xiQ-S7

[ksi-kjuː] or [sai-kjuː]

• USB3 Vision ultra-compact cameras

XIMEA Cameras •
Technical Manual •
Version v260402 •

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 3.1 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

XIMEA is a worldwide operating company

Headquarters, Sales worldwide	Sales America	R&D, Production
XIMEA GmbH Am Mittelhafen 16 48155 Münster Germany	XIMEA Corp. 12600 W Colfax Ave., Suite A-130 Lakewood, CO 80215 USA	XIMEA s.r.o. Lesná 52 900 33 Marianka Slovakia
Tel: +49 (251) 202 408-0 Fax: +49 (251) 202 408-99	Tel: +1 (303) 389-9838 Fax: +1 (303) 202-6350	Tel: +421 (2) 205 104 26 Fax: +421 (2) 205 104 27

Web	www.ximea.com
General inquiries	info@ximea.com
Sales	sales@ximea.com
Support	XIMEA Support

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

MQ013CG-E2-S7	MQ013CG-ON-S7	MQ013MG-E2-S7	MQ013MG-ON-S7
MQ013RG-E2-S7	MQ013RG-ON-S7	MQ022CG-CM-S7	MQ022MG-CM-S7
MQ022RG-CM-S7	MQ042CG-CM-S7	MQ042MG-CM-S7	MQ042MG-CM-S7-TG
MQ042RG-CM-S7			

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

MQ013CG-E2-S7	MQ013CG-ON-S7	MQ013MG-E2-S7	MQ013MG-ON-S7
MQ013RG-E2-S7	MQ013RG-ON-S7	MQ022CG-CM-S7	MQ022MG-CM-S7
MQ022RG-CM-S7	MQ042CG-CM-S7	MQ042MG-CM-S7	MQ042MG-CM-S7-TG
MQ042RG-CM-S7			

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

MQ013CG-E2-S7	MQ013CG-ON-S7	MQ013MG-E2-S7	MQ013MG-ON-S7
MQ013RG-E2-S7	MQ013RG-ON-S7	MQ022CG-CM-S7	MQ022MG-CM-S7
MQ022RG-CM-S7	MQ042CG-CM-S7	MQ042MG-CM-S7	MQ042MG-CM-S7-TG
MQ042RG-CM-S7			

Camera Sub-Assemblies

The “semi” housed camera models do not comply with CE/FCC/Class A limits (Canada) regulations. The system integrator (customer) is liable for compliance with CE/FCC/ Class A limits (Canada) regulations.

This text applies to

MQ013CG-E2-S7-FL	MQ013CG-E2-S7-FV	MQ013MG-E2-S7-FL	MQ013MG-E2-S7-FV
MQ013RG-E2-S7-FL	MQ013RG-E2-S7-FV	MQ022CG-CM-S7-FL	MQ022MG-CM-S7-FL
MQ022RG-CM-S7-FL	MQ042CG-CM-S7-FL	MQ042MG-CM-S7-FL	MQ042RG-CM-S7-FL

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.

AIA standard USB3 Vision

The xiQ cameras are compliant with the USB 3 Vision standard.

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

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

Contents

1 xiQ camera series

1.1 What is xiQ

xiQ is the world's smallest USB3 Vision camera family, offering resolutions from 1.3 to 4 Mpx resolution. Able to achieve 210 fps at full resolution or up to 1000 fps with downsampling. Lowest power consumption and heat generation. Single PCB - board level versions available lightest in class.

- Extremely small footprint
- Low thermal dissipation
- Single PC board electronics
- USB3 Vision Standard compatible
- sensors: 1.3 Mpx, 2.2 Mpx and 4.1 Mpx, b/w, color and NIR extended
- Frame rates up to 210 fps

1.2 Advantages

Industry standard interface	compliant with USB 3.0 SuperSpeed specification
AIA standard compatibility	USB 3 Vision standard
Small	fits into places where no other camera can fit
Low power consumption	1.0 to 1.8 W
Powerful	5 Gbit/s interface up to 450 Mpx/s data throughput
Fast	high speed, high frame rate: > 210 fps at 1.3 Mpx and 90 fps at 4 Mpx resolutions
Robust	full metal housing, no sheet metal covers
Lightweight	facilitates increased performance of robotic arms and gimbals
Connectivity	programmable opto-isolated input and output, 3 status LEDs
Compatibility	support for Windows, Linux and MacOS, ARM, various Image Processing Libraries
Software interfaces	GenICam / GenTL and highly optimized xiAPI SDK
Economical	excellent value and price, low TCO and fast ROI

1.3 Camera applications

- Automation
- Ultra-fast 3D scanning
- Miniature and fast robotic arms
- Mobile devices
- In-situ optical inspection camera
- Material and life science microscopy
- Ophthalmology and retinal imaging
- Broadcasting
- Fast process capture, e.g. golf club swings
- Intelligent Transportations Systems (ITS) and traffic monitoring
- UAV

1.4 Common features

Sensor Technology	CMOS, Global shutter
Acquisition Modes	continuous, software and hardware trigger, defined fps, exposure defined by trigger pulse and burst
Partial Image Readout	ROI, Skipping and Binning modes supported (model specific)
Image data formats	8 or 10 bit RAW pixel data[1]
Color image processing	host based de-bayering, sharpening, gamma, color matrix, true color CMS
Hot/blemish pixels correction	on camera storage of up to 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	USB 3.0 standard micro B with screw lock threads compliant to USB 3 Vision standard
General Purpose I/O	1x opto-isolated input, 1x opto-isolated output, power LED, 3x LED software programmable
Signal conditioning	programmable debouncing time
Synchronization	hardware trigger input, software trigger, exposure strobe output, busy output
Housing and lens mount	standard C-mount, available options are CS mount, and board level
Power requirements	1 to 1.8 W, supplied via USB 3.0 interface, supplied via USB 3.0 interface
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 updatable

[1] Maximal image data precision depends on sensor ADC precision

1.5 Model nomenclature

xiQ	MQxxxyT-zz-S7[-OPT]$_n$
MQ =	xiQ 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 (all xiQ cameras are global shutter)
zz =	Vendor of the sensor
E2:	E2V
CM:	CMOSIS
ON:	Onsemi (Current xiQ models produced utilize a newer FPGA indicated by the S7 in the part number.)
[-OPT] =	Connector options
TG:	sensor with taped sensor glass
BRD:	board level camera
FL / FV:	camera featuring flex cable connector (only specific models), please contact sales for more information
NIO:	models without IO connector

1.6 Models and sensors overview

Camera model	Sensor model	Sensor type	Filter	Resolution [px]	Pixel size [µm]
MQ013CG-E2-S7	e2v EV76C560	Color	BayerRG	1280 × 1024	5.3
MQ013CG-E2-S7-FL	e2v EV76C560	Color	BayerRG	1280 × 1024	5.3
MQ013CG-E2-S7-FV	e2v EV76C560	Color	BayerRG	1280 × 1024	5.3
MQ013CG-ON-S7	OnSemi PYTHON1300	Color	BayerRG	1280 × 1024	4.8
MQ013MG-E2-S7-FV	e2v EV76C560	Monochrome	None	1280 × 1024	5.3
MQ013MG-E2-S7	e2v EV76C560	Monochrome	None	1280 × 1024	5.3
MQ013MG-E2-S7-FL	e2v EV76C560	Monochrome	None	1280 × 1024	5.3
MQ013MG-ON-S7	OnSemi PYTHON1300	Monochrome	None	1280 × 1024	4.8
MQ013RG-E2-S7	e2v EV76C661	Monochrome-NIR	None	1280 × 1024	5.3
MQ013RG-E2-S7-FL	e2v EV76C661	Monochrome-NIR	None	1280 × 1024	5.3
MQ013RG-E2-S7-FV	e2v EV76C661	Monochrome-NIR	None	1280 × 1024	5.3
MQ013RG-ON-S7	OnSemi PYTHON1300	Monochrome-NIR	None	1280 × 1024	4.8
MQ022CG-CM-S7	CMOSIS CMV2000	Color	BayerGB	2048 × 1088	5.5
MQ022CG-CM-S7-FL	CMOSIS CMV2000	Color	BayerGB	2048 × 1088	5.5
MQ022MG-CM-S7	CMOSIS CMV2000	Monochrome	None	2048 × 1088	5.5
MQ022MG-CM-S7-FL	CMOSIS CMV2000	Monochrome	None	2048 × 1088	5.5
MQ022RG-CM-S7	CMOSIS CMV2000	Monochrome-NIR	None	2048 × 1088	5.5
MQ022RG-CM-S7-FL	CMOSIS CMV2000	Monochrome-NIR	None	2048 × 1088	5.5
MQ042CG-CM-S7	CMOSIS CMV4000	Color	BayerGB	2048 × 2048	5.5
MQ042CG-CM-S7-FL	CMOSIS CMV4000	Color	BayerGB	2048 × 2048	5.5
MQ042MG-CM-S7-FL	CMOSIS CMV4000	Monochrome	None	2048 × 2048	5.5
MQ042MG-CM-S7	CMOSIS CMV4000	Monochrome	None	2048 × 2048	5.5
MQ042MG-CM-S7-TG	CMOSIS CMV4000	Monochrome	None	2048 × 2048	5.5
MQ042RG-CM-S7-FL	CMOSIS CMV4000	Monochrome-NIR	None	2048 × 2048	5.5
MQ042RG-CM-S7	CMOSIS CMV4000	Monochrome-NIR	None	2048 × 2048	5.5

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
CBL-U3-3M0	3.0 m USB 3.0 cable, micro B connector
CBL-U3-3M0-ANG	3.0 m USB 3.0 cable, angled micro B USB3 connector
CBL-U3-5M0	5.0 m USB 3.0 cable, micro B connector
CBL-MQ-FL-0M1	Cable FPC MQ/MC Flex-Line, 0.1 m (gold color)
CBL-MQ-FL-0M25	Cable FPC MQ/MC Flex-Line, 0.25 m (gold color)
CBL-USB3FLEX-0M10	Cable FPC MQ/MC Flex-Line, 0.1 m (white color)
CBL-USB3FLEX-0M25	Cable FPC MQ/MC Flex-Line, 0.25 m (white color)
CBL-USB3FLEX-0M50	Cable FPC MQ/MC Flex-Line, 0.5 m (white color)
BOB-MQ-FL	Break Out Board, Flex-Line, Simple Board Level Micro-B USB3.0
MQ-BRACKET-T	xiQ series tripod mounting bracket, 5.5 mm thick
MQ-BRACKET-T-THICK	xiQ series tripod mounting bracket, 9.5 mm thick
U3X4-PCIE4XE111	PCI express adapter, 4x USB 3.0 ports, PCIe x4 slot[1]
CBL-S-M5-3P-PT-5M0	IO pigtail cable 5 m long unshielded[2]
CBL-S-M5-3P-PT-5M0-S	IO pigtail cable 5 m long shielded[2]
CBL-S-PB3-PT-0M40	IO pigtail cable 0.4 m long shielded[2]

[1]For more information please visit website:USB 3 Host Adapters
[2]These trigger cables are for the newer S7 camera variants

Table 2: List of accessories available for xiQ-S7 cameras

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

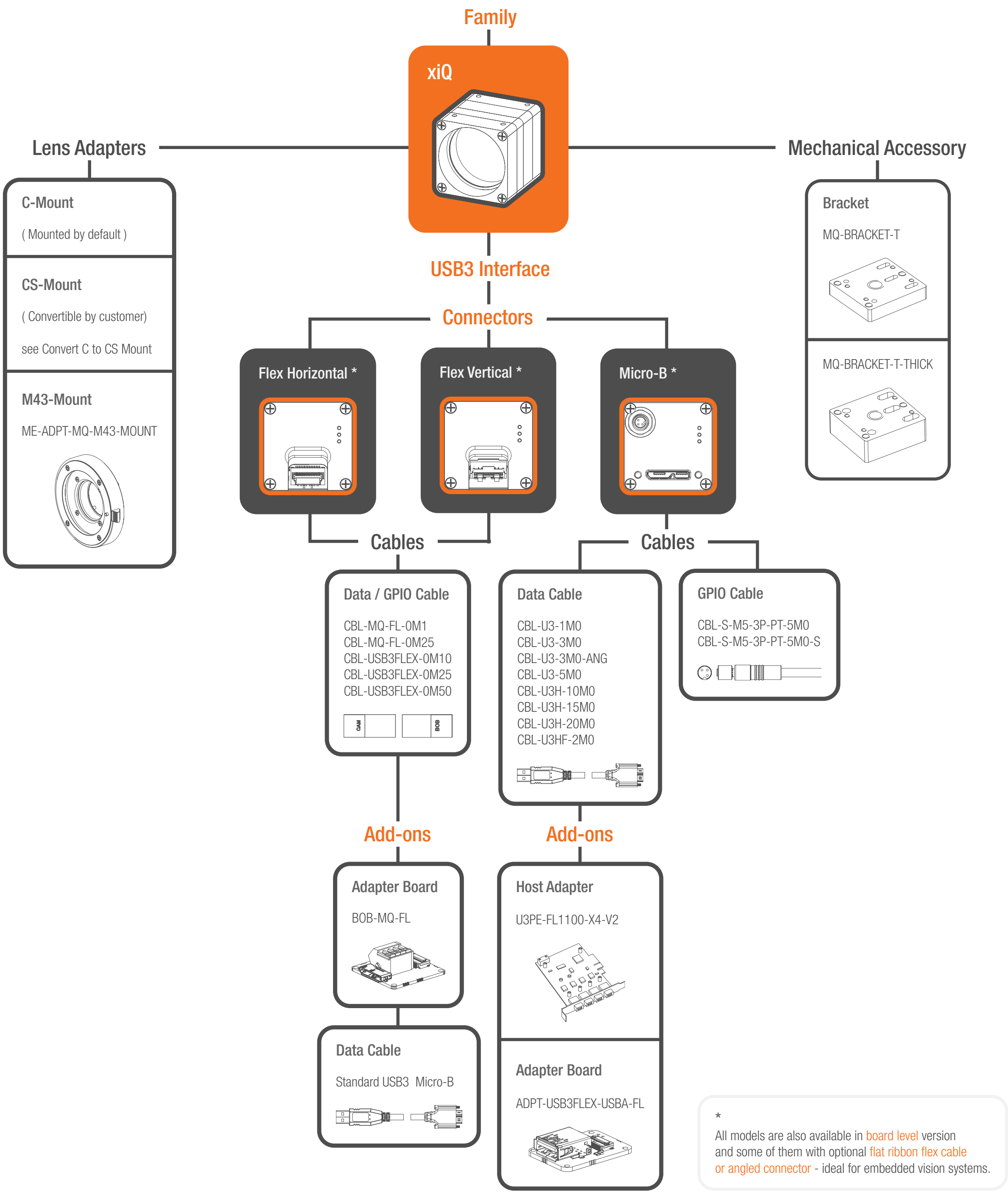


Figure 6: Diagram of accessories and specific connections for the xiQ camera family

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:

MQ013CG-E2-S7 MQ013CG-E2-S7-FL MQ013CG-E2-S7-FV MQ013MG-E2-S7-FV
MQ013MG-E2-S7 MQ013MG-E2-S7-FL MQ013RG-E2-S7 MQ013RG-E2-S7-FL
MQ013RG-E2-S7-FV

Supply Voltage[1]	Consumption idle	Consumption typical	Consumption maximum
5 V	0.68 W	0.98 W	1.05 W

[1]Supported voltage 4.5 - 5.5 V

Table 3: Power consumption of the specific models

Power consumption of:

MQ013CG-ON-S7 MQ013MG-ON-S7 MQ013RG-ON-S7

Supply Voltage[1]	Consumption idle	Consumption typical	Consumption maximum
5 V	0.8 W	1.58 W	1.65 W

[1]Supported voltage 4.5 - 5.5 V

Table 4: Power consumption of the specific models

Power consumption of:

MQ022CG-CM-S7 MQ022CG-CM-S7-FL MQ022MG-CM-S7 MQ022MG-CM-S7-FL
MQ022RG-CM-S7 MQ022RG-CM-S7-FL MQ042CG-CM-S7 MQ042CG-CM-S7-FL
MQ042MG-CM-S7-FL MQ042MG-CM-S7 MQ042MG-CM-S7-TG MQ042RG-CM-S7-FL
MQ042RG-CM-S7

Supply Voltage[1]	Consumption idle	Consumption typical	Consumption maximum
5 V	1.3 W	1.55 W	1.65 W

[1]Supported voltage 4.5 - 5.5 V

Table 5: Power consumption of the specific models

2.1.1 Power input

The xiQ-S7 cameras are powered via the USB 3.1 Micro-B connector or the flex line connector. The USB 3.1 cable that you use with the camera is responsible for the power supply and the data transfer to the PC. The input voltage is 5 V DC. Power consumption depends on the camera model. We recommend using XIMEA industrial USB 3.1 cables to achieve the maximum possible performance of the camera.

XIMEA offers several passive USB 3.1 cables and a sync cables, please see CBL-U3-1M0 / CBL-U3-3M0 / CBL-U3-5M, CBL-U3-3M0-ANG and CBL-MQ-FL-0M1 / CBL-MQ-FL-0M25.

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 6: 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/CS-mount

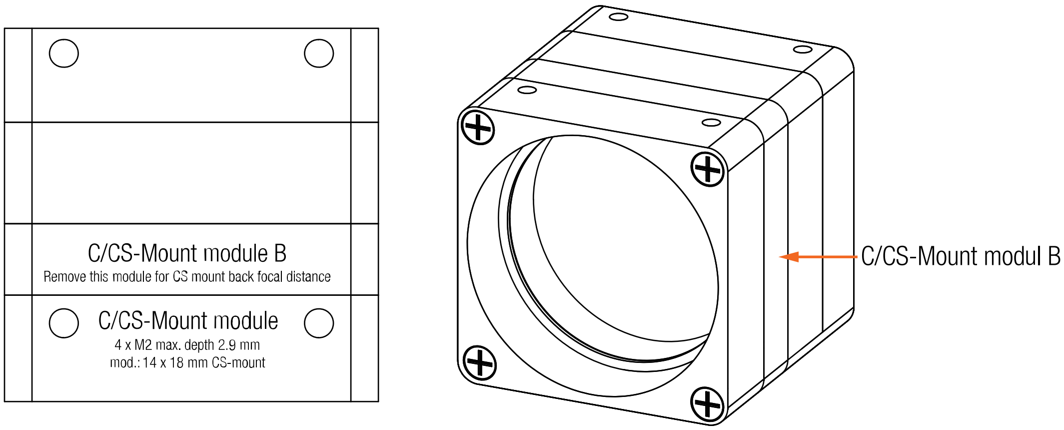


Figure 7: Lens mount adapter C/CS-mount

The cameras are initially equipped with a C-mount back focal length. Through the removal of the “C/CS-Mount module B”, the camera can be transformed for CS-mount compatibility, effectively reducing the back focal distance and overall length of the camera by 5 mm. The required M2x8 mm special screws for this conversion are included in the camera delivery. The length of the lens thread measured at 6.5 mm. For detailed instructions, please refer to section Optical path.

Conversion between these two options is described here: Convert C to CS Mount

Lens mount adapter configuration:

- C-Mount (with C/CS Mount module B)
- CS-Mount (without C/CS Mount module B)

The mentioned lens adapter is 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.

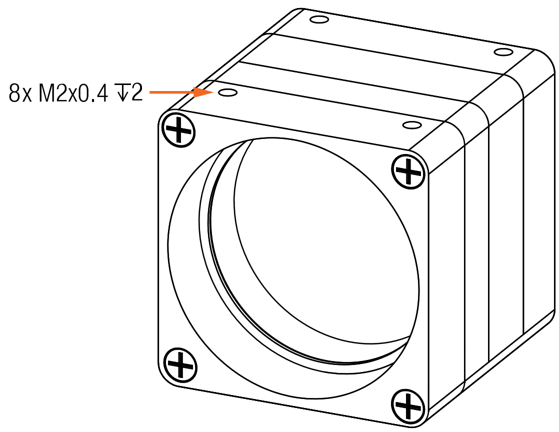


Figure 8: xiC camera mounting points

2.4.1 M2 Mounting screws

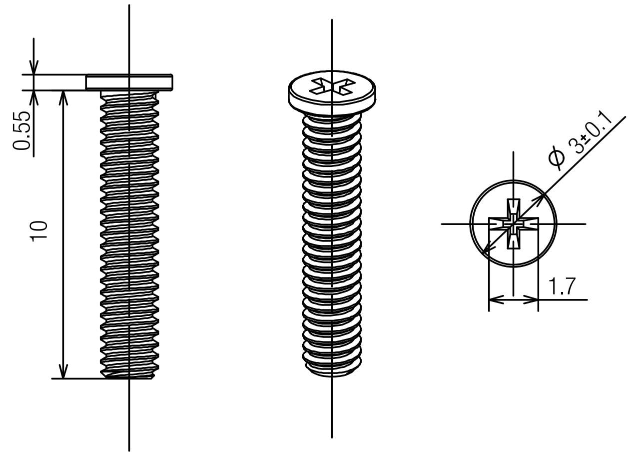


Figure 9: M2 mounting screws

Item	Material	Surface	Thread	Driver	Avail. lengths
Value	Steel	Black zinc	M2	PH 00	3 to 24 mm

Table 7: M2 screw description

Never exceed a maximum torque of 0.3 N m when fastening the M2 mounting screws.

