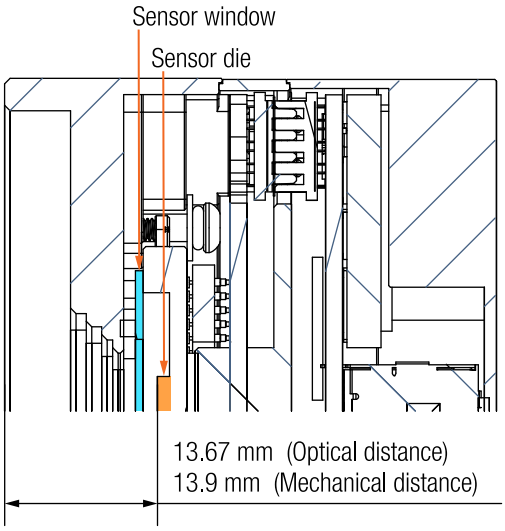


Figure 12: Cross section of CB024xG-GP-X8G3-SFF

Sensor window	Value
Thickness	0.7 mm

Table 16: Sensor window details

Cross-section corresponding to:
CB100CG-GP-X8G3-SFF CB100MG-GP-X8G3-SFF

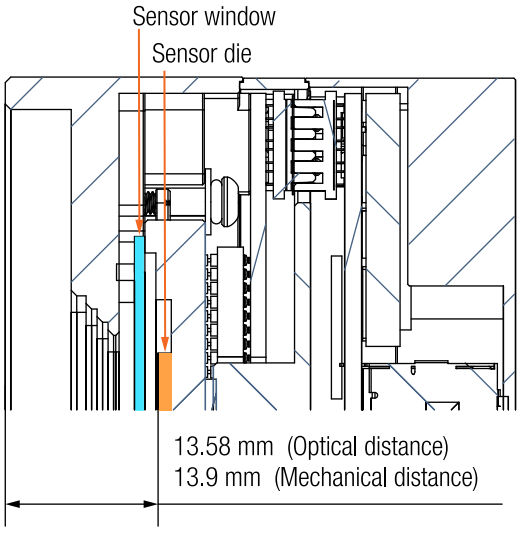


Figure 13: Cross section of CB100xG-GP-X8G3-SFF

Sensor window	Value
Thickness	0.95 mm (+/- 0.05 mm)

Table 17: Sensor window details

Cross-section corresponding to:

CB120CG-CM-X8G3 CB120MG-CM-X8G3 CB120RG-CM-X8G3

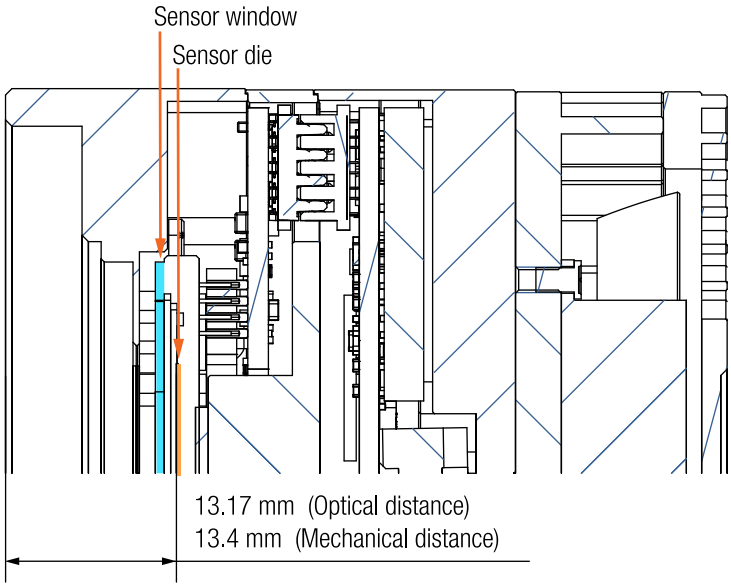


Figure 14: Cross section of CB120xG-CM-X8G3 camera models

Sensor window	Value
Thickness	0.7 mm (+/- 0.05 mm)

Table 18: Sensor window details

Cross-section corresponding to:

CB160CG-LX-X8G3 CB160MG-LX-X8G3

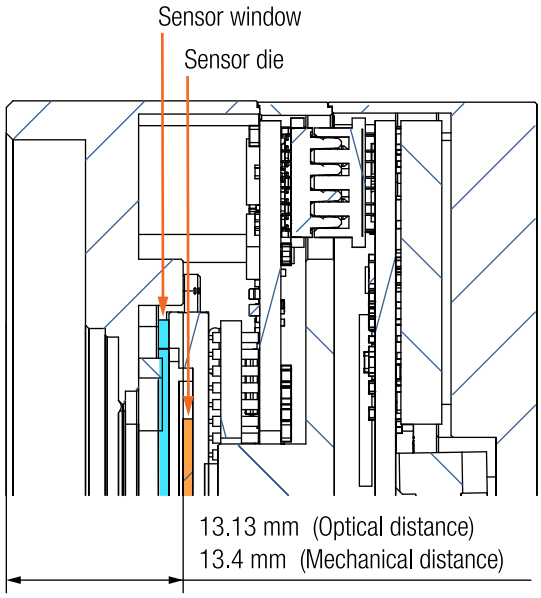


Figure 15: Cross section of CB013/019/160xG-LX-X8G3 camera models

Sensor window	Value
Thickness	0.7 mm

Table 19: Sensor window details

Cross-section corresponding to:
CB209CG-GP-X8G3-SFF CB209MG-GP-X8G3-SFF

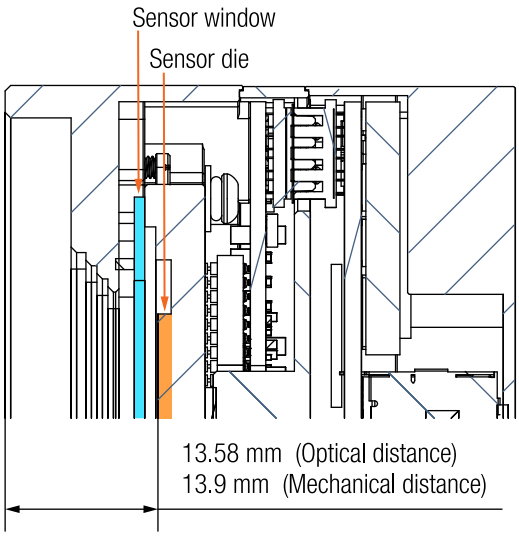


Figure 16: Cross section of CB209xG-GP-X8G3-SFF

Sensor window	Value
Thickness	0.95 mm (+/- 0.05 mm)

Table 20: Sensor window details

Cross-section corresponding to:
CB262CG-GP-X8G3 CB262MG-GP-X8G3 CB262RG-GP-X8G3

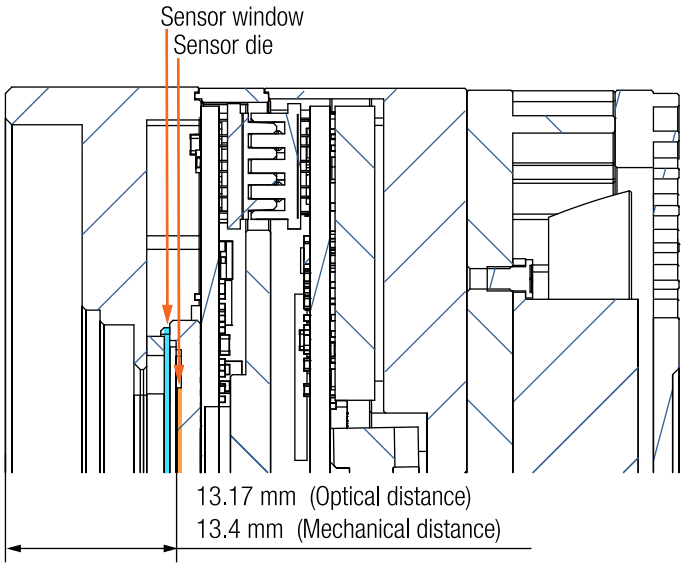


Figure 17: Cross section of CB262xG-GP-X8G3 camera models

Sensor window	Value
Thickness	0.7 mm (+/- 0.05 mm)

Table 21: Sensor window details

Cross-section corresponding to:
CB654CG-GP-X8G3 CB654MG-GP-X8G3

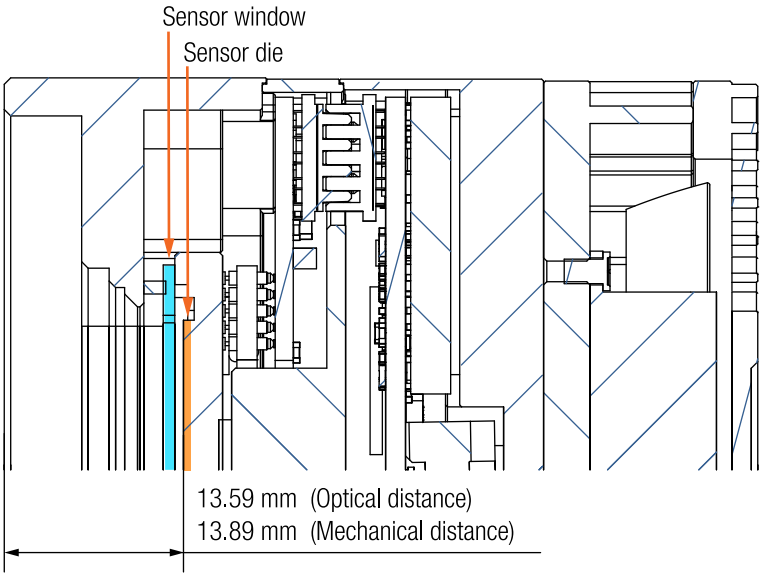


Figure 18: Cross section of CB654xG-GP-X8G3 camera models

Sensor window	Value
Thickness	0.90 mm (+/- 0.345 mm)

Table 22: Sensor window details

The following text applies to:
all models in this manual (refer to the table Models and sensors overview)

Ximea does not add any filter window. All windows are provided by the sensor vendor.

2.6 Sensor and camera characteristics

2.6.1 Sensor and camera parameters

Sensor parameters of:
CB013CG-LX-X8G3 CB013MG-LX-X8G3

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	1280 x 864	[px]
Active area size (H X V)	17.5 x 11.8	[mm]
Sensor diagonal	21.2	[mm]
Pixel size (H x V)	13.7 x 13.7	[µm]

Table 23: Sensor parameters of the specific models

Sensor parameters of:
CB019CG-LX-X8G3 CB019MG-LX-X8G3

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	1920 x 1080	[px]
Active area size (H X V)	19.2 x 10.8	[mm]
Sensor diagonal	22.0	[mm]
Pixel size (H x V)	10 x 10	[µm]

Table 24: Sensor parameters of the specific models

Sensor parameters of:
CB024CG-GP-X8G3-SFF CB024MG-GP-X8G3-SFF

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	2048 x 1216	[px]
Active area size (H X V)	5.5 x 9.2	[mm]
Sensor diagonal	10.7	[mm]
Pixel size (H x V)	4.5 x 4.5	[µm]

Table 25: Sensor parameters of the specific models

Sensor parameters of:
CB100CG-GP-X8G3-SFF CB100MG-GP-X8G3-SFF

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	4608 x 2176	[px]
Active area size (H X V)	20.7 x 9.8	[mm]
Sensor diagonal	22.9	[mm]
Pixel size (H x V)	4.5 x 4.5	[µm]

Table 26: Sensor parameters of the specific models

Sensor parameters of:
CB120CG-CM-X8G3 CB120MG-CM-X8G3 CB120RG-CM-X8G3

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	4096 x 3072	[px]
Active area size (H X V)	22.5 x 16.9	[mm]
Sensor diagonal	28.2	[mm]
Pixel size (H x V)	5.5 x 5.5	[µm]

Table 27: Sensor parameters of the specific models

Sensor parameters of:
CB160CG-LX-X8G3 CB160MG-LX-X8G3

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	4704 x 3424	[px]
Active area size (H X V)	18.3 x 13.3	[mm]
Sensor diagonal	22.7	[mm]
Pixel size (H x V)	3.9 x 3.9	[µm]

Table 28: Sensor parameters of the specific models

Sensor parameters of:
CB209CG-GP-X8G3-SFF CB209MG-GP-X8G3-SFF

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	5120 x 4096	[px]
Active area size (H X V)	23 x 18.4	[mm]
Sensor diagonal	29.5	[mm]
Pixel size (H x V)	4.5 x 4.5	[µm]

Table 29: Sensor parameters of the specific models

Sensor parameters of:
CB262CG-GP-X8G3 CB262MG-GP-X8G3 CB262RG-GP-X8G3

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	5120 x 5120	[px]
Active area size (H X V)	12.8 x 12.8	[mm]
Sensor diagonal	18.1	[mm]
Pixel size (H x V)	2.5 x 2.5	[µm]

Table 30: Sensor parameters of the specific models

Sensor parameters of:
CB654CG-GP-X8G3 CB654MG-GP-X8G3

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	9344 x 7000	[px]
Active area size (H X V)	29.9 x 22.4	[mm]
Sensor diagonal	37.4	[mm]
Pixel size (H x V)	3.2 x 3.2	[µm]

Table 31: Sensor parameters of the specific models

2.6.2 Image quality parameters

The image quality parameters listed below represent typical values for these camera models. Minor variations may occur between different units of the same model.

Image quality parameters of:
CB013CG-LX-X8G3

Mode		10 bit
Sensor bit/px	[bit/px]	10
Analog gain	[dB]	None
Parameters		
Temporal dark noise	[e^-]	42.35
Absolute sensitivity threshold	[e^-]	42.85
Saturation capacity	[ke^-]	21.2
Dynamic range	[dB]	53.76
MAX Signal-to-noise ratio	[dB]	42.27
Overall system gain	[e^-/DN]	22.67
Dark current	[e^-/s]	1037.54
Dark current meas. temp.	[°C]	41.4
DSNU	[e^-]	97.04
PRNU	[%]	1.43
Linearity error	[%]	8.21

Table 32: Image quality parameters of the specific models

Image quality parameters of:
CB013MG-LX-X8G3

Mode		10 bit
Sensor bit/px	[bit/px]	10
Analog gain	[dB]	None
Parameters		
Temporal dark noise	[e^-]	36.48
Absolute sensitivity threshold	[e^-]	36.98
Saturation capacity	[ke^-]	19.29
Dynamic range	[dB]	53.9
MAX Signal-to-noise ratio	[dB]	42.06
Overall system gain	[e^-/DN]	21.19
Dark current	[e^-/s]	3353.87
Dark current meas. temp.	[°C]	41.9
DSNU	[e^-]	93.15
PRNU	[%]	2.96
Linearity error	[%]	7.63

Table 33: Image quality parameters of the specific models

Image quality parameters of:
CB019CG-LX-X8G3

Mode		10 bit
Sensor bit/px	[bit/px]	10
Analog gain	[dB]	None
Parameters		
Temporal dark noise	[e^-]	20.26
Absolute sensitivity threshold	[e^-]	20.76
Saturation capacity	[ke^-]	12.16
Dynamic range	[dB]	57.17
MAX Signal-to-noise ratio	[dB]	39.36
Overall system gain	[e^-/DN]	15.43
Dark current	[e^-/s]	1288.73
Dark current meas. temp.	[°C]	42.8
DSNU	[e^-]	41.0
PRNU	[%]	1.34
Linearity error	[%]	12.19

Table 34: Image quality parameters of the specific models

Image quality parameters of:
CB019MG-LX-X8G3

Mode		10 bit
Sensor bit/px	[bit/px]	10
Analog gain	[dB]	None
Parameters		
Temporal dark noise	[e^-]	25.28
Absolute sensitivity threshold	[e^-]	25.78
Saturation capacity	[ke^-]	13.87
Dynamic range	[dB]	53.84
MAX Signal-to-noise ratio	[dB]	41.38
Overall system gain	[e^-/DN]	15.25
Dark current	[e^-/s]	1476.07
Dark current meas. temp.	[°C]	41.3
DSNU	[e^-]	72.57
PRNU	[%]	1.33
Linearity error	[%]	9.48

Table 35: Image quality parameters of the specific models

Image quality parameters of:
CB024CG-GP-X8G3-SFF CB024MG-GP-X8G3-SFF

Mode		8 bit	10 bit	12 bit
Sensor bit/px	[bit/px]	None	None	None
Parameters				
Temporal dark noise	[e^-]	95.97	33.52	17.19
Absolute sensitivity threshold	[e^-]	96.47	34.02	17.69
Saturation capacity	[ke^-]	29.24	28.49	30.56
Dynamic range	[dB]	49.63	58.46	64.75
MAX Signal-to-noise ratio	[dB]	43.63	44.48	44.93
Overall system gain	[e^-/DN]	123.1	29.78	8.07
Dark current	[e^-/s]	167.27	5.13	6.59
Dark current meas. temp.	[°C]	None	None	None
DSNU	[e^-]	25.5	7.31	3.21
PRNU	[%]	0.77	0.74	0.7
Linearity error	[%]	0.58	1.06	0.35

Table 36: Image quality parameters of the specific models

Image quality parameters of:
CB100CG-GP-X8G3-SFF CB100MG-GP-X8G3-SFF

Mode		8 bit Full Res.	10 bit Full Res.	12 bit Full Res.	12 bit 12dB gain Full Res.	8 bit Bin 2x2	12 bit Bin 2x2
Sens.Bin. (H x V)	-	None	None	None	None	None	None
Sensor bit/px	[bit/px]	None	None	None	None	None	None
Parameters							
Temporal dark noise	[e^-]	108.46	39.14	18.39	3.99	555.37	68.56
Absolute sensitivity threshold	[e^-]	108.96	39.64	18.89	4.49	555.87	69.06
Saturation capacity	[ke^-]	31.9	32.71	32.52	7.76	159.77	134.42
Dynamic range	[dB]	49.33	58.33	64.72	64.75	49.17	65.78
MAX Signal-to-noise ratio	[dB]	43.85	45.15	45.29	39.06	46.88	51.58
Overall system gain	[e^-/DN]	138.48	34.33	8.54	2.06	690.79	40.38
Dark current	[e^-/s]	19.58	19.86	8.39	9.79	1755.01	72.32
Dark current meas. temp.	[°C]	None	None	None	None	None	None
DSNU	[e^-]	50.72	9.57	4.97	1.33	174.48	22.45
PRNU	[%]	0.66	0.56	0.54	0.95	0.55	0.42
Linearity error	[%]	0.33	0.33	0.3	2.31	2.46	2.51

Table 37: Image quality parameters of the specific models

Image quality parameters of:
CB120CG-CM-X8G3

Mode		12 bit
Sensor bit/px	[bit/px]	12
Parameters		
Temporal dark noise	[e^-]	13.28
Absolute sensitivity threshold	[e^-]	13.78
Saturation capacity	[ke^-]	9.38
Dynamic range	[dB]	56.76
MAX Signal-to-noise ratio	[dB]	40.22
Overall system gain	[e^-/DN]	2.77
Dark current	[e^-/s]	642.58
Dark current meas. temp.	[°C]	48.6
DSNU	[e^-]	37.93
PRNU	[%]	1.89
Linearity error	[%]	2.63

Table 38: Image quality parameters of the specific models

Image quality parameters of:
CB120MG-CM-X8G3

Mode		12 bit
Sensor bit/px	[bit/px]	12
Parameters		
Temporal dark noise	[e^-]	13.35
Absolute sensitivity threshold	[e^-]	13.85
Saturation capacity	[ke^-]	9.9
Dynamic range	[dB]	57.05
MAX Signal-to-noise ratio	[dB]	40.38
Overall system gain	[e^-/DN]	2.89
Dark current	[e^-/s]	601.57
Dark current meas. temp.	[°C]	49.5
DSNU	[e^-]	34.03
PRNU	[%]	1.67
Linearity error	[%]	3.05

Table 39: Image quality parameters of the specific models

Image quality parameters of:
CB120RG-CM-X8G3

Mode		12 bit
Sensor bit/px	[bit/px]	12
Parameters		
Temporal dark noise	[e^-]	13.77
Absolute sensitivity threshold	[e^-]	14.27
Saturation capacity	[ke^-]	10.34
Dynamic range	[dB]	57.07
MAX Signal-to-noise ratio	[dB]	40.52
Overall system gain	[e^-/DN]	3.05
Dark current	[e^-/s]	488.67
Dark current meas. temp.	[°C]	48.1
DSNU	[e^-]	24.54
PRNU	[%]	1.71
Linearity error	[%]	2.02

Table 40: Image quality parameters of the specific models

Image quality parameters of:
CB160CG-LX-X8G3

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e^-]	8.96
Absolute sensitivity threshold	[e^-]	9.46
Saturation capacity	[ke^-]	7.21
Dynamic range	[dB]	57.64
MAX Signal-to-noise ratio	[dB]	38.96
Overall system gain	[e^-/DN]	7.83
Dark current	[e^-/s]	982.69
Dark current meas. temp.	[°C]	40.0
DSNU	[e^-]	81.88
PRNU	[%]	2.24
Linearity error	[%]	2.93

Table 41: Image quality parameters of the specific models

Image quality parameters of:
CB160MG-LX-X8G3

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e^-]	9.16
Absolute sensitivity threshold	[e^-]	9.66
Saturation capacity	[ke^-]	7.21
Dynamic range	[dB]	58.15
MAX Signal-to-noise ratio	[dB]	39.16
Overall system gain	[e^-/DN]	7.82
Dark current	[e^-/s]	1043.09
Dark current meas. temp.	[°C]	42.9
DSNU	[e^-]	76.05
PRNU	[%]	2.32
Linearity error	[%]	3.61

Table 42: Image quality parameters of the specific models

Image quality parameters of:
CB209CG-GP-X8G3-SFF CB209MG-GP-X8G3-SFF

Mode		8 bit Full Res.	10 bit Full Res.	12 bit Full Res.	12 bit Bin 2x2
Sens.Bin. (H x V)	-	None	None	None	None
Sensor bit/px	[bit/px]	None	None	None	None
Parameters					
Temporal dark noise	[e^-]	101.23	35.85	18.28	68.15
Absolute sensitivity threshold	[e^-]	101.73	36.35	18.78	68.65
Saturation capacity	[ke^-]	28.71	30.16	32.67	139.49
Dynamic range	[dB]	49.01	58.38	64.81	66.16
MAX Signal-to-noise ratio	[dB]	43.25	44.79	45.33	51.8
Overall system gain	[e^-/DN]	126.93	31.5	8.59	40.55
Dark current	[e^-/s]	226.5	9.9	7.78	56.73
Dark current meas. temp.	[°C]	None	None	None	None
DSNU	[e^-]	40.04	7.57	3.84	14.7
PRNU	[%]	0.87	0.8	0.78	0.5
Linearity error	[%]	1.02	0.98	0.51	2.03

Table 43: Image quality parameters of the specific models

Image quality parameters of:
CB262CG-GP-X8G3

Mode		10 bit	12 bit
Sensor bit/px	[bit/px]	10	12
Parameters			
Temporal dark noise	[e^-]	3.62	2.66
Absolute sensitivity threshold	[e^-]	4.12	3.16
Saturation capacity	[ke^-]	4.4	4.53
Dynamic range	[dB]	60.57	63.14
MAX Signal-to-noise ratio	[dB]	37.26	35.63
Overall system gain	[e^-/DN]	4.64	1.18
Dark current	[e^-/s]	3.77	4.35
Dark current meas. temp.	[°C]	42.2	43.1
DSNU	[e^-]	17.5	0.99
PRNU	[%]	1.21	1.06
Linearity error	[%]	1.19	0.35

Table 44: Image quality parameters of the specific models

Image quality parameters of:
CB262MG-GP-X8G3

Mode		12 bit
Sensor bit/px	[bit/px]	12
Parameters		
Temporal dark noise	[e^-]	2.68
Absolute sensitivity threshold	[e^-]	3.18
Saturation capacity	[ke^-]	4.53
Dynamic range	[dB]	63.01
MAX Signal-to-noise ratio	[dB]	35.58
Overall system gain	[e^-/DN]	1.19
Dark current	[e^-/s]	8.77
Dark current meas. temp.	[°C]	45.1
DSNU	[e^-]	0.99
PRNU	[%]	0.86
Linearity error	[%]	0.46

Table 45: Image quality parameters of the specific models

Image quality parameters of:
CB262RG-GP-X8G3

Mode		12 bit
Sensor bit/px	[bit/px]	12
Parameters		
Temporal dark noise	[e^-]	2.62
Absolute sensitivity threshold	[e^-]	3.12
Saturation capacity	[ke^-]	4.58
Dynamic range	[dB]	63.38
MAX Signal-to-noise ratio	[dB]	35.68
Overall system gain	[e^-/DN]	1.2
Dark current	[e^-/s]	11.95
Dark current meas. temp.	[°C]	44.6
DSNU	[e^-]	0.99
PRNU	[%]	1.1
Linearity error	[%]	0.42

Table 46: Image quality parameters of the specific models

Image quality parameters of:
CB654CG-GP-X8G3

Mode		12 bit
Sensor bit/px	[bit/px]	12
Parameters		
Temporal dark noise	[e^-]	5.45
Absolute sensitivity threshold	[e^-]	5.95
Saturation capacity	[ke^-]	10.24
Dynamic range	[dB]	64.67
MAX Signal-to-noise ratio	[dB]	40.24
Overall system gain	[e^-/DN]	2.7
Dark current	[e^-/s]	11.46
Dark current meas. temp.	[°C]	45.1
DSNU	[e^-]	3.35
PRNU	[%]	1.09
Linearity error	[%]	1.44

Table 47: Image quality parameters of the specific models

Image quality parameters of:
CB654MG-GP-X8G3

Mode		12 bit
Sensor bit/px	[bit/px]	12
Parameters		
Temporal dark noise	[e^-]	5.35
Absolute sensitivity threshold	[e^-]	5.85
Saturation capacity	[ke^-]	10.09
Dynamic range	[dB]	64.79
MAX Signal-to-noise ratio	[dB]	40.19
Overall system gain	[e^-/DN]	2.69
Dark current	[e^-/s]	12.33
Dark current meas. temp.	[°C]	46.8
DSNU	[e^-]	3.48
PRNU	[%]	0.82
Linearity error	[%]	1.43

Table 48: Image quality parameters of the specific models

2.6.3 Sensor read-out modes

Note: Since the minimum and maximum exposure times depend on the sensor read-out mode used, we recommend checking the exposure range in the Camera Model Frame Rate Calculator of the specific model.

