ximea

xiC

[ksi-see: or sai-see:]

USB 3.1 camera series

Technical Manual

Version 2.02, January, 2024

1. Introduction

1.1. 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 questions or if you wish to claim a service or warranty case, please contact your local dealer or refer to the XIMEA Support on our website: www.ximea.com/support

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

This document is subject to change without notice.

1.2. About XIMEA

We develop, manufacture and market innovative camera solutions and imaging systems for integrators, OEMs, and the global markets in general. Our history in research, development, and production dates back to 1992. From our locations in Slovakia, Germany, and the US, and with a global distributor network, we offer our solutions to all types of companies and institutions across every imaginable application field.

Industrial cameras, scientific cameras, custom engineering, imaging ecosystems as well as software and tools form the portfolio.

A 50/50 mix of custom projects and series production guarantees innovative, technology-driven developments, as well as reliable supply and support.

We utilize the latest CMOS and sCMOS sensors combined with the fastest and highly efficient interfaces such as USB3, Thunderbolt, and PCIe.

The robust camera packages are the smallest and lightest in class. The mechanical and electrical design aims for a high degree of flexibility that facilitates all sorts of integrations.

Innovative cooling concepts and deep knowledge in sensor tuning, elevate the imaging performance.

The extensive software support spans across various platforms, operating systems, and programming environments. In addition, we support generic camera interfaces and a multitude of vision libraries.

Technology-driven and always seeking innovative solutions, our creations are already solving future problems today.

We don‘t just make imaging systems - we invent them.

1.2.1. Contact XIMEA

XIMEA is a worldwide operating company

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

Internet	www.ximea.com
General inquiries	info@ximea.com
Sales	sales@ximea.com
Support	https://www.ximea.com/support/wiki/allprod/Contact_Support

1.3. Standard Conformity

The xiC cameras have been tested using the following equipment:

Model option –UB (micro-B USB 3.1 connector)

- A shielded USB 3.0 cable ref. CBL-U3-3M0 (3m)
- A shielded I/O Sync cable ref. CBL-702-8P-SYNC-5M0 (5m)

Model option – TC (Type C connector in USB 3.1 Gen 1 mode)

- A shielded USB 3.1 Type-C to A cable (1m)
- A shielded I/O Sync cable ref. CBL-702-8P-SYNC-5M0 (5m)

Model option –FV and – FL

- Camera is connected to Tegra TX1 processor board via TX1CB-PHOXI-BRD and CBL-MQ-FL-0M1. Whole setup is housed in AW16918ESS enclosure, with modified end panels to hold camera and provide access to power connector and Ethernet connector. System is Linux operating system controlled over Ethernet from remote computer. For more information, please contact our support: https://www.ximea.com/support/wiki/allprod/Contact_Support

Warning: Changes or modifications to the product or the environment may render it ineligible for operation under CE, FCC or other jurisdictions. XIMEA recommends using the above configuration to ensure compliance with the following standards.
Please refer also to chapter 1.3.8.

1.3.1. CE Conformity

CE

The xiC cameras described in this manual comply with the requirements of the

- EC EMC Directive 2014/30/EU electromagnetic compatibility of equipment

1.3.2. For customers in the US: FCC Conformity

FC

The xiC cameras described in this manual 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:

- This device may not cause harmful interference, and
- 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 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 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.
Please refer also to chapter *1.3.8 Camera Sub-Assemblies*.

1.3.3. For customers in Canada

The xiC cameras comply with the Class A limits for radio noise emissions set out in Radio Interference Regulations.
Please refer also to chapter *1.3.8 Camera Sub-Assemblies*.

1.3.4. RoHS Conformity

The xiC cameras comply with the requirements of the RoHS (Restriction of Hazardous Substances) Directive 2011/65/EU.

1.3.5. WEEE Conformity

The xiC cameras comply with the requirements of the WEEE (waste electrical and electronic equipment) Directive 2012/19/EU.

1.3.6. AIA standard USB3 Vision

The xiC cameras are compliant with the USB 3.0 SuperSpeed specification and are designed to be compliant with the AIA USB3 Vision standard.

1.3.7. GenICam GenTL API

GenICam standard transport layer interface, grabbing images. GenICam/GenTL provides an agnostic transport layer interface to acquire images or other data and to communicate with a device. Each XIMEA camera can be GenTL Producer.

1.3.8. Camera Sub-Assemblies

The FL and FV camera models are "semi" housed with flex ribbon cable interfaces. As such, these devices 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.