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).

Note: The general tolerance of the mechanical distance from the top of the sensor to the front part of the camera is +/- 0.15 mm.

Cross-section corresponding to:

MQ013CG-E2-S7
MQ013CG-E2-S7-FL
MQ013CG-E2-S7-FV
MQ013MG-E2-S7-FV
MQ013MG-E2-S7
MQ013MG-E2-S7-FL
MQ013RG-E2-S7
MQ013RG-E2-S7-FL
MQ013RG-E2-S7-FV

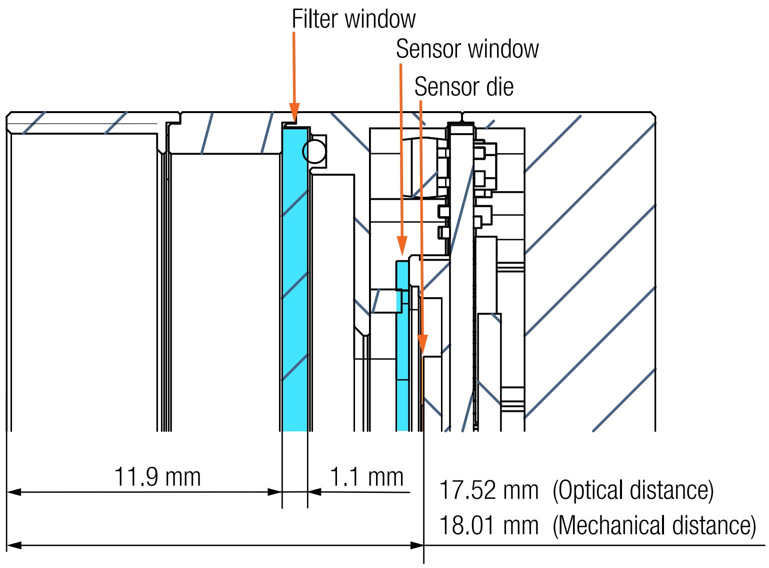


Figure 10: Cross section of MQ013xG-E2-S7 camera models

Sensor window	Value
Thickness	0.55 mm (+/- 0.05 mm)
Distance to sensor die	0.63 mm

Table 8: Sensor window details

Cross-section corresponding to:

MQ013CG-ON-S7 MQ013MG-ON-S7 MQ013RG-ON-S7

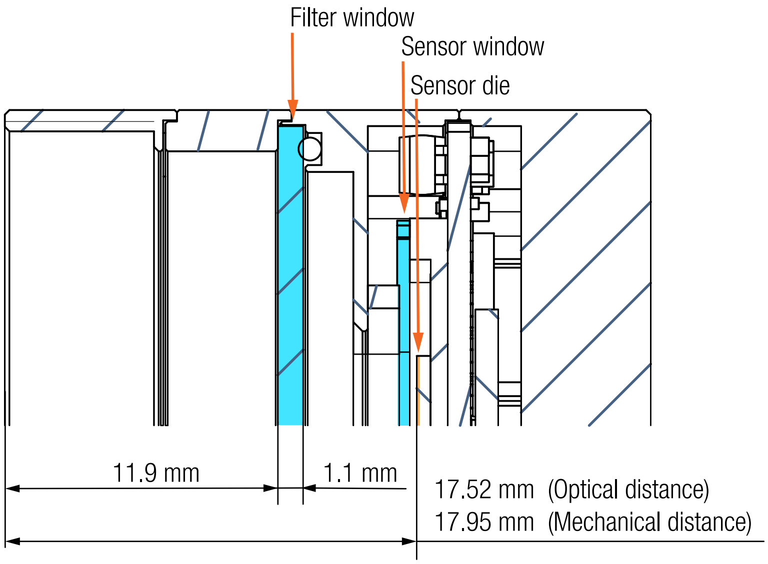


Figure 11: Cross section of MQ013xG-ON-S7 camera models

Sensor window	Value
Thickness	0.55 mm (+/- 0.05 mm)
Distance to sensor die	0.4 mm

Table 9: Sensor window details

Cross-section corresponding to:

MQ022CG-CM-S7 MQ022CG-CM-S7-FL MQ022MG-CM-S7 MQ022MG-CM-S7-FL
MQ022RG-CM-S7 MQ022RG-CM-S7-FL MQ042CG-CM-S7 MQ042CG-CM-S7-FL
MQ042MG-CM-S7-FL MQ042MG-CM-S7 MQ042MG-CM-S7-TG MQ042RG-CM-S7-FL
MQ042RG-CM-S7

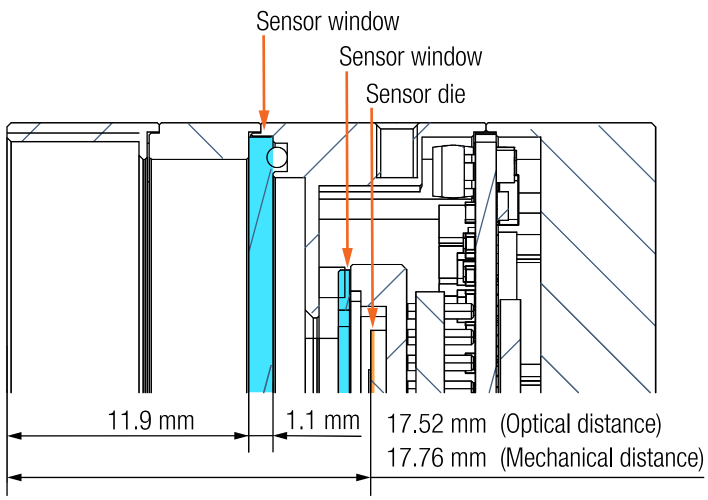


Figure 12: Cross section of MQ022/042xG-CM-S7 camera models

Sensor window	Value
Thickness	0.55 mm (+/- 0.05 mm)
Distance to sensor die	1.05 mm (+/- 0.180 mm)

Table 10: Sensor window details

The following filter window is implemented in:

MQ013CG-E2-S7	MQ013CG-E2-S7-FL	MQ013CG-E2-S7-FV	MQ013CG-ON-S7
MQ022CG-CM-S7	MQ022CG-CM-S7-FL	MQ042CG-CM-S7	MQ042CG-CM-S7-FL

Filter	Coating	Thickness
IR Filter IR650	ARx2	1.1 mm

Table 11: IR650 filter window parameter

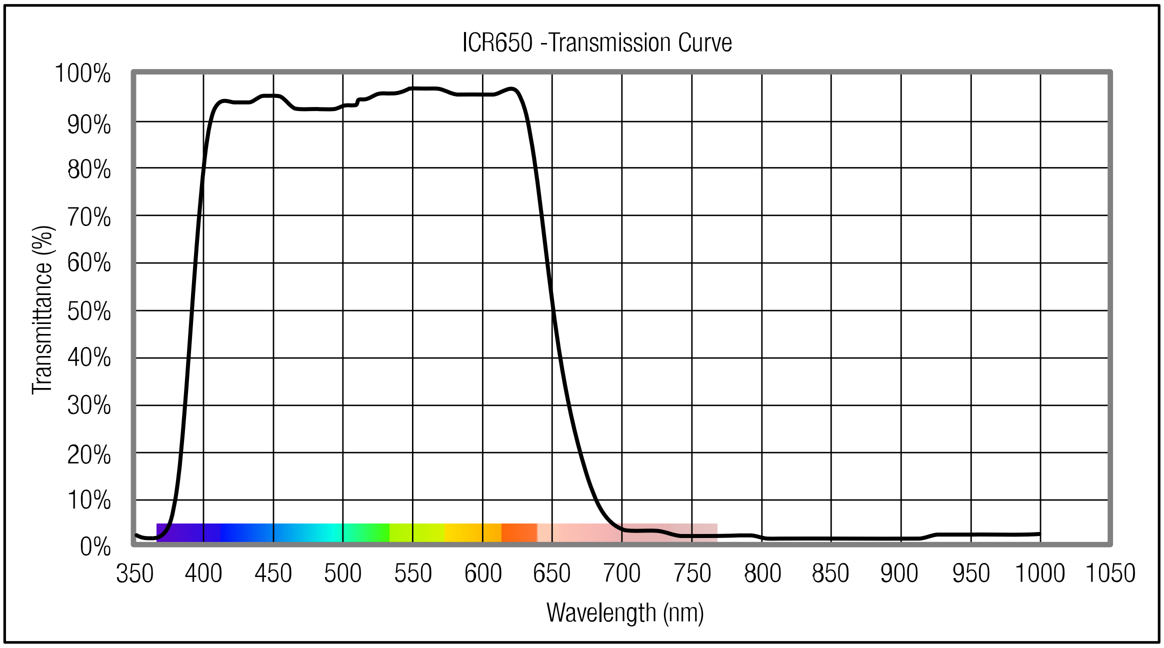


Figure 13: Filter glass ICR650 Transmission Curve

The following filter window is implemented in:

MQ013MG-E2-S7 MQ013MG-E2-S7-FL MQ013MG-E2-S7-FV MQ013MG-ON-S7
MQ013RG-E2-S7 MQ013RG-E2-S7-FL MQ013RG-E2-S7-FV MQ013RG-ON-S7
MQ022MG-CM-S7 MQ022MG-CM-S7-FL MQ022RG-CM-S7 MQ022RG-CM-S7-FL
MQ042MG-CM-S7-FL MQ042MG-CM-S7 MQ042MG-CM-S7-TG MQ042RG-CM-S7-FL
MQ042RG-CM-S7

Filter	Coating	Thickness
Filter BK7	ARx2	1.1 mm

Table 12: BK7 filter window parameter

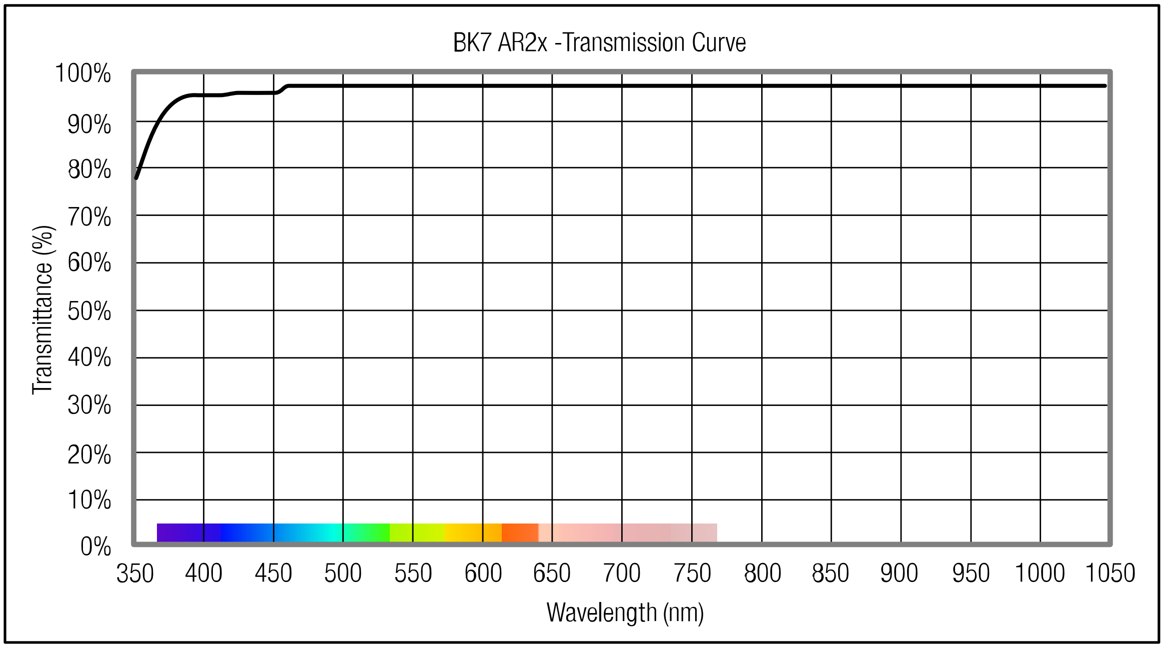


Figure 14: Filter glass BK7 AR2x Transmission Curve

2.6 Sensor and camera characteristics

2.6.1 Sensor and camera parameters

Sensor parameters of:

MQ013CG-E2-S7 MQ013CG-E2-S7-FL MQ013CG-E2-S7-FV MQ013MG-E2-S7-FV
MQ013MG-E2-S7 MQ013MG-E2-S7-FL MQ013RG-E2-S7 MQ013RG-E2-S7-FL
MQ013RG-E2-S7-FV

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	1280 x 1024	[px]
Active area size (H X V)	6.9 x 5.5	[mm]
Sensor diagonal	8.7	[mm]
Pixel size (H x V)	5.3 x 5.3	[μm]

Table 13: Sensor parameters of the specific models

Sensor parameters of:

MQ013CG-ON-S7 MQ013MG-ON-S7 MQ013RG-ON-S7

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	1280 x 1024	[px]
Active area size (H X V)	6.18 x 4.95	[mm]
Sensor diagonal	7.9	[mm]
Pixel size (H x V)	4.8 x 4.8	[μm]

Table 14: Sensor parameters of the specific models

Sensor parameters of:

MQ022CG-CM-S7 MQ022CG-CM-S7-FL MQ022MG-CM-S7 MQ022MG-CM-S7-FL
MQ022RG-CM-S7 MQ022RG-CM-S7-FL

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	2048 x 1088	[px]
Active area size (H X V)	11.27 x 6	[mm]
Sensor diagonal	12.8	[mm]
Pixel size (H x V)	5.5 x 5.5	[μm]

Table 15: Sensor parameters of the specific models

Sensor parameters of:

MQ042CG-CM-S7 MQ042CG-CM-S7-FL MQ042MG-CM-S7-FL MQ042MG-CM-S7
MQ042MG-CM-S7-TG MQ042RG-CM-S7-FL MQ042RG-CM-S7

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	2048 x 2048	[px]
Active area size (H X V)	11.27 x 11.27	[mm]
Sensor diagonal	15.9	[mm]
Pixel size (H x V)	5.5 x 5.5	[µm]

Table 16: 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:

MQ013CG-E2-S7 MQ013CG-E2-S7-FL MQ013CG-E2-S7-FV

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e_-]	27.7
Absolute sensitivity threshold	[e_-]	28.2
Saturation capacity	[ke_-]	10.82
Dynamic range	[dB]	51.65
MAX Signal-to-noise ratio	[dB]	40.46
Overall system gain	[e_-/DN]	11.28
Dark current	[e_-/s]	1347.29
Dark current meas. temp.	[°C]	39.9
DSNU	[e_-]	33.75
PRNU	[%]	1.86
Linearity error	[%]	3.77

Table 17: Image quality parameters of the specific models

Image quality parameters of:

MQ013CG-ON-S7

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e_-]	8.99
Absolute sensitivity threshold	[e_-]	9.49
Saturation capacity	[ke_-]	7.82
Dynamic range	[dB]	58.38
MAX Signal-to-noise ratio	[dB]	39.09
Overall system gain	[e_-/DN]	9.11
Dark current	[e_-/s]	790.76
Dark current meas. temp.	[°C]	49.9
DSNU	[e_-]	5.09
PRNU	[%]	0.95
Linearity error	[%]	1.79

Table 18: Image quality parameters of the specific models

Image quality parameters of:

MQ013MG-E2-S7-FV MQ013MG-E2-S7 MQ013MG-E2-S7-FL

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e_-]	27.65
Absolute sensitivity threshold	[e_-]	28.15
Saturation capacity	[ke_-]	10.92
Dynamic range	[dB]	51.76
MAX Signal-to-noise ratio	[dB]	40.41
Overall system gain	[e_-/DN]	11.31
Dark current	[e_-/s]	1096.42
Dark current meas. temp.	[°C]	40.2
DSNU	[e_-]	34.66
PRNU	[%]	1.39
Linearity error	[%]	4.77

Table 19: Image quality parameters of the specific models

Image quality parameters of:

MQ013MG-ON-S7

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e_-]	9.37
Absolute sensitivity threshold	[e_-]	9.87
Saturation capacity	[ke_-]	7.35
Dynamic range	[dB]	57.42
MAX Signal-to-noise ratio	[dB]	38.86
Overall system gain	[e_-/DN]	8.85
Dark current	[e_-/s]	756.84
Dark current meas. temp.	[°C]	49.6
DSNU	[e_-]	5.53
PRNU	[%]	0.88
Linearity error	[%]	2.43

Table 20: Image quality parameters of the specific models

Image quality parameters of:

MQ013RG-E2-S7 MQ013RG-E2-S7-FL MQ013RG-E2-S7-FV

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e_-]	23.71
Absolute sensitivity threshold	[e_-]	24.21
Saturation capacity	[ke_-]	7.89
Dynamic range	[dB]	50.23
MAX Signal-to-noise ratio	[dB]	38.81
Overall system gain	[e_-/DN]	8.26
Dark current	[e_-/s]	789.44
Dark current meas. temp.	[°C]	39.7
DSNU	[e_-]	23.13
PRNU	[%]	1.38
Linearity error	[%]	2.18

Table 21: Image quality parameters of the specific models

Image quality parameters of:

MQ013RG-ON-S7

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e_-]	9.07
Absolute sensitivity threshold	[e_-]	9.57
Saturation capacity	[ke_-]	7.87
Dynamic range	[dB]	58.21
MAX Signal-to-noise ratio	[dB]	39.38
Overall system gain	[e_-/DN]	9.18
Dark current	[e_-/s]	778.76
Dark current meas. temp.	[°C]	49.6
DSNU	[e_-]	5.09
PRNU	[%]	1.17
Linearity error	[%]	2.35

Table 22: Image quality parameters of the specific models

Image quality parameters of:
MQ022CG-CM-S7 MQ022CG-CM-S7-FL

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e_-]	15.96
Absolute sensitivity threshold	[e_-]	16.46
Saturation capacity	[ke_-]	8.67
Dynamic range	[dB]	54.49
MAX Signal-to-noise ratio	[dB]	39.21
Overall system gain	[e_-/DN]	9.88
Dark current	[e_-/s]	2215.37
Dark current meas. temp.	[°C]	49.4
DSNU	[e_-]	19.98
PRNU	[%]	1.52
Linearity error	[%]	0.88

Table 23: Image quality parameters of the specific models

Image quality parameters of:
MQ022MG-CM-S7 MQ022MG-CM-S7-FL

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e_-]	15.83
Absolute sensitivity threshold	[e_-]	16.33
Saturation capacity	[ke_-]	8.86
Dynamic range	[dB]	54.79
MAX Signal-to-noise ratio	[dB]	39.56
Overall system gain	[e_-/DN]	9.45
Dark current	[e_-/s]	1975.2
Dark current meas. temp.	[°C]	49.1
DSNU	[e_-]	19.01
PRNU	[%]	1.24
Linearity error	[%]	0.65

Table 24: Image quality parameters of the specific models

Image quality parameters of:
MQ022RG-CM-S7 MQ022RG-CM-S7-FL

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e_-]	15.68
Absolute sensitivity threshold	[e_-]	16.18
Saturation capacity	[ke_-]	7.47
Dynamic range	[dB]	53.38
MAX Signal-to-noise ratio	[dB]	38.06
Overall system gain	[e_-/DN]	8.96
Dark current	[e_-/s]	2058.65
Dark current meas. temp.	[°C]	49.4
DSNU	[e_-]	18.62
PRNU	[%]	1.43
Linearity error	[%]	0.7

Table 25: Image quality parameters of the specific models

Image quality parameters of:
MQ042CG-CM-S7 MQ042CG-CM-S7-FL

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e_-]	16.15
Absolute sensitivity threshold	[e_-]	16.65
Saturation capacity	[ke_-]	7.56
Dynamic range	[dB]	53.07
MAX Signal-to-noise ratio	[dB]	38.36
Overall system gain	[e_-/DN]	8.92
Dark current	[e_-/s]	1741.6
Dark current meas. temp.	[°C]	49.1
DSNU	[e_-]	21.67
PRNU	[%]	1.49
Linearity error	[%]	1.32

Table 26: Image quality parameters of the specific models

Image quality parameters of:

MQ042MG-CM-S7-FL MQ042MG-CM-S7 MQ042MG-CM-S7-TG

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e_-]	15.82
Absolute sensitivity threshold	[e_-]	16.32
Saturation capacity	[ke_-]	8.24
Dynamic range	[dB]	54.29
MAX Signal-to-noise ratio	[dB]	39.21
Overall system gain	[e_-/DN]	9.04
Dark current	[e_-/s]	1773.28
Dark current meas. temp.	[°C]	49.3
DSNU	[e_-]	22.43
PRNU	[%]	1.38
Linearity error	[%]	1.12

Table 27: Image quality parameters of the specific models

Image quality parameters of:

MQ042RG-CM-S7-FL MQ042RG-CM-S7

Mode		10 bit
Sensor bit/px	[bit/px]	10
Parameters		
Temporal dark noise	[e_-]	15.53
Absolute sensitivity threshold	[e_-]	16.03
Saturation capacity	[ke_-]	7.1
Dynamic range	[dB]	53.02
MAX Signal-to-noise ratio	[dB]	37.83
Overall system gain	[e_-/DN]	8.54
Dark current	[e_-/s]	1598.79
Dark current meas. temp.	[°C]	49.1
DSNU	[e_-]	20.88
PRNU	[%]	1.37
Linearity error	[%]	1.76

Table 28: 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:

MQ013CG-E2-S7 MQ013CG-E2-S7-FL MQ013CG-E2-S7-FV MQ013MG-E2-S7-FV
MQ013MG-E2-S7 MQ013MG-E2-S7-FL MQ013RG-E2-S7 MQ013RG-E2-S7-FL
MQ013RG-E2-S7-FV

Downsampling (Hor.x Ver.)	Sensor bit/px	Resolution (Wid x Hei)	Transport bit/px	Frame rate[1]
1 x 1	10	1280 x 1024	8	61.6
1 x 1	10	1280 x 1024	10	61.6
1 x 1	10	1280 x 1024	12	61.6
Bin.2 x 2	10	640 x 512	8	61.6
Bin.2 x 2	10	640 x 512	10	61.6
Bin.2 x 2	10	640 x 512	12	61.6

[1]Frame rate was measured using the transport format at bandwidth limit 380.0 MB/s

Table 29: Sensor read-out modes of the specific models

Sensor Read-out modes of:

MQ013CG-ON-S7 MQ013MG-ON-S7 MQ013RG-ON-S7

Downsampling (Hor.x Ver.)	Zero ROT	Sensor bit/px	Resolution (Wid x Hei)	Transport bit/px	Frame rate[1]
1 x 1	-	10	1280 x 1024	8	172.2
1 x 1	-	10	1280 x 1024	10	172.2
1 x 1	-	10	1280 x 1024	12	141.1
Dec.2 x 2	-	10	640 x 512	8	554.0
Dec.2 x 2	-	10	640 x 512	10	554.0
Dec.2 x 2	-	10	640 x 512	12	541.6
1 x 1	On	10	1280 x 1024	8	210.5
1 x 1	On	10	1280 x 1024	10	210.5
1 x 1	On	10	1280 x 1024	12	140.8
Dec.2 x 2	On	10	640 x 512	8	789.9
Dec.2 x 2	On	10	640 x 512	10	789.9
Dec.2 x 2	On	10	640 x 512	12	538.5

[1]Frame rate was measured using the transport format at bandwidth limit 380.0 MB/s

Table 30: Sensor read-out modes of the specific models

Sensor Read-out modes of:

MQ022CG-CM-S7 MQ022CG-CM-S7-FL MQ022MG-CM-S7 MQ022MG-CM-S7-FL
MQ022RG-CM-S7 MQ022RG-CM-S7-FL

Downsampling (Hor.x Ver.)	Sensor bit/px	Resolution (Wid x Hei)	Transport bit/px	Frame rate[1]
1 x 1	10	2048 x 1088	8	169.9
1 x 1	10	2048 x 1088	10	134.5
1 x 1	10	2048 x 1088	12	85.0

[1] Frame rate was measured using the transport format at bandwidth limit 380.0 MB/s

Table 31: Sensor read-out modes of the specific models

Sensor Read-out modes of:

MQ042CG-CM-S7 MQ042CG-CM-S7-FL MQ042MG-CM-S7-FL MQ042MG-CM-S7
MQ042MG-CM-S7-TG MQ042RG-CM-S7-FL MQ042RG-CM-S7

Downsampling (Hor.x Ver.)	Sensor bit/px	Resolution (Wid x Hei)	Transport bit/px	Frame rate[1]
1 x 1	10	2048 x 2048	8	90.3
1 x 1	10	2048 x 2048	10	71.5
1 x 1	10	2048 x 2048	12	45.2

[1] Frame rate was measured using the transport format at bandwidth limit 380.0 MB/s

Table 32: Sensor read-out modes of the specific models

2.6.4 Quantum efficiency curves

Quantum efficiency curves for:

MQ013CG-E2-S7
MQ013MG-E2-S7
MQ013RG-E2-S7-FV
MQ013CG-E2-S7-FL
MQ013MG-E2-S7-FL
MQ013CG-E2-S7-FV
MQ013RG-E2-S7
MQ013MG-E2-S7-FV
MQ013RG-E2-S7-FL

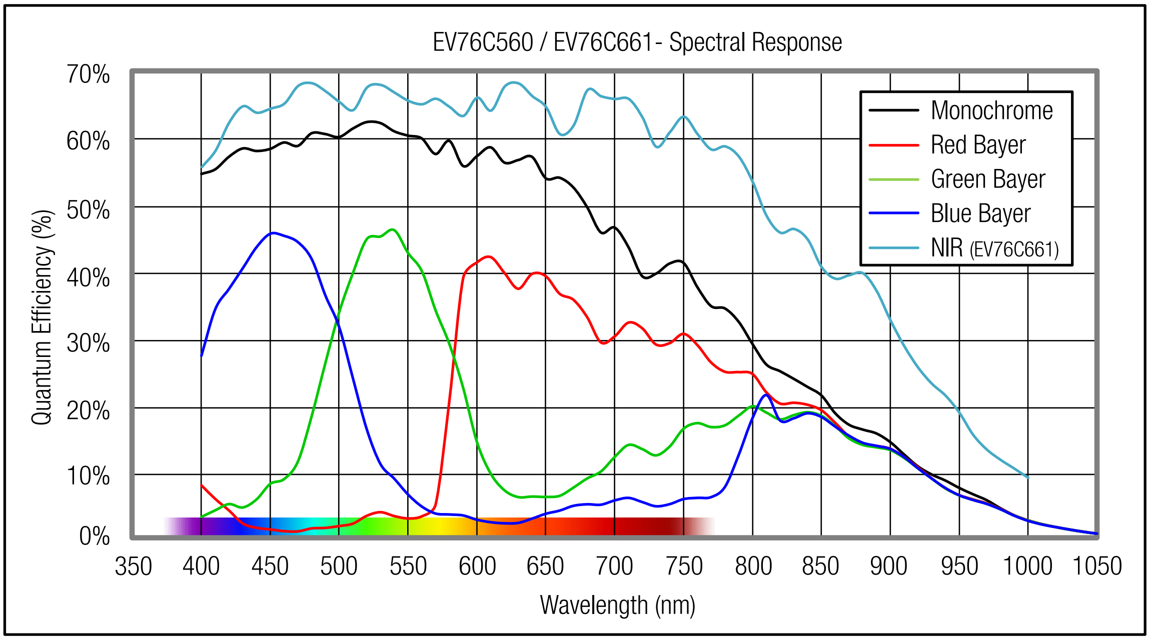


Figure 15: Graph quantum efficiency of E2V EV76C560 / EV76C661

Quantum efficiency curves for:

MQ013CG-ON-S7
MQ013MG-ON-S7
MQ013RG-ON-S7

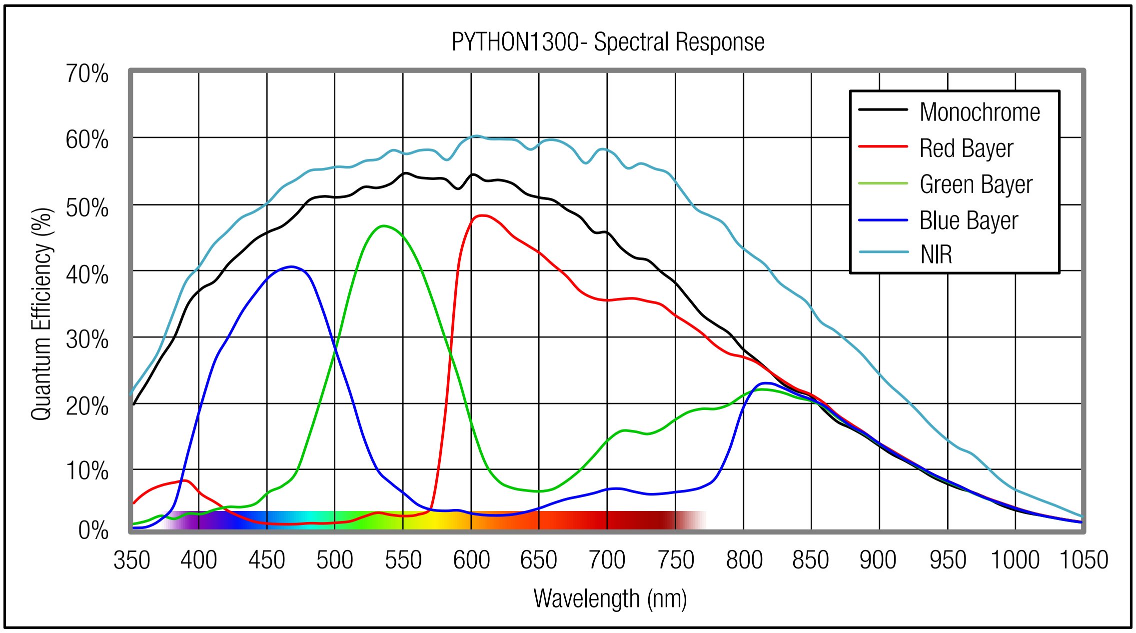


Figure 16: Graph quantum efficiency of OnSemi PYTHON1300

Quantum efficiency curves for:

MQ022CG-CM-S7	MQ022CG-CM-S7-FL	MQ022MG-CM-S7	MQ022MG-CM-S7-FL
MQ022RG-CM-S7	MQ022RG-CM-S7-FL		

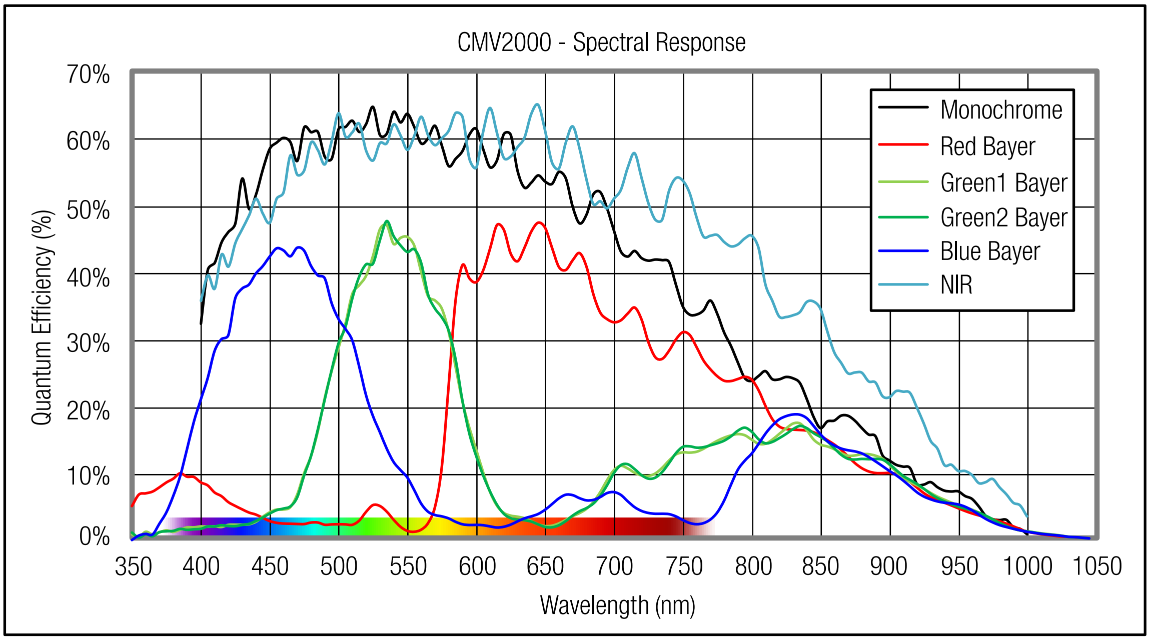


Figure 17: Graph quantum efficiency of CMOSIS CMV2000

Quantum efficiency curves for:

MQ042CG-CM-S7	MQ042CG-CM-S7-FL	MQ042MG-CM-S7-FL	MQ042MG-CM-S7
MQ042MG-CM-S7-TG	MQ042RG-CM-S7-FL	MQ042RG-CM-S7	

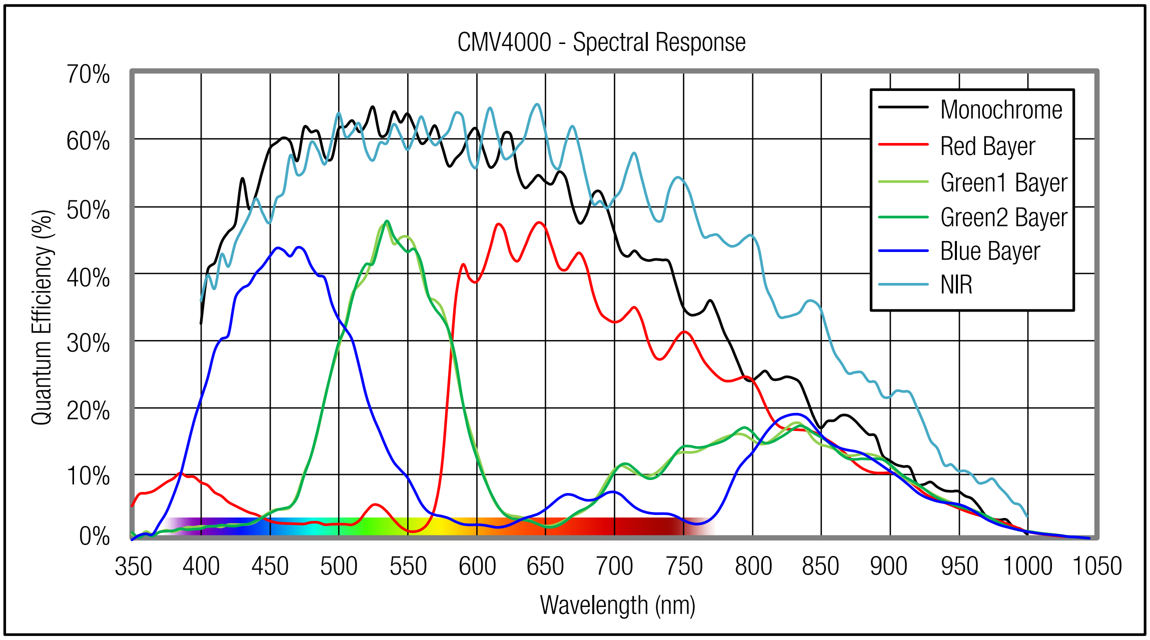


Figure 18: Graph quantum efficiency of CMOSIS CMV4000

2.7 Mechanical characteristics

2.7.1 Dimensions and mass

Dimensions and mass of:

MQ013CG-E2-S7 MQ013MG-E2-S7 MQ013RG-E2-S7

Width [W]	Height [H]	Depth [D]	Mass[1] [M]
26.4 mm	26.4 mm	32.8 mm	30 g

[1] without adapters

Table 33: Camera parameters of the specific models

Dimensions and mass of:

MQ013CG-E2-S7-FL MQ013CG-E2-S7-FV MQ013MG-E2-S7-FL MQ013MG-E2-S7-FV MQ013RG-E2-S7-FL MQ013RG-E2-S7-FV

Width [W]	Height [H]	Depth [D]	Mass[1] [M]
26.4 mm	26.4 mm	26.2 mm	26.6 g

[1] without adapters

Table 34: Camera parameters of the specific models

Dimensions and mass of:

MQ013CG-ON-S7 MQ013MG-ON-S7 MQ013RG-ON-S7

Width [W]	Height [H]	Depth [D]	Mass[1] [M]
26.4 mm	26.4 mm	32.9 mm	30 g

[1] without adapters

Table 35: Camera parameters of the specific models

Dimensions and mass of:

MQ022CG-CM-S7-FL MQ022MG-CM-S7-FL MQ022RG-CM-S7-FL

Width [W]	Height [H]	Depth [D]	Mass[1] [M]
26.4 mm	26.4 mm	30.2 mm	31.8 g

[1] without adapters

Table 36: Camera parameters of the specific models

Dimensions and mass of:

MQ022CG-CM-S7 MQ022MG-CM-S7 MQ022RG-CM-S7 MQ042CG-CM-S7
MQ042MG-CM-S7 MQ042MG-CM-S7-TG MQ042RG-CM-S7

Width [W]	Height [H]	Depth [D]	Mass[1] [M]
26.4 mm	26.4 mm	36.8 mm	35 g

[1] without adapters

Table 37: Camera parameters of the specific models

Dimensions and mass of:

MQ042CG-CM-S7-FL MQ042MG-CM-S7-FL MQ042RG-CM-S7-FL

Width [W]	Height [H]	Depth [D]	Mass[1] [M]
26.4 mm	26.4 mm	30.1 mm	30.8 g

[1] without adapters

Table 38: Camera parameters of the specific models

2.7.2 Dimensional drawings

Dimensional drawings of:

MQ013CG-E2-S7 MQ013MG-E2-S7 MQ013RG-E2-S7

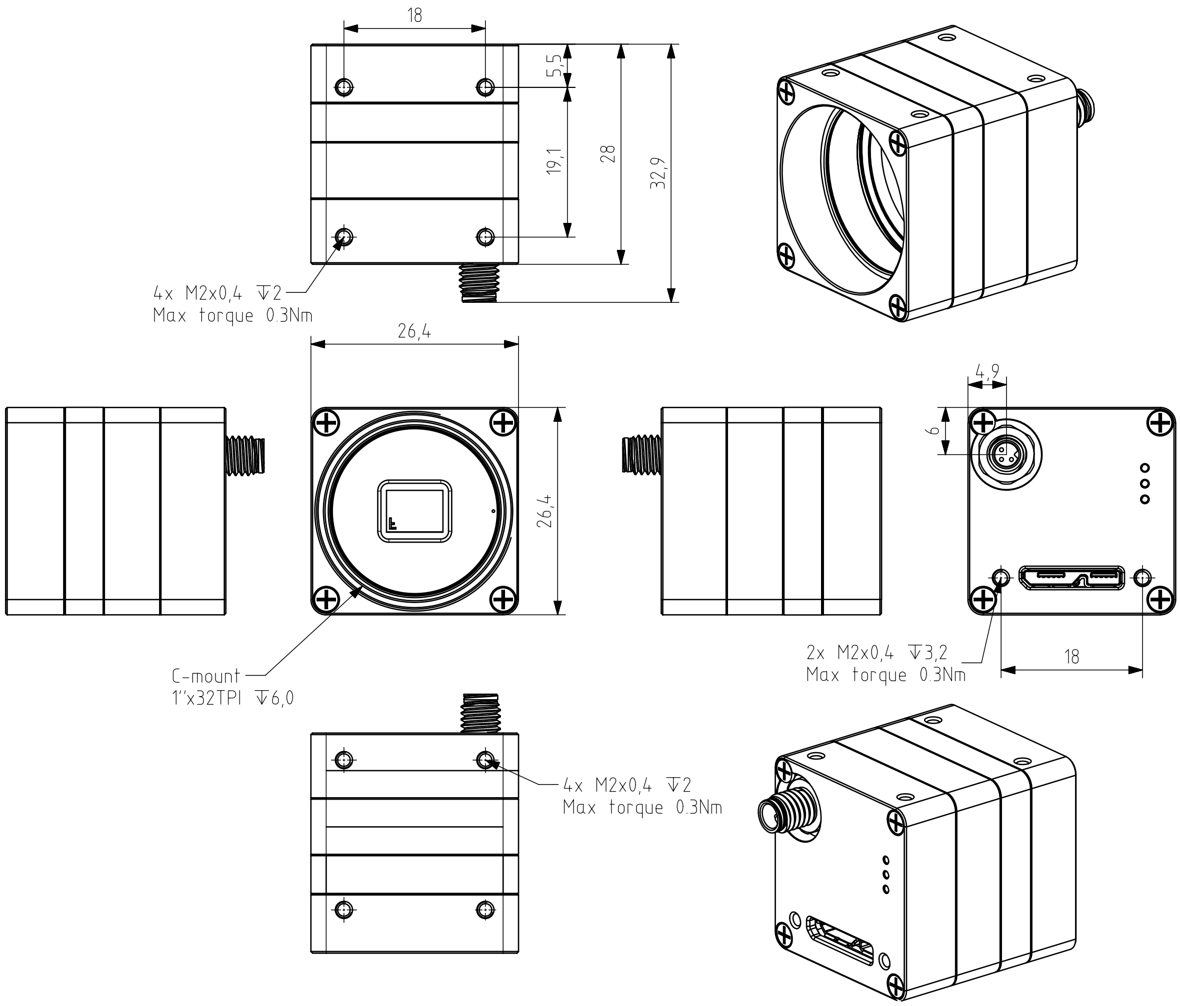


Figure 19: Dimensional drawing of MQ013xG-E2-S7

Dimensional drawings of:

MQ013CG-E2-S7-FL MQ013MG-E2-S7-FL MQ013RG-E2-S7-FL

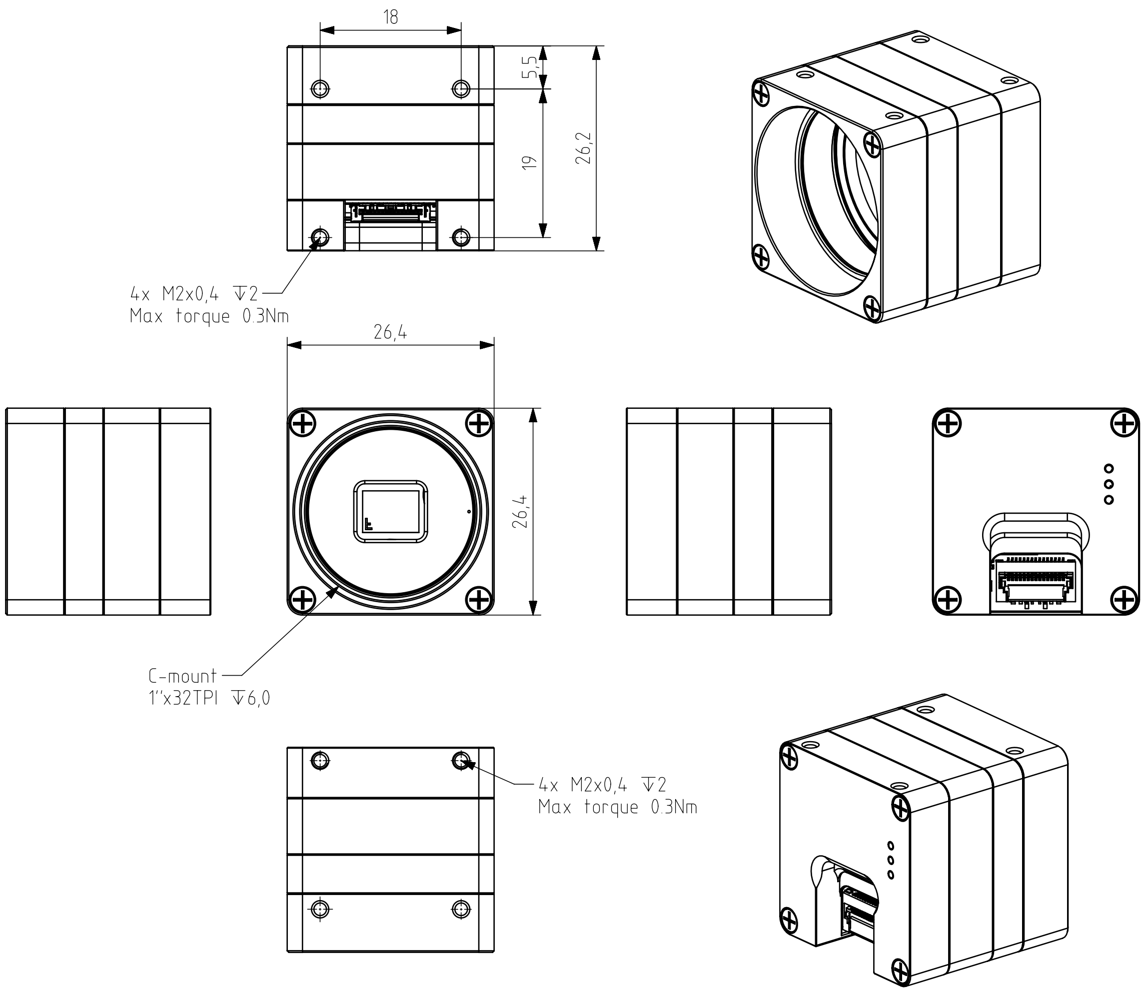


Figure 20: Dimensional drawing of MQ013xG-E2-FL

Dimensional drawings of:

MQ013CG-E2-S7-FV MQ013MG-E2-S7-FV MQ013RG-E2-S7-FV

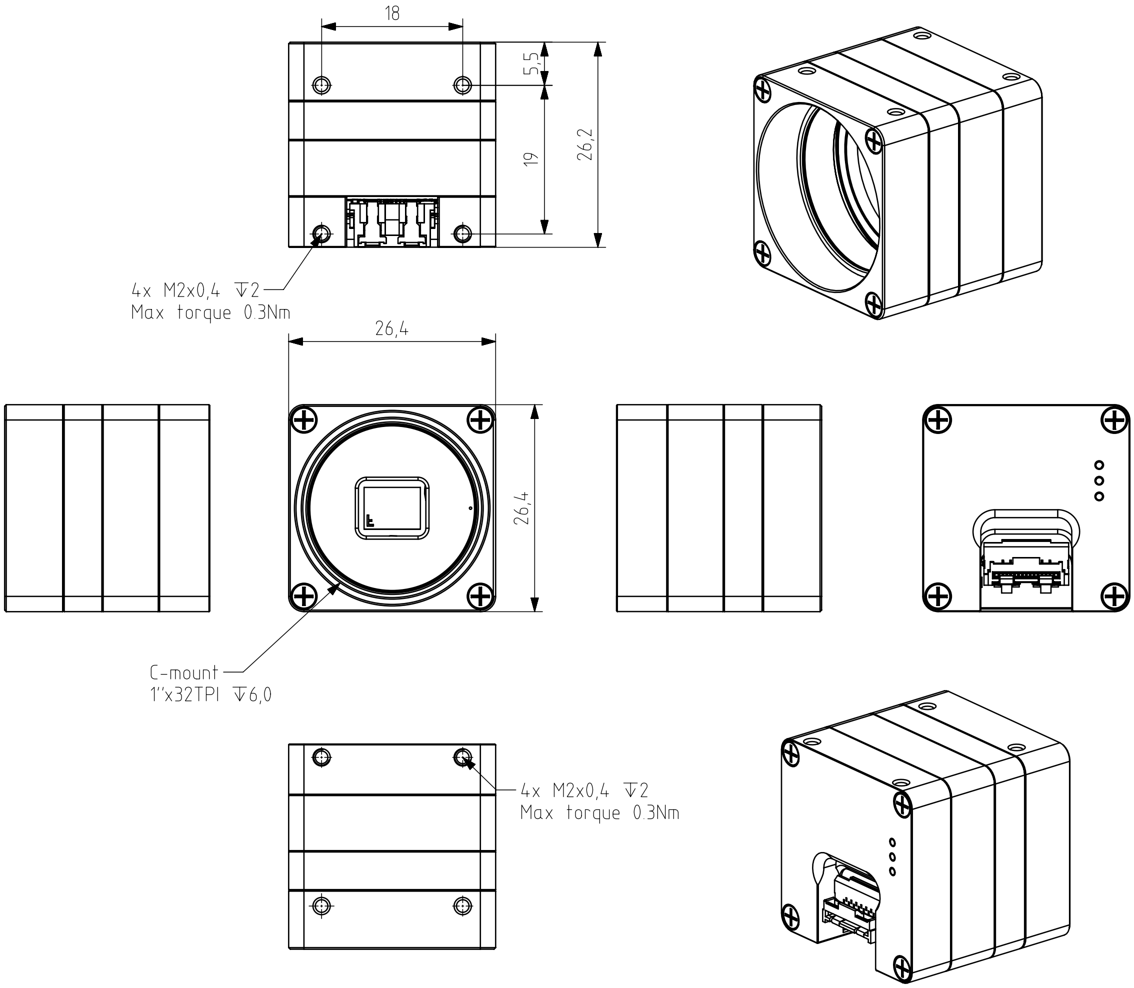


Figure 21: Dimensional drawing of MQ013xG-E2-FV

Dimensional drawings of:

MQ013CG-ON-S7 MQ013MG-ON-S7 MQ013RG-ON-S7

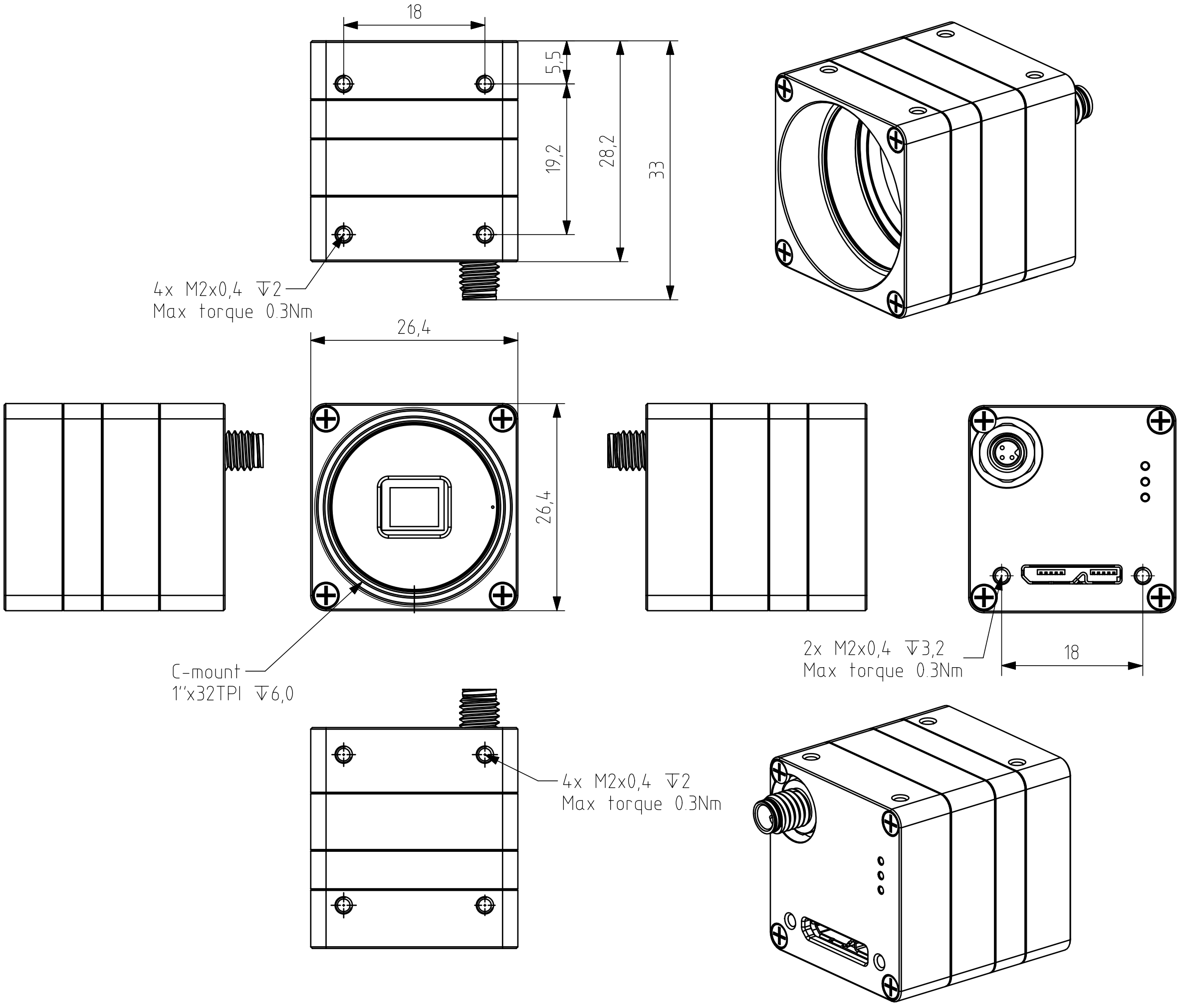


Figure 22: Dimensional drawing of MQ013xG-ON-S7

Dimensional drawings of:

MQ022CG-CM-S7 MQ022MG-CM-S7 MQ022RG-CM-S7 MQ042CG-CM-S7
MQ042MG-CM-S7 MQ042MG-CM-S7-TG MQ042RG-CM-S7

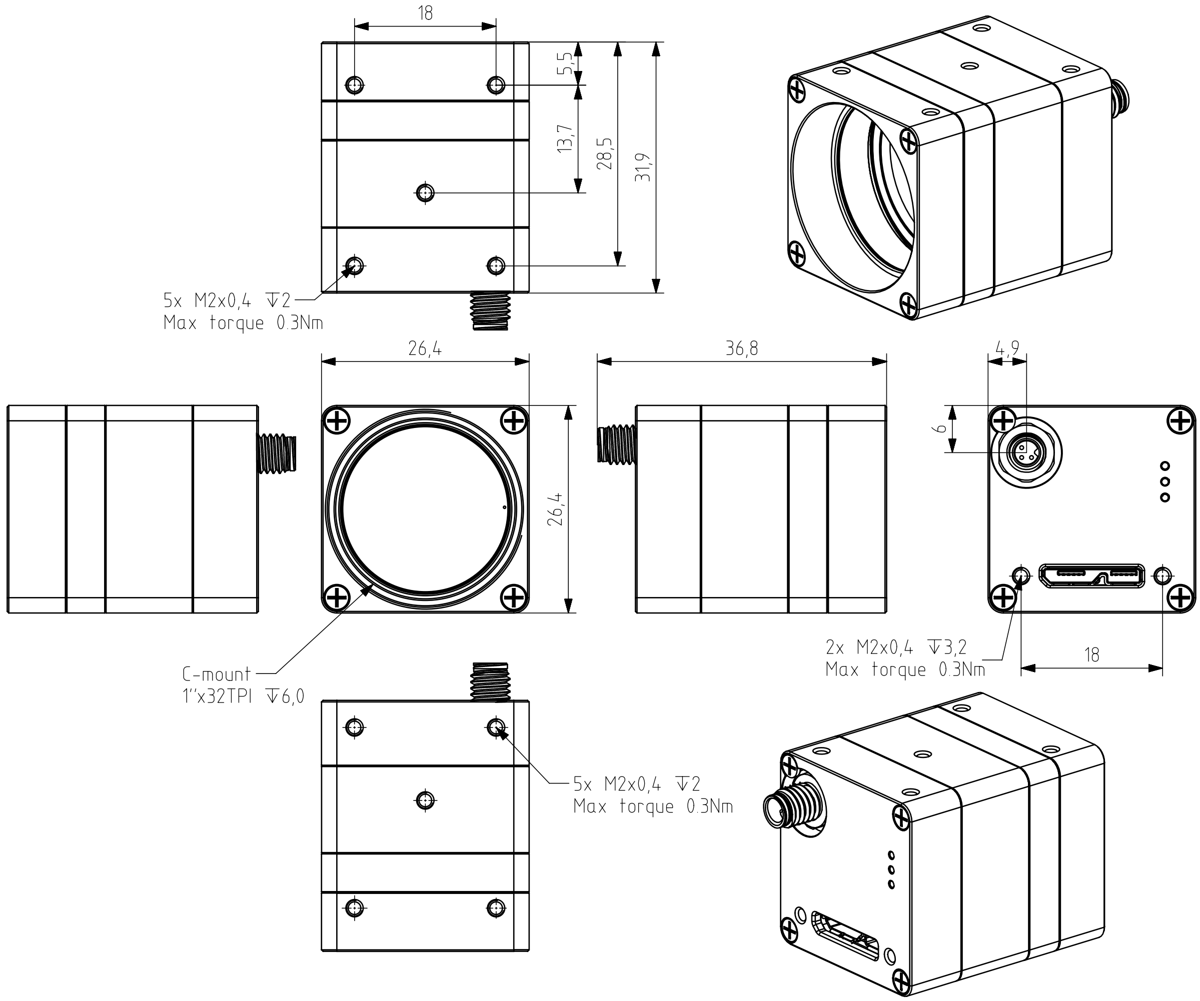


Figure 23: Dimensional drawing of MQ022/042xG-CM-S7

Dimensional drawings of:

MQ022CG-CM-S7-FL MQ022MG-CM-S7-FL MQ022RG-CM-S7-FL MQ042CG-CM-S7-FL
MQ042MG-CM-S7-FL MQ042RG-CM-S7-FL

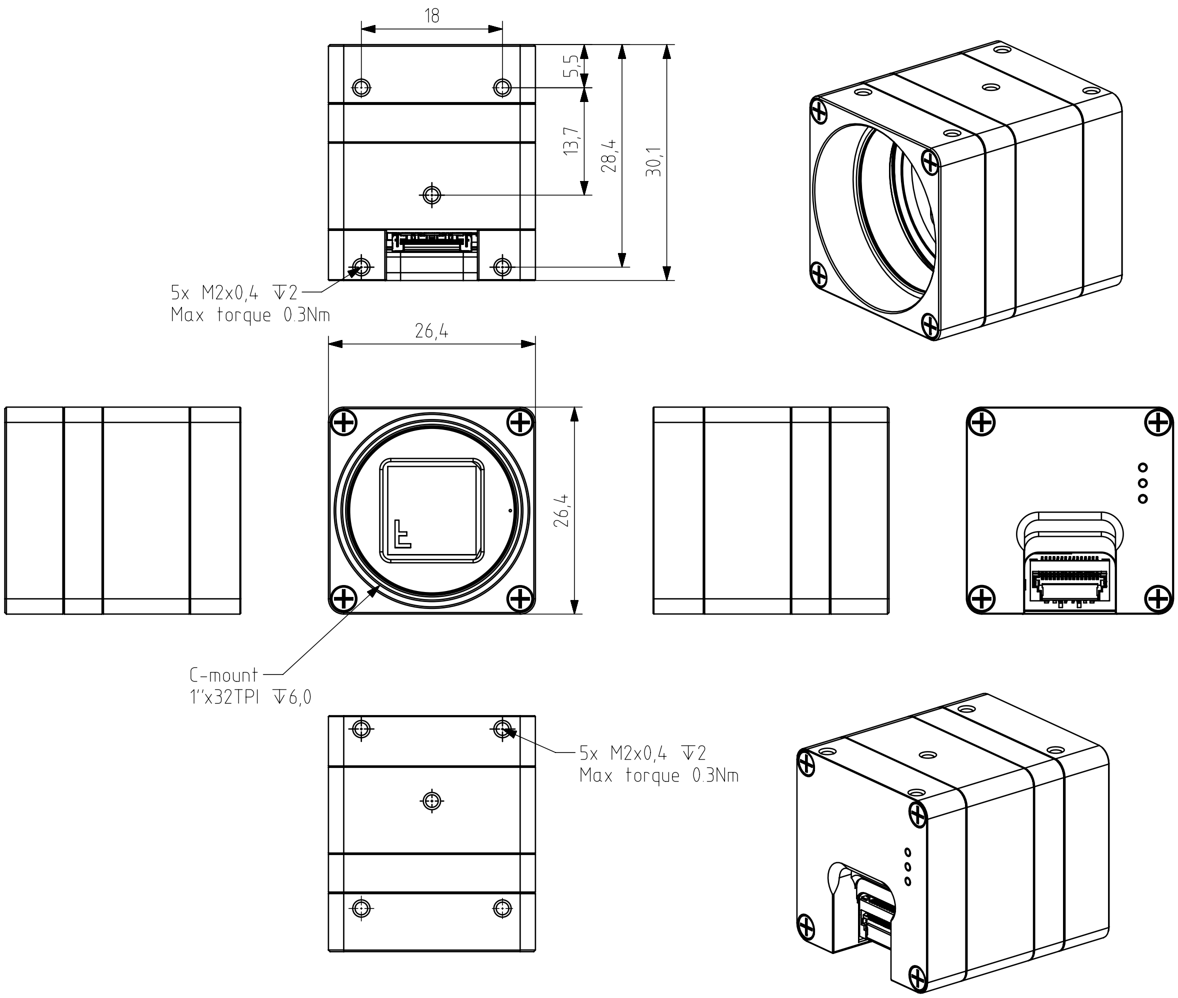


Figure 24: Dimensional drawing of MQ022xG-CM-FL

2.8 User interface – LEDs

LED	Color	Defaults	Note
1	Red	Streaming	User-configurable
2	Green	Connection status	User configurable
3	Orange	Camera is powered	User configurable (can be turned off)

Table 39: LED output description during camera power up

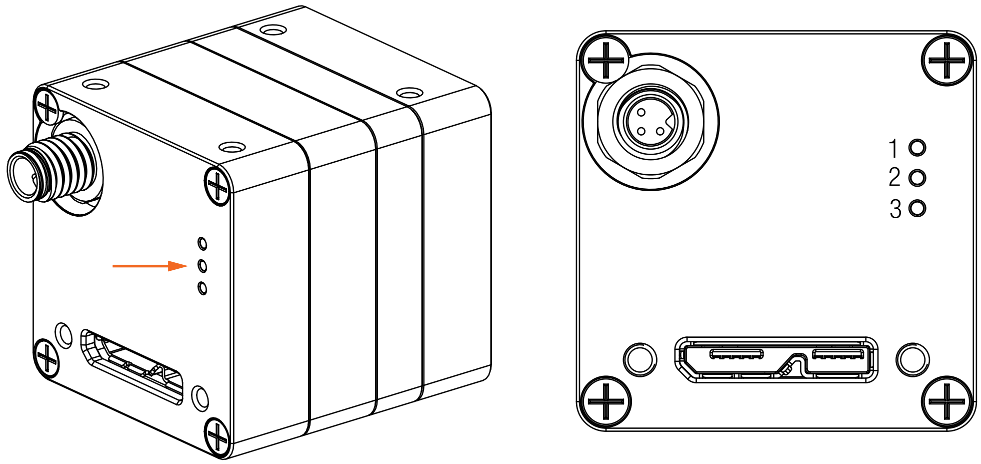


Figure 25: Position of LEDs on xiQ-S7 camera

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
OFF	Off	Off	Off
Power	Off	Off	On
FPGA booted + FX3 booted	On	Off	On
HW SPI init	flash	1 Hz	Off
SW SPI init(wait for enum)	flash	2 Hz	Off
FX3_enumerated_as_USB2	Off	flash 2 Hz	On
FX3_enumerated_as_USB3	Off	On	On
Device stop	flash 2 Hz	flash 2 Hz	On
Error flash	2 Hz	async flash 2 Hz	On