Sensor Read-out modes of:
CB013CG-LX-X8G3 CB013MG-LX-X8G3

Downsampling (H x V)	Sensor bit/px	Resolution (W x H)	Transport bit/px	Frame rate[1]
1 x 1	10	1280 x 864	8	3709.3
1 x 1	10	1280 x 864	10	3709.3
1 x 1	10	1280 x 864	12	3709.3
1 x 1	10	1280 x 864	16	3164.8

[1]Frame rate was measured using the transport format at bandwidth limit 7000.0 MB/s

Table 49: Sensor read-out modes of the specific models

Sensor Read-out modes of:
CB019CG-LX-X8G3 CB019MG-LX-X8G3

Downsampling (H x V)	Sensor bit/px	Resolution (W x H)	Transport bit/px	Frame rate[1]
1 x 1	10	1920 x 1080	8	2279.2
1 x 1	10	1920 x 1080	10	2279.2
1 x 1	10	1920 x 1080	12	2250.5
1 x 1	10	1920 x 1080	16	1687.9

[1]Frame rate was measured using the transport format at bandwidth limit 7000.0 MB/s

Table 50: Sensor read-out modes of the specific models

Sensor Read-out modes of:
CB024CG-GP-X8G3-SFF

Downsampling (H x V)	Sensor bit/px	Resolution (W x H)	Transport bit/px	Frame rate[1]
1 x 1	12	2048 x 1216	12	847.0
1 x 1	10	2048 x 1216	10	1754.3
1 x 1	8	2048 x 1216	8	2570.8
Bin.mono 2 x 2	12	1024 x 608	12	2981.7
Bin.mono 2 x 2	10	1024 x 608	10	5855.9
Bin.mono 2 x 2	8	1024 x 608	8	8076.7

[1]Frame rate was measured using the transport format at bandwidth limit 7000.0 MB/s

Table 51: Sensor read-out modes of the specific models

Sensor Read-out modes of:
CB024MG-GP-X8G3-SFF

Downsampling (H x V)	Sensor bit/px	Resolution (W x H)	Transport bit/px	Frame rate[1]
1 x 1	12	2048 x 1216	12	847.0
1 x 1	10	2048 x 1216	10	1754.3
1 x 1	8	2048 x 1216	8	2570.8
Bin.2 x 2	12	1024 x 608	12	2981.7
Bin.2 x 2	10	1024 x 608	10	5855.9
Bin.2 x 2	8	1024 x 608	8	8076.7

[1]Frame rate was measured using the transport format at bandwidth limit 7000.0 MB/s

Table 52: Sensor read-out modes of the specific models

Sensor Read-out modes of:
CB100CG-GP-X8G3-SFF

Downsampling (H x V)	Sensor bit/px	Resolution (W x H)	Transport bit/px	Frame rate[1]
1 x 1	12	4608 x 2176	12	454.6
1 x 1	10	4608 x 2176	10	541.1
1 x 1	8	4608 x 2176	8	668.3
Bin.mono 2 x 2	12	2304 x 1088	12	1688.8
Bin.mono 2 x 2	10	2304 x 1088	10	1967.3
Bin.mono 2 x 2	8	2304 x 1088	8	2355.8

[1]Frame rate was measured using the transport format at bandwidth limit 7000.0 MB/s

Table 53: Sensor read-out modes of the specific models

Sensor Read-out modes of:
CB100MG-GP-X8G3-SFF

Downsampling (H x V)	Sensor bit/px	Resolution (W x H)	Transport bit/px	Frame rate[1]
1 x 1	12	4608 x 2176	12	454.6
1 x 1	10	4608 x 2176	10	541.1
1 x 1	8	4608 x 2176	8	668.3
Bin.2 x 2	12	2304 x 1088	12	1688.8
Bin.2 x 2	10	2304 x 1088	10	1967.3
Bin.2 x 2	8	2304 x 1088	8	2355.8

[1]Frame rate was measured using the transport format at bandwidth limit 7000.0 MB/s

Table 54: Sensor read-out modes of the specific models

Sensor Read-out modes of:
CB120CG-CM-X8G3 CB120MG-CM-X8G3 CB120RG-CM-X8G3

Downsampling (H x V)	Sensor bit/px	Resolution (W x H)	Transport bit/px	Frame rate[1]
1 x 1	8	4096 x 3072	8	335.6
Dec.1 x 2	8	4096 x 1536	8	1068.1
Dec.2 x 2	8	2048 x 1536	8	791.1
Bin.2 x 2	8	2048 x 1536	8	251.0
1 x 1	10	4096 x 3072	10	300.1
Dec.1 x 2	10	4096 x 1536	10	858.8
Dec.2 x 2	10	2048 x 1536	10	1049.5
Bin.2 x 2	10	2048 x 1536	10	267.8
1 x 1	12	4096 x 3072	12	132.1
Dec.1 x 2	12	4096 x 1536	12	519.3
Dec.2 x 2	12	2048 x 1536	12	528.8
Bin.2 x 2	12	2048 x 1536	12	267.1

[1]Frame rate was measured using the transport format at bandwidth limit 7000.0 MB/s

Table 55: Sensor read-out modes of the specific models

Sensor Read-out modes of:
CB160CG-LX-X8G3 CB160MG-LX-X8G3

Downsampling (H x V)	Sensor bit/px	Resolution (W x H)	Transport bit/px	Frame rate[1]
1 x 1	10	4704 x 3424	8	311.5
1 x 1	10	4704 x 3424	10	311.5
1 x 1	10	4704 x 3424	12	289.7

[1]Frame rate was measured using the transport format at bandwidth limit 7000.0 MB/s

Table 56: Sensor read-out modes of the specific models

Sensor Read-out modes of:
CB209CG-GP-X8G3-SFF

Downsampling (H x V)	Sensor bit/px	Resolution (W x H)	Transport bit/px	Frame rate[1]
1 x 1	12	5120 x 4096	12	219.5
1 x 1	10	5120 x 4096	10	262.3
1 x 1	8	5120 x 4096	8	325.8
Bin.mono 2 x 2	12	2560 x 2016	12	856.8
Bin.mono 2 x 2	8	2560 x 2016	8	1233.3

[1]Frame rate was measured using the transport format at bandwidth limit 7000.0 MB/s

Table 57: Sensor read-out modes of the specific models

Sensor Read-out modes of:
CB209MG-GP-X8G3-SFF

Downsampling (H x V)	Sensor bit/px	Resolution (W x H)	Transport bit/px	Frame rate[1]
1 x 1	12	5120 x 4096	12	219.5
1 x 1	10	5120 x 4096	10	262.3
1 x 1	8	5120 x 4096	8	325.8
Bin.2 x 2	12	2560 x 2016	12	856.8
Bin.2 x 2	8	2560 x 2016	8	1233.3

[1]Frame rate was measured using the transport format at bandwidth limit 7000.0 MB/s

Table 58: Sensor read-out modes of the specific models

Sensor Read-out modes of:
CB262CG-GP-X8G3 CB262MG-GP-X8G3 CB262RG-GP-X8G3

Downsampling (H x V)	Sensor bit/px	Resolution (W x H)	Transport bit/px	Frame rate[1]
1 x 1	10	5120 x 5120	10	150.3
Dec.1 x 2	10	5120 x 2560	10	298.8
Dec.1 x 4	10	5120 x 1280	10	590.5
1 x 1	12	5120 x 5120	12	41.8
Dec.1 x 2	12	5120 x 2560	12	83.4
Dec.1 x 4	12	5120 x 1280	12	165.6

[1]Frame rate was measured using the transport format at bandwidth limit 7000.0 MB/s

Table 59: Sensor read-out modes of the specific models

Sensor Read-out modes of:
CB654CG-GP-X8G3 CB654MG-GP-X8G3

Downsampling (H x V)	Sensor bit/px	Resolution (W x H)	Transport bit/px	Frame rate[1]
1 x 1	10	9344 x 7000	10	71.1
Dec.1 x 2	10	9344 x 3500	10	141.6
Dec.1 x 4	10	9344 x 1750	10	280.9
1 x 1	12	9344 x 7000	12	31.6
Dec.1 x 2	12	9344 x 3500	12	62.9
Dec.1 x 4	12	9344 x 1750	12	124.7

[1]Frame rate was measured using the transport format at bandwidth limit 7000.0 MB/s

Table 60: Sensor read-out modes of the specific models

2.6.4 Quantum efficiency curves

Quantum efficiency curves for:
CB013CG-LX-X8G3 CB013MG-LX-X8G3

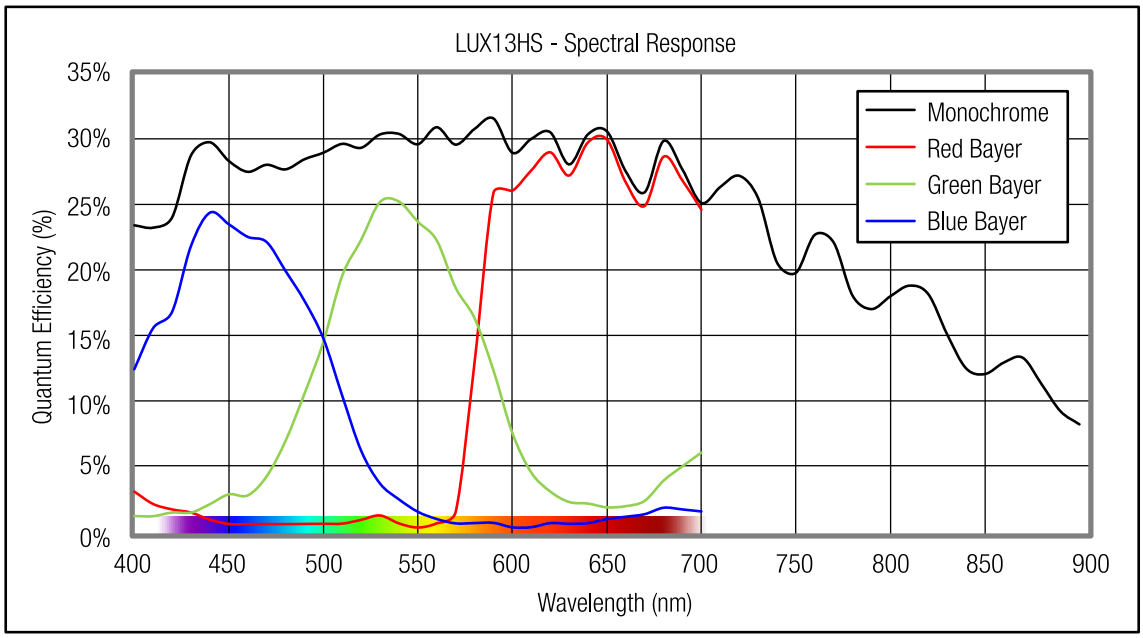


Figure 19: Graph quantum efficiency of LUXIMA LUX13HS

Quantum efficiency curves for:
CB019CG-LX-X8G3 CB019MG-LX-X8G3

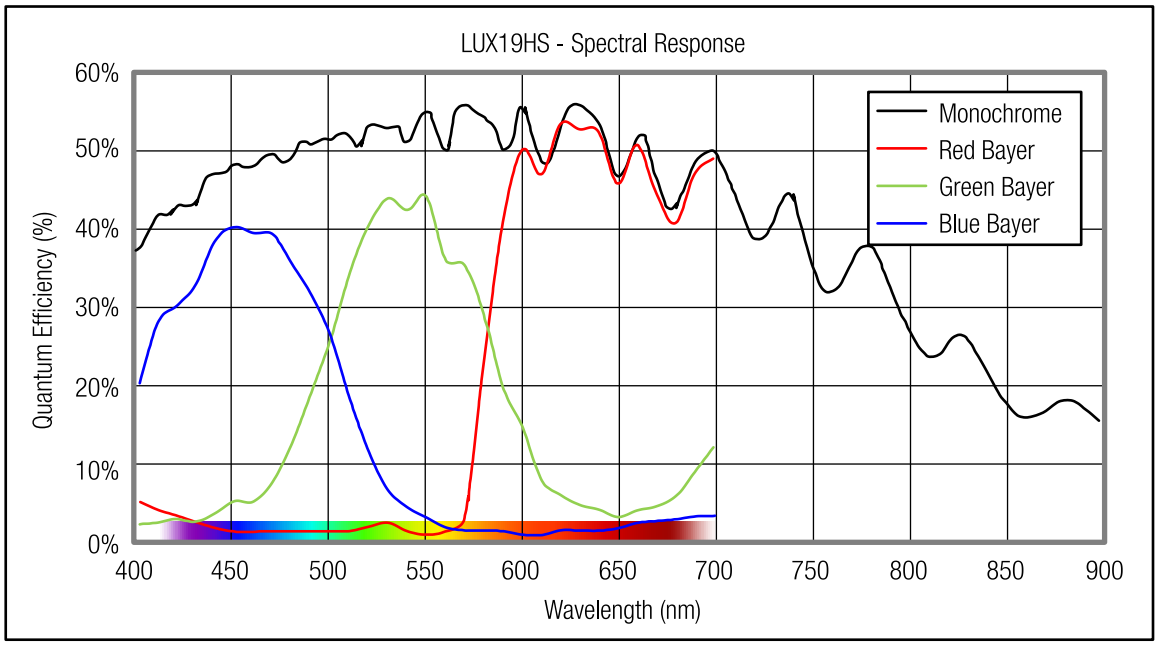


Figure 20: Graph quantum efficiency of LUXIMA LUX19HS

Quantum efficiency curves for:
CB024CG-GP-X8G3-SFF CB024MG-GP-X8G3-SFF

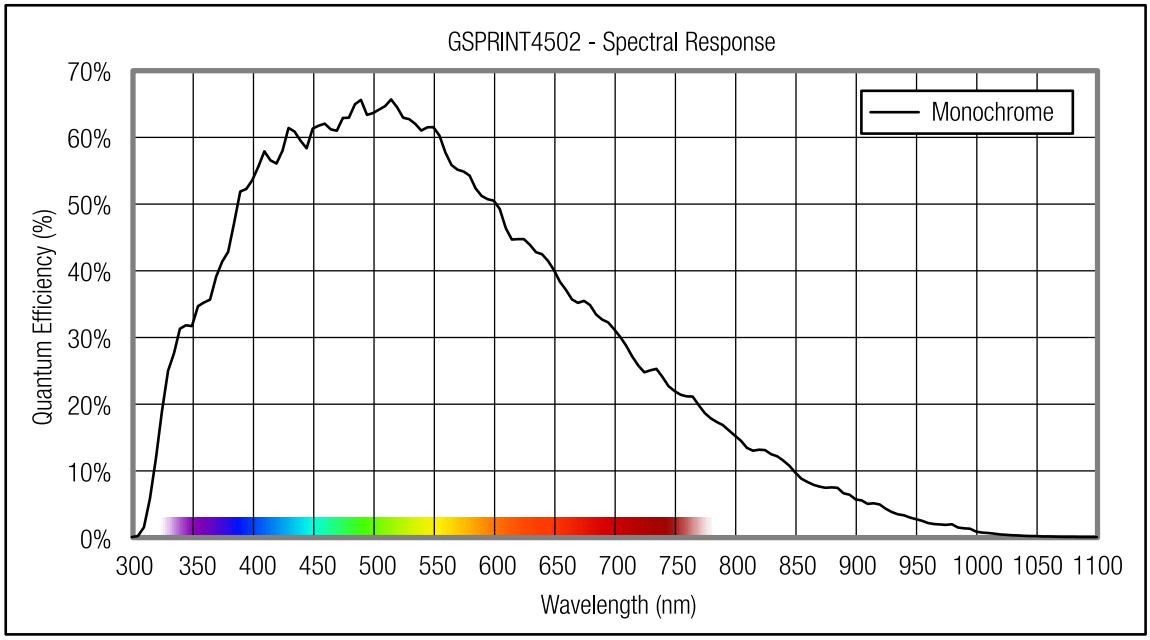


Figure 21: Graph quantum efficiency of GPixel GSPRINT4502

Quantum efficiency curves for:
CB100CG-GP-X8G3-SFF CB100MG-GP-X8G3-SFF

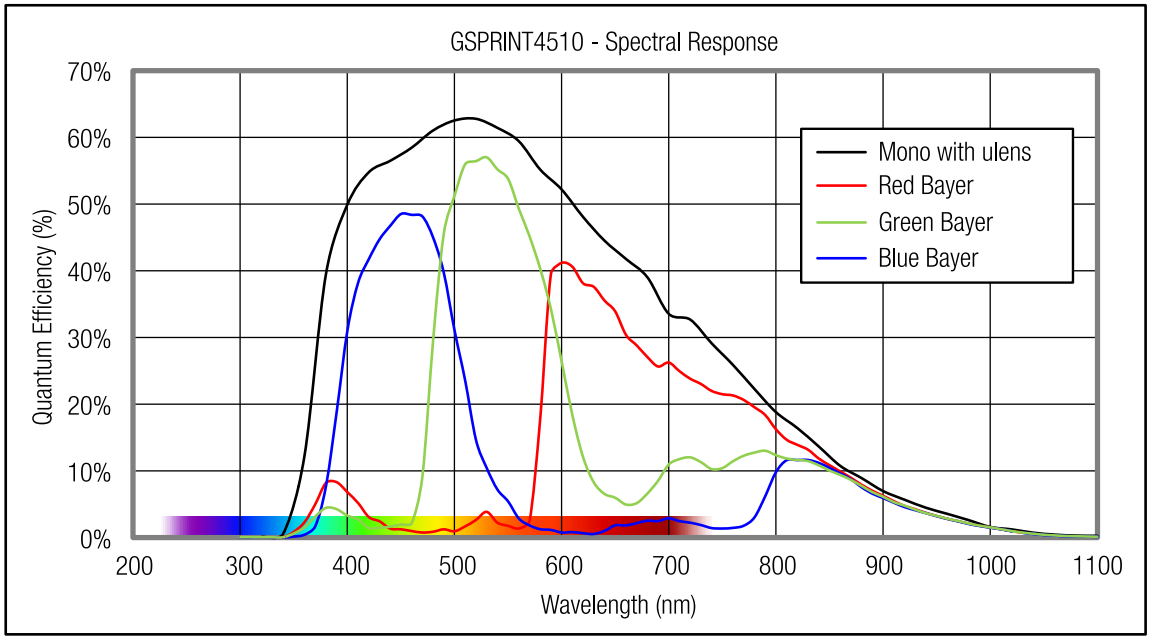


Figure 22: Graph quantum efficiency of GPixel GSPRINT4510.