1.4. Helpful Links

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

1.5. Table of Contents

2. xiC Camera Series

2.1. What is xiC

xiC [ksi-see: or sai-see:] is an ultra-compact USB 3.1 (gen 1) Industrial camera family with outstanding features:

- Extremely small footprint, very light, robust full-alloy housings
- Low power consumption
- USB3 Vision Standard compatible
- Utilizing Sony Pregius and Pregius S global shutter sensors from 2.3 MP to 24.5 MP
- frame rates: 2.3 MP @ 165 fps to 24.5 MP @ 15.5 fps

2.2. Advantages

Industry standard interface	USB 3.1 Gen1
AIA standard compatibility	USB3 Vision standard
Small	Fits into places where no other camera can fit
Low power consumption	2.2-3.5 W
Powerful	5Gb/s interface up to 450Mbyte/s data throughput for USB3.1 gen1
Fast	High speed, high frame rate: >650fps at VGA and 30fps at 12Mpix resolutions
Robust	Full metal housing, no sheet metal covers
Lightweight	Facilitates increased performance of robotic arms and gimbals
Connectivity	Programmable opto-isolated I/O, and non-isolated digital input and output. 4 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

table 2-1, advantages

2.3. USB3 Vision 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

2.4. Common features

Sensor Technology	CMOS, Global shutter
Acquisition Modes	Continuous, software and hardware trigger, fps limiting, triggered exposure, and burst
Partial Image Readout	ROI, Decimation and Binning modes supported (model specific)
Image data formats	8, 10 or 12 bit RAW pixel data
Color image processing	Host based de-bayering, sharpening, Gamma, color matrix, true color CMS
Hot/blemish pixels correction	On camera storage of up to 5000 pixel 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 3.1 standard Micro-B and standard Type-C with screw lock threads compliant to USB3 Vision standard. Alternative flat ribbon cable interface for embedded integrations At the time of writing, the USB cameras utilize USB 3.1 gen1 definitions and yield a bandwidth of about 450 Mbyte/s. The cameras are backward compatible with USB 3.0 and 2.0 (with concomitant reduction in pixel throughput).
General Purpose I/O	1x opto-isolated input, 1x opto-isolated output, and 2 non-isolated bidirectional I/O, 4X user configurable LEDs
Signal conditioning	Programmable debouncing time
Synchronization	Hardware trigger input, software trigger, exposure strobe output, busy output
Housing and lens mount	Standard C-mount convertible to CS mount, and "semi-housed"
Power requirements	2.2-3.5W, supplied via USB 3.1 interface
Environment	Operating 0°C to 50°C on housing, RH 80% non-condensing, -30°C to 70°C storage Ingress Protection: IP40
Operating systems	Windows 10 (x86 and x64), Windows 7 SP1 (x86 and x64), Linux Ubuntu, MacOS 10.8 and newer
Software support	xiAPI SDK, adapters and drivers for various image processing packages
Firmware updates	Field firmware updatable

table 2-2, common features

2.5. Model Nomenclature

Part number convention for different models:

MCxxxyG-zz[-OPT][-DR]

MC xiC family name

xxx: Resolution in 0.1 MPixel. E.g., 2.3 MPixel Resolution: xxx = 023

y: y=C: color model
y=M: black & white model

G: Global shutter (all xiC cameras are global shutter)