Table 40: 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:

MQ013CG-E2-S7, MQ013CG-ON-S7, MQ013MG-E2-S7, MQ013MG-ON-S7, MQ013RG-E2-S7, MQ013RG-ON-S7, MQ022CG-CM-S7, MQ022MG-CM-S7, MQ022RG-CM-S7, MQ042CG-CM-S7, MQ042MG-CM-S7, MQ042MG-CM-S7-TG, MQ042RG-CM-S7

2.9.1 USB 3 Gen1 micro-B

Item	Value
Connector	USB 3.1
Signals	Standard USB 3.1 Gen 1 Micro B Female Connector
Mating Connectors	Standard USB 3.1 Gen1 Micro-B Connector with thumbscrews[1]

[1]Screw thread M2, thread distance 18.0 mm

Table 41: USB 3.1 micro-B mating connector description

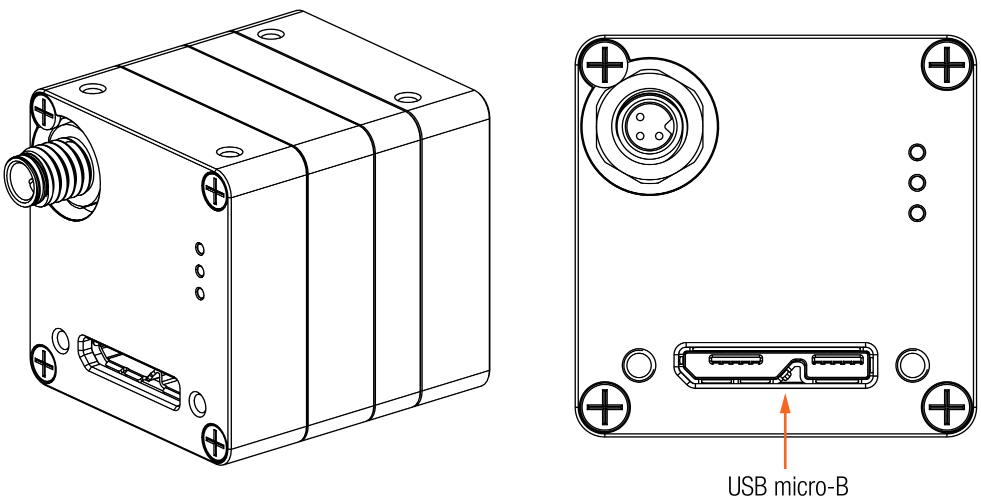


Figure 26: USB Micro-B connector location

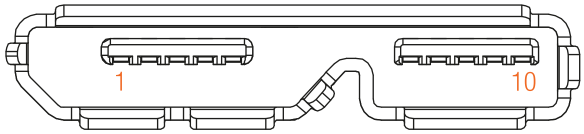


Figure 27: USB Micro-B connector pinning

Pin	Signal	Description
1	VBUS	Power input
2	D-	USB 2.0 signal pair
3	D+	USB 2.0 signal pair
4	ID	OTG Identification
5	GND	Power Ground
6	SSTX-	USB 3.0 SuperSpeed transmitter signal pair
7	SSTX+	USB 3.0 SuperSpeed transmitter signal pair
8	GND_DRAIN	USB 3.0 signal Ground
9	SSRX-	USB 3.0 SuperSpeed receiver signal pair
10	SSRX+	USB 3.0 SuperSpeed receiver signal pair

Table 42: USB 3.1 micro-B connector pin assignment

The following section applies to:

MQ013CG-E2-S7-FL	MQ013CG-E2-S7-FV	MQ013MG-E2-S7-FL	MQ013MG-E2-S7-FV
MQ013RG-E2-S7-FL	MQ013RG-E2-S7-FV	MQ022CG-CM-S7-FL	MQ022MG-CM-S7-FL
MQ022RG-CM-S7-FL	MQ042CG-CM-S7-FL	MQ042MG-CM-S7-FL	MQ042RG-CM-S7-FL

2.9.2 Flex cable interface

The flex cable interface is located on the back of the camera and comes with two different options based on the orientation the cable plugs into the camera. The (FL) version of the camera allows the cable to approach from the bottom of the camera and the (FV) version has the cable connecting to the camera perpendicular to the sensor surface. The flex line cameras have one input and one output (GPIO) available through the flex line (see Digital inputs / outputs (GPIO) interface for pinout description).

Item	Value
Connector	Molex 502244-15300 (-FL), Molex 502231-1500 (-FV)
Signals	USB 3.1 Gen1, power, IO
Mating Connectors	CBL-MQ-FL-0M1, CBL-MQ-FL-0M25

Table 43: Flex cable interface mating connector description

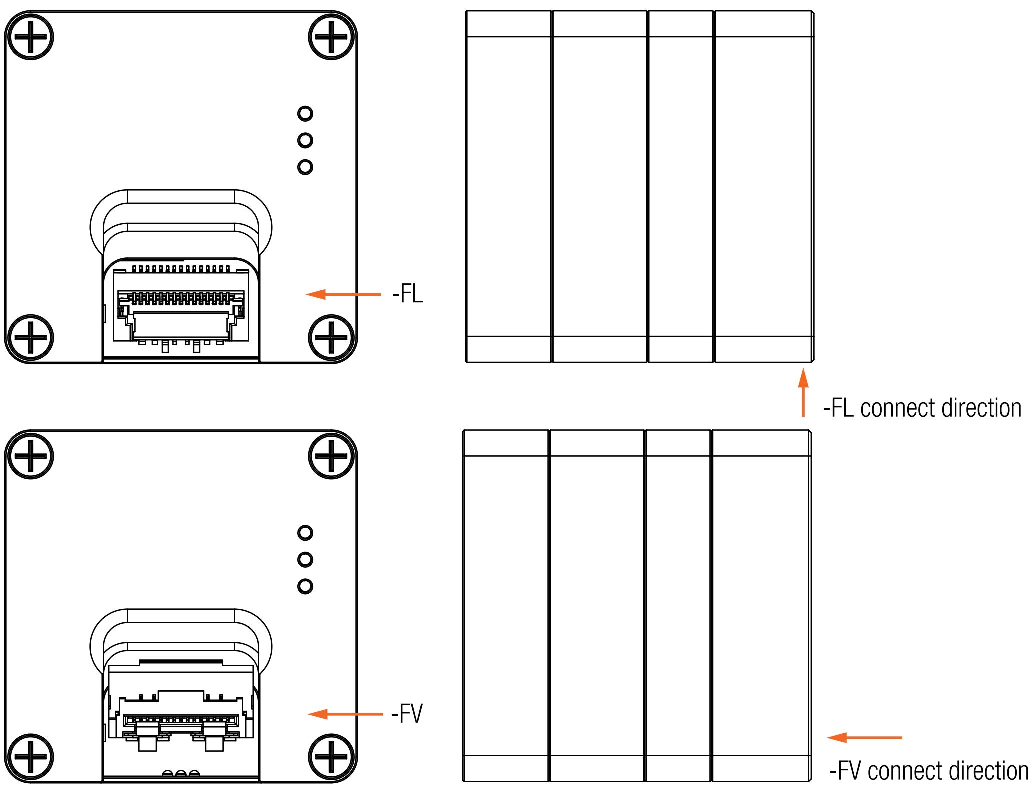


Figure 28: Flex connector location

2.10 Digital inputs / outputs (GPIO) interface

The description of the GPIO interface below applies to:

MQ013CG-E2-S7
MQ013CG-ON-S7
MQ013MG-E2-S7
MQ013MG-ON-S7
MQ013RG-E2-S7
MQ013RG-ON-S7
MQ022CG-CM-S7
MQ022MG-CM-S7
MQ022RG-CM-S7
MQ042CG-CM-S7
MQ042MG-CM-S7
MQ042MG-CM-S7-TG
MQ042RG-CM-S7

Item	Value
Connector	I/O & Binder 09 3105 81 03
Signals	Digital Input and Output
Mating Connectors	Binder 77 3550 0000 40003-0x000 (connector on cable side)

Table 44: GPIO mating connector description

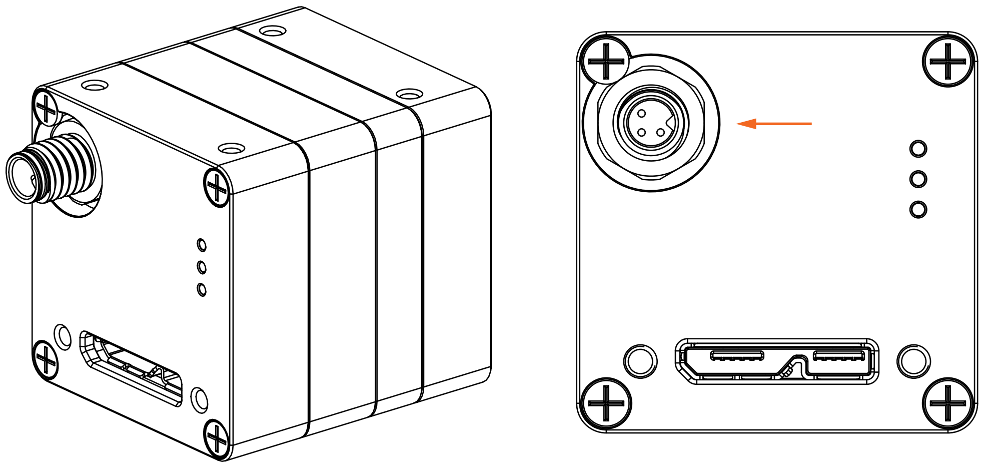


Figure 29: IO connector location

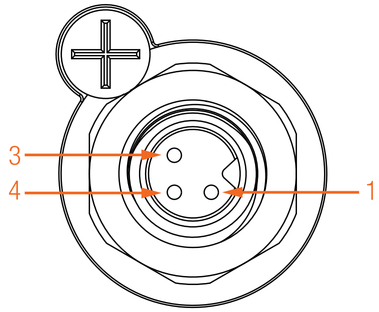


Figure 30: IO connector pinning

Pin	Name	GPI/GPO index API	Type
1	GPIO_GND	None	Common ground for Opto-Isolated Input and Output
3	IN	1/-	Optically isolated Digital Input (IN)
4	OUT	-/1	Optically isolated Digital Output (OUT)

Table 45: I/O connector pin assignment

The description of the GPIO interface below applies to:

MQ013CG-E2-S7-FL MQ013CG-E2-S7-FV MQ013MG-E2-S7-FL MQ013MG-E2-S7-FV
MQ013RG-E2-S7-FL MQ013RG-E2-S7-FV MQ022CG-CM-S7-FL MQ022MG-CM-S7-FL
MQ022RG-CM-S7-FL MQ042CG-CM-S7-FL MQ042MG-CM-S7-FL MQ042RG-CM-S7-FL

Item	Value
Connector	Molex 502244-15300 (-FL), Molex 502231-1500 (-FV)
Signals	USB 3.1 Gen1, power, IO
Mating Connectors	CBL-MQ-FL-0M1, CBL-MQ-FL-0M25

Table 46: GPIO mating connector description

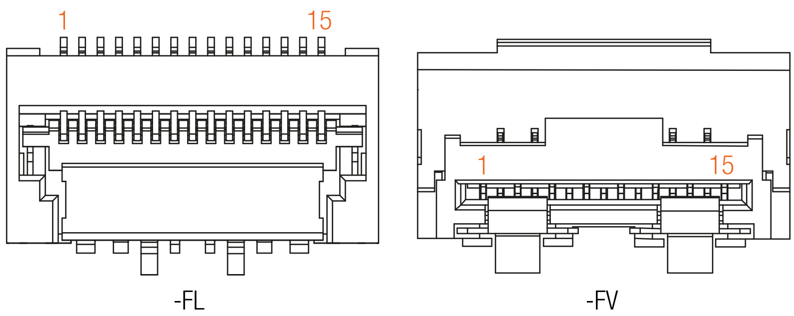


Figure 31: Flex / IO connector pinning

Pin	Name	GPI/GPO index API	Type
1	GND	None	Ground for pwr. and SuperSpeed signal return
2	SSRX-	None	SuperSpeed receiver differential pair
3	SSRX+	None	SuperSpeed receiver differential pair
4	GND	None	Ground for pwr. and SuperSpeed signal return
5	SSTX+	None	SuperSpeed transmitter differential pair
6	SSTX-	None	SuperSpeed transmitter differential pair
7	GND	None	Ground for pwr. and SuperSpeed signal return
8	D+	None	USB 2.0 differential pair
9	D-	None	USB 2.0 differential pair
10	GND	None	Ground for pwr. and SuperSpeed signal return
11	VBUS	None	Power input
12	VBUS	None	Power input
13	OUT1	-/1	Optically isolated Digital Output (OUT)
14	IN/OUT GND	None	Common pole (IO Ground)
15	IN1	1/-	Optically isolated Digital Input (IN)
Gnd. pins	SGND	None	Shield of FPC cbl. connected to shield of host controller

Table 47: I/O connector pin assignment

2.10.1 Optically isolated Digital Input (IN)

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

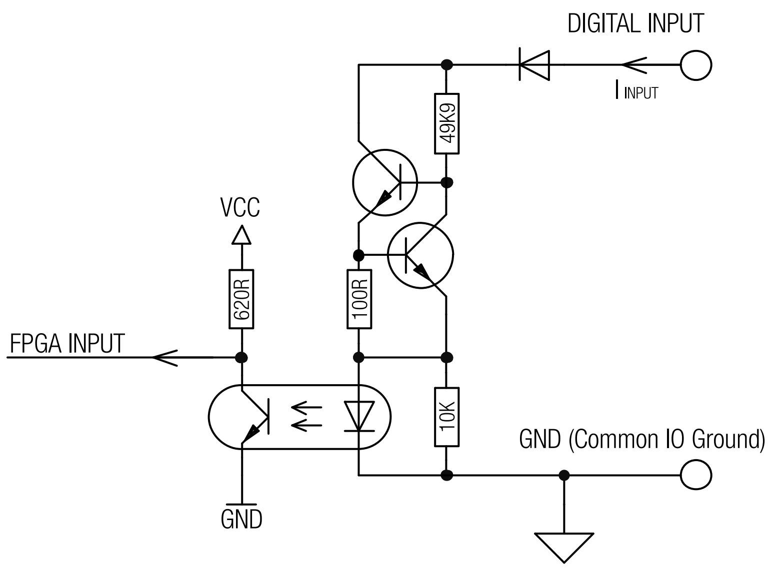


Figure 32: Digital input, interface schematic

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 48: General info for optically isolated digital input

2.10.2 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)

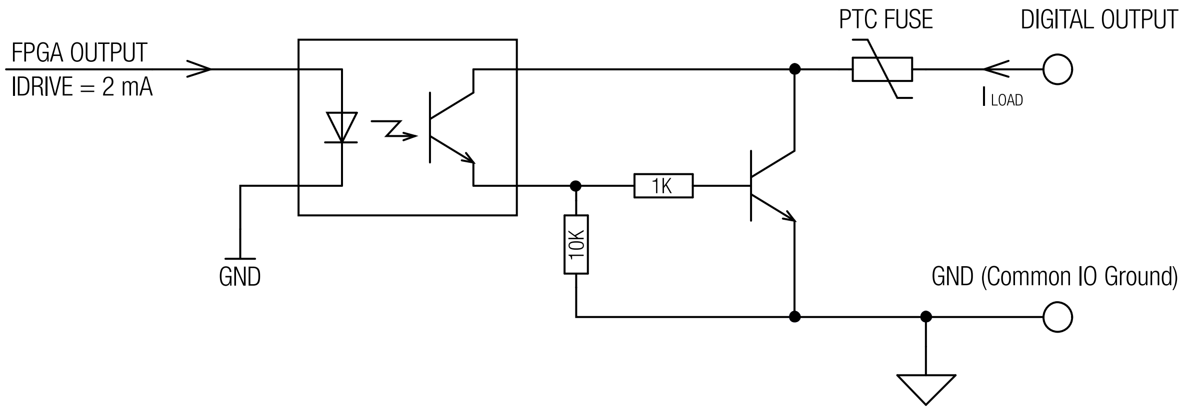


Figure 33: Digital output, interface schematic

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 49: General info for optically isolated digital output

2.11 Accessories

2.11.1 CBL-U3-1M0 / CBL-U3-3M0 / CBL-U3-5M

1.0 m / 3.0 m / 5.0 m USB 3.0 cable.

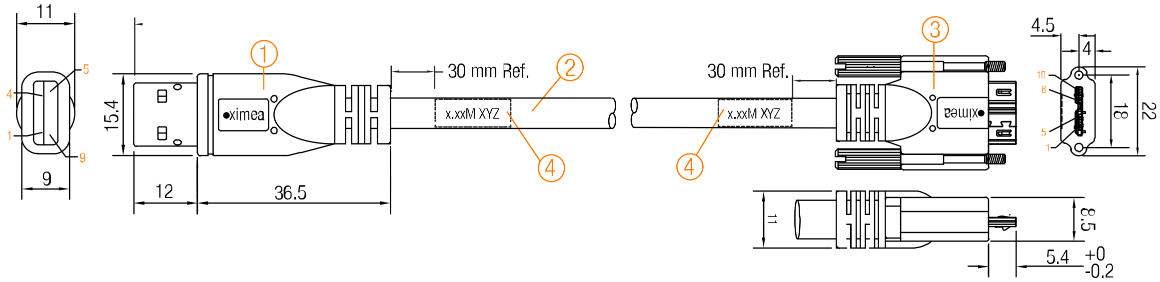


Figure 34: CBL-U3-1M0 / CBL-U3-3M0 / CBL-U3-5M cable components

1 USB A 3.0 9 pin Molded Plug <BLK>

2 MCD-USB-211 [OD = 7.3 mm] <BLK>

3 3 USB MicB 3.0 sl 10 pin Molded Plug with Screw Locking <BLK>

4 Cable Label

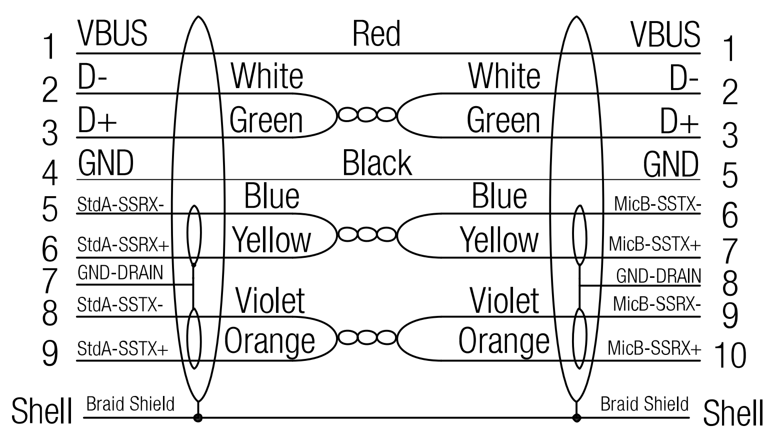


Figure 35: Wiring of CBL-U3-1M0 / CBL-U3-3M0 / CBL-U3-5M

Pin	Signal	Description
1	VBUS	Power
2	D-	USB 2.0 signal pair
3	D+	
4	ID	OTG Identification
5	GND	Power Ground
6	MicB_SSTX-	USB 3.0 SuperSpeed transmitter signal pair
7	MicB_SSTX+	
8	GND_DRAIN	USB 3.0 signal Ground
9	MicB_SSRX-	USB 3.0 SuperSpeed receiver signal pair
10	MicB_SSRX+	

Table 50: CBL-U3-1M0 / CBL-U3-3M0 / CBL-U3-5M pin assignment

2.11.2 CBL-U3-3M0-ANG

3.0 m USB 3.0 cable, angled micro USB3 connector.