Quantum efficiency curves for:
CB120CG-CM-X8G3 CB120MG-CM-X8G3 CB120RG-CM-X8G3

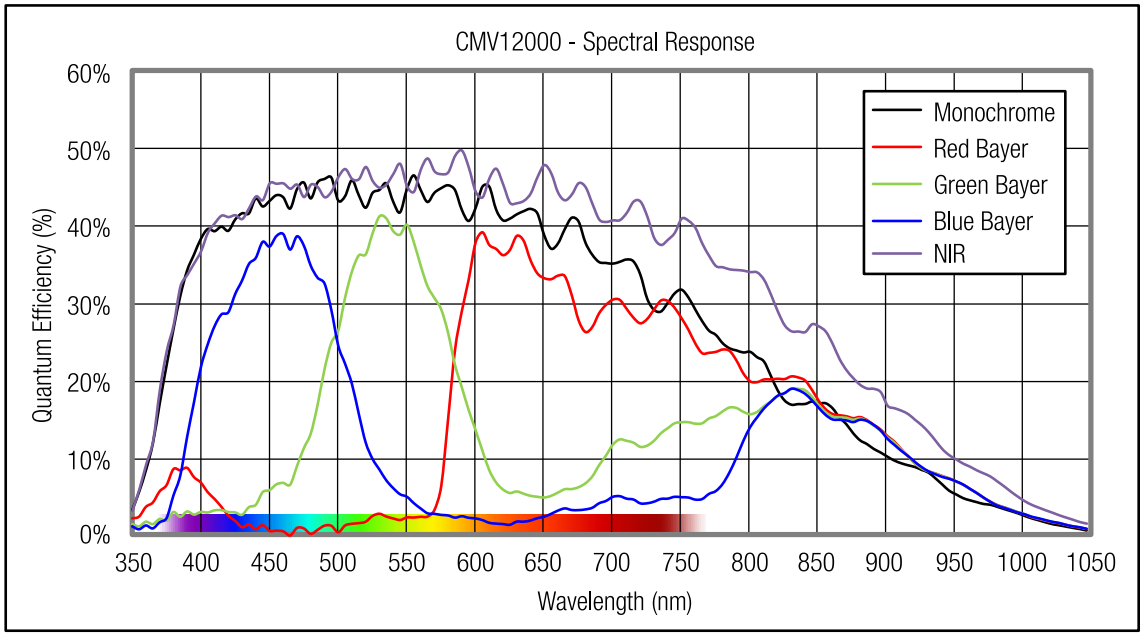


Figure 23: Graph quantum efficiency of CMOSIS CMV12000

Quantum efficiency curves for:
CB160CG-LX-X8G3 CB160MG-LX-X8G3

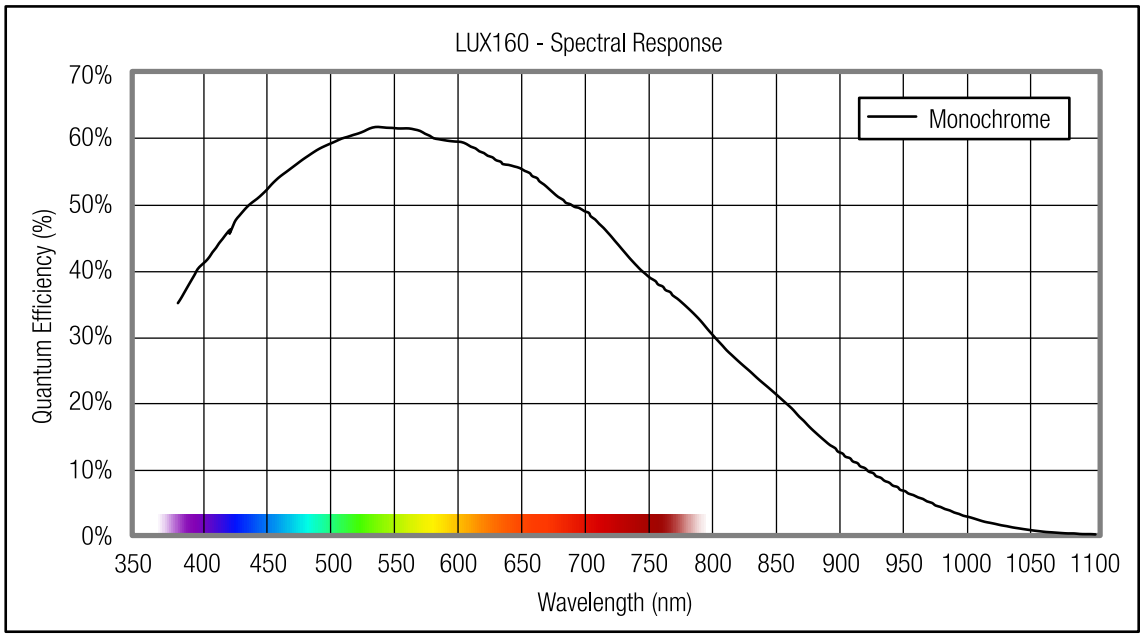


Figure 24: Graph quantum efficiency of LUXIMA LUX160

Quantum efficiency curves for:
CB209CG-GP-X8G3-SFF CB209MG-GP-X8G3-SFF

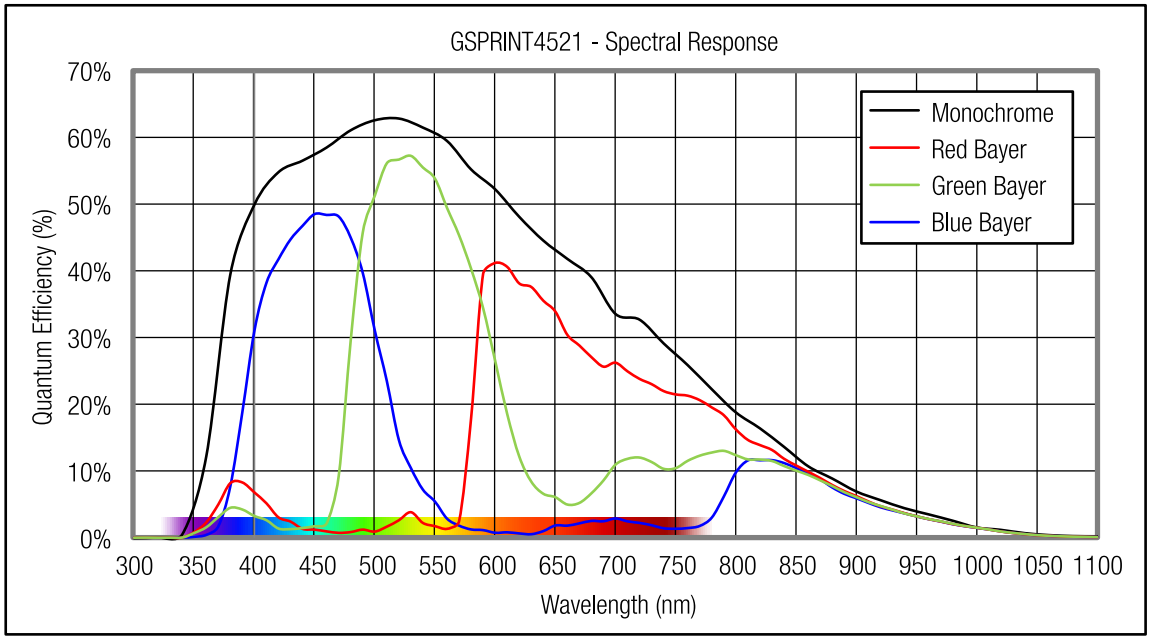


Figure 25: Graph quantum efficiency of GPixel GSPRINT4521

Quantum efficiency curves for:
CB262CG-GP-X8G3 CB262MG-GP-X8G3 CB262RG-GP-X8G3

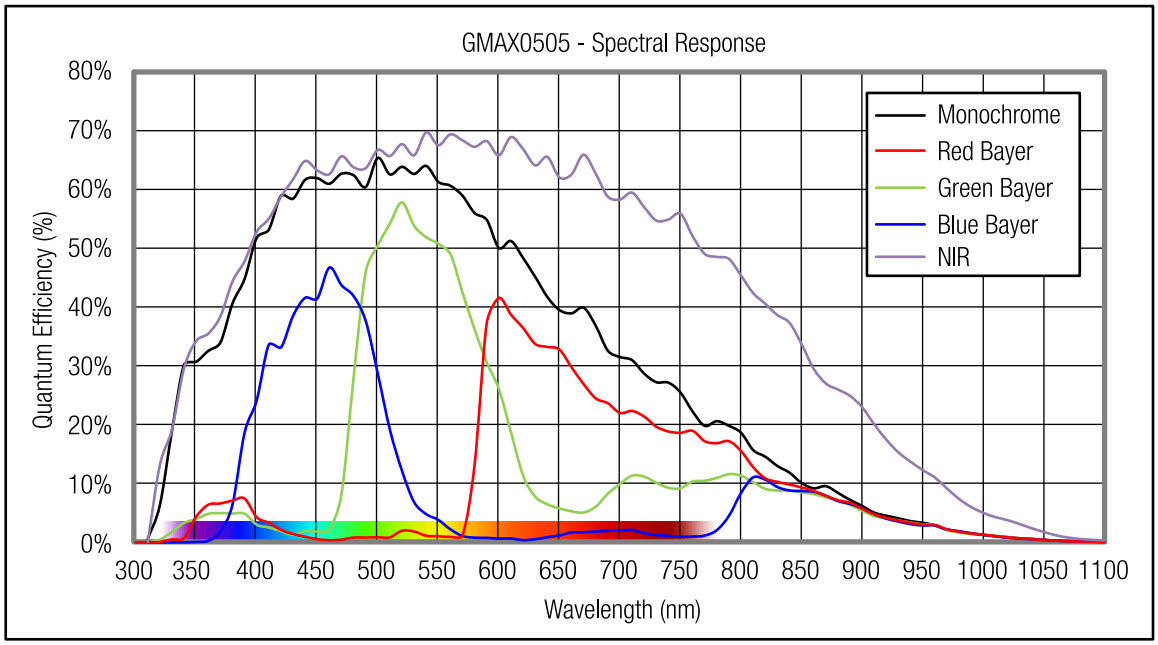


Figure 26: Graph quantum efficiency of GPixel GMAX0505

Quantum efficiency curves for:

CB654CG-GP-X8G3 CB654MG-GP-X8G3

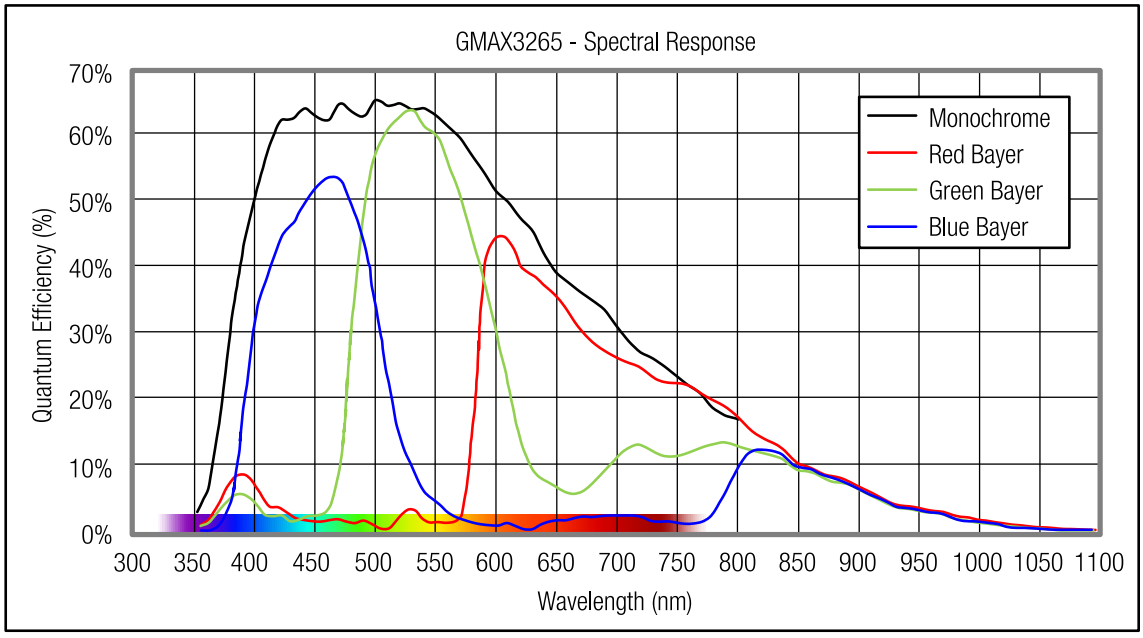


Figure 27: Graph quantum efficiency of GPixel GMAX3265

2.7 Mechanical characteristics

2.7.1 Dimensions and mass

Dimensions and mass of:
CB024CG-GP-X8G3-SFF CB024MG-GP-X8G3-SFF

Width [W]	Height [H]	Depth [D]	Mass[1] [M]
70 mm	65.4 mm	44.7 mm	400 g

[1] without adapters

Table 61: Camera parameters of the specific models

Dimensions and mass of:
CB120CG-CM-X8G3 CB120MG-CM-X8G3 CB120RG-CM-X8G3

Width [W]	Height [H]	Depth [D]	Mass[1] [M]
70 mm	65.4 mm	40 mm	280 g

[1] without adapters

Table 62: Camera parameters of the specific models

Dimensions and mass of:
CB013CG-LX-X8G3 CB013MG-LX-X8G3 CB019CG-LX-X8G3 CB019MG-LX-X8G3
CB160CG-LX-X8G3 CB160MG-LX-X8G3

Width [W]	Height [H]	Depth [D]	Mass[1] [M]
70 mm	65.5 mm	41 mm	268 g

[1] without adapters

Table 63: Camera parameters of the specific models

Dimensions and mass of:
CB100CG-GP-X8G3-SFF CB100MG-GP-X8G3-SFF CB209CG-GP-X8G3-SFF CB209MG-GP-X8G3-SFF

Width [W]	Height [H]	Depth [D]	Mass[1] [M]
70 mm	65.4 mm	46.4 mm	TBD

[1] without adapters

Table 64: Camera parameters of the specific models

Dimensions and mass of:
CB262CG-GP-X8G3 CB262MG-GP-X8G3 CB262RG-GP-X8G3

Width [W]	Height [H]	Depth [D]	Mass[1] [M]
70 mm	65.5 mm	36.1 mm	250 g

[1] without adapters

Table 65: Camera parameters of the specific models

Dimensions and mass of:

CB654CG-GP-X8G3 CB654MG-GP-X8G3

Width [W]	Height [H]	Depth [D]	Mass[1] [M]
70 mm	65.5 mm	41.8 mm	290 g

[1] without adapters

Table 66: Camera parameters of the specific models

2.7.2 Dimensional drawings

Dimensional drawings of:
CB024CG-GP-X8G3-SFF CB024MG-GP-X8G3-SFF

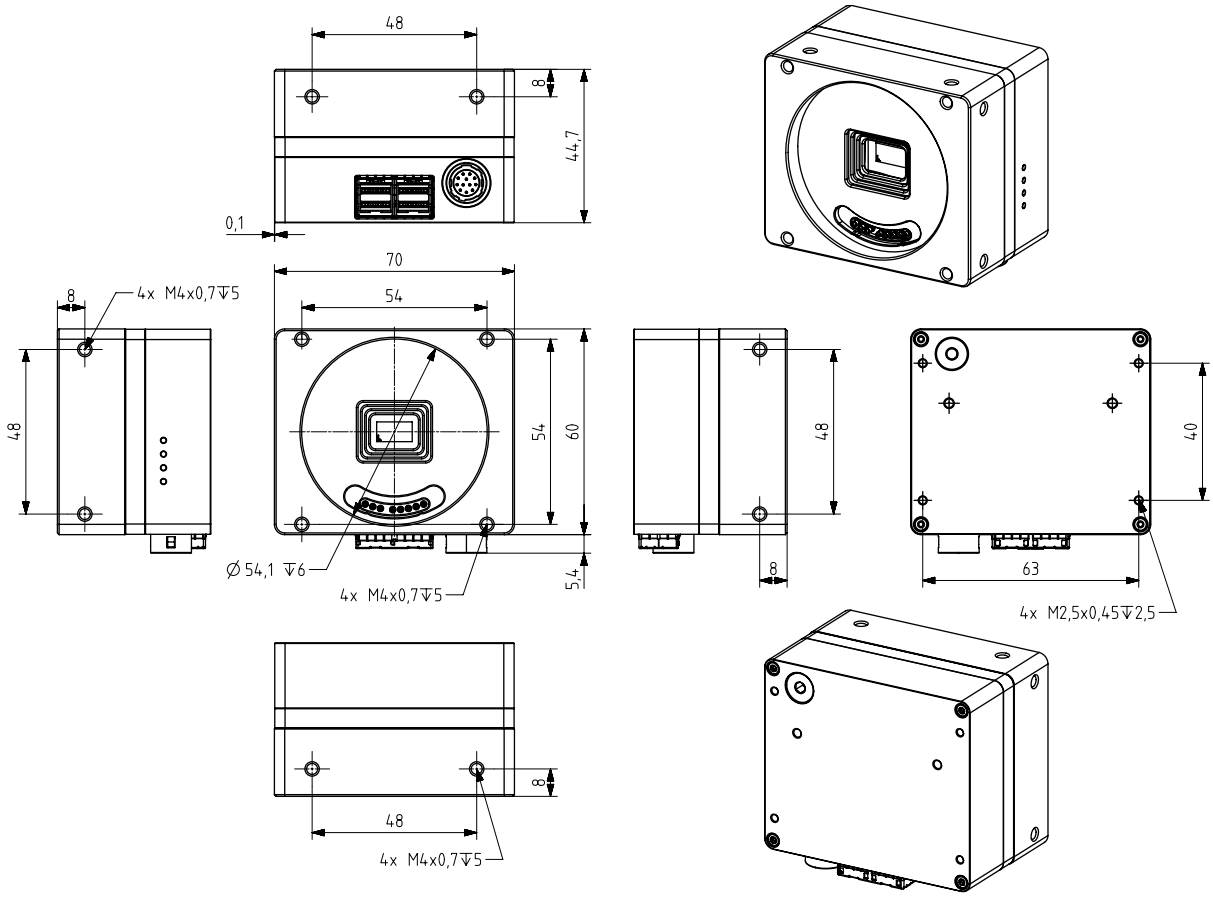


Figure 28: Dimensional drawing of CB024xG-GP-X8G3-SFF

Dimensional drawings of:
CB100CG-GP-X8G3-SFF CB100MG-GP-X8G3-SFF

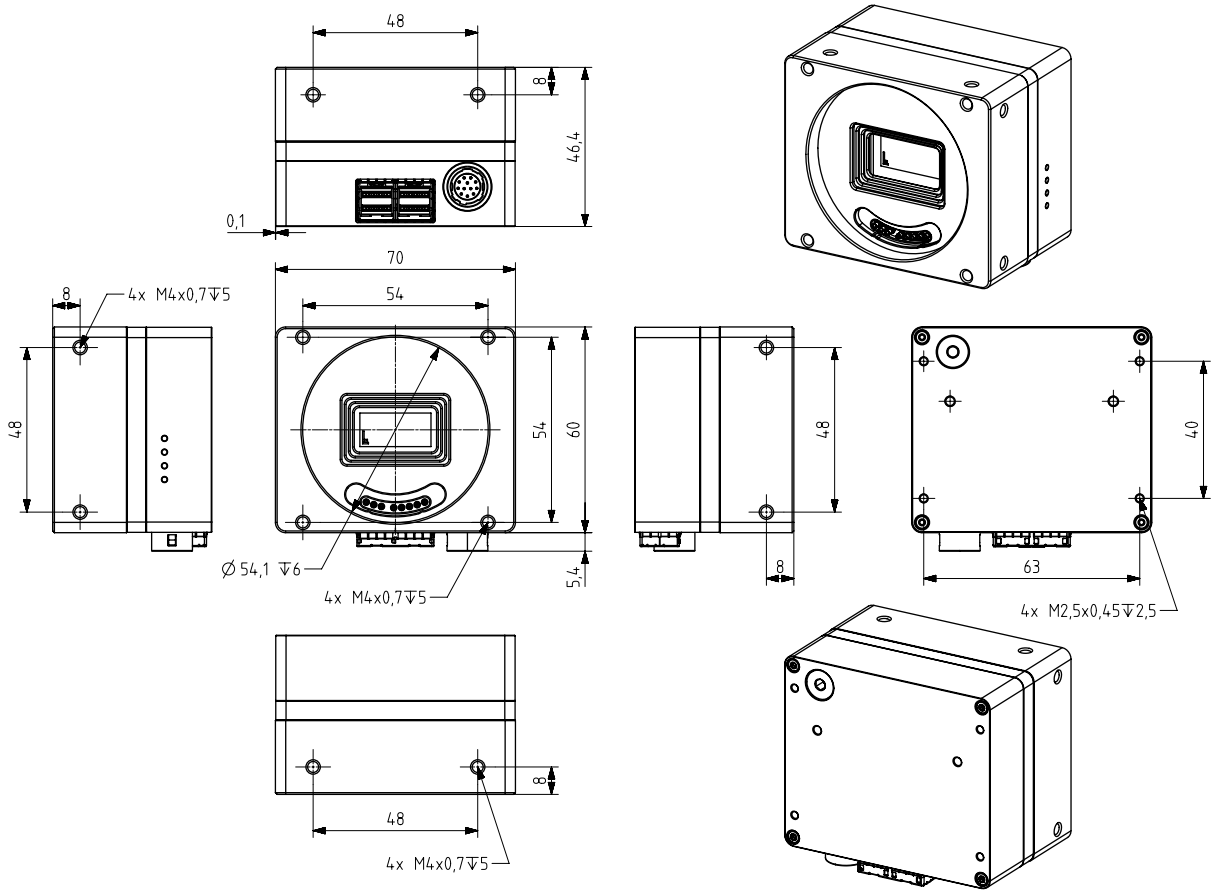


Figure 29: Dimensional drawing of CB100xG-GP-X8G3-SFF

Dimensional drawings of:

CB120CG-CM-X8G3 CB120MG-CM-X8G3 CB120RG-CM-X8G3

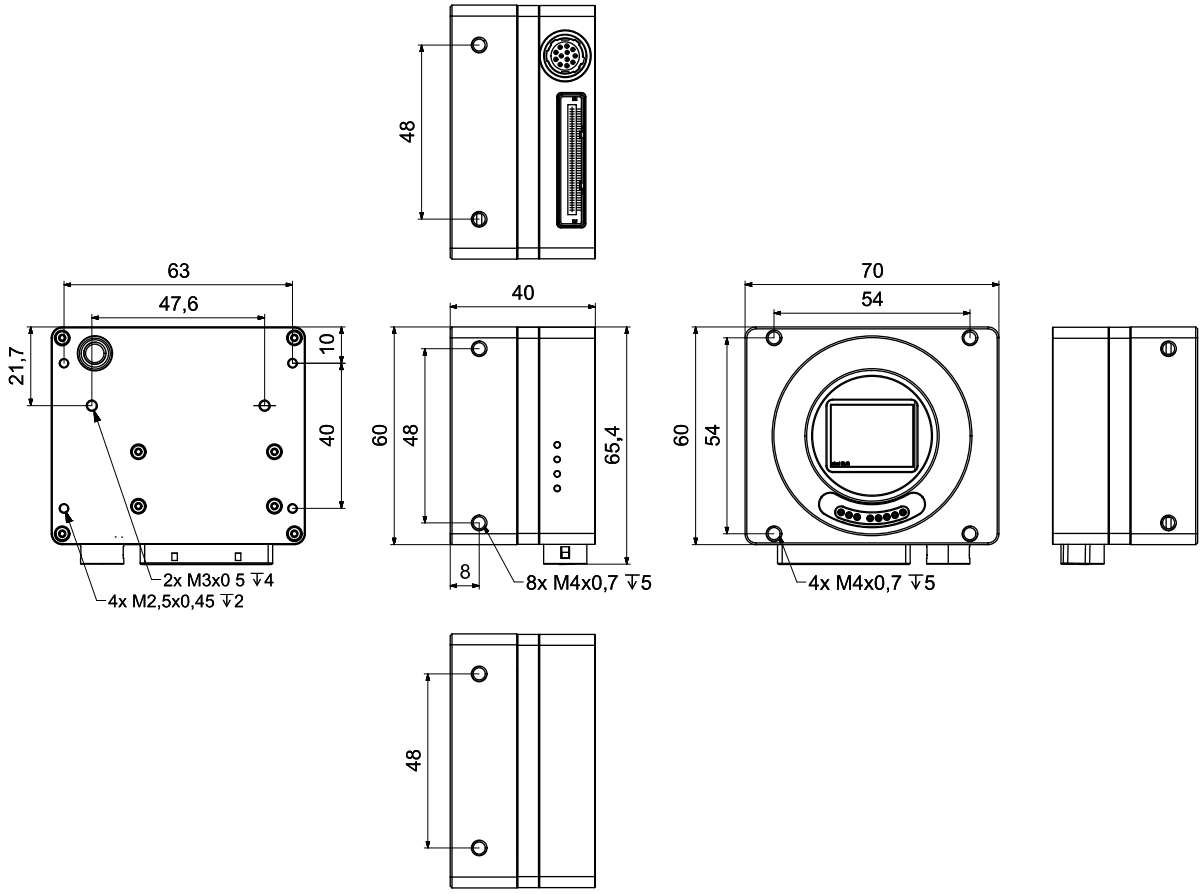


Figure 30: Dimensional drawing of CB120xG-CM-X8G3

Dimensional drawings of:

CB013CG-LX-X8G3 CB013MG-LX-X8G3 CB019CG-LX-X8G3 CB019MG-LX-X8G3
CB160CG-LX-X8G3 CB160MG-LX-X8G3

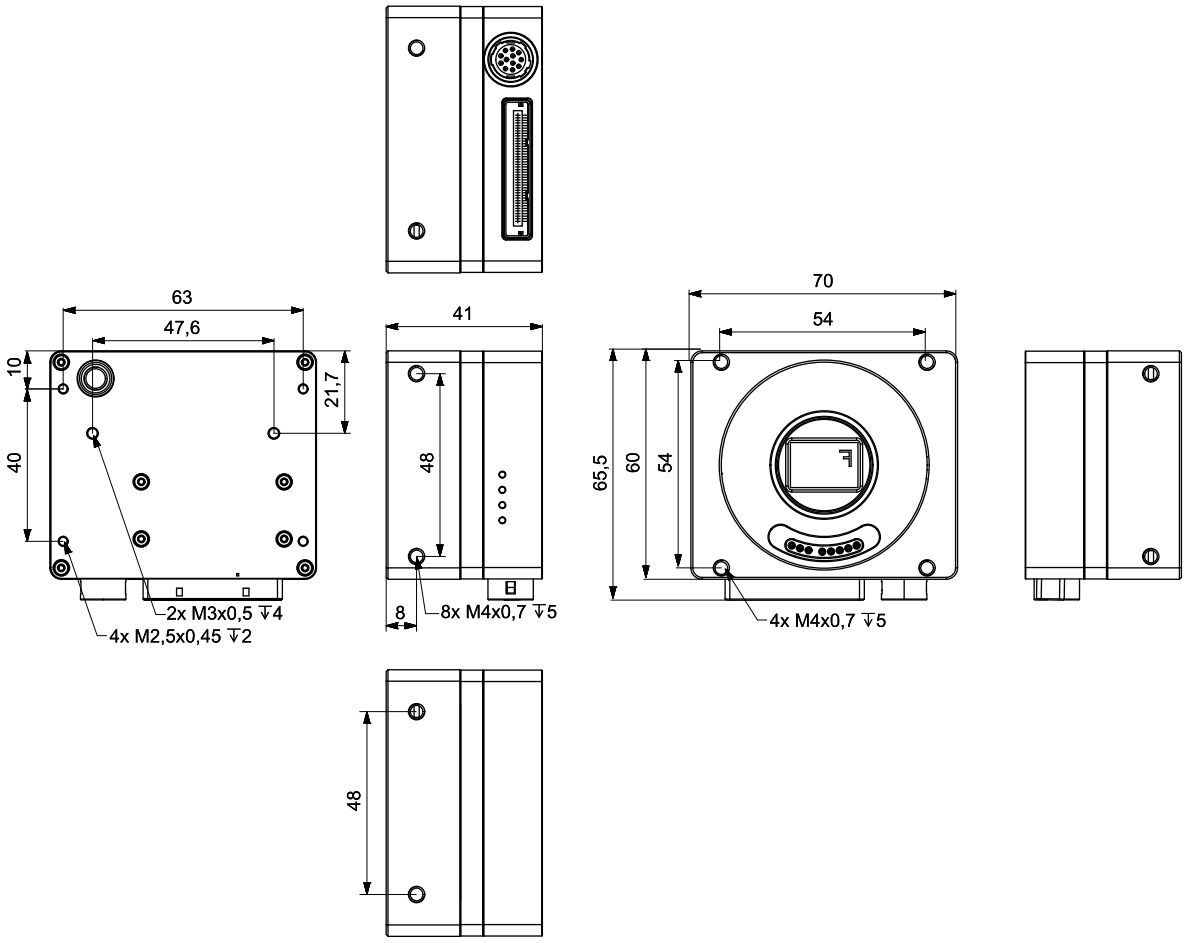


Figure 31: Dimensional drawing of CB013/019/160xG-LX-X8G3

Dimensional drawings of:
CB209CG-GP-X8G3-SFF CB209MG-GP-X8G3-SFF

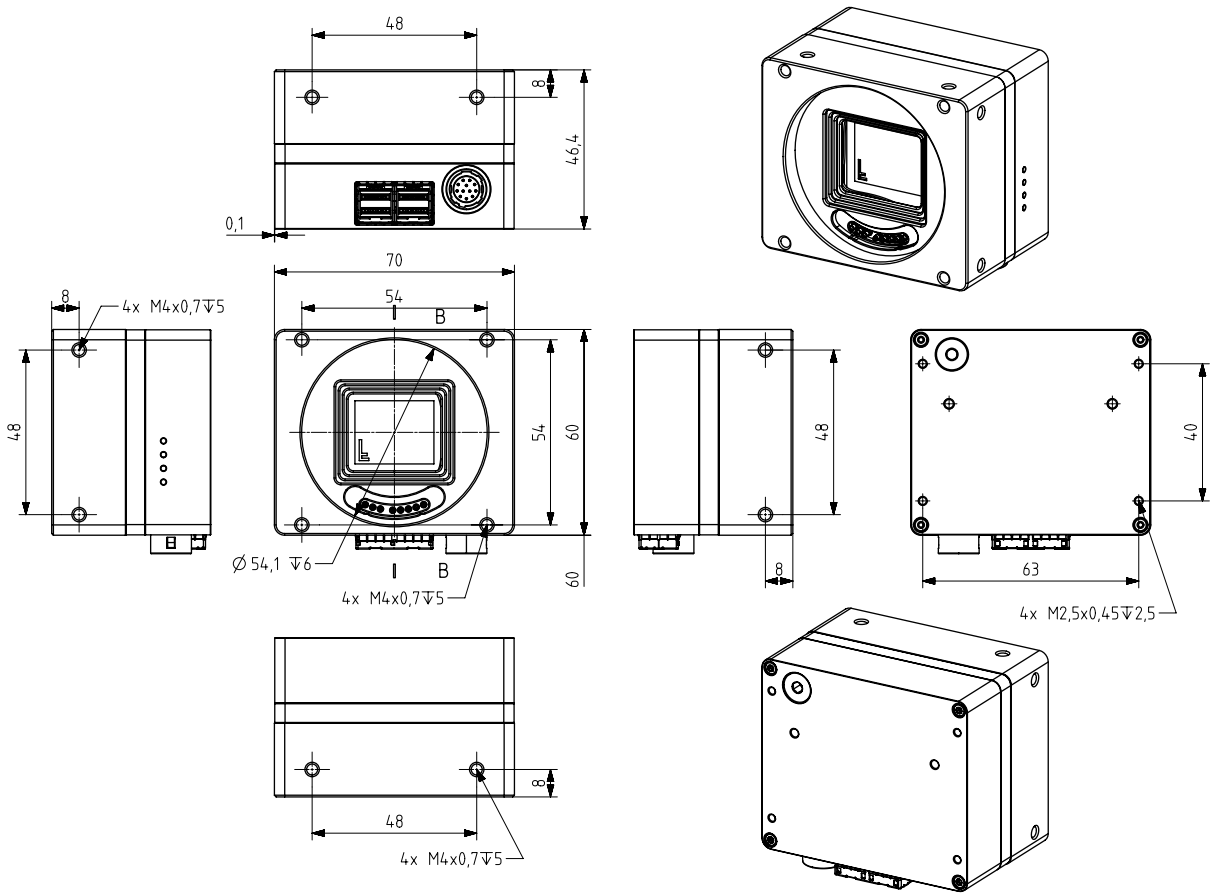


Figure 32: Dimensional drawing of CB209xG-GP-X8G3-SFF

Dimensional drawings of:

CB262CG-GP-X8G3 CB262MG-GP-X8G3 CB262RG-GP-X8G3

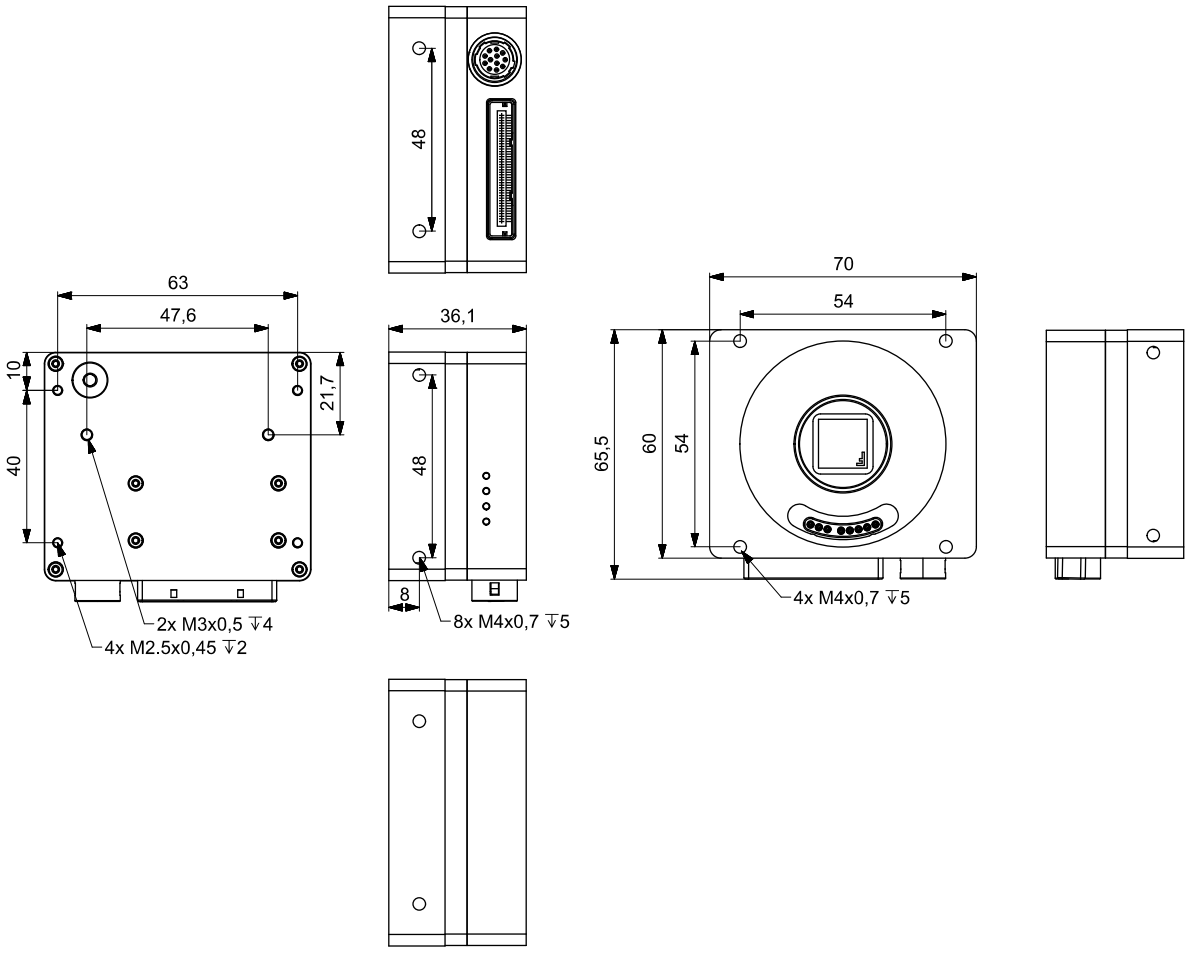


Figure 33: Dimensional drawing of CB262xG-GP-X8G3

Dimensional drawings of:
CB654CG-GP-X8G3 CB654MG-GP-X8G3

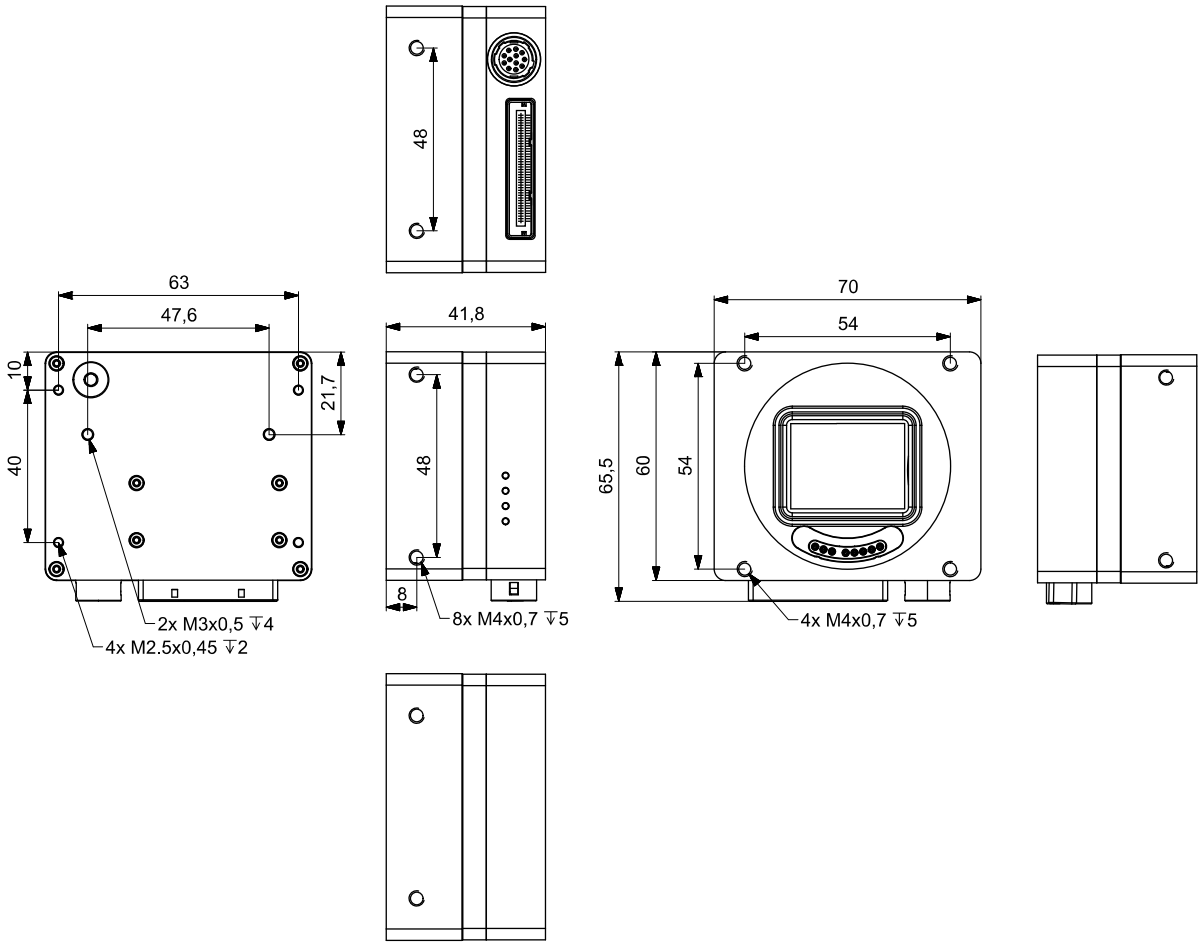


Figure 34: Dimensional drawing of CB654xG-GP-X8G3

2.8 User interface – LEDs

LED	Color	Defaults	Note
1	Green	PCIe Lanes	User configurable
2	Red	PCIe Clock Present	User configurable
3	Blue	PCIe Clock Present	User configurable
4	Orange	PCIe Link Speed	User configurable

Table 67: LED output description during camera power up

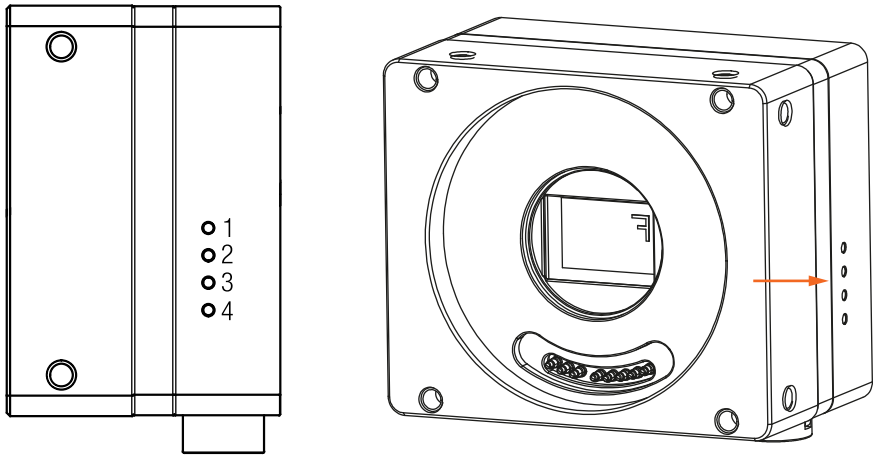


Figure 35: Position of LEDs on camera

LED statuses during boot sequence of:
all models in this manual (refer to the table Models and sensors overview)

Status	LED 1	LED 2	LED 3	LED 4
Off	Off	Off	Off	Off
Power	On	Off	Off	Off
Camera booted no PCIe	Off	Off	On	On
Golden firmware loaded[1]	flash	flash	flash	flash
PCIe connected X8 Gen3	On	flash	flash	On
PCIe connected X8 Gen2(Gen1)	On	flash	flash	flash
PCIe connected x4(X2 or X1) Gen3	flash	flash	flash	On
PCIe connected x4(X2 or X1) Gen2(Gen1)[1]	flash	flash	flash	flash

[1]To identify, if the golden firmware is loaded, please start xiCOP. See XIMEA control panel

Table 68: LED statuses during boot sequence

2.9 Camera interface

NOTE: It is important that the power is turned off when inserting/detaching the cable. General ESD precautions need to be applied. Failing this requirement may lead to camera damage.

The following section applies to:

CB013CG-LX-X8G3	CB013MG-LX-X8G3	CB019CG-LX-X8G3	CB019MG-LX-X8G3
CB120CG-CM-X8G3	CB120MG-CM-X8G3	CB120RG-CM-X8G3	CB160CG-LX-X8G3
CB160MG-LX-X8G3	CB262CG-GP-X8G3	CB262MG-GP-X8G3	CB262RG-GP-X8G3
CB654CG-GP-X8G3	CB654MG-GP-X8G3		

2.9.1 PCIe iPass™ (68-pin, X8)

The iPass™ connector is used for high speed data transmission. Please note that many computers do not initialize PCIe buses that do not have devices plugged in upon boot. The camera needs to be plugged in with power when the computer is booted up before use.

Item	Value
Connector	High-speed iPass right-angle receptacle, 68-position, PCIe x8 iPass connector (thin front edge)
Signals	PCI Express (PCIe x8, high-speed differential pairs)
Mating Cable	XIMEA PN: CBL-PCI-X8G3-COP-5M0, CBL-PCI-X8G3-COP-3M0, CBL-PCI-X8G3-COP-7M0 - PCIe x8 iPass cables

Table 69: PCI express mating connector description

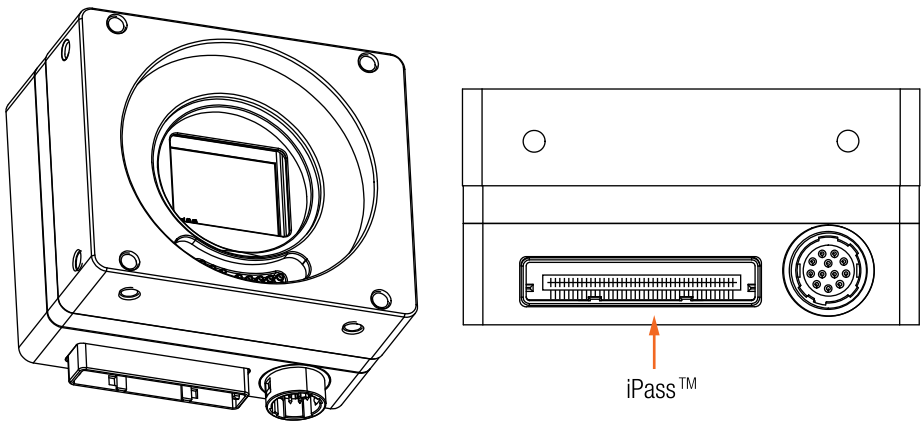


Figure 36: iPass connector location

The following section applies to:

CB024CG-GP-X8G3-SFF CB024MG-GP-X8G3-SFF CB100CG-GP-X8G3-SFF CB100MG-GP-X8G3-SFF
CB209CG-GP-X8G3-SFF CB209MG-GP-X8G3-SFF

2.9.2 PCIe iPass+ (Mini-SAS HD, SFF-8644)

Item	Value
Connector	Mini-SAS HD receptacle, 2x36 position, right angle, push-in type (PCIe iPass+ HD 2x4 connector)
Signal	PCIe Gen3 high-speed differential pairs for camera data transmission
Mating Cable	XIMEA PN: CBL-SFF-X4G3-30M0, CBL-SFF-X4G3-COP-5M0

Table 70: PCIe iPass Mini-SAS connector description

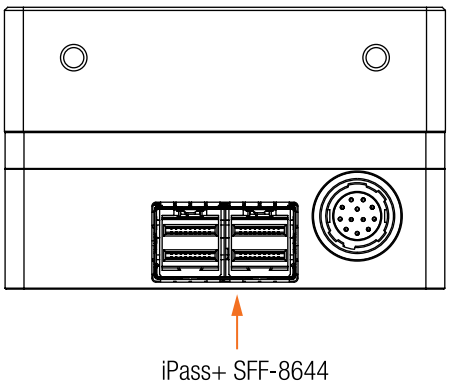


Figure 37: PCIe iPass+ SFF-8644 connector location

2.10 Digital inputs / outputs (GPIO) interface

The description of the GPIO interface below applies to:
all models in this manual (refer to the table Models and sensors overview)

PCIe xiB-64 cameras use the 12-pin connector for the GPIO interface and power. There are several input and output lines (both optically isolated and non-isolated).

Item	Value
Connector	I/O and Power 12-pin Alysium 60-30-1112
Signals	Opto-isolated trigger input and non-isolated I/O plus camera power
Mating Connectors	Alysium 60-41-1012, 60-41-1112, 60-01-1012, 60-01-1112, 60-03-1012, 60-03-1112
Ximea PN	CBL-MT-PWR-SYNC-3M0 for 3 m cable

Table 71: GPIO mating connector description

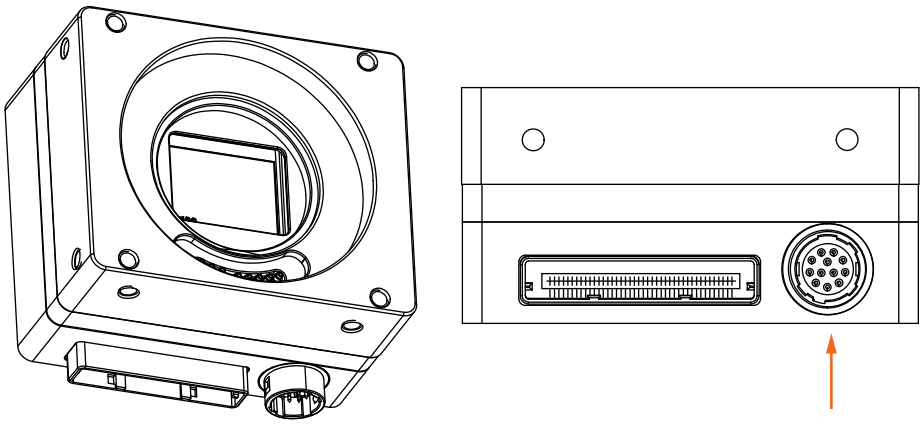


Figure 38: IO connector location

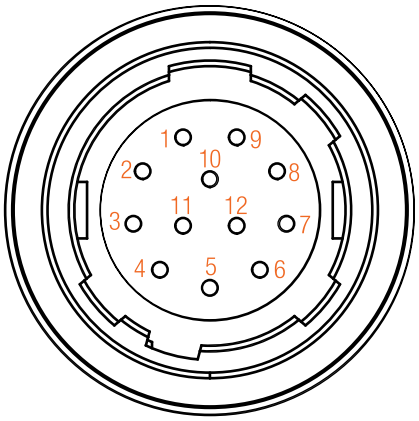


Figure 39: IO connector pinning

Pin	Name	GPI/GPO index API	Type
1	IN2	2/-	Optically isolated Digital Input (IN)
2	IN1	1/-	Optically isolated Digital Input (IN)
3	OUT2	-/2	Optically isolated Digital Output (OUT)
4	OUT1	-/1	Optically isolated Digital Output (OUT)
5	AUX PWR	None	Power input
6	GND	None	External grounds for power and non-isolated I/O
7	INOUT1	3/3	Non-isolated digital lines - Digital Input-Output (INOUT)
8	INOUT3	5/5	Non-isolated digital lines - Digital Input-Output (INOUT)
9	INOUT2	4/4	Non-isolated digital lines - Digital Input-Output (INOUT)
10	IN GND	None	Ground for Opto-Isolated Inputs
11	OUT GND	None	Ground for Opto-Isolated Out
12	INOUT4	6/6	Non-isolated digital lines - Digital Input-Output (INOUT)

Table 72: I/O connector pin assignment

2.10.1 Optically isolated Digital Input (IN)

The description of optically isolated digital input below applies to:

CB013CG-LX-X8G3	CB013MG-LX-X8G3	CB019CG-LX-X8G3	CB019MG-LX-X8G3
CB120CG-CM-X8G3	CB120MG-CM-X8G3	CB120RG-CM-X8G3	CB160CG-LX-X8G3
CB160MG-LX-X8G3	CB262CG-GP-X8G3	CB262MG-GP-X8G3	CB262RG-GP-X8G3
CB654CG-GP-X8G3	CB654MG-GP-X8G3		

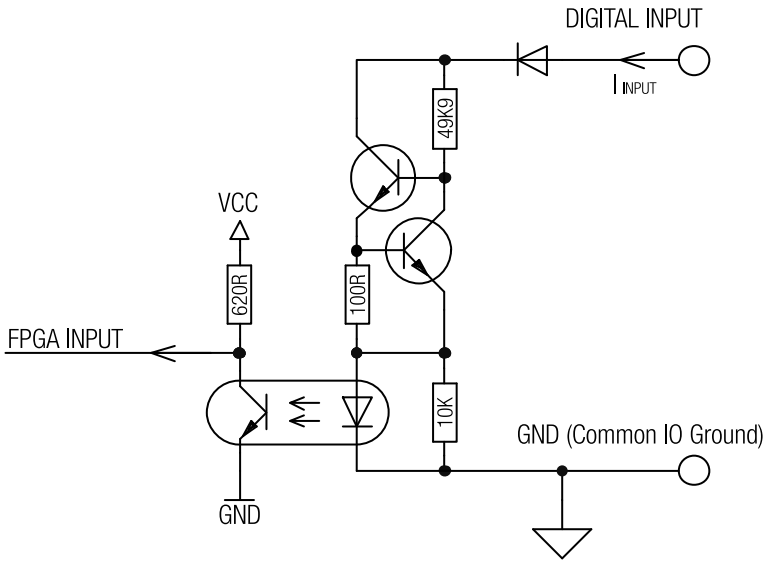


Figure 40: Digital input, interface schematic

Item	Parameter	Note
Maximal input voltage	24 V DC	None
Common pole	YES	IN GND
Effect of incorrect input terminal connection	Reverse voltage polarity protected	None
Effects when withdrawing/inserting input module under power	no damage, no lost data	None
Maximal recommended cable length	10 m	None
Input Level for logical 0	Voltage < 2.0 V / Current < 0.5 mA	None
Input Level for logical 1	Voltage > 4.0 V / Current > 2 mA	None
Input debounce filter	NO	None
Input delay - rising edge	1.7+-0.2 µs	VINPUT=10 V,TAMBIENT=25 °C
Input delay - falling edge	10.7+-0.2 µs	VINPUT=10 V,TAMBIENT=25 °C
External trigger mapping	YES	None
Input functions	Trigger	Rising or falling edge are supported for trigger

Table 73: General info for optically isolated digital input

2.10.2 Optically isolated Digital Input (IN)

The description of optically isolated digital input below applies to:

CB024CG-GP-X8G3-SFF CB024MG-GP-X8G3-SFF CB100CG-GP-X8G3-SFF CB100MG-GP-X8G3-SFF
CB209CG-GP-X8G3-SFF CB209MG-GP-X8G3-SFF

Item	Parameter	Note
Maximal input voltage	24 V DC	None
Common pole	YES	IN GND
Effect of incorrect input terminal connection	Reverse voltage polarity protected	None
Effects when withdrawing/inserting input module under power	no damage, no lost data	None
Maximal recommended cable length	10m	None
Input Level for logical 0	Voltage < 1.8 V / Current < 0.5 mA	None
Input Level for logical 1	Voltage > 3.3 V / Current > 3 mA	None
Input debounce filter	No	None
Input delay - rising edge	0.08 µs	VINPUT=10 V,TAMBIENT=25 °C
Input delay - falling edge	0.06 µs	VINPUT=10 V,TAMBIENT=25 °C
External trigger mapping	YES	None
Input functions	Trigger	Rising or falling edge are supported for trigger