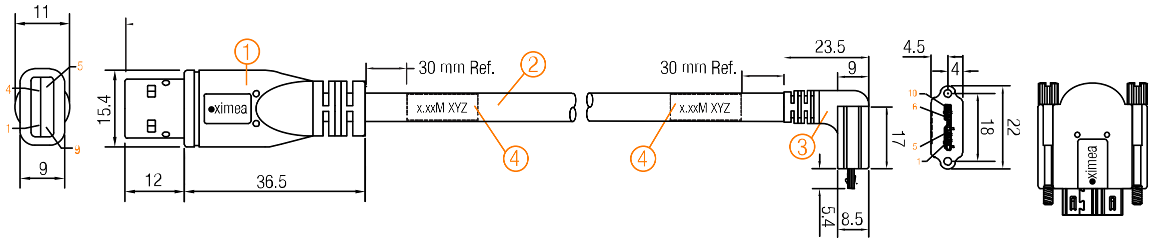


Figure 36: CBL-U3-3M0-ANG cable components

1 USB A 3.0 9 pin Molded Plug <BLK>

2 A12-7143 [OD = 5.9 mm] <BLK> UL20726 2STP#30 + 1UTP#28 + 2C#26

3 USB MicB 3.0 sl 90D A1(10 pin Molded Plug) <BLK>

4 Cable Label

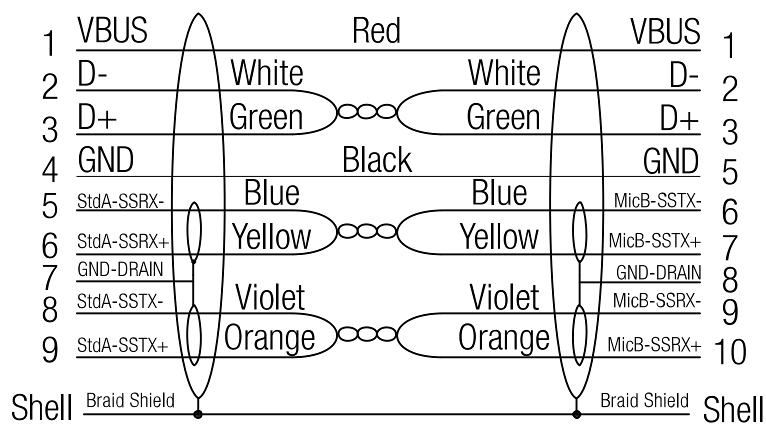


Figure 37: CBL-U3-3M0-ANG wiring

Pin	Signal	Description
1	VBUS	Power
2	D-	USB 2.0 signal pair
3	D+	
4	ID	OTG Identification
5	GND	Power Ground
6	MicB_SSTX-	USB 3.0 SuperSpeed transmitter signal pair
7	MicB_SSTX+	
8	GND_DRAIN	USB 3.0 signal Ground
9	MicB_SSRX-	USB 3.0 SuperSpeed receiver signal pair
10	MicB_SSRX+	

Table 51: CBL-U3-3M0-ANG pin assignment

2.11.3 CBL-MQ-FL-0M1 / CBL-MQ-FL-0M25

Cable FPC MQ Flex-Line, 0.1 m, 0.25 m can be used for connecting xiC flex line models to carrier board or trough adapter and standard USB 3.0 cable to the host computer. Minimal advised bending radius is 2 mm. Cable thickness 0.16 mm.

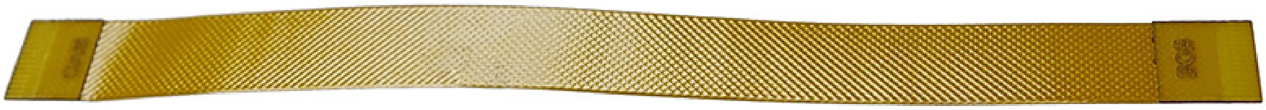


Figure 38: CBL-MQ-FL-0M1 / CBL-MQ-FL-0M25

Note: Cable have marked ends. It is important to connect the end marked “CAM” to the camera and end marked “BOB” to host or adapter. Swapped orientation leads to nonoperational state. Connecting camera to powered host can cause destruction of camera. For detaching cable, the connector needs to be unlocked, otherwise connector soldering may be damaged.

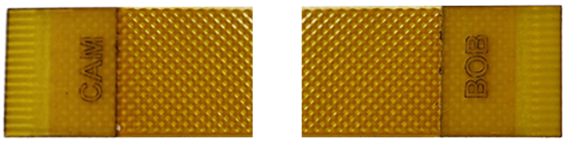


Figure 39: CBL-MQ-FL-0M1 / CBL-MQ-FL-0M25 cable zoom

2.11.4 CBL-USB3FLEX-0M10 / CBL-USB3FLEX-0M25 / CBL-USB3FLEX-0M50

The newer generation of FFC cable with available lengths 0.1 m, 0.25 m, 5 m can be used for connecting camera to carrier board or trough adapter to the host computer. Minimal advised bending radius is 5 mm. Cable thickness 0.38 mm. This cable is NOT polarized and either end can be used for the camera or the host.

Figure 40: CBL-USB3FLEX-0M10 / CBL-USB3FLEX-0M25 / CBL-USB3FLEX-0M50

2.11.5 CBL-S-M5-3P-PT-5M0 / CBL-S-M5-3P-PT-5M0-S

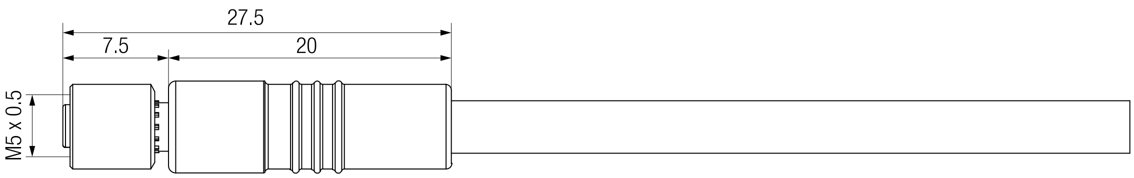


Figure 41: CBL-S-M5-3P-PT-5M0

Connect optically isolated input and output to the xiQ-S7 family of cameras. Also connect non-isolated IO to the xiMU cameras featuring binder connector. 3 pin IO cable for cameras featuring M5 connector, two variants of cable are available:

Part number	CBL-S-M5-3P-PT-5M0
Binder part number	77 3450 0000 40003-0500
Description	M5 Female cable connector, Contacts: 3, unshielded, moulded on the cable, IP67, UL, M5x0.5, PUR, black, 3 × 0.14 mm, 5 m
Part number	CBL-S-M5-3P-PT-5M0-S
Binder part number	77 3550 0000 40003-0500
Description	M5 Female cable connector, Contacts: 3, shielded, moulded on the cable, IP67, M5x0.5, PUR, black, 3 × 0.14 mm, 5 m

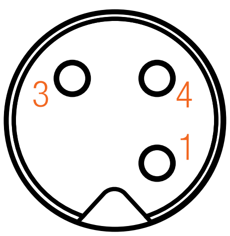


Figure 42: CBL-S-M5-3P-PT-5M0 / CBL-S-M5-3P-PT-5M0-S pinout

Pin	Wire color	Signal MQ-S7	Signal MU
1	brown	GPIO_GND	GND
2	-	-	-
3	blue	IN	INOUT 1
4	black	OUT	OUT 1
Shielding	-	connected to camera housing[1]	connected to camera housing[1]

[1] Only for CBL-S-M5-3P-PT-5M0-S variant

Table 52: CBL-S-M5-3P-PT-5M0 / CBL-S-M5-3P-PT-5M0-S pin assignment

2.11.6 CBL-S-PB3-PT-0M40

IO pigtail cable is for board-level variants of MQ cameras. Connects optically isolated input and output to xiQ-S7 family of cameras. For more information contact our XIMEA Support Team.

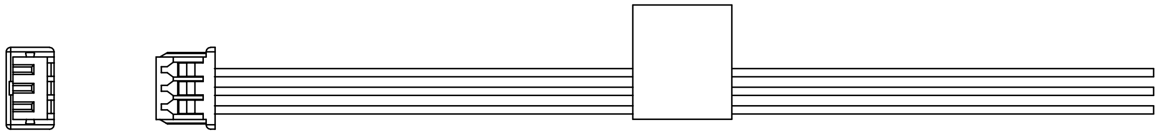


Figure 43: CBL-S-PB3-PT-0M40

Pin	Signal MQ-S7
1	GPIO_GND
2	IN
3	OUT

Table 53: CBL-S-PB3-PT-0M40 pin assignment

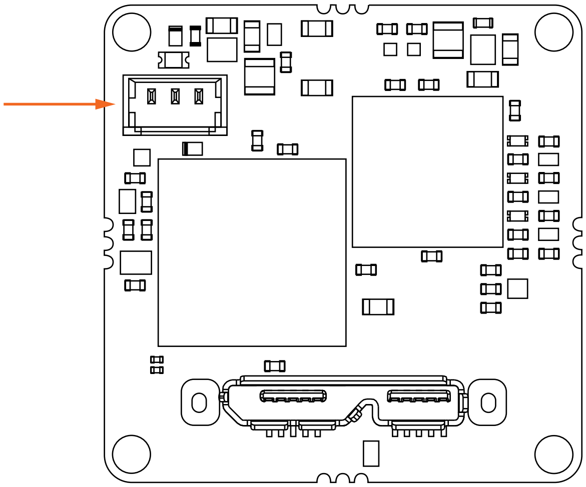


Figure 44: Board-level camera - connector location

2.11.7 BOB-MQ-FL

Break Out Board, Simple Board Level. Enables access to the optoisolated input and output. FPC cable connector pinout is exactly mirrored from camera pinout.

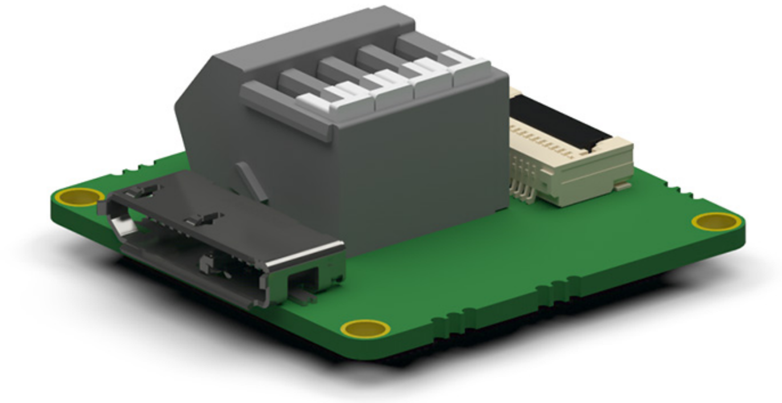


Figure 45: BOB-MQ-FL

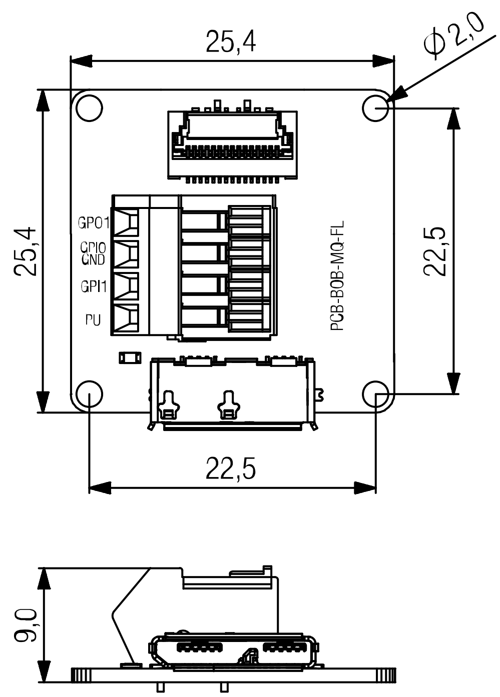


Figure 46: BOB-MQ-FL dimensions

Pin	Signal	Description
1	GPO1	Trigger/sync digital Output (GPO) - Open collector NPN – connected to pin 3 on Flex connector
2	GPIO	GND GPO1 and GPI1 common ground – connected to pin2 on Flex connector
3	GPI1	Trigger/sync digital Input (GPI) Current limited input – connected to pin1 on Flex connector
4	PU	Pull up 1 kΩ to GPO1 – Connect power supply up to 25 V if needed

Table 54: IO connector (WAGO 218-104), pin assignment

2.11.8 MQ-BRACKET-T

Figure 47: MQ-BRACKET-T

Tripod mounting bracket with 1/4-20 thread. Use 4x SROB-M2x4-CUST screws for mounting. Bracket can be mounted on the bottom or top side of the camera. Brackets are delivered as kit with respective screws. There are two variants. Standard MQ-BRACKET-T-KIT with height of 5.5 mm and thick MQ-BRACKET-T-THICK-KIT for use with lenses with diameter > 37 mm37

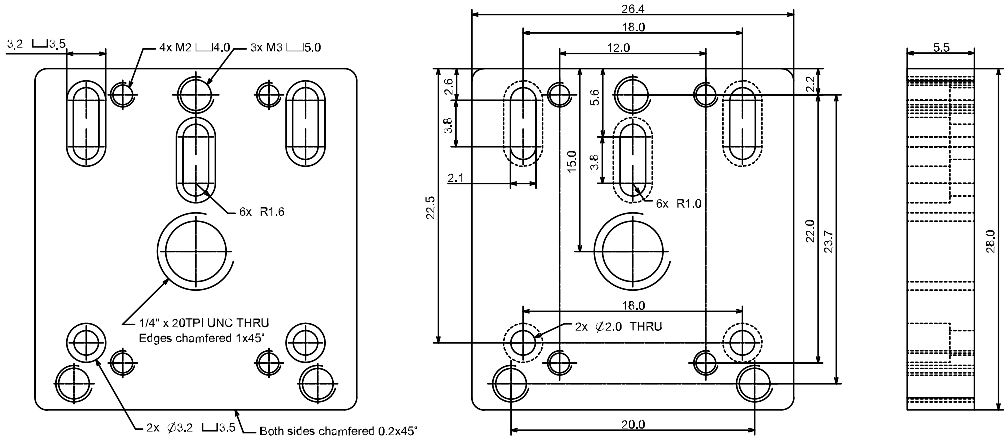


Figure 48: MQ-BRACKET-T dimensional drawing

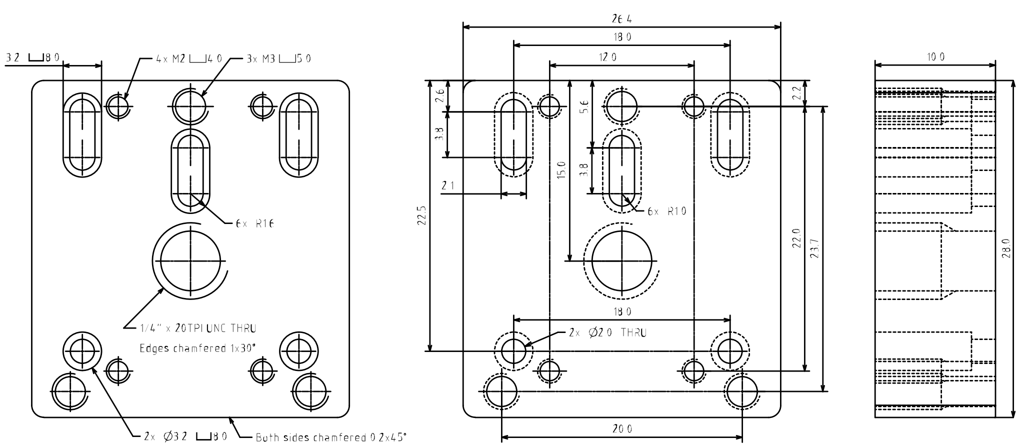


Figure 49: MQ-BRACKET-T thick dimensional drawing

2.11.9 USB 3 host adapters

USB 3.0 to PCI Express x1 Gen2 Host Card

Please refer to following page USB 3 Host Adapters for more information.

USB 3.1 Host Adapter

For a stable operation of your camera and achieving the maximum possible system performance with the highest frame rate it is important to choose an appropriate USB 3.1 host adapter chipset. Please have a look at the following link to our webpage: USB3 Hardware Compatibility

XIMEA maintains a regularly updated overview of compatible USB 3.0 and USB 3.1 host adapters together with the available bandwidth USB 3 Host Adapters

The maximum data transfer rate depends on different conditions (motherboard, chipset, driver version, operating system, etc.).

To achieve maximum performance of USB3 cameras - USB 3.1 host adapter must be connected to the PCIe slot/port/hub and running at 5 GT/s in case of PCIe Gen2 host adapters. For cards requiring Gen3 the speed needs to be 8 GT/s.

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:

MQ013CG-E2-S7	MQ013CG-E2-S7-FL	MQ013CG-E2-S7-FV	MQ013CG-ON-S7
MQ022CG-CM-S7	MQ022CG-CM-S7-FL	MQ042CG-CM-S7	MQ042CG-CM-S7-FL

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_RGB24	RGB data format. [Blue][Green][Red][1]
XI_RGB32	RGBA data format. [Blue][Green][Red][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 55: Image data output formats

This table is applicable to:

MQ013MG-E2-S7	MQ013MG-E2-S7-FL	MQ013MG-E2-S7-FV	MQ013MG-ON-S7
MQ013RG-E2-S7	MQ013RG-E2-S7-FL	MQ013RG-E2-S7-FV	MQ013RG-ON-S7
MQ022MG-CM-S7	MQ022MG-CM-S7-FL	MQ022RG-CM-S7	MQ022RG-CM-S7-FL
MQ042MG-CM-S7-FL	MQ042MG-CM-S7	MQ042MG-CM-S7-TG	MQ042RG-CM-S7-FL
MQ042RG-CM-S7			

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 56: 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).

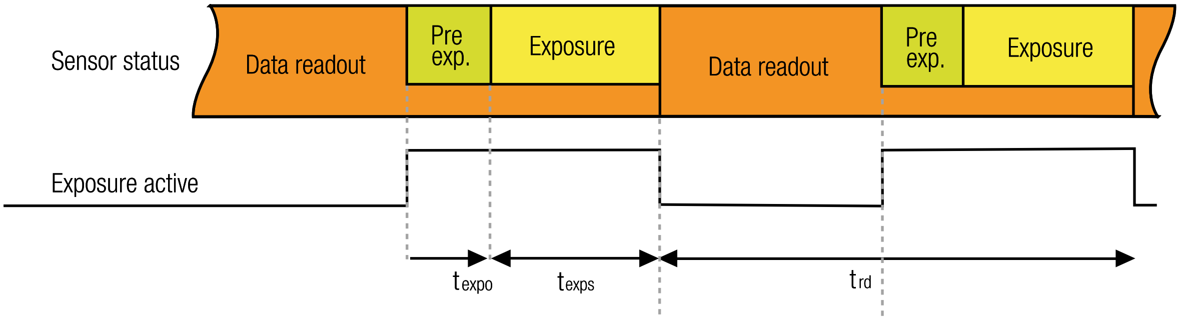


Figure 50: Acquisition mode - free run

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 with overlap

Several sensors are capable to trigger exposure in overlap mode, so it is capable to reach the same frame rate as in free run mode. When the trigger period is longer than the exposure and readout time, the signal wave form will look similar to Triggered mode without overlap. 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.

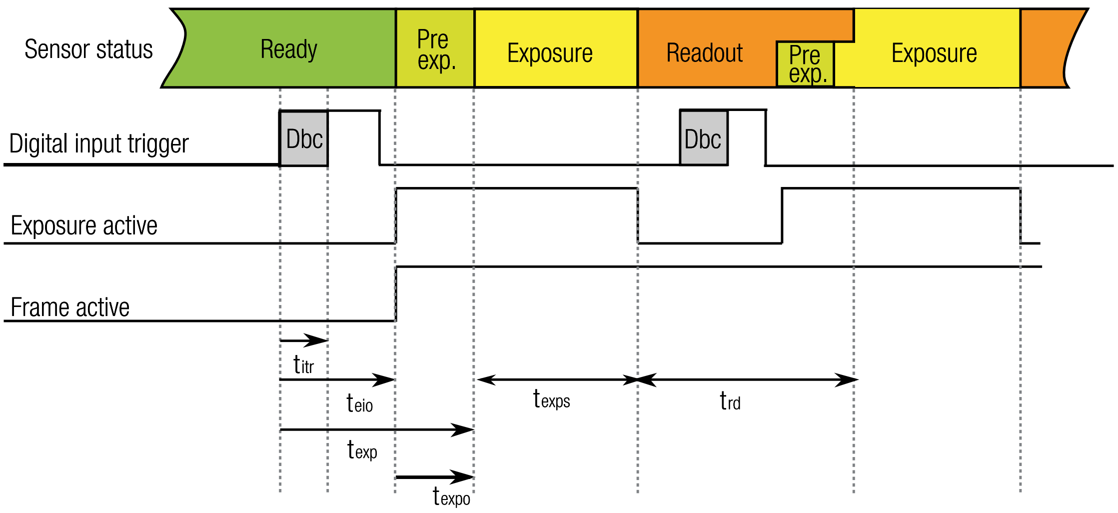


Figure 51: Acquisition mode – triggered with overlap

Camera Model	DownS	t_{itr} [µs]	t_{exp} [µs]	t_{eio} [µs]	t_{expo} [µs]	t_{rd} [µs]	Notes
MQ042xG-CM	any	1.4	10	11/224	0	(64.5 + 5.375 x LC) x BWF	N1[1],N2[2]
MQ022xG-CM	any	1.4	10	11/224	0	(37.625 + 5.375 x LC) x BWF	N1[1],N2[2]

[1]N1: V(Input)=15 V
[2]N2: 8bit per pixel maximum bandwidth

Table 57: Trigger mode with overlap, timing

DownS	Current camera DownSampling (XI_PRM_DOWNSAMPLING)
t_{eio}	Trigger (Digital Input) to Strobe (Digital Output) (on some models is listed: Off->On change / On->Off change)
t_{exp}	Strobe (Sensor) to Digital Output (on some models is listed: Off->On change / On->Off change)
t_{expo}	Start of exposition to Exposure Active Digital Output
LC	Current Line Count (XI_PRM_ HEIGHT)
BW	Bandwidth Factor see table below
t_{exps}	Current Exposure Time set (XI_PRM_EXPOSURE)
Conditions	XI_PRM_DEBOUNCE_EN=0 (off)

Bandwidth factor

Bandwidth factor is a number reflecting the ratio between the maximum sensor frequency and the current sensor frequency, calculated from the Bandwidth Limit.

$$\mathrm{BWF} = \frac{F_{max}}{F_{limit}}$$

Where F_{max} is maximum possible clock for used sensor in MHz and F_{limit} is used clock depending on Bandwidth Limit parameter set in API (XI_PRM_LIMIT_BANDWIDTH). F_{limit} is set in 1 MHz steps and cannot go lower than F_{min}.

MQ042xG-CM and MQ022xG-CM

$$F_{max} = 48\,\mathrm{MHz}$$

$$F_{min} = 5\,\mathrm{MHz}$$

$$F_{limit} = \frac{129 \times \mathrm{BW}}{8192 \times \mathrm{BPP}} \times \frac{12 + \mathrm{LC}}{\mathrm{LC}}\,[\mathrm{MHz}]$$

$$t_{fot} = 64.5 \times \mathrm{BWF}\mu\mathrm{s}$$

$$\mathrm{BPP} = \text{number of bytes per pixel}$$

$$\mathrm{BWL} = \text{bandwith limit in Mbit/s}$$

Minimum trigger period (t_{rig_min})

Minimum trigger period can be calculated using the following formula:

$$t_{trig\_min} = t_{exp} + t_{exps} \text{ (When exposure time is longer than readout time)}$$

$$t_{trig\_min} = t_{rd} \text{ (When exposure time is significantly shorter then readout time)}$$

$$t_{trig\_min} = t_{exps} + t_{fot} \text{ (When exposure is smaller than readout time but the difference is less than } t_{fot}\text{)}$$

MQ022MG-CM

$$\text{Exposure time} = 500\,\mu\mathrm{s}$$

$$\text{Image} = 2048\,\text{px width} \times 1088\,\text{px height with maximum bandwidth and 1 byte per pixel:}$$

$$t_{rig\_min} = 10\,\mu\mathrm{s} + (37.625 + 5.375 \times 1088\text{ lines}) \times 1 = 5895\,\mu\mathrm{s}$$

Triggered mode without overlap

This mode gives lower FPS compared to Free-Run mode and lower FPS than Exposure Overlapped with Data Readout mode.

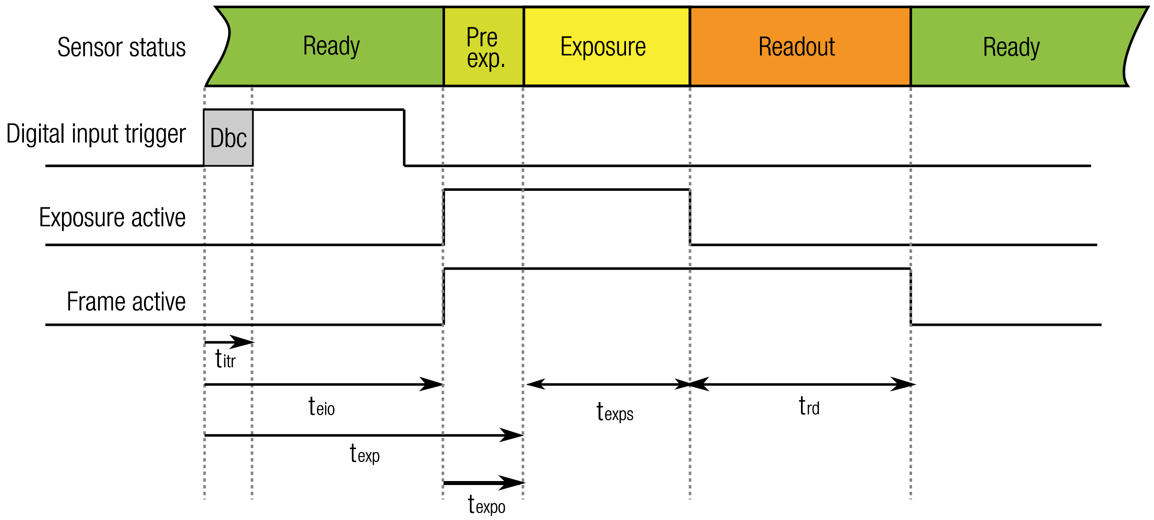


Figure 52: Acquisition mode – triggered without overlap

In this mode the timing depends on sum of:

- Input transition time (t_{itr}), depends on:
  - Digital input delay - time for changing internal circuit to active state. It is constant for each camera model.
  - Input debouncing time - time for stabilizing uneven input signals (e.g. from mechanical switches). This time can be can be set using xiAPI with parameters XI_PRM_DEBOUNCE_EN and XI_PRM_DEBOUNCE_T0 on some cameras. Default 0.
- Exposure time (see ET above)
- Data Readout time (see t_{rd} above)

Typical times for selected camera models

Camera Model	DownS	t_{itr} [µs]	t_{exp} [µs]	t_{eio} [µs]	t_{expo} [µs]	t_{rd} [µs]	Notes
MQ013xG-E2	any	1.4	29	19/238	-10	400 + 16.6 x BWF x LC	N1[1], N2[2]

[1]N1: V(Input)=15 V
[2]N2:x in model name means all available models (M, C, R)

Table 58: Trigger mode w/o overlap, timing

DownS	Current camera DownSampling (XI_PRM_DOWNSAMPLING)
t_{eio}	Trigger (Digital Input) to Strobe (Digital Output) (on some models is listed: Off->On change / On->Off change)
t_{exp}	Strobe (Sensor) to Digital Output (on some models is listed: Off->On change / On->Off change)
t_{expo}	Start of exposition to Exposure Active Digital Output
LC	Current Line Count (XI_PRM_ HEIGHT)
BW	Bandwidth Factor for maximum bandwidth this is 1 when the bandwidth will be lower BWF will rise
t_{exps}	Current Exposure Time set (XI_PRM_EXPOSURE)
Conditions	XI_PRM_DEBOUNCE_EN=0 (off)

Minimum trigger period (T_{trig_min})

Minimum trigger period can be calculated using the following formula:

$$t_{trig\_min} = t_{exp} + t_{exps} + t_{rd}$$

MQ013MG-E2

$$\text{Exposure time} = 500\,\mu s$$

$$\text{Image} = 500\,\text{px width} \times 200\,\text{px height:}$$

$$t_{trig\_min} = 29\,\mu s + 500\,\mu s + 400\,\mu s + 16.6\,\mu s \times 200\text{lines} = 4.249\,\text{ms}$$

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.

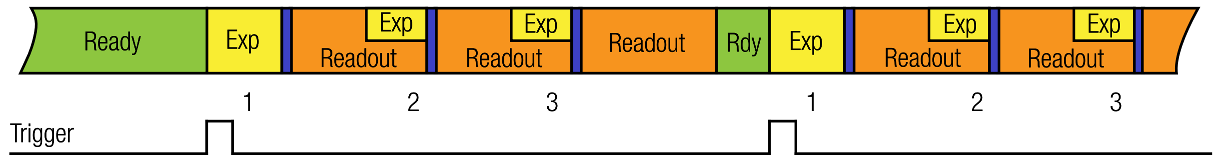


Figure 53: Triggered burst of frames – frame burst start

Frame Burst Active

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

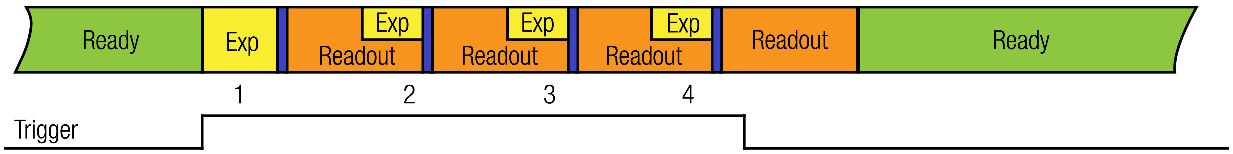


Figure 54: Triggered burst of frames – frame burst active

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

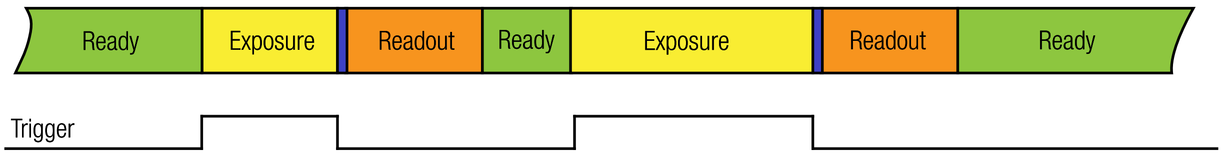


Figure 55: Exposure defined by trigger pulse length

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):

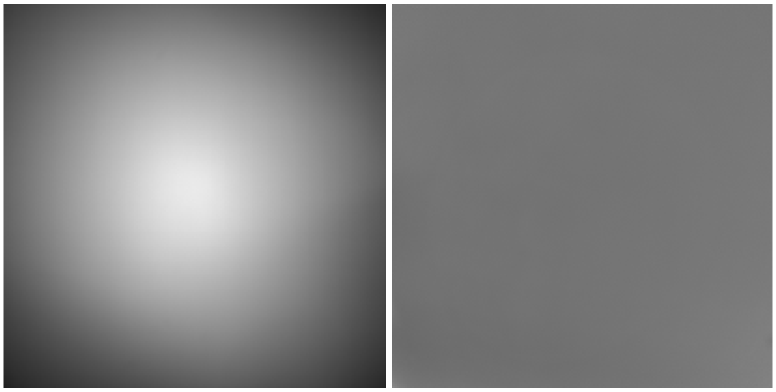


Figure 56: Flat field correction - images comparison

Acquisition of calibration images

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

Figure 57: 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.

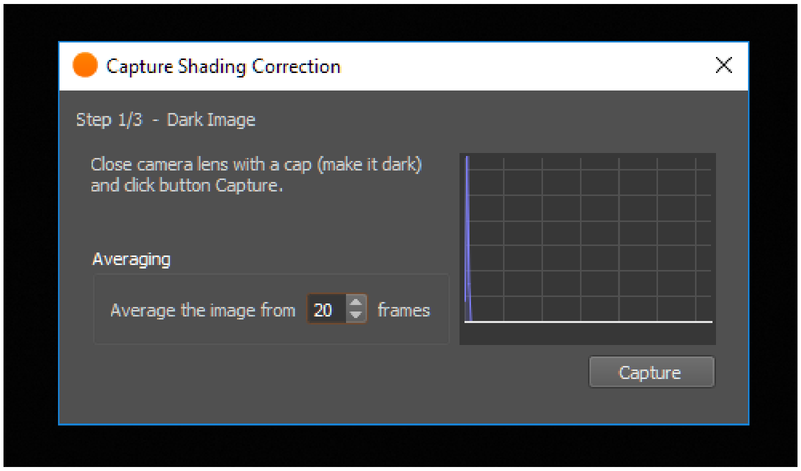


Figure 58: Flat field correction - Dark image

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.

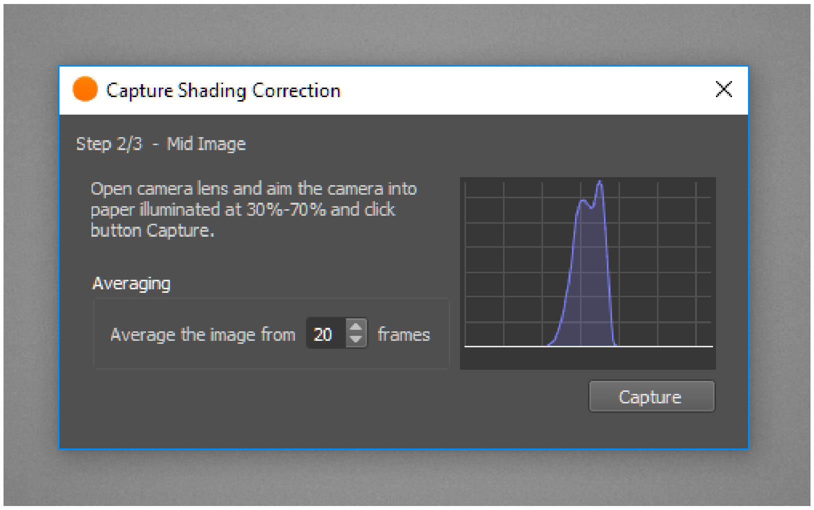


Figure 59: Flat field correction - Mid- saturated image

Save TIFF files

Save the new preset how it be displayed in CamTool.

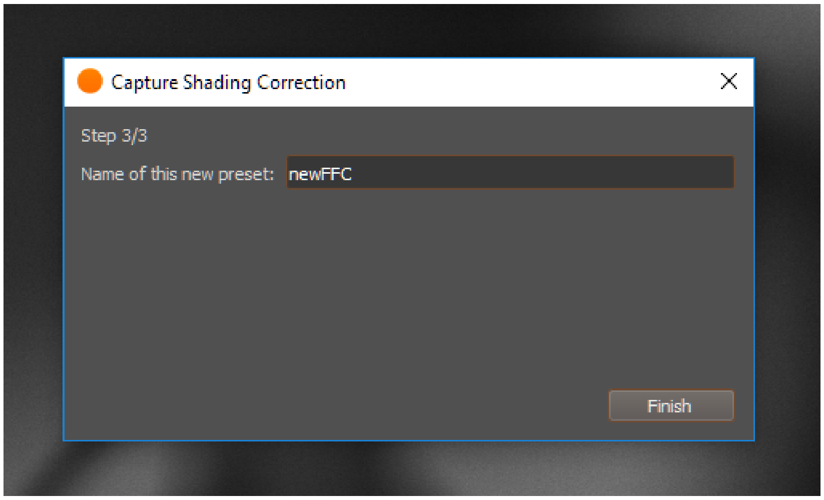


Figure 60: Flat field correction - new preset

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

Figure 61: 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

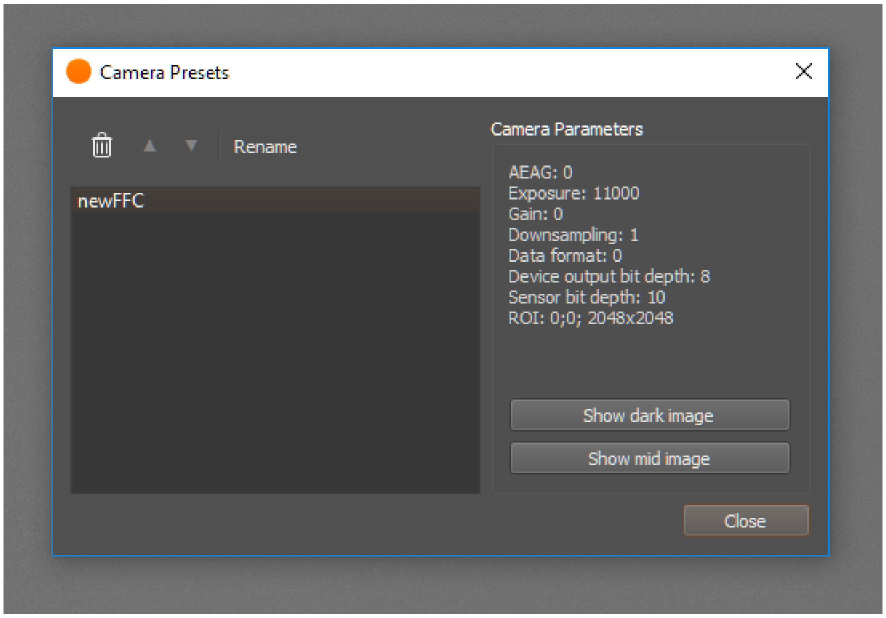


Figure 62: Flat field correction - FFC management

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.

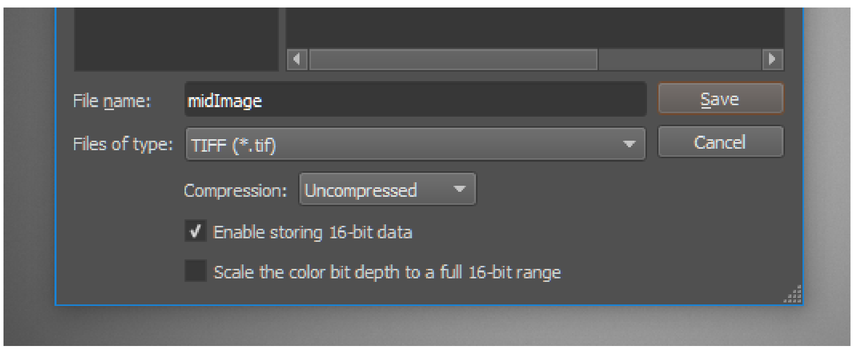


Figure 63: Flat field correction - Safe TIFF

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.

3.5.8 HDR

Some sensors offer the ability to acquire images with a higher dynamic range than the value presented in the specification. High dynamic range can be achieved by several means as part of the sensor output. The feature supported by some cameras (see Sensor and camera parameters) is a piecewise linear response, a so-called multiple slope integration.

The dynamic range of a linear image sensor is limited by the saturation of the pixel. Different light intensities are shown in the figure below. All blue marked light intensities cause different signal levels and can be separated without saturation. All red marked intensities cause an overexposure and the info about the different light intensity above 100% is lost.

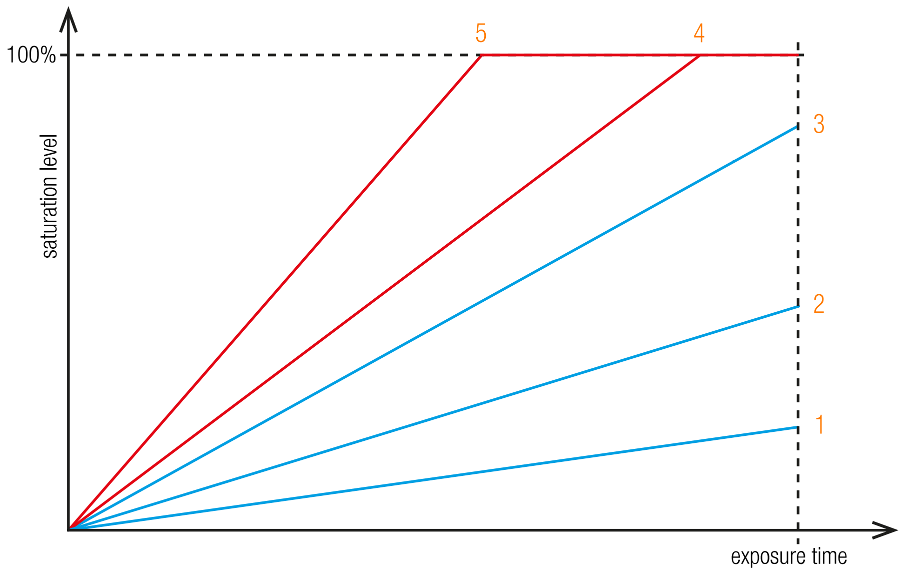


Figure 64: Saturation example without HDR

The dynamic range can be increased by dividing the integration (exposure time) in two or three phases (slopes), with different maximum saturation levels. The camera supports the dividing in three slopes.

To use this kind of HDR method the user has to define two pairs of parameters: (T1, SL1) and (T2, SL2).