Table 74: General info for optically isolated digital input

2.10.3 Optically isolated Digital Output (OUT)

The description of optically isolated digital output below applies to:
all models in this manual (refer to the table Models and sensors overview)

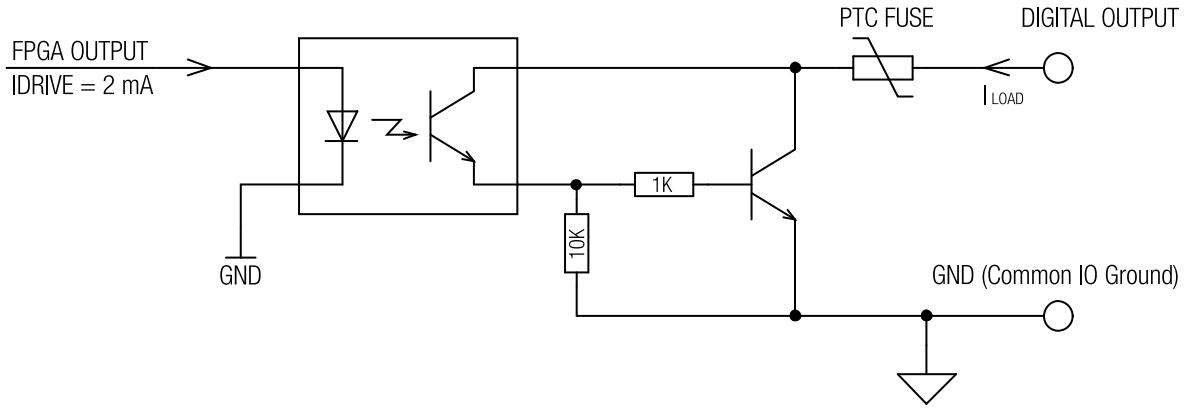


Figure 41: Digital output, interface schematic

Item	Parameter	Note
Maximal open circuit voltage	24 V DC	None
Output port type	Open collector NPN	None
Common pole	YES	OUT GND
Protection	short-circuit / over-current / Reverse voltage	None
Protection circuit	PTC Resettable Fuse	None
Maximal sink current	25 mA	None
Trip current	50 mA	Self-restarting when failure mode current disconnected
Inductive loads	NO	None
Effect of incorrect output terminal connection	Protected against reverse voltage connection	None
Maximal output dropout	1 V	Sink current 25 mA
Output delay - rising edge	51 µs	VOUTPUT=10 V,TAMBIENT=25 °C
Output delay - falling edge	0.8 µs	VOUTPUT=10 V,TAMBIENT=25 °C
Strobe output mapping	YES	None

Table 75: General info for optically isolated digital output

2.10.4 Non-isolated digital lines - Digital Input-Output (INOUT)

The description of non-isolated digital lines below applies to:
all models in this manual (refer to the table Models and sensors overview)

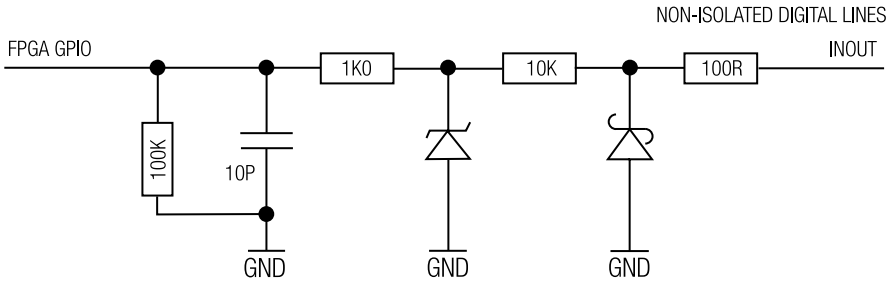


Figure 42: Non-isolated input/output, interface schematic

Item	Parameter	Note
Maximal input voltage	24 V DC	None
Common pole	YES	None
Effect of incorrect input terminal connection	Reverse voltage polarity protected	None
Effects when withdrawing/inserting input module under power	no damage, no lost data	None
Protection	short-circuit / over-current / Reverse voltage	None
Maximal output sink current	30 µA	Maximal advised load = 50kOhm serial output impedance 5.7 kOhm
Inductive loads	NO	None
Output Level logical 0	< 0.4 V	Load 100kOhm
Output Level logical 1	> 2.8 V	Load 100 kOhm
Output delay - rising edge	150 ns	Load 100kOhm/10pF threshold 0.5 V
Output delay - falling edge	250 ns	Load 100kOhm/10pF threshold 0.5 V
Input Impedance- minimum	20 kOhm	None
Input Level for logical 0	< 0.7 V	None
Input Level for logical 1	> 2.4 V	None
Input debounce filter	NO	None
Input delay - rising edge	150 ns	VINPUT=5 V
Input delay - falling edge	250 ns	VINPUT=5 V
Input functions	Trigger	Rising or falling edge are supported for trigger
Output functions	YES	Off, On, Exposure active, Frame active; Signal inversion supported[1]

[1]Functions may vary depending on camera model

Table 76: General info for non-isolated digital in/out trigger lines

2.11 Accessories

2.11.1 CBL-PCI-COP-xxx/ CBL-PCI-FIB-xxx

1.0 m, 3.0 m, 5.0 m, 7.0 m, 10 m, 20 m PCIe cables

The PCI express cable that you use with the camera is responsible for the supply of power and the data transfer to the PC. It is critical to use an industrial PCI express cable with the proper wiring and shielding.

Ximea offers a selection of different PCIe cables to interface the camera to the host computer. PCIe cables can be purchased in copper or fiber optic form. Longer lengths (up to 100 m) can be achieved with the fiber optic option, since the copper cables are limited to 7.0 m (to 3.0 m for PCIe Gen 3). Both cables interface with a PCIe adapter board for your PC - see section PCIe host adapter cards Get the latest information on available accessories at: PCI Express Cameras

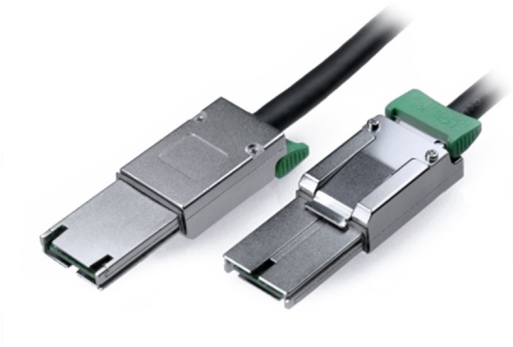


Figure 43: CBL-PCI-COP-xM0 PCIe Gen.2 x4 copper cable



Figure 44: CBL-PCI-FIB-xM0 PCIe Gen.3 x4 fiber optics cable

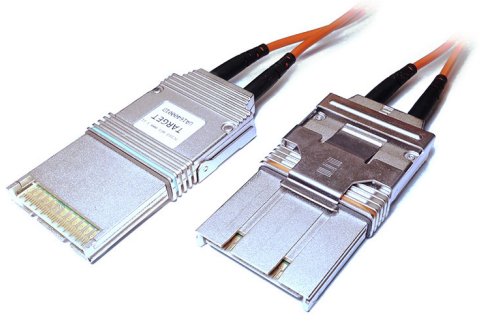


Figure 45: CBL-PCI-FIB-xM0 PCIe Gen.3 x8 fiber optics cable

2.11.2 CBL-SFF-X4G3-10M0

The cable is available in 30 m, and 50 m lengths. PCIe Gen3 x4 fiber SFF cable (SFF-8644) is a high-speed optical connection used to link PCIe devices over longer distances. It uses Corning ClearCurve glass fiber (OM3, 850 nm) and provides four bi-directional data lanes, reaching up to 12 Gbps per lane (48 Gbps in total).



Figure 46: CBL-SFF-X4G3-10M0

2.11.3 CBL-SFF-X4G3-COP-5M0

The CBL-SFF-X4G3-30M0 is a PCIe Gen3 x4 copper cable (SFF-8644) designed to connect compatible XIMEA products. Cable provides four data lanes with speeds of up to 12 Gbps per lane (48 Gbps total). The cable length is 5 m, making it suitable for short-distance, high-bandwidth camera connections.



Figure 47: CBL-SFF-X4G3-COP-5M0

2.11.4 CBL-MT-PWR-SYNC-3M0

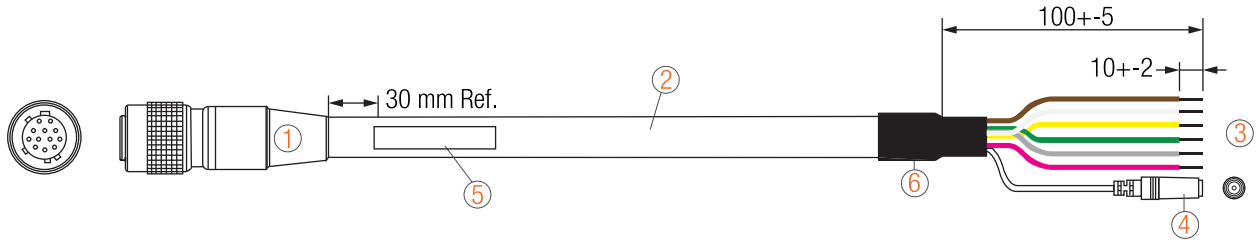


Figure 48: CBL-MT-PWR-SYNC-3M0 drawing

1 Series60 Female Circular Plug 60-01-1112 IO <BLK>
2 TBAUL20276 4STP#28 + 4C#28 + 2C#24 [OD=6.80mm] <BLK>
3 Process end with wire end stripped and tin soldered
4 DC power in socket female (OD5.5/ID2.1) <BLK>
5 Cable label
6 Heat shrinkable tube

Pin	1	2	3	4	5	6	7	8	9	10	11	12
Signal	IN2	IN1	OUT2	OUT1	AUX PWR	GND	INOUT1	INOUT3	INOUT2	IN GND	OUT GND	INOUT4

Table 77: CBL-MT-PWR-SYNC-3M0 pin assignment

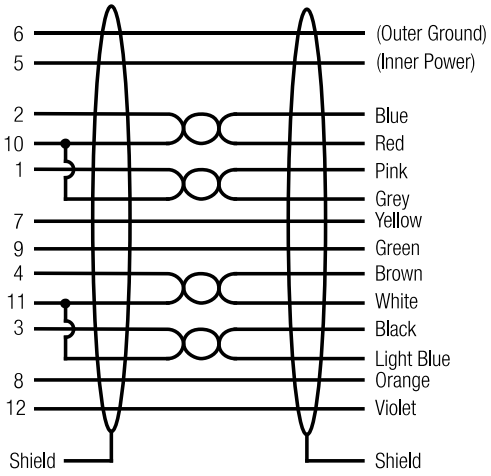


Figure 49: Wiring diagram of the CBL-MT-PWR-SYNC-3M0

2.11.5 XC-X8G3-MTP-X8G3-IPASS

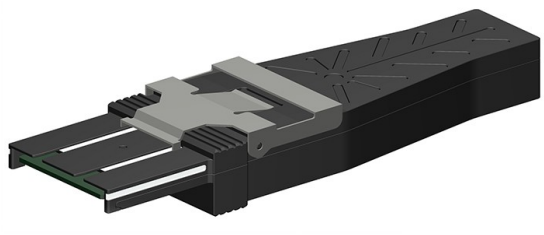


Figure 50: Isometric view of XC-X8G3-MTP-X8G3-IPASS

Adapter for connection of iPass camera port to MTP fiber optics cable. Then PCUO cable (from Samtec) can be used between two MTP connectors can be used as connection. The cage (XCable housing) has been designed with standard MTP 10 cm cable.

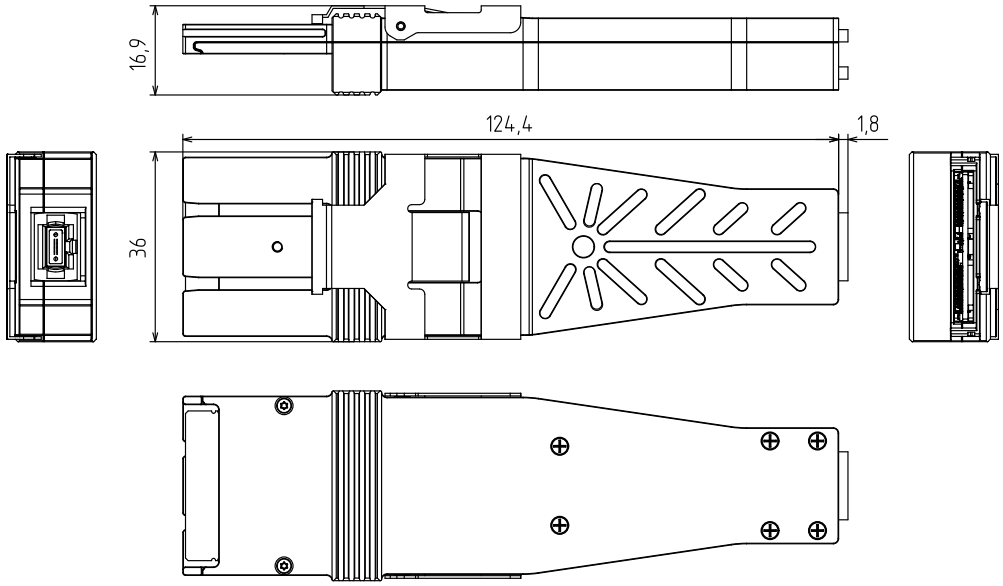


Figure 51: Dimensional drawing of XC-X8G3-MTP-X8G3-IPASS

Width [W]	Height [H]	Depth [D]	Mass [M]
36 mm	126.2 mm	16.9 mm	85.4 g

Table 78: Mechanical parameters of XC-X8G3-MTP-X8G3-IPASS

2.11.6 XC-X8G3-SFF-X8G3-IPASS

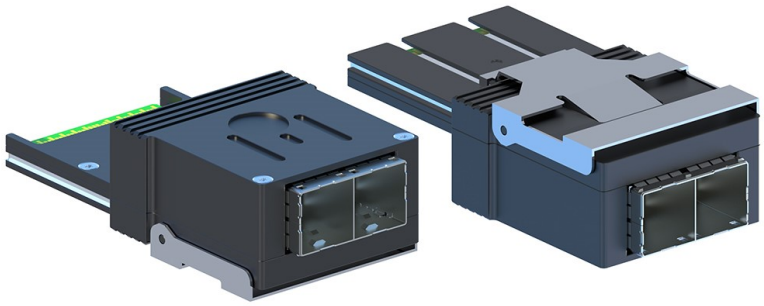


Figure 52: Isometric view of XC-X8G3-SFF-X8G3-IPASS

Adapter for connection of iPass camera port to SFF cable.

- Adapter connecting iPass X8 target interface to SFF-8644 host interface
- PCIe Gen3 x8 bandwidth with a link speed of 64 Gb/s

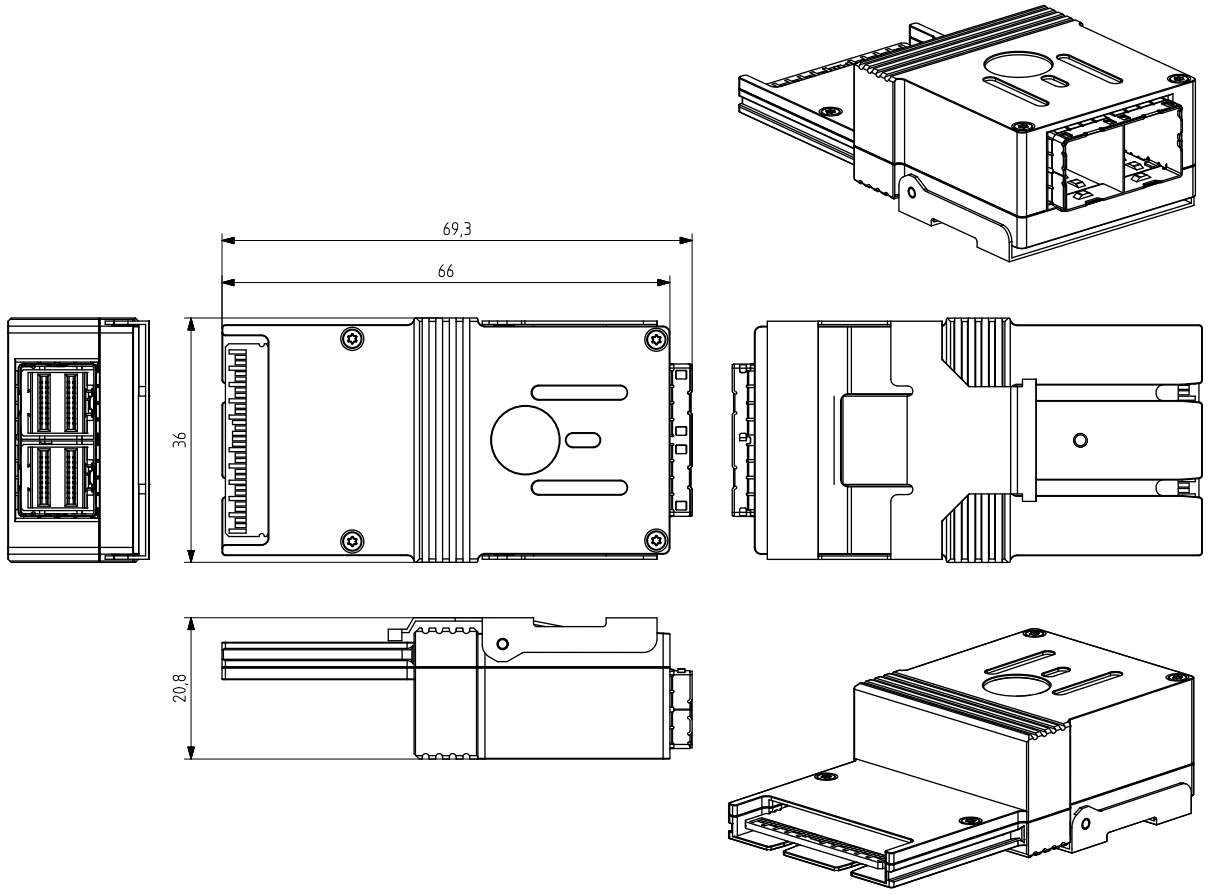


Figure 53: Dimensional drawing of XC-X8G3-SFF-X8G3-IPASS

Width [W]	Height [H]	Depth [D]	Mass [M]	Material
36 mm	20.8 mm	69.3 mm	57.7 g	Machined Aluminum alloy

Table 79: Mechanical parameters of XC-X8G3-SFF-X8G3-IPASS

2.11.7 MECH-60MM-BRACKET-T

Bracket is made of solid high quality anodized aluminum. All threads are milled and all edges chamfered. Use 2x M4 screws provided with bracket as a kit for mounting. Bracket can be mounted on the bottom or side of the camera (depending on the camera model).

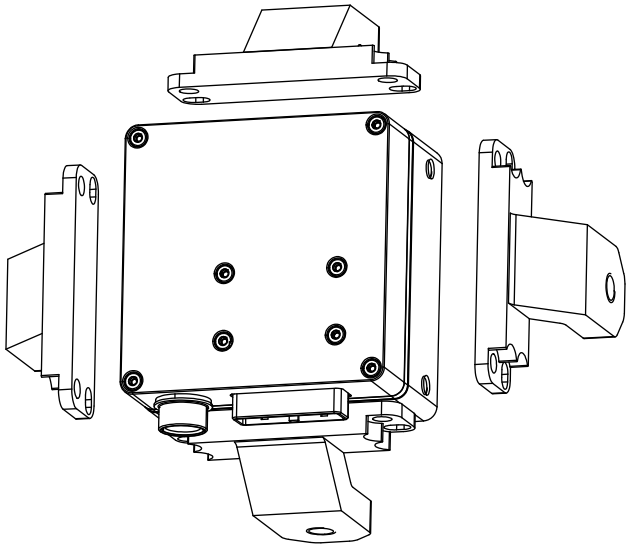


Figure 54: MECH-60MM-BRACKET-T

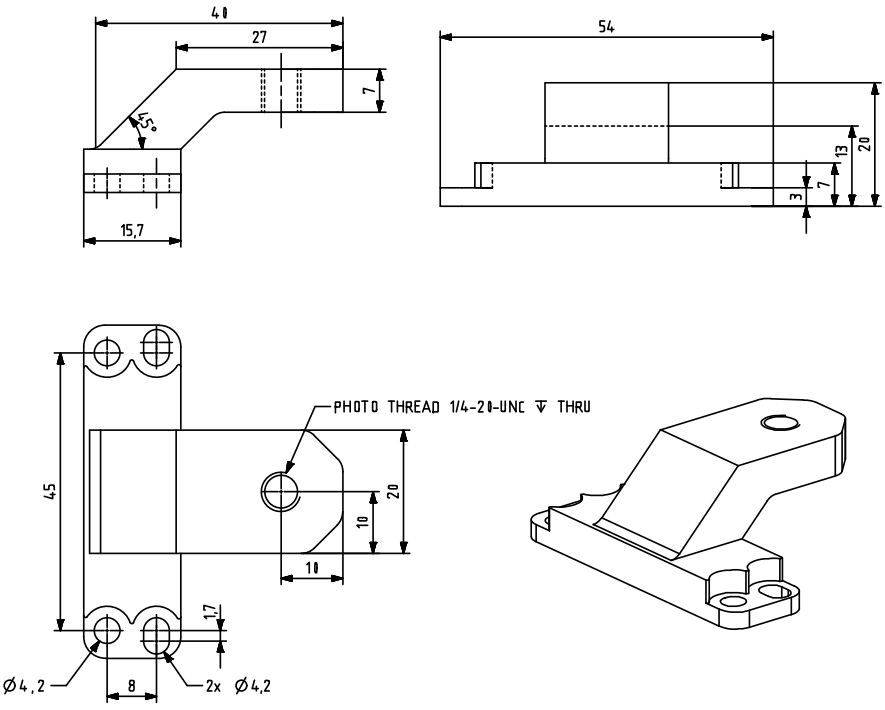


Figure 55: Dimensional drawing of MECH-60MM-BRACKET-T

Width [W]	Height [H]	Depth [D]	Mass [M]
54 mm	20 mm	40 mm	20 g

Table 80: Parameters of MECH-60MM-BRACKET-T

2.11.8 CB-X8G3-FAN-COOLER



Figure 56: CB-X8G3-FAN-COOLER

The camera needs to have proper cooling to ensure optimal performance. A fan cooling element can be included with the camera. This fan module is designed to provide air cooling for the camera and can be mounted on the backside of the camera.

To attach or detach the fan module, you will need a hex 2.0 screwdriver and four M2.5x14 screws. When removing or inserting the fan assembly, it's important to be careful not to damage the spring pins that connect the cooling unit to the camera electronics.

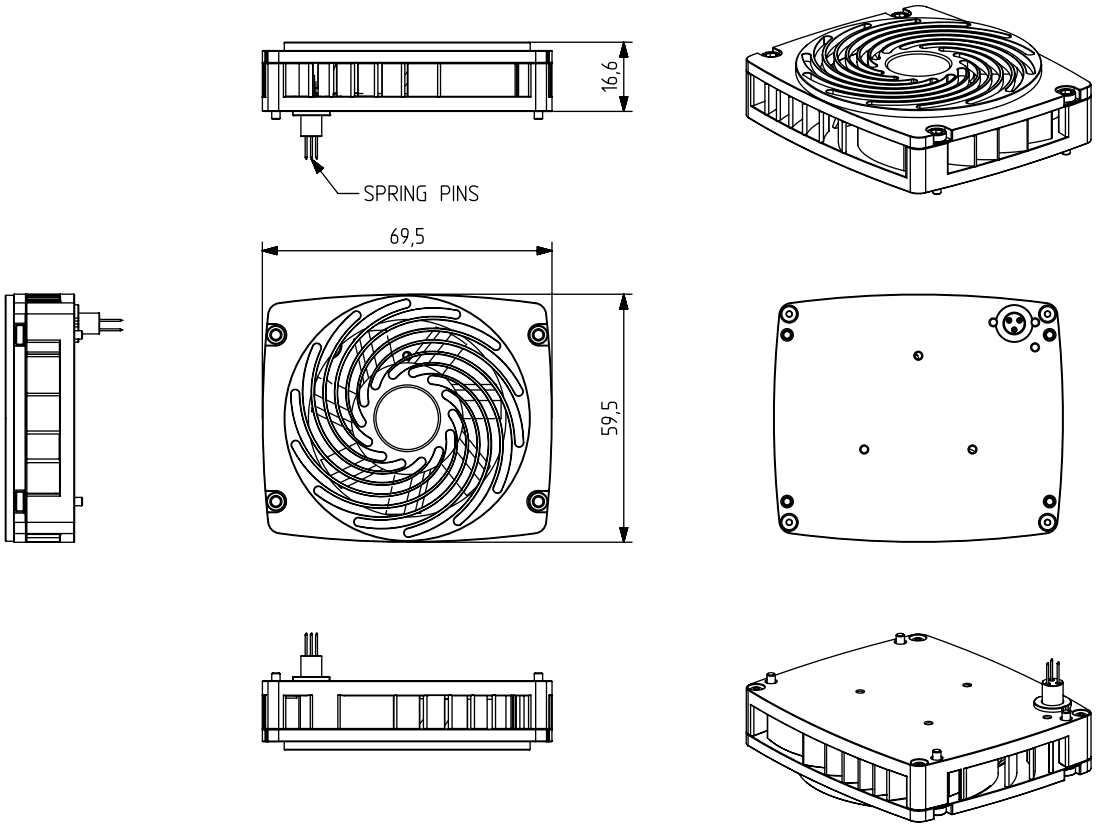


Figure 57: Dimensional drawing of CB-X8G3-FAN-COOLER

Width [W]	Height [H]	Depth [D]	Mass [M]
60 mm	70 mm	17 mm	20 g

Table 81: Mechanical parameters of CB-X8G3-FAN-COOLER

2.11.9 CB-X8G3-WAT-COOLER-KIT



Figure 58: CB-X8G3-WAT-COOLER

A heatsink water cooler from anodized aluminum with a screws kit is available for X8G3/X4G3 cameras. This water cooling option is designed to prevent vibrations and can be conveniently mounted on the backside of the camera.

1 SSC6 - M5 quick coupler with airtight washer for 6 mm tubes (water rated)

2 6061 aluminum housing with optimized ater flow and cooling abilities

3 airtight sealing (tested at 10 bars)

4 M 2.5 x 18 screws for mounting cooler

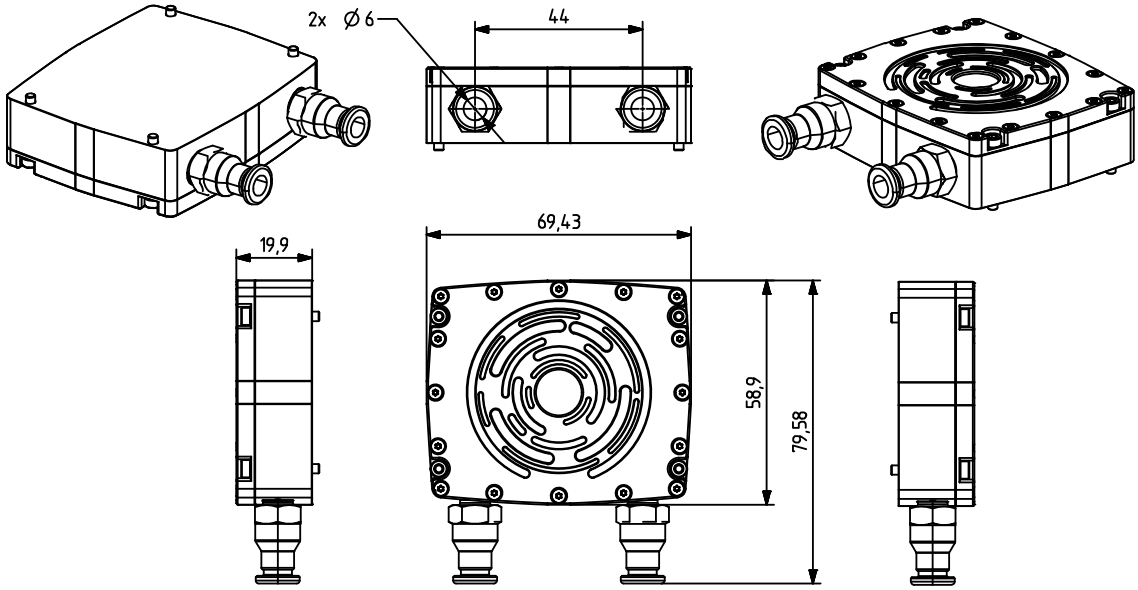


Figure 59: Dimensional drawing of CB-X8G3-WAT-COOLER-KIT

2.11.10 Water cooler tube connection

There are various 6 mm OD tubes available from multiple manufacturers that can be used with the camera cooler. It is recommended to consult the websites of the push-in fitting manufacturer for a list of compatible tubes and specific tube specifications necessary to ensure a leak-free connection. Adherence to their provided installation instructions is crucial. Always conduct a leak inspection after making tube connections. XIMEA disclaims any liability for damages resulting from improper installation. Following these guidelines correctly is vital for protecting your equipment and ensuring its peak performance.

XIMEA has conducted tests and endorses the use of PISCO brand tubes (part number UCQ06-2F-20-C) along with insert rings (part number WR0640) for creating secure and leak-proof connections. The recommended procedure for connecting and disconnecting tubes is as follows

Please refer to the pictures and steps below for the correct connection of the water cooler.

Ring inserting

The insert ring is designed to prevent deformation of the tube. A soft tube can be connected to the Fitting.

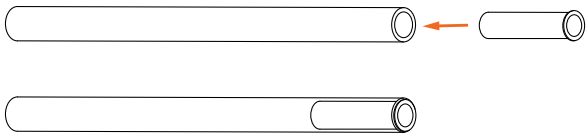


Figure 60: Inserting the ring into the tube

Tube insertion

Insert the tube into the Push-In Fitting until it reaches the end. The collet will secure the tube automatically, while the elastic sleeve creates a seal around it.

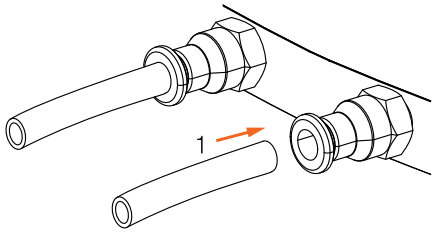


Figure 61: Tube insertion

Tube disconnection

To disconnect the tube, simply push the collet. Ensure that the water supply is halted before disconnecting the tube.

Step 1. Push the collet.

Step 2. Pull the tube out.

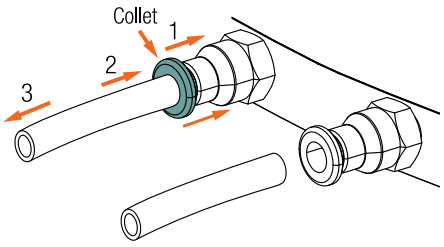


Figure 62: Tube disconnection

2.11.11 MECH-60MM-EF-ADAPTER



Figure 63: MECH-60MM-EF-ADAPTER

Cameras feature an active control interface for lenses with a CANON EF-mount. Integration of such lenses requires the MECH-60MMEF-ADAPTER, which securely attaches to the camera using four front mount holes. The necessary screws are included in the MECH-60MM-EF-ADAPTER-KIT, available for purchase from XIMEA. Additionally, the camera can be assembled with this adapter during production if requested along with the camera order (A-MECH-60MM-EF-ADAPTER-KIT).

Note: To be used with standard Canon Mount Lenses. Use 4x M4x6 or standard M4 screws for attaching the camera. The nominal flange focal distance from the front of the adapter to the active area in the sensor is 44.00 mm + / - 0.2 mm.

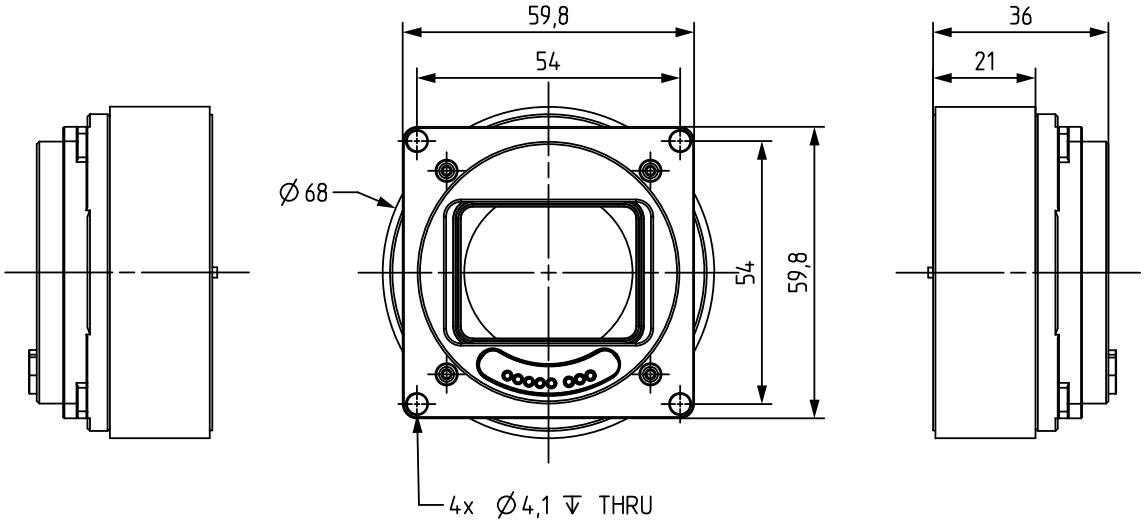


Figure 64: Dimensional drawing of MECH-60MM-EF-ADAPTER

Width [W]	Height [H]	Depth [D]	Mass [M]	Material
80 mm	80 mm	12.25 mm	30 g	Machined aluminum alloy[1]

[1] anodized to black color

Table 82: Mechanical parameters of MECH-60MM-EF-ADAPTER

2.11.12 LA-C-MNT-60MM-xxx-KIT



Figure 65: LA-C-MNT-60MM-KIT lens adapter

The C-mount lens adapter can be assembled during production if the operation is ordered along with the camera (A-LA-C-MNT-60MM-KIT). The mechanical dimensions of the LA-C-MNT-60MM-KIT are designed for the use of filter glass with a thickness of 1 mm and a refraction index of 1.4-1.55. Without the filter glass, the correct optical flange focal distance is not achieved.

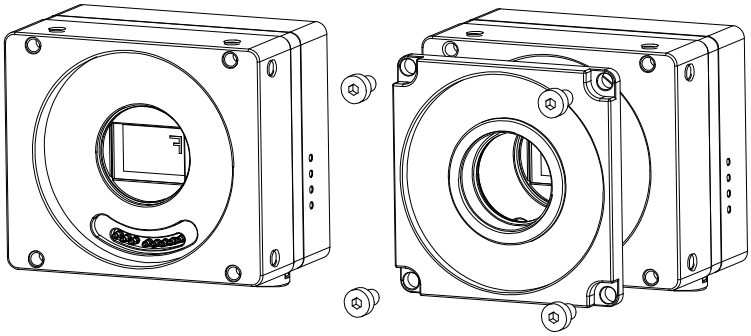


Figure 66: Camera without and with C-mount LA-C-MNT-60MM-KIT lens adapter

2.11.13 PCIe host adapter cards

Ximea offers several host adapter cards.
Please check our website for the latest information on available cards for your PC:

- XIMEA Host Adapters
- XIMEA Adapter Boards

3 General features

3.1 Camera features

3.1.1 ROIs – Region of interest

ROI, also called area-of-interest (AOI) or windowing, allows the user to specify a sub-area of the original sensor size for read-out. ROI can be set by specifying the size (width and height) as well as the position (based on upper left corner) of the of the sub-area.

3.1.2 Downsampling modes

Downsampling describes the possibility of reducing the image resolution without affecting the sensors physical size, i.e. without reducing the physical size of the sensing area. This feature is useful when optics are used, that are particularly fitted to a certain sensor size and if it is necessary to maintain the full image circle on the sensor.

Downsampling can be achieved in two ways: binning and decimation.
Binning/decimation selector selects which binning/decimation engine is used (Sensor, FPGA, CPU). After setting of selector, multiple parameters could be get or set for the selected unit.

They can be divided into:

Patterns define the horizontal/vertical pattern how photo-sensitive cells are combined (mono or bayer)

Values reduce the horizontal or vertical resolution of the image by the specified horizontal/vertical downsampling factor

Modes in case of binning set the mode used to combine horizontal/vertical photo-sensitive cells together (sum or average)

Binning

When binning is applied, the image is divided into cluster of k*l pixels, where all pixels in each cluster are interpolated and result in the value of one output pixel. For example, a 2*2 binning produces 2*2-pixel clusters and results in images with ¼ of the original resolution.

Decimation – Skipping

When decimation is chosen, only every n-th pixel is used to create the output image. For example, with a 2x1 vertical skipping, every odd number line is used and every even number line is skipped, resulting in an image with half its original vertical resolution. Skipping is a faster downsampling mode, but also introduces more aliasing effects.

3.1.3 Image data output formats

All modes are provided by the xiAPI or standard interfaces using the xiAPI (please see Programming). Each camera model supports several Image Data Output Formats.

This table is applicable to:

CB013MG-LX-X8G3	CB019MG-LX-X8G3	CB024MG-GP-X8G3-SFF	CB100MG-GP-X8G3-SFF
CB120MG-CM-X8G3	CB120RG-CM-X8G3	CB160MG-LX-X8G3	CB209MG-GP-X8G3-SFF
CB262MG-GP-X8G3	CB262RG-GP-X8G3	CB654MG-GP-X8G3	

Mode	Description
XI_MONO8	8 bits per pixel. [Intensity][1,2]
XI_MONO16	16 bits per pixel. [Intensity LSB] [Intensity MSB][1,2]
XI_RAW8	8 bits per pixel raw data from sensor. [pixel byte] raw data from transport (camera output)
XI_RAW16	16 bits per pixel raw data from sensor. [pixel byte low] [pixel byte high] 16 bits (depacked) raw data
XI_FRM_TRANSPORT	Data from transport layer (e.g. packed). Depends on data on the transport layer[3]

[1]Higher CPU processing is required when this mode is selected because color filter array processing is implemented on PC. This processing is serialized when multiple cameras is used at once. The most effective way to get data from camera is to use XI_RAW8, where no additional processing is done in API.

[2]On monochromatic cameras the black level is not subtracted in XI_MONO8 and XI_MONO16 formats by Image Processing in xiAPI, so black level remains the same as in RAW format.

[3]When using Transport Data Format, the Image Processing block from XiAPI Image Data Flow is skipped and therefore the Transport format is the most effective data format in terms of CPU and RAM usage.

Table 83: Image data output formats

This table is applicable to:

CB013CG-LX-X8G3 CB019CG-LX-X8G3 CB024CG-GP-X8G3-SFF CB100CG-GP-X8G3-SFF
CB120CG-CM-X8G3 CB160CG-LX-X8G3 CB209CG-GP-X8G3-SFF CB262CG-GP-X8G3
CB654CG-GP-X8G3

Mode	Description
XI_MONO8	8 bits per pixel. [Intensity][1,2]
XI_MONO16	16 bits per pixel. [Intensity LSB] [Intensity MSB][1,2]
XI_RAW8	8 bits per pixel raw data from sensor. [pixel byte] raw data from transport (camera output)
XI_RAW16	16 bits per pixel raw data from sensor. [pixel byte low] [pixel byte high] 16 bits (depacked) raw data
XI_RGB16_PLANAR	RGB16 planar data format
XI_RGB24	RGB data format. [Blue][Green][Red][1]
XI_RGB32	RGBA data format. [Blue][Green][Red][0][1]
XI_RGB48	RGB data format. [Blue low byte][Blue high byte][Green low][Green high][Red low][Red high][1]
XI_RGB64	RGBA data format. [Blue low byte][Blue high byte][Green low][Green high][Red low][Red high][0][0][1]
XI_RGB_PLANAR	RGB planar data format. [Red][Red]...[Green][Green]...[Blue][Blue]...[1]
XI_FRM_TRANSPORT	Data from transport layer (e.g. packed). Depends on data on the transport layer[3]

[1]Higher CPU processing is required when this mode is selected because color filter array processing is implemented on PC. This processing is serialized when multiple cameras is used at once. The most effective way to get data from camera is to use XI_RAW8, where no additional processing is done in API.

[2]On monochromatic cameras the black level is not subtracted in XI_MONO8 and XI_MONO16 formats by Image Processing in xiAPI, so black level remains the same as in RAW format.

[3]When using Transport Data Format, the Image Processing block from XiAPI Image Data Flow is skipped and therefore the Transport format is the most effective data format in terms of CPU and RAM usage.

Table 84: Image data output formats

3.2 Acquisition modes

3.2.1 Free-Run

Also known as continuous acquisition. In this mode the sensor delivers a constant stream of image data at the maximum speed available by the current bandwidth, without any external trigger. Each image exposure is sequentially started automatically when possible.

For all sensors the exposure of the next frame overlaps with the data readout of the previous frame.
This Overlap mode gives the highest number of frames per second (FPS).

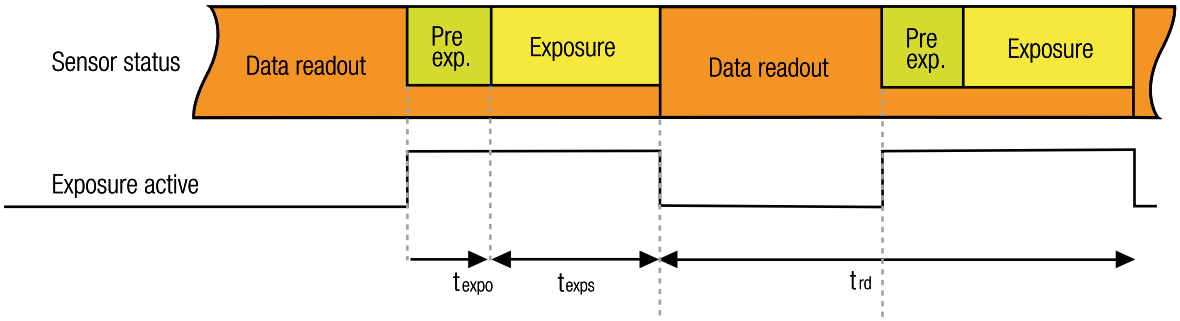


Figure 67: Acquisition mode - free run

The frame rate in free run mode depends inversely on the frame time. In general the frame time roughly equals to the readout time or to the exposure time, depending on which one of the two is larger. This means that when exposure time is larger than the readout time, the frame rate gradually decreases with increasing exposure time (frame_rate $\sim$ 1/t_exp).

In this mode the timing depends on the Exposure Time and Data Readout Time. In situation when the exposure time is comparable or longer than readout time, the exposure active signal might have constant active level during acquisition. This might be caused also by different propagation delay for rising and falling edge of opto isolated outputs. Polarity inversion might help to make visible the separated exposure pulses. Some camera models support limiting of FPS. When set the camera will limit the frame rate so it does not exceed the set value. Please see: Frame_Rate_Control. This is also applicable in case of triggered acquisition.

3.2.2 Trigger controlled acquisition/exposure

Unlike in the free-run, each image exposure can also be triggered with an input trigger signal. In this mode, the sensor waits in stage until the trigger signal arrives. Only then, the exposure of first frame is started, which is followed by the data readout. XIMEA cameras supports several triggered modes along with single image exposure after one trigger. The trigger signal can be either edge sensitive or level sensitive. In the case of “level sensitive”, it can be used to control length of exposure or acquisition itself. Generally trigger sources can be divided into two groups:

Software trigger

The trigger signal can be sent to the sensor using a software command. In this case, common system related latencies and jitter apply.

Hardware trigger

A hardware trigger can be sent to the sensor using the digital input. Triggering by hardware is usually used to reduce latencies and jitter in applications that require the most accurate timing. In this case rising edge of input signal is suggested as the delay of opto coupler is smaller as well as introduced jitter. Triggering by hardware is usually used to reduce latencies and jitter in applications that require the most accurate timing.

Triggered mode - Single frame

Sensors support exposure overlapped with readout. When the trigger period (t_{tper}) is longer than the exposure plus readout time, exposure is not overlapped with readout. However, when the trigger period is decreased, the sensor will expose the images in overlap mode. In this case, the frame active signal will be constantly active. The trigger period has to be long enough, so the exposure of next frame does not end sooner than readout of previous frame.

Sensor timing in Exposure Overlapped with Data Readout Mode

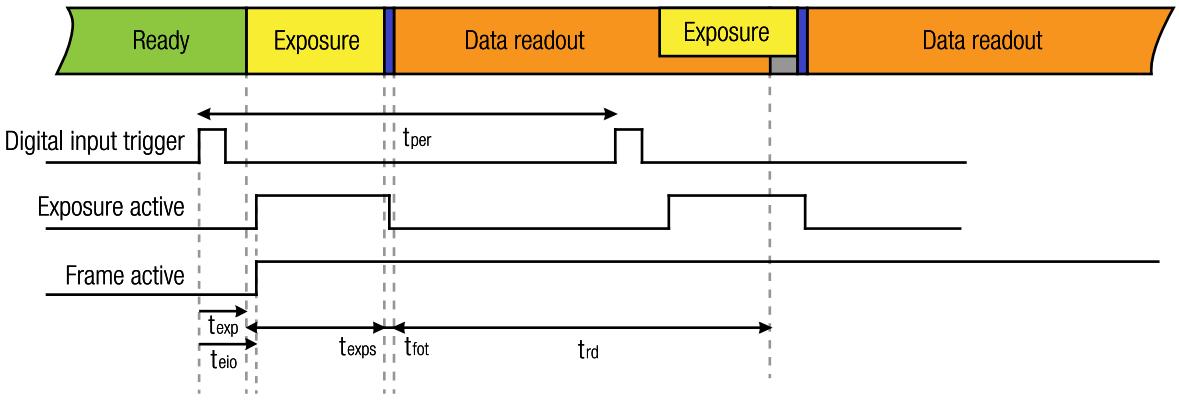


Figure 68: Acquisition mode - triggered with overlap

Description

- t_{eio} Trigger (Digital Input) to Exposure Active (Digital Output)
- t_{exp} Trigger (Digital Input) to start of exposure
- t_{exps} Current Exposure Time set (XI_PRM_EXPOSURE)
- t_{fot} Frame overhead time (FOT)
- t_{rd} readout time (Readout Time)
- t_{row} readout time of one row (Line period) depends on sensor settings

Conditions: Debounce on trigger input line and trigger delay are disabled.

The timing strongly depends on camera settings. Most of the times can be calculated using Camera performance calculator.

The delay between trigger input and start of exposure:

$$t_{exp} = t_{sensdelay} + t_{idelay}$$

t_{delay} – Delay introduced by sensor itself. For most sensors the delay is constant. Cameras with CMV50000 sensor have this time dependent on setting of the sensor. Namely it is line period and bandwidth limit.

t_{delay} – Delay inside camera caused by internal electronics. This depends on input type. Please refer to: Optically isolated Digital Input (IN)

The output signaling is then delayed the delay introduced from the output electronic:

$$t_{eio} = t_{exp} + t_{odelay}$$

t_{odelay} – Delay inside camera caused by internal electronics. This depends on output type. Please refer to: Optically isolated Digital Output (OUT)

For minimum trigger period (t_{tper}) the following applies. The next trigger after one is processed needs to be applied so the end of the triggered exposure does not overlap with the readout of the previous frame.

$$t_{per} > \max(t_{rd}, t_{exp} + t_{fot})$$

Triggered mode - Burst of frames

For more information please see: Frame Burst Modes

Frame Burst Start

In this mode each trigger pulse triggers defined number of exposed frames.

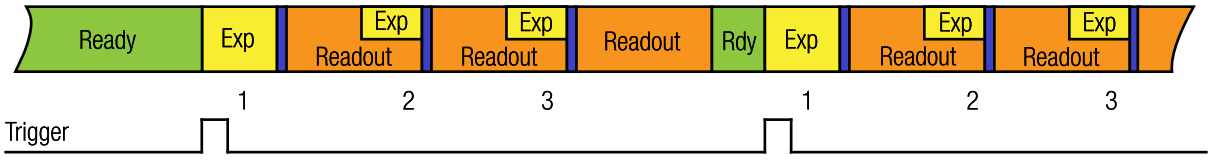


Figure 69: Triggered burst of frames – frame burst start

Frame Burst Active

If trigger is level-sensitive, it can be used to control image acquisition.