- T1 and T2 define portions of the total exposure time and the length of the three timing phases
- SL1 and SL2 define portions of the sensor saturation, so called kneepoint1 and kneepoint2

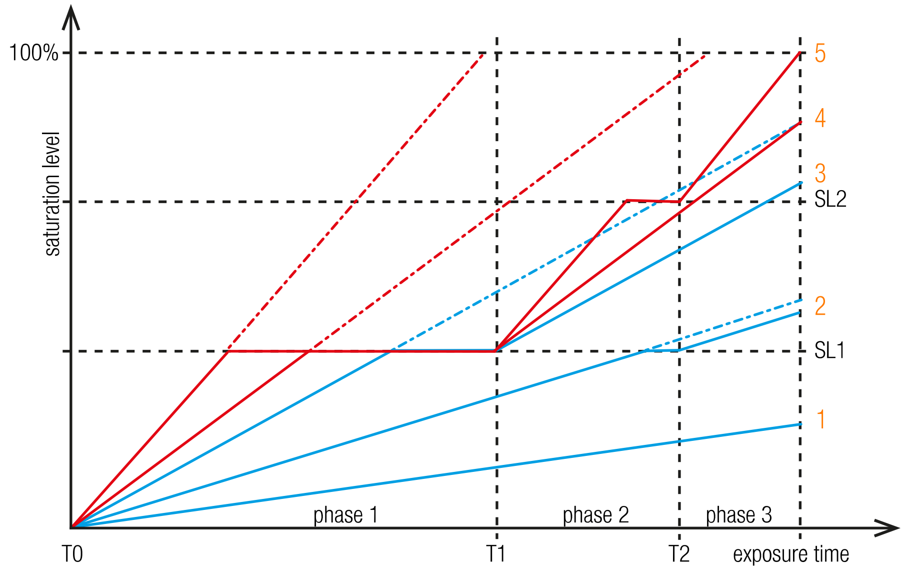


Figure 65: Saturation example with HDR

Description of the multiple slope integration

Phase 1

- All pixels are integrated until they reach the defined saturation level of kneepoint1 (SL1)
- If the saturation level of kneepoint1 is reached, the integration stops. SL1 is the maximum saturation level for all pixels in this phase

Phase 2

- All pixels are integrated until they reach the defined saturation level of kneepoint2 (SL2)
- If the saturation level of kneepoint2 is reached, the integration stops. SL2 is the maximum saturation level for all pixels in this phase

Phase 3

- All pixels are integrated until the exposure time is reached. The pixel saturation may reach the maximum saturation level

The main idea of this method is to reach an approx. logarithmic saturation curve. In order to achieve this goal phase2 always has a smaller slope than phase1 and phase3 smaller than phase 2. Thus, the signal response during phase1 is higher as during phase2. And the signal increase during phase2 is higher than during phase3.

As a result, darker pixels can be integrated during the complete integration time and the full sensor sensitivity can be exploited. Brighter pixels are limited at the knee points and lose a part of their integration time.

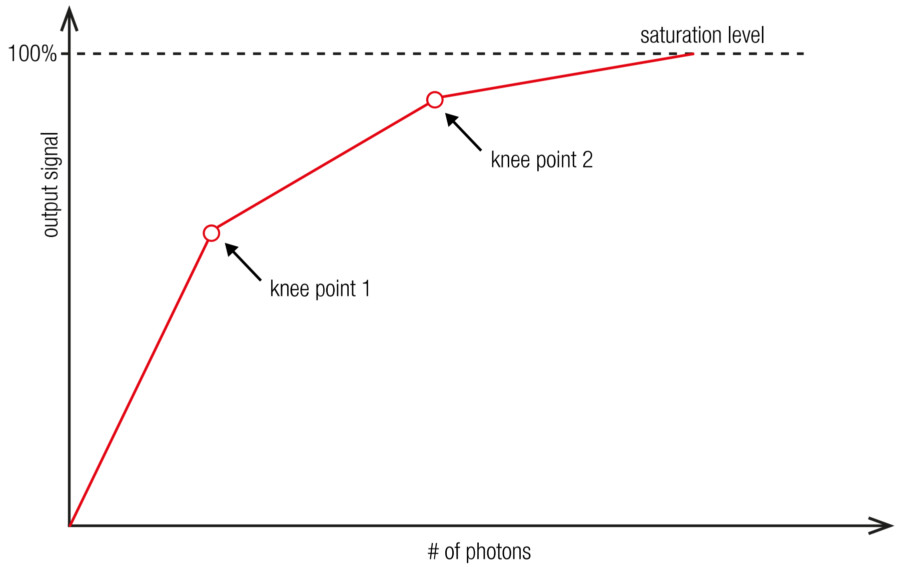


Figure 66: HDR approx logarithmic saturation curve

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.

4.1.2 API Compatibility

S7 camera models achieve full functionality with API version 4.28.01 or higher. Prior to version 4.26.01 (with this version included), they operate identically to their non-S7 counterparts. While compatibility may exist in the intervening API range, certain limitations may arise. To ensure maximum performance, we recommend utilizing API versions 26.01 or earlier and 28.01 or higher.

4.1.3 Hardware requirements

The XIMEA USB3 cameras are compatible with USB 3.1, USB 3.0 and USB 2.0. Please note, that the highest performance can only be achieved by using high performance USB 3.1 or USB 3.0 ports. Using a USB 2.0 port will lead to a limited frame rate.

Please note details and the most recent info on our website: USB3 Hardware Compatibility.

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

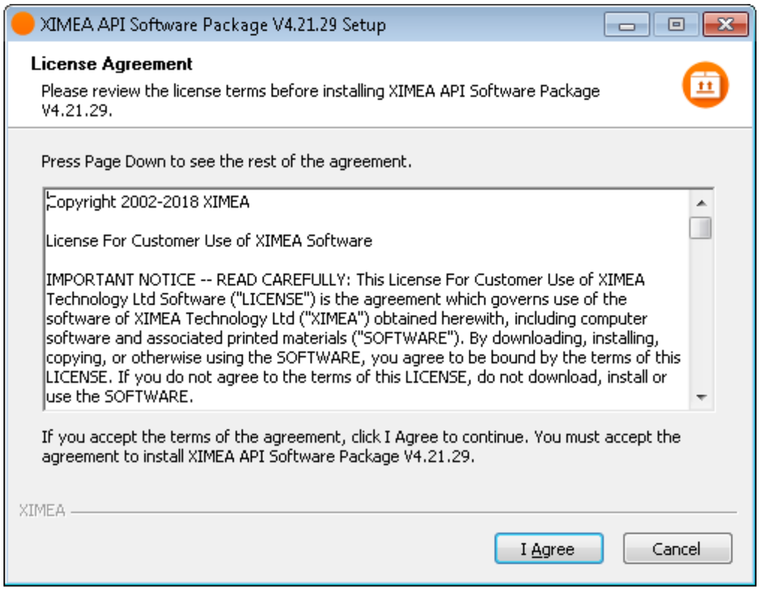
The package contains:

- 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

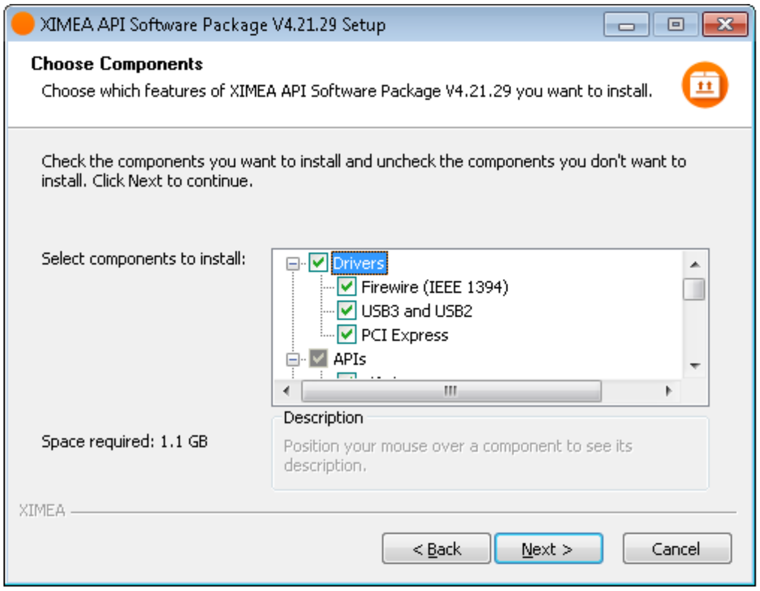
Installation

- 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

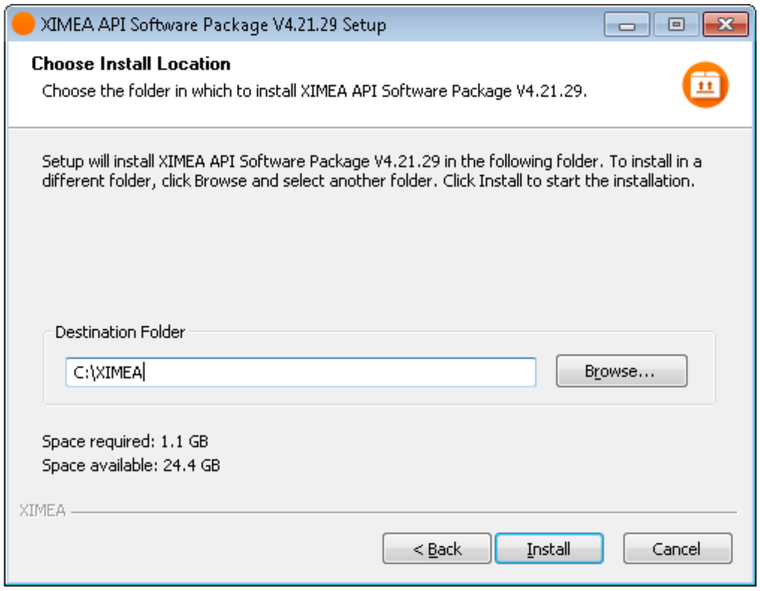
  Be sure that you have administrator privileges or start the Installer with administrator rights
  (right click and select “run as administrator”):



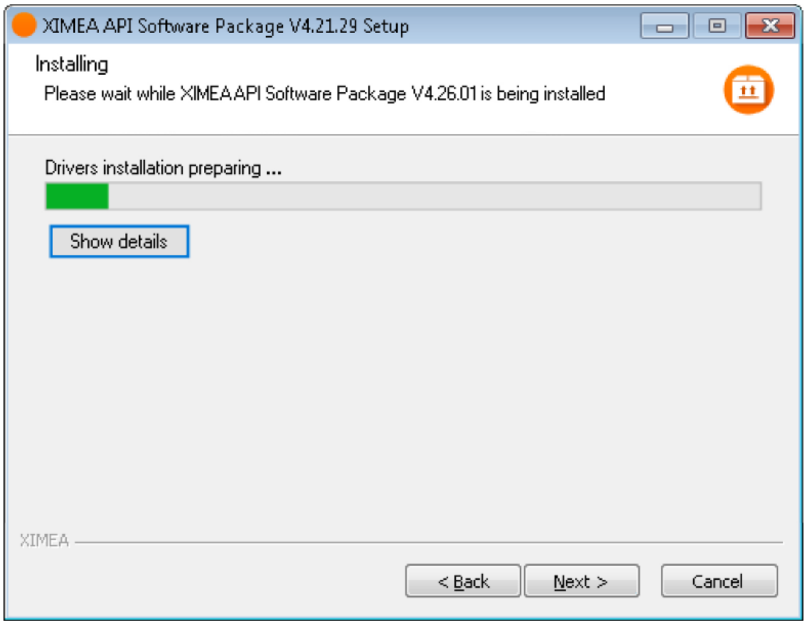
- Select the Software components you want to install. You can uncheck the components you don't want to install, but it is recommended to leave them all checked



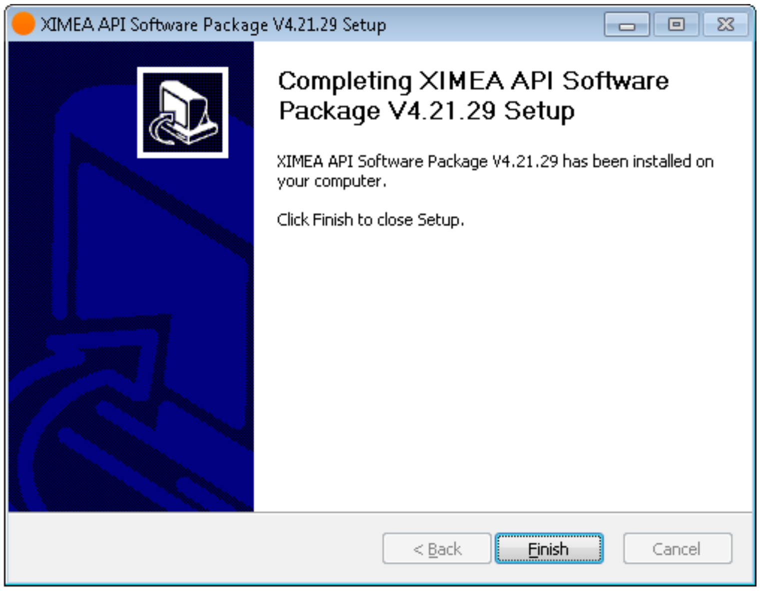
- Specify the install location - you can leave the default location or change it to your desired location



- 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

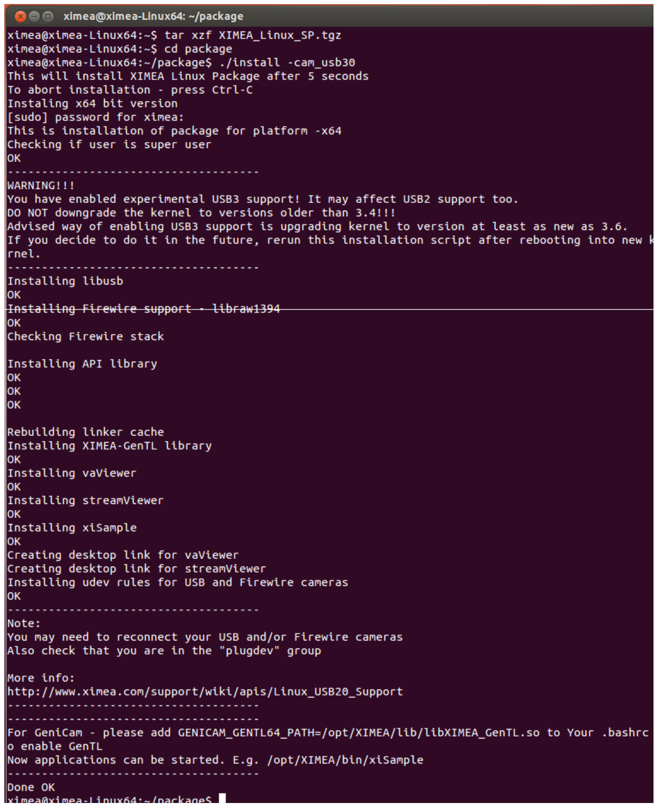
  ```
  wget http://www.ximea.com/downloads/recent/XIMEA_Linux_SP.tgz
  ```

- 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:

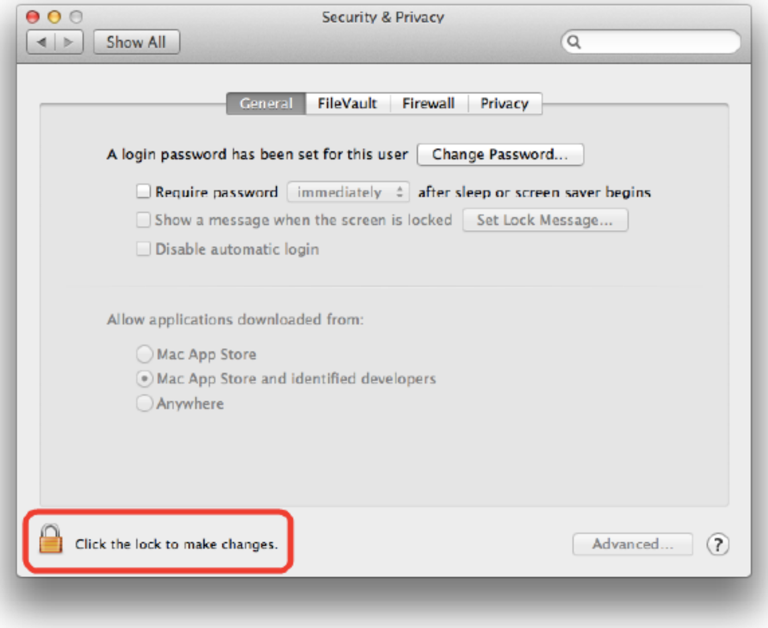
- Driver (beta version) for XIMEA USB2 and USB3 cameras
- xiAPI
- XIMEA CamTool
- Examples:
  - xiSample - sample showing basic image acquisition in xiAPI

Installation

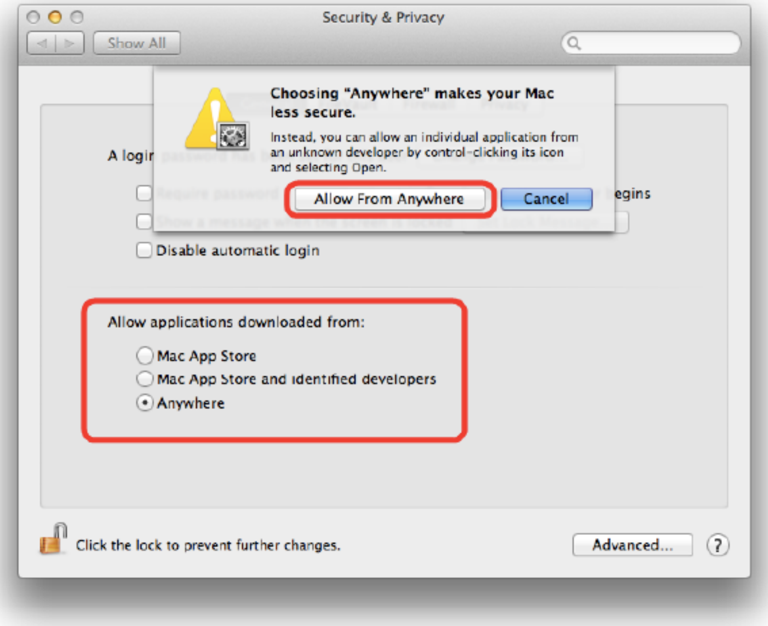
Before installing XIMEA macOS Software Package it may be necessary to modify security settings on your computer. The new feature of OS X 10.8 called GateKeeper can prevent you from using our macOS Software Package due to the fact that the current version is unsigned.

- 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 67: CamTool preview

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

Table 59: 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.

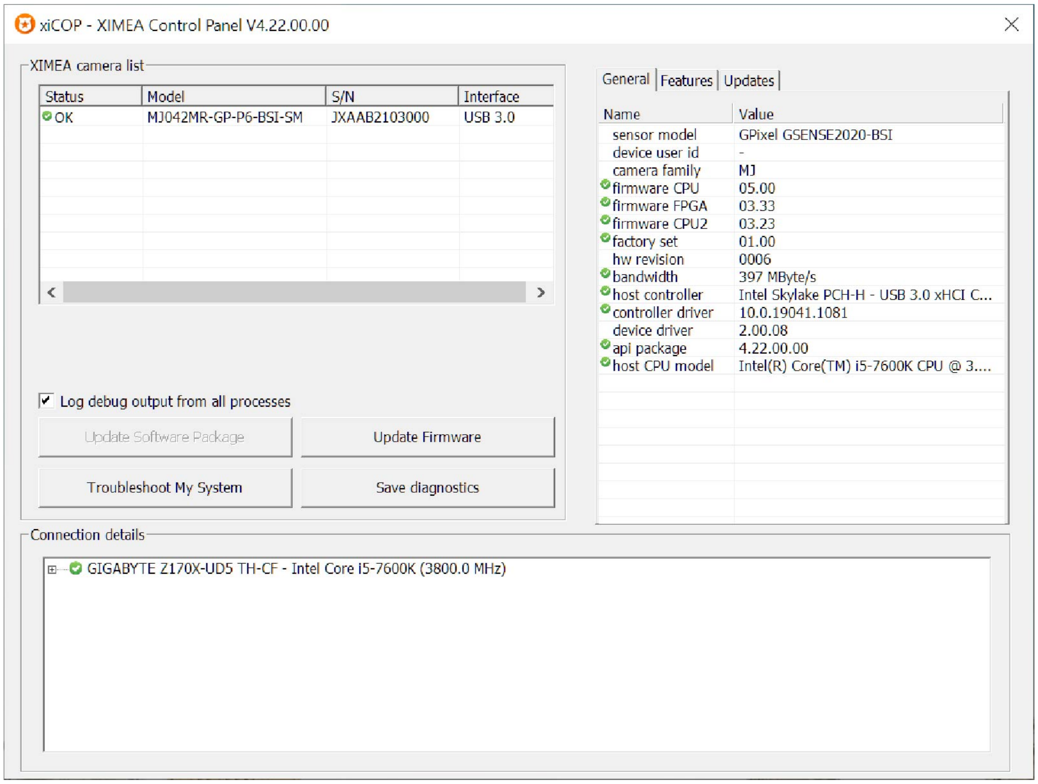


Figure 68: xiCOP example

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.

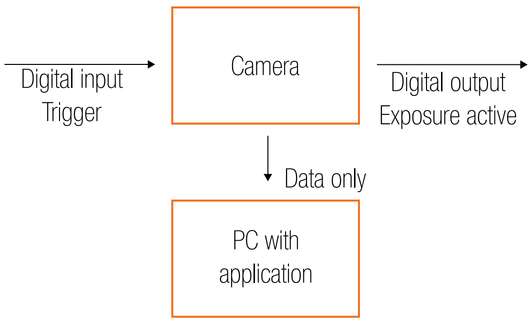


Figure 69: GPIO scheme

```
        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 60: 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 67

CMOS Complementary Metal-Oxide-Semiconductor 68

ESD Electrostatic discharge 45

FPGA Field Programmable Gate Array 60

FPS Frame Per Second 62

PSR Product Service Request 94

ROI Region Of Interest 60

List of Figures

List of Tables

XIMEA GmbH
Am Mittelhafen 16 • 48155 Münster • Germany • www.ximea.com