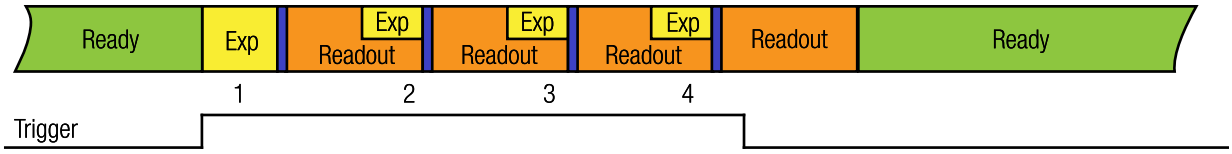


Figure 70: Triggered burst of frames – frame burst active

Triggered mode - Exposure defined by trigger pulse length

In this mode the exposure is defined by trigger pulse length. This can be used to achieve longer exposure than allowed by API. Also, it can be used to trigger several images in sequence with different exposure time. Exposure time is measured and reported in image metadata. Please see: Exposure Defined by Trigger Pulse Length

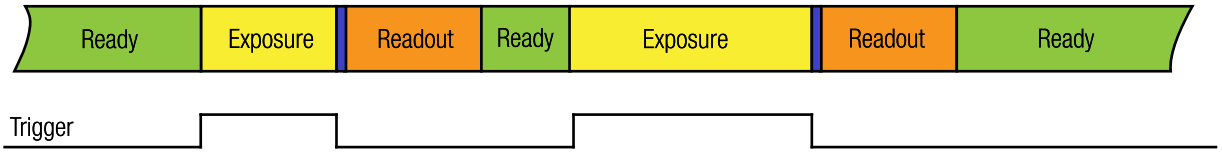


Figure 71: Exposure defined by trigger pulse length

3.3 Exposure time

Also known as shutter speed. This parameter defines the length of the integration period for each frame. Most CMOS sensors generate the exposure interval internally. For some it is possible to control it by external signaling. The sensor internal timing depends on the provided system clock. Most sensors use dividers to generate slower clocks for internal usage.

The minimum exposure time is defined mostly by row times, where the row time (T_R) is dependent on various internal settings. Very few sensors support exposure times equal to zero. There is a defined minimum exposure time as well as minimum steps between possible exposure times. There is also a maximum exposure time, defined by sensor architecture.

3.4 Gain

The gain value influences the analog-to-digital conversion process of the image sensor pipeline and acts as a multiplier of the output signal. Using gain values greater than 0 will increase the pixel intensities but may also increase the overall noise level. For some camera models the gain can be set in discrete steps only.

3.5 API Features

Host-assisted image processing features available in xiAPI

3.5.1 Exposure – Auto gain

When AEAG is used, every captured image is evaluated for its mean intensity. Based on the result, the exposure and gain values are modified with the objective to achieve a target intensity level for the following image. Further, the maximum applicable exposure and gain values can be defined. Since both, exposure and gain, have an influence on the intensity, the ratio between those two parameters in their contribution to the algorithm can also be set (exposure priority).

3.5.2 White balance

Only for color models: The white balance can be adjusted with three coefficients kR, kG and kB, one for each color channel. These coefficients can be set individually in order to increase or decrease each channel's contribution and therefore allow the user to control the color tint of the image.

Assisted manual white balance

This feature measures the white balance a single time and sets the white balance coefficient to achieve a mean grey (neutral) tint. The measurement is performed on the central rectangle of the image, with 1/8th of its width and height. The function expects a white sheet of paper exposed to 50% of the intensity values (8 Bit RGB values should be around 128) to be visible.

Auto White Balance

The white balance is measured across the full image for every 4th image that is acquired, and the white balance coefficients are set to to achieve a neutral colour tint.

3.5.3 Gamma

Only for color models: As a part of the color filtering process, it is possible to adjust the gamma level of the image. The adjustment can be set separately for the luminosity and the chromaticity.

3.5.4 Sharpness

Only for color models: As a part of the color filtering process, it is possible to adjust the sharpness of the image.

3.5.5 Color correction matrix

The color correction matrix is a 4x4-matrix which is applied on each pixel of an image in a host-assisted port-processing step. This Matrix can be used for example to adjust the brightness, contrast, and saturation.

3.5.6 Sensor defect correction

During the manufacturing process, every camera is tested for various type of defects and a list of the measured defect pixels is created and stored in the camera's non-volatile memory. This list is then used for the correction of acquired images during operation. The correction is inactive by default, but can be turned on by the user if a non-processed output is required.

3.5.7 Flat field correction

Flat field correction (FFC or shading correction) is a method to remove non-uniformities in the image caused by different sensitivities of the pixels and by distortions caused by optics. For XIMEA cameras this correction is applied in the image processing part of the image data flow diagram (it is performed on the host computer thus depending on the image size and CPU performance enabling it may cause increased processing time).

In order for the xiapi to calculate the gain and offset coefficients for each individual pixel, it is necessary to load calibration images (1 dark image and 1 mid-saturated image) before applying FFC in RAW8 or RAW16 format depending on desired output bit depth. To obtain optimal results, camera should be in the same setup (lens, device output bit depth, gain, ROI, downsampling, Zero ROT, light conditions...) during acquisition of calibration images and while using FFC.

Compare of camera output with shading (left) and after FFC enabled (right):

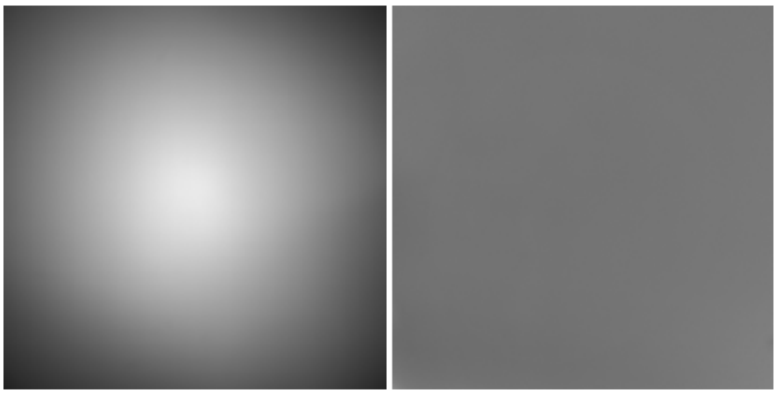


Figure 72: Flat field correction - images comparison

Acquisition of calibration images

The easiest way to acquire calibration images is by using CamTool guide:

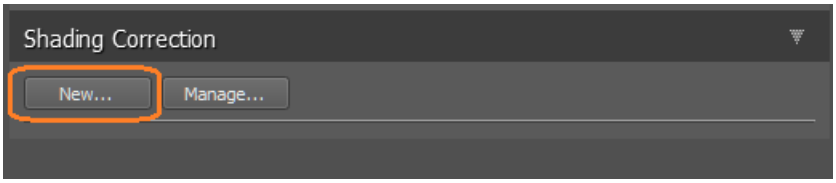


Figure 73: Flat field correction - new FFC

Dark Image

Close camera lens with a cap (make it dark) and click button Capture. Average the image from set number of frames to suppress dynamic noise.

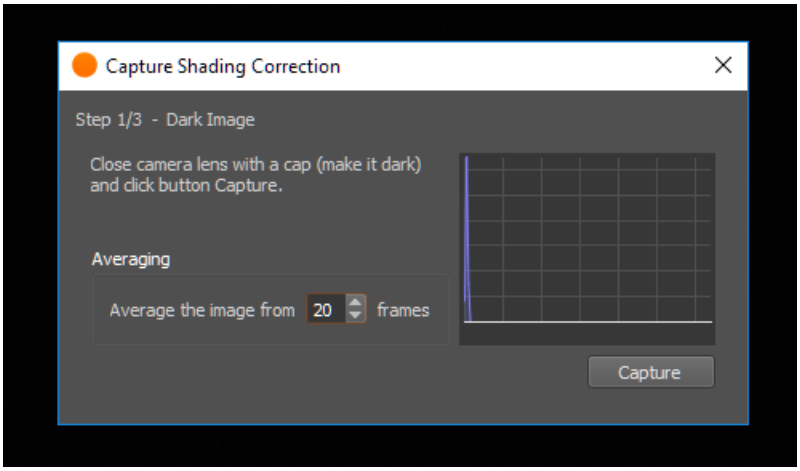


Figure 74: Flat field correction - Dark image

Mid-saturated image

Open camera lens and aim the camera into paper illuminated at 30-70% and click button Capture. Average the image from set number of frames. Image should be focused out of captured plane to reduce dust or other details in the scene.

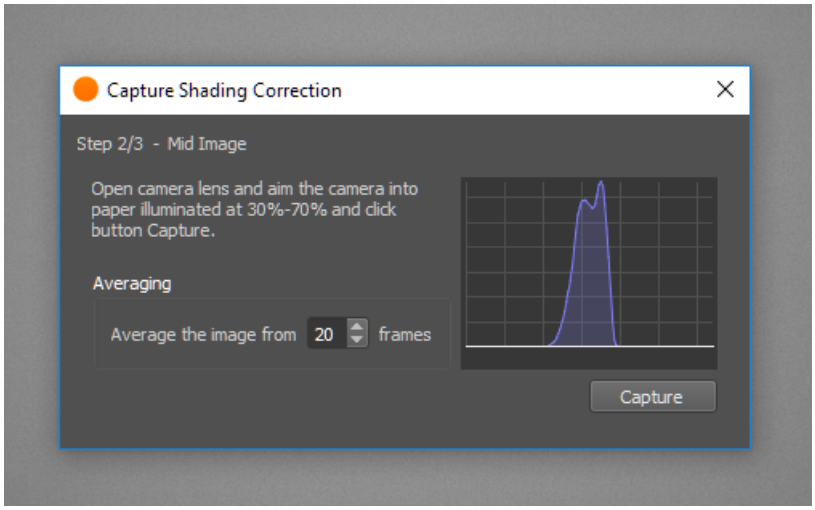


Figure 75: Flat field correction - Mid- saturated image

Save TIFF files

Save the new preset how it be displayed in CamTool.

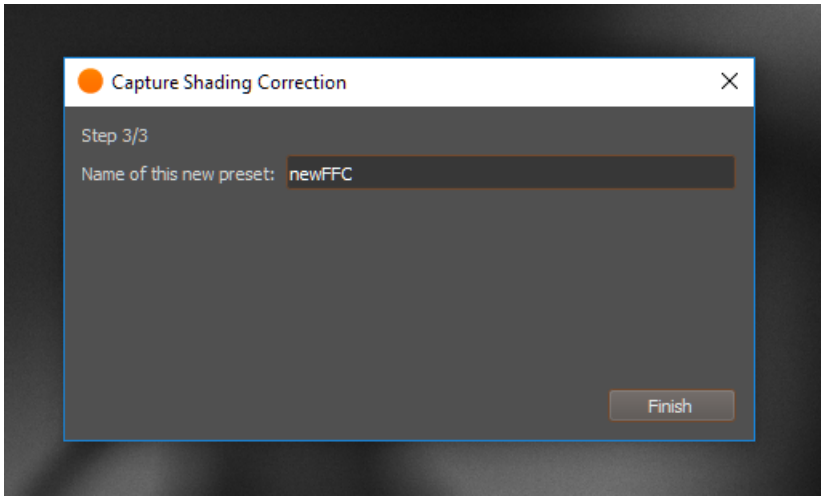


Figure 76: Flat field correction - new preset

To verify calibration, FFC can be also enabled in CamTool by clicking on created preset

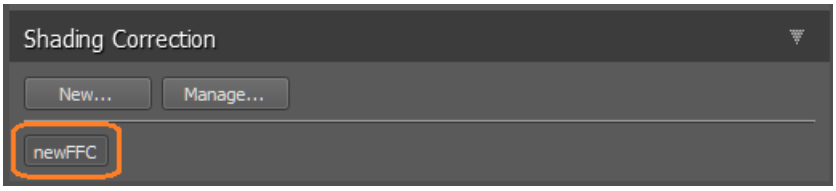


Figure 77: Flat field correction - Enabling FFC

In case of any issue, please double check that all dependent camera parameters (device output bit depth, ROI, downsampling, Zero ROT, exposure, gain...) are in the same setup as during acquisition of calibration images

To see calibration images and be able to save them, click on Manage, then choose preset from list. Camera parameters for that particular preset will be displayed. Click on show dark/mid image

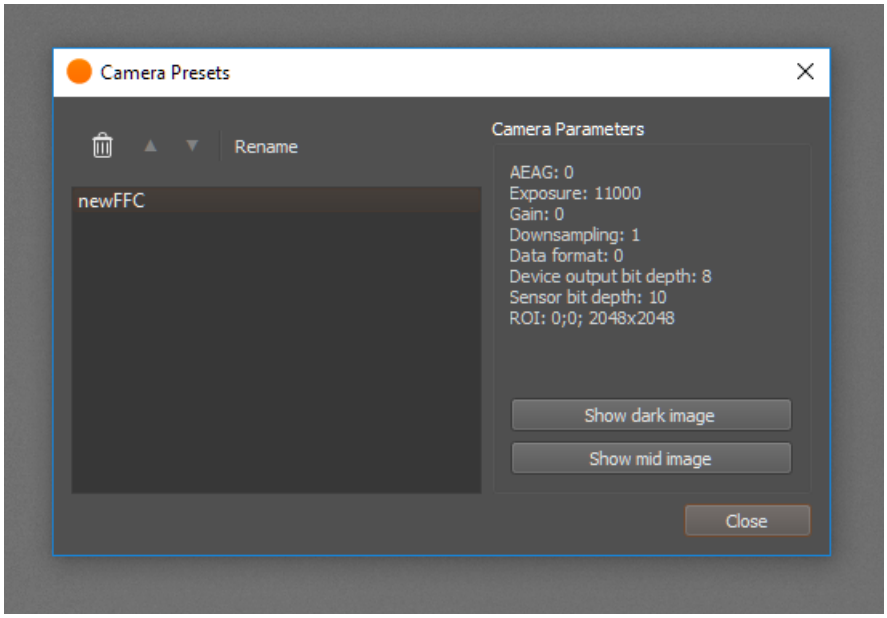


Figure 78: Flat field correction - FFC management

When images are shown in CamTool it is possible to save them by clicking on save icon in top toolbar. Images should be saved in uncompressed TIFF format to use in API.

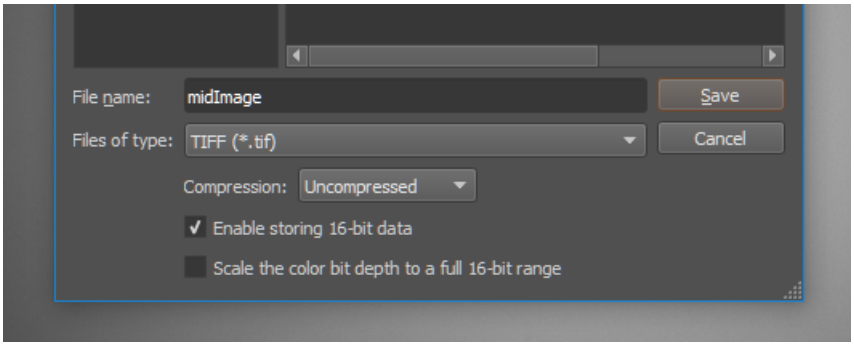


Figure 79: Flat field correction - Safe TIFF

Otherwise, calibration images from CamTool are stored in hidden AppData folder. It can be opened in Windows Run application by command:

```
%LOCALAPPDATA%\xiCamTool\shading
```

Calibration images might be also acquired in any other tool as long as the output is in TIFF format and with the same camera setup.

Applying FFC in xiAPI

xiAPI command sequence:

- Set all dependent camera parameters (device output bit depth, ROI, downsampling, Zero ROT, exposure, gain...) to be in the same setup as during acquisition of calibration images.
- Load dark image - XI_PRM_FFC_DARK_FIELD_FILE_NAME
  `size` - size of the file name - `strlen(file\_name)`.
- Load mid-saturated image - XI_PRM_FFC_FLAT_FIELD_FILE_NAME
  `size` - size of the file name - `strlen(file\_name)` (place both image files into project folder).

Note: Use the same image file for this parameter as for XI_PRM_FFC_DARK_FIELD_FILE_NAME for dark-field correction only. Processing will subtract the dark image only while using the unity (1.00) gain for correction.

- Enable XI_PRM_FFC.

Sample code:

```
xiSetParamInt(0, XI_PRM_NEW_PROCESS_CHAIN_ENABLE, XI_ON); // MU,MQ,MD camera families

xiOpenDevice(0, &xiH);
// set dependent camera params to same values as during calibration

xiSetParamString(xiH, XI_PRM_FFC_DARK_FIELD_FILE_NAME, "darkImage.tif", strlen("darkImage.tif"));
xiSetParamString(xiH, XI_PRM_FFC_FLAT_FIELD_FILE_NAME, "midImage.tif", strlen("midImage.tif"));
xiSetParamInt(xiH, XI_PRM_FFC, 1);
```

In FFCdemoWithOpenCV.cpp is FFC demonstrated in OpenCV+xiAPI example. FFC might be enabled or disabled by pressing any key while program is running.

4 Operation

For a proper operation of your camera there are certain requirements that have to be met. You can read more about these requirement as well as about the correct usage of camera in the following sections.

4.1 System requirements

4.1.1 Software requirements

Cameras are compatible with the following operating systems:

- Windows 10, 11
- Linux Ubuntu
- MacOS 10.8 or newer



All XIMEA cameras are compatible with the most advanced Vision and Image Processing Libraries. See chapter XIMEA Software Packages for more information about the options to access cameras, as well as a list of currently supported libraries and frameworks supported in Windows. For more information visit API - Application Programming Interfaces.

4.2 XIMEA software packages

4.2.1 XIMEA Windows software package

XIMEA API Software Package can be installed on: Microsoft Windows 10, 11.

Contents

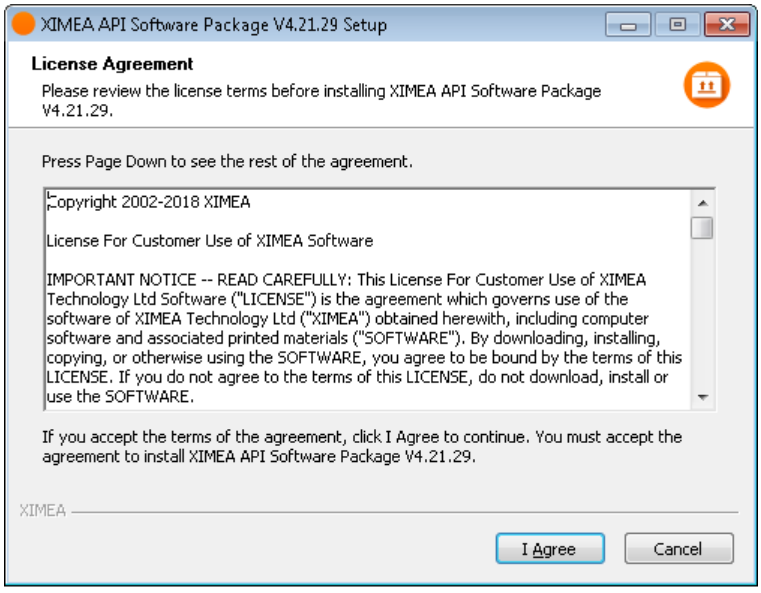
The package contains:

- OS Drivers of all XIMEA camera types for OS Microsoft Windows, Windows Server 2008 R2 x86-64, Windows 10 32/64 bit
- APIs (xiAPI, xiAPI.NET, xiApiPython)
- Examples
- CamTool
- xiCOP
- GenTL Producer - for connection of GenTL Consumer applications
- Vision Libraries integration demonstrations:
  - NI LabView interface - xiLib

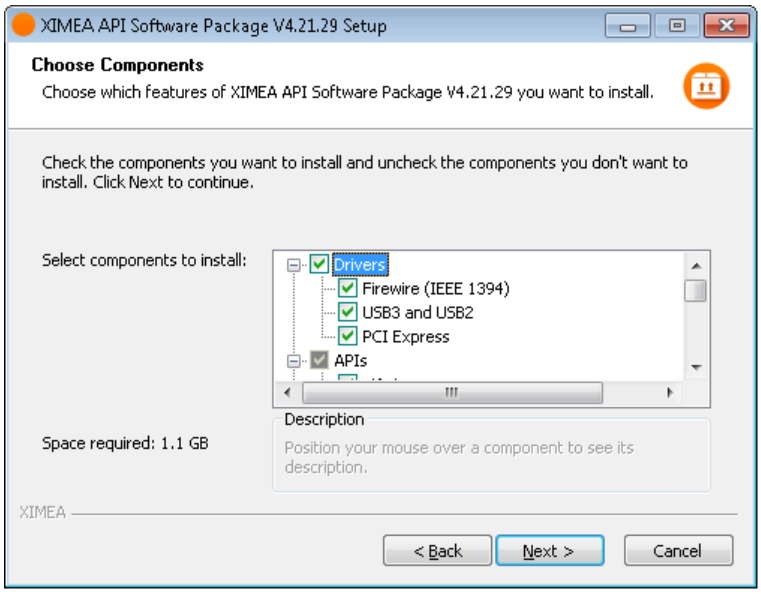
Installation

- Download and execute the XIMEA API Software Package installer (EXE-file, approximate size 100 MB): http://www.ximea.com/downloads/recent/XIMEA_Installer.exe
- Read the License Agreement
- Start the installer

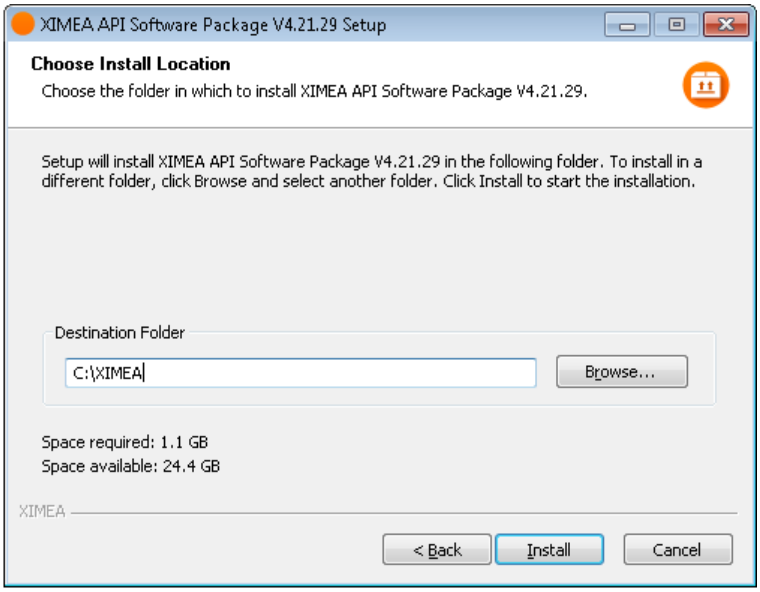
  Be sure that you have administrator privileges or start the Installer with administrator rights (right click and select “run as administrator”):



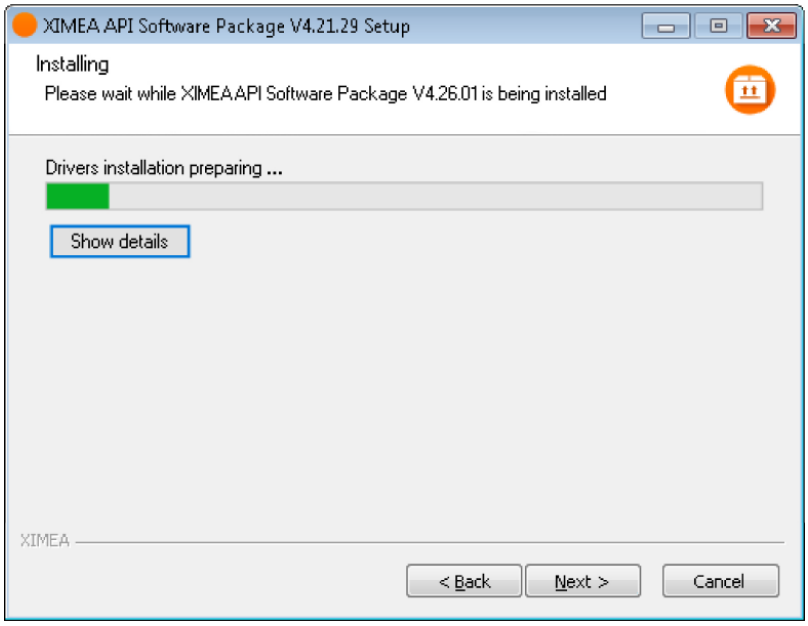
- Select the Software components you want to install. You can uncheck the components you don't want to install, but it is recommended to leave them all checked



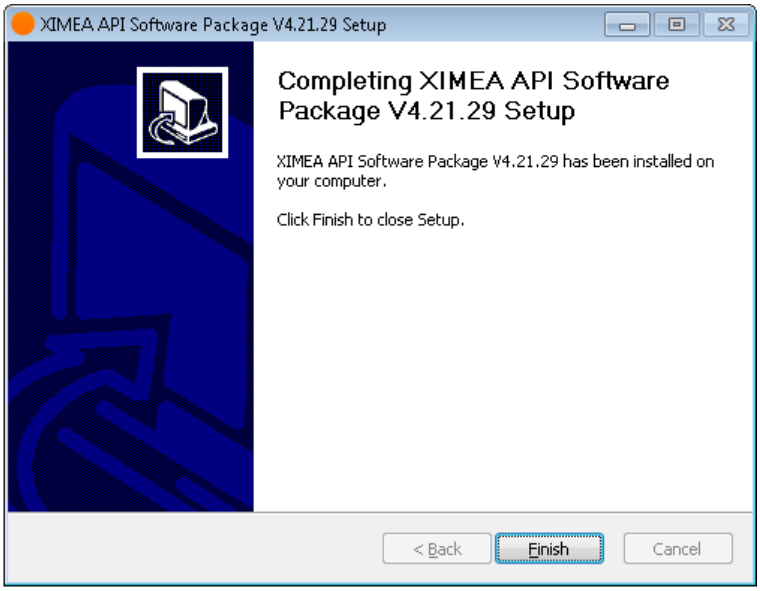
- Specify the install location - you can leave the default location or change it to your desired location



- Now the XIMEA API Software Package should start copying files, updating System Variables and installing drivers if necessary



- Installation is completed
- Finish



4.2.2 XIMEA Linux software package

XIMEA Linux Software Package is tarred installer with files that can be run on Linux Ubuntu 14.04 and 16.04 (32 and 64 Bit) and newer releases.

Contents

The package contains:

- Driver for XIMEA USB2 and USB3 cameras
- xiAPI
- XIMEA CamTool
- Examples:
  - xiSample - sample showing basic image acquisition in xiAPI

Instalation

- Download XIMEA Linux Software Package:

  http://www.ximea.com/downloads/recent/XIMEA_Linux_SP.tgz

  ```
  wget http://www.ximea.com/downloads/recent/XIMEA_Linux_SP.tgz
  ```

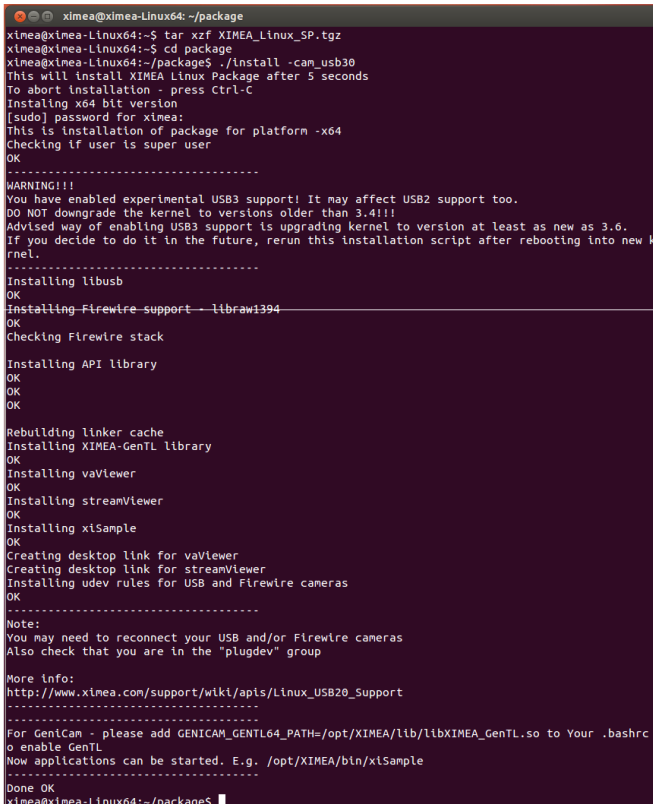


- Untar

  ```
  tar xzf XIMEA_Linux_SP.tgz
  cd package
  ```

- Start installation script

  ```
  ./install
  ```



Note: If logged in user is not root, you will be asked for your password to get root access, because the installation runs with root account using sudo.

4.2.3 XIMEA macOS software package

XIMEA macOS Software Package is native DMG installer that can be run on macOS 10.8 (Mountain Lion) or newer.

Contents

The package contains:

- Driver (beta version) for XIMEA USB2 and USB3 cameras
- xiAPI
- XIMEA CamTool
- Examples:
  - xiSample - sample showing basic image acquisition in xiAPI

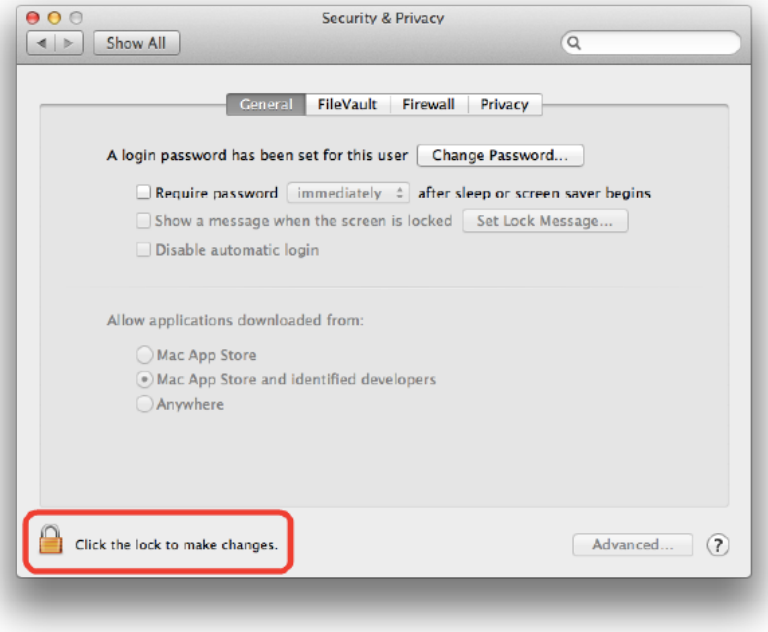
Installation

Before installing XIMEA macOS Software Package it may be necessary to modify security settings on your computer. The new feature of OS X 10.8 called GateKeeper can prevent you from using our macOS Software Package due to the fact that the current version is unsigned.

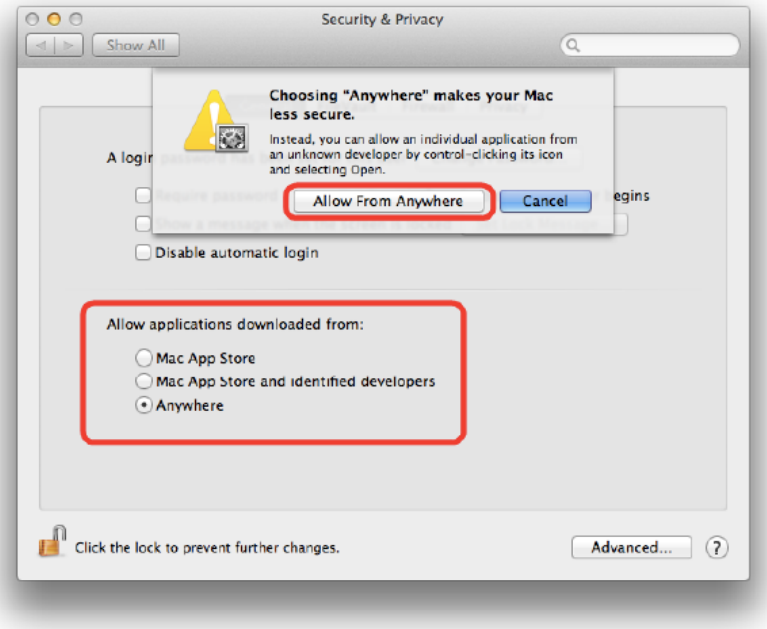
- Open System Preferences application and click on Security & Privacy



- Click on the lock to allow changes to be made



- On the General Tab select the option Anywhere under Allow applications downloaded from:



- Download XIMEA macOS Software:
  http://www.ximea.com/downloads/recent/XIMEA_OSX_SP.dmg
- Mount it by double-clicking this file in Finde
- Run the install script to install XiAPI on your macOS system
- A window with package contents will open

Start XIMEA CamTool

- Connect camera
- Start Applications / XIMEA CamTool
- Start acquisition by clicking on orange triangle at upper left corner of CamTool



Short description

The CamTool is a cross-platform application showcasing the features of all XIMEA camera families. It runs on Windows, Linux, macOS systems offering a substantial imaging tool set, which can be further extended with custom modules using a plugin infrastructure. CamTool is based on Qt for the UI and xiAPI for the camera control. Its camera settings menu resembles the parameter set of the xiAPI.

4.3 XIMEA CamTool

CamTool allows to operate all connected cameras simultaneously. In this case all controls are layered for the cameras. Basic controls are placed as tabs in upper part of the window. Image window can be detached from application if needed. Amount of visible camera controls depend on visibility level which can be set in Edit → Options. For more information, please, visit our website page: CamTool.



Figure 80: CamTool preview

Number	1	2	3	4	5
Description	Control panel	Image window	Analytics tools	Proccessing chain	Camera control

Table 85: CamTool layout

Functions

- To see live image from multiple XIMEA cameras connected
- Control the camera parameters
- Store of camera image and video
- Analyze the image properties
- Histogram and line profile
- Image averaging, image flip/mirror
- Software trigger timer, save/load camera and program settings
- LUT (Look up table)
- Lua scripting

4.4 XIMEA control panel

The XIMEA Control Panel (xiCOP), is a diagnostics and management tool for all XIMEA cameras.
xiCOP is available for Windows (32, 64-bit) and Linux (64-bit) operating system.

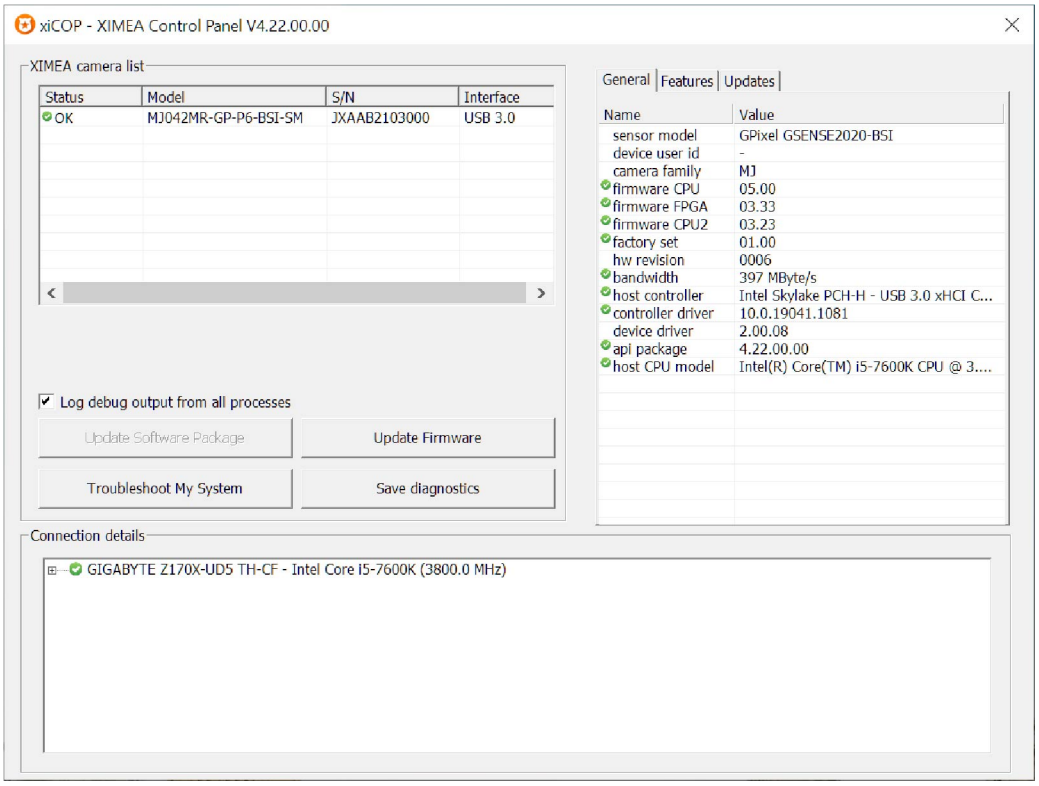


Figure 81: xiCOP example

Features

- Facilitates diagnostics of system performance bottlenecks
  xiCOP is capable of retrieving the system's hardware tree, thus problematic hardware configurations can be identified
- Diagnosis of firmware and software compatibility
  xiCOP checks relevant firmware and software versions and warns if a component is not up-to-date
- Lists all currently attached XIMEA devices and their features.
- Saves a diagnostic log and debug output which can be reviewed by technical support
- Suggests solution for diagnosed issues
- Allows setting of User IDs to XIMEA cameras
- One click to switch selected XIMEA cameras to USB3 Vision standard and back to XIMEA API
- One click update to the latest XIMEA API Software Package
- One click update of firmware in selected cameras

4.5 Supported vision libraries

All XIMEA cameras are compatible with the most advanced vision and image processing libraries. For GUI based software packages, the cameras can be directly accessed without the need of programming. Code libraries are generally used in conjunction with one of our APIs, in order to add additional functionality (e.g. image processing, communication, data storage).

For an up-to-date listing of the supported vision libraries and software packages, visit our website page: Vision Libraries.

4.5.1 MathWorks MATLAB



MathWorks® is the leading developer and supplier of software for technical computing and Model-Based Design. More on our website page: MathWorks MATLAB.

4.5.2 MVTec HALCON



HALCON is the comprehensive standard software for machine vision with an integrated development environment (IDE) that is used world-wide. More on our website page: MVTec HALCON.

4.5.3 National Instruments LabVIEW vision library



LabVIEW is a graphical programming environment. More on our website page: National Instruments LabVIEW Vision Library.

4.5.4 OpenCV



OpenCV is an open-source library of programming functions mainly aimed at real time computer vision. More on our website page: OpenCV

4.6 Programming

Depending on the target application, the user can choose between several ways of accessing and controlling the camera. These can be divided into two categories: a programmatic approach, through programming code, or an integrated approach, through a supported, GUI based software package. The programmatic approach is generally used for the development of a custom application or image processing pipeline. The integrated approach is favored, if the specific toolset of a certain software package is sufficient and the camera serves as an integrated capture device.

4.6.1 Standard interface

As an alternative to the proprietary API, the camera can be accessed through a set of standard interfaces. These interfaces decouple a specific hardware design (e.g. physical interface) of a camera from its control in software. Therefore, multiple camera classes and types can be used in a unified way.

GenICam/GenTL

GenICam/GenTL provides a camera-agnostic transport layer interface to acquire images or other data and to communicate with a device. Each camera serves as a GenTL Producer which can be accessed in all software packages that are compatible with the GeniCam standard, as well as through custom developments which implement this standard interface. For more information on programing according the GenICam standard, please visit the standard's website at www.emva.org.

4.6.2 xiAPI

xiAPI stands for XIMEA Application Programming Interface. It is a common interface for all XIMEA cameras.

Architecture

API is a software interface between the camera system driver and application.

- On Windows: xiAPI is compiled into xiapi32.dll or xiapi64.dll
- On Linux: xiAPI is compiled into /usr/lib/libm3api.so

Installation

xiAPI is part of all current XIMEA software packages for Windows, Linux and MacOS. For information on the software packages, see XIMEA Software Packages.

xiAPI functions description

The core of xiAPI consists of the following functions, which allow controlling of the camera functionality.

```
// get the number of discovered devices.
XI_RETURN xiGetNumberDevices(OUT DWORD *pNumberDevices);

// open interface
XI_RETURN xiOpenDevice(IN DWORD DevId, OUT PHANDLE hDevice);

// get parameter
XI_RETURN xiGetParam(IN HANDLE hDevice, const char* prm, void* val,
DWORD * size, XI_PRM_TYPE * type);

// set parameter
XI_RETURN xiSetParam(IN HANDLE hDevice, const char* prm, void* val,
DWORD size, XI_PRM_TYPE type);
```

```
// start the data acquisition
XI_RETURN xiStartAcquisition(IN HANDLE hDevice);

// acquire image and return image information
XI_RETURN xiGetImage(IN HANDLE hDevice, IN DWORD TimeOut, INOUT XI_IMG * img);

// stop the data acquisition
XI_RETURN xiStopAcquisition(IN HANDLE hDevice);

// close interface
XI_RETURN xiCloseDevice(IN HANDLE hDevice);
```

xiAPI parameters description

For a complete list of available parameters, please visit the xiAPI online manual at xiAPI Manual. All functions in xiAPI return status values in form of the XI_RETURN structure which is defined in xiApi.h. If a parameter is not supported by a certain camera, the return value will represent a respective error code (e.g. 106 - Parameter not supported).

Note: Since xiAPI is a unified programming interface for all of XIMEA's cameras, not all of the described parameters apply for every camera and sensor model.

xiAPI examples

Connect device

This example shows the enumeration of available devices. If any device was found the first device (with index 0) is opened.

```
HANDLE xiH = NULL;

// Get number of camera devices
DWORD dwNumberOfDevices = 0;
xiGetNumberDevices(&dwNumberOfDevices);

if (!dwNumberOfDevices)
{
 printf("No camera found\n");
}
else
{
// Retrieving a handle to the camera device
xiOpenDevice(0, &xiH);
}
```

Parameterize device

This example shows how an exposure time is set. Next, the maximum possible downsampling rate is retrieved and the result is set as new downsampling rate.

```
// Setting "exposure" parameter (10ms)
int time_us = 10000;
xiSetParam(xiH, XI_PRM_EXPOSURE, &time_us, sizeof(time_us), xiTypeInteger);

// Getting maxium possible downsampling rate
int dspl_max = 1;
xiGetParamInt(xiH, XI_PRM_DOWNSAMPLING XI_PRM_INFO_MAX, &dspl_max);

// Setting maxium possible downsampling rate
xiSetParamInt(xiH, XI_PRM_DOWNSAMPLING, dspl_max);
```

Acquire images

This example shows how the acquisition is started on the device with the handle xiH, ten images are acquired in a row and the acquisition is stopped.

```
            xiStartAcquisition(xiH);

    #define EXPECTED_IMAGES 10
    for (int images=0;images < EXPECTED_IMAGES;images++)
    {
    // getting image from camera
    xiGetImage(xiH, 5000, &image);
    printf("Image %d (%dx%d) received from camera\n", images,
    (int)image.width, (int)image.height);
    }
    xiStopAcquisition(xiH);
```

Hardware trigger and exposure active output

In this setup each image is triggered by a Digital Input Trigger. After the image is triggered, it can be transferred using xiGetImage. This setup ensures a low latency between the trigger signal and image Exposure start.

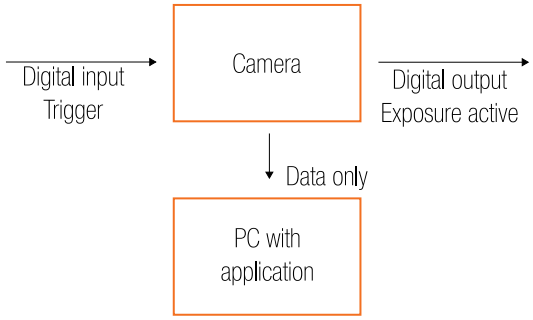


Figure 82: GPIO scheme

```
            HANDLE xiH;
    xiOpenDevice(0, & xiH);

    // select trigger source
    xiSetParamInt(xiH, XI_PRM_TRG_SOURCE, XI_TRG_EDGE_RISING);

    // select input pin 1 mode
    xiSetParamInt(xiH, XI_PRM_GPI_SELECTOR, 1);
    xiSetParamInt(xiH, XI_PRM_GPI_MODE, XI_GPI_TRIGGER)

    // set digital output 1 mode
    xiSetParamInt(xiH, XI_PRM_GPO_SELECTOR, 1);
    xiSetParamInt(xiH, XI_PRM_GPO_MODE,  XI_GPO_EXPOSURE_ACTIVE);

    xiStartAcquisition(handle1);

    // Trigger signal should start image exposure within timeout
    #define TIMEOUT_IMAGE_WAITING_MS 10000
    xiGetImage(handle, TIMEOUT_IMAGE_WAITING_MS, &image);
    // process image here…
```

xiAPI Auto Bandwidth Calculation

xiAPI uses Auto Bandwidth Calculation (ABC) before the opening of each camera by default. After the measurement, 90% of the measured value is used as the maximum allowed transfer speed of the camera to ensure the stability of transfer.

It is important to set this parameter to XI_OFF to ensure highest possible data transfer speed.
To disable ABC, the application should set parameter XI_PRM_AUTO_BANDWIDTH_CALCULATION to XI_OFF before the first xiOpenDevice is used. This setting disabled ABC and the camera stream is not limited.

xiAPI.NET

XIMEA Application Programming Interface for Dot Net - Microsoft Visual C#. xiAPI.NET is designed as a wrapper around xiAPI and therefore shares most of its functionality.

xiApiPython

Applications in Python can access XIMEA cameras using xiApiPython interface. It is a wrapper around xiAPI, which integrates camera features and capabilities into PYTHON.

5 Appendix

5.1 Troubleshooting and support

This chapter explains how to proceed, if you have issues in bringing your camera to proper operation.

At first, please make sure that you have installed the latest version of the following XIMEA software package, based on your OS:

- XIMEA Windows Software Package
- XIMEA Linux Software Package
- XIMEA macOS Software Package

Please make sure, that you have connected your camera with the appropriate XIMEA cable to an appropriate port. Ensure that the connections are carefully locked. Follow the instructions described in section 4.3 (run the camera with the Ximea CamTool). In case that you still have issues, please read the following chapters.

5.1.1 Worldwide support

We offer worldwide first level support to you by our partners. Please refer to your local dealer if you need technical support for your camera.

5.1.2 Before contacting technical support

There are several steps to take before contacting your local dealer for technical support. In case you cannot display images from your camera, please open the XIMEA xiCOP software (please see section 4.4). It will immediately start searching for connected cameras. Your camera will appear in the XIMEA camera list on the upper left side of the xiCOP window if it is connected properly and your USB interface meets the minimum system requirements described in section 4.1. If the camera does not appear, please proceed with the following steps:

Step 1 Click on the button “Troubleshoot My System” and follow the instructions that are suggested.

Step 2 If step 1 does not lead to a positive result, please click the button “Save diagnostics”.
Keep the diagnostic file ready for providing it to support.

Step 3 Contact your local dealer where you bought the camera either by phone or by email for first level support.
They will decide if they can help you immediately or if more information is necessary for initiating the next steps.

5.2 Frequently Asked Questions

- Frequently Asked Questions
- Knowledge Base

5.3 Product service request (PSR)

If you experienced any unexpected behavior of your camera, please, follow the steps described below:

Step 1 – Contact support

If your camera is not working as expected, please, contact your local dealer for troubleshooting the product and determine the eligibility of a Product Service Request (Product Service Request (PSR)). In case you were asked to create a PSR by your local contact, please continue to Step 2.

NOTE: Your product must be UNDER WARRANTY in order to qualify for a free repair or replacement.

Step 2 – Create product service request (PSR)

- Read the XIMEA General Terms & Conditions
- Open the XIMEA Helpdesk
- Set field Department to “Service”
- Fill in all fields
- Confirm with the button “Submit”

Step 3 – Wait for PSR approval

Our support personnel will verify the PSR for validity. If your PSR is valid and no further information is required, the PSR will be approved within 3 business days. After that you will get a notification email contains the shipping instructions. When you received the PSR Approval email – please continue to Step 4. In case your PSR was rejected – please do not send the product to XIMEA.

Step 4 – Sending the camera to XIMEA

If possible, send the camera back in the original package. If not possible, please pack the camera in a way that it cannot be damaged during shipment and send it back as described in the PSR Approval email that you have received.

Step 5 – Waiting for service conclusion

Once we have received the camera, we will send you a notification. The XIMEA Service will then check the status of the camera that you have sent for a possible repair. Depending on warranty conditions, product status and agreement one of the following operations will be performed:

Operation	Repair costs paid by	Return delivery costs paid by
repaired in warranty	XIMEA	XIMEA
replaced in warranty	XIMEA	XIMEA
repaired for cost	Customer	Customer
not repaired and returned	—	Customer
not repaired and discarded if requested by customer	—	—

Table 86: Service operations overview

If the camera will be returned, you will receive the tracking number. In this case, please continue to Step 6.

Step 6 – Waiting for return delivery

After you have received the return shipment, please confirm it by changing the status of the PSR to “Received by customer”.

NOTE: If you have any problems accessing the links below, please contact our Support Team at www.ximea.com.

5.4 Safety instructions and precautions

Safety instructions and precautions are available at the following XIMEA webpage: Safety instructions and precautions.

5.5 Warranty

Information about warranty is available at the following XIMEA webpage: Warranty.

5.6 Standard Terms & Conditions of XIMEA GmbH

The Standard Terms and Conditions are available at the following XIMEA webpage: General Terms and Conditions.

5.7 List of Trademarks

List of Trademarks is available at the following XIMEA webpage: List of Trademarks.

5.8 Copyright

All texts, pictures and graphics are protected by copyright and other laws protecting intellectual property. It is not permitted to copy or modify them for trade use or transfer, nor may they be used on websites.

Glossary

API	Application Programming Interface 81
CMOS	Complementary Metal-Oxide-Semiconductor 82
ESD	Electrostatic discharge 56
FPGA	Field Programmable Gate Array 76
FPS	Frame Per Second 79
PCIe	PCI Express 8, 56
PSR	Product Service Request 105
ROI	Region Of Interest 76

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