zz: Vendor of the sensor

zz = SY: Sony

[-OPT]: Connector options

OPT = TC: connector Type-C

OPT = UB: connector micro-B

OPT = FL: flex line variant, connector parallel to board, semi-housed

OPT = FV: flex line variant, connector perpendicular to board, semi-housed

[-DR]: Dynamic range

OPT = '': camera without HDR (Dual ADC) functionality

OPT = HDR: camera with HDR (Dual ADC) functionality

2.6. Models Overview

Model[1]		Resolution	Pixel size	ADC [bit]	DR[2]	Optical size	Sensor diagonal	FPS[3]
MC023MG-SY	b/w	1936 x 1216	5.86 µm	10/12	71.7 dB	1/1.2"	13.4 mm	165
MC023CG-SY	Color							
MC031MG-SY	b/w	2064 x 1544	3.45 µm	8/10/12	70.9 dB	1/1.8"	8.9 mm	122
MC031CG-SY	Color							
MC050MG-SY	b/w	2464 x 2056	3.45 µm	8/10/12	70.8 dB	2/3"	11.1 mm	76
MC050CG-SY	Color							
MC089MG-SY	b/w	4112 x 2176	3.45 µm	8/10/12	70.5 dB	1"	16.1 mm	43
MC089CG-SY	Color							
MC124MG-SY	b/w	4112 x 3008	3.45 µm	8/10/12	70.4 dB	1.1"	17.6 mm	31
MC124CG-SY	Color							
MC161MG-SY	b/w	5328 x 3040	2.74 µm	8/10/12	70.2 dB	1.1"	16.78 mm	23.2
MC161CG-SY	Color							
MC161MG-SY-HDR	b/w				72.1 dB			23.1
MC161CG-SY-HDR	Color							
MC203MG-SY	b/w	4512 x 4512	2.74 µm	8/10/12	TBD dB	1.1"	17.45 mm	18.7
MC203CG-SY	Color							
MC203MG-SY-HDR	b/w				72.1 dB			18.6
MC203CG-SY-HDR	Color							
MC245MG-SY	b/w	5328 x 4608	2.74 µm	8/10/12	TBD dB	1.1"	19.27 mm	15.5
MC245CG-SY	Color							
MC245MG-SY-HDR	b/w				TBD dB			15.5
MC245CG-SY-HDR	Color							

table 2-3, models overview

Note: 1) In the model's name please add

- -TC for USB 3.1 Gen1 Type C
- -UB for USB 3.1 Gen1 Micro-B
- -FL for flat-flex cable connecting from the bottom of the camera
- -FV for flat-flex cable connecting perpendicular to the sensor

2) The highest possible dynamic range

3) Full resolution, 8-bit RAW

2.7. Accessories

The following accessories are available (short list):

Item P/N	Description
CBL-U3-1M0	1.0m USB 3.0 cable, micro-B connector on camera side
CBL-U3-3M0	3.0m USB 3.0 cable, micro-B connector on camera side
CBL-U3-3M0-ANG	3.0m USB 3.0 cable, angled micro-B USB3 connector
CBL-U3-5M0	5.0m USB 3.0 cable, micro-B connector on camera side
CBL-U31TC-3M0	3.0m USB 3.1 Gen 1 Type-C cable (Type-A - Type-C)
CBL-U31TC-5M0	5.0m USB 3.1 Gen 1 Type-C cable (Type-A - Type-C)
MECH-MC-BRACKET-KIT	xiC series tripod mounting bracket with Screws Kit
CBL-MQ-FL-0M1	Cable FPC MQ/MC Flex-Line, 0.1m (gold color)
CBL-MQ-FL-0M25	Cable FPC MQ/MC Flex-Line, 0.25m (gold color)
CBL-USB3FLEX-0M10	Cable FPC MQ/MC Flex-Line, 0.1m (white color)
CBL-USB3FLEX-0M25	Cable FPC MQ/MC Flex-Line, 0.25m (white color)
CBL-USB3FLEX-0M50	Cable FPC MQ/MC Flex-Line, 0.5m (white color)
BOB-MQ-FL	Break Out Board, Flex-Line, Simple Board Level Micro-B USB3.0
U31PE1G3-V1-X2[1]	PCI express adapter, 2x USB 3.1 ports ASMedia ASM1142, xHCI
U3PE-FL1100-X4[1]	PCI express adapter, 4x USB 3.0 ports, PCIe x4 slot
CBL-702-8P-SYNC-5M0	5.0m Trigger/Sync I/O cable

table 2-4, accessories

Note: 1) For more information please visit:
https://www.ximea.com/support/projects/usb3/wiki/USB_3_Host_Adapters

3. Hardware Specification

3.1. Power Supply

The xiC cameras are powered via the USB Micro-B, type C or flex line connector. The input voltage is 5 V DC. The power consumption is 2.2 - 3.5W depending on the xiC model.

Power supply, via USB system connector:

- 5 V (nominal)
- 4.45 V to 5.5 V (at the camera connector)

Additionally, the models with Micro-B (-UB) and Type-C (-TC) connector can use external power supply, with same requirements as power supply defined above. For information about connection please see chapter: *3.10 xiC Digital Input / Output (GPIO) Interface* and *3.11 External power supply input (AUX)*.

Power supply, via Digital Input / Output (GPIO) Interface connector:

- 5 V (nominal)
- 4.45 V to 5.5 V (at the camera connector)

3.2. General Specification

3.2.1. 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	$T_{storage}$	-30 to +70 °C
Relative Humidity, non-condensing	RH	80 %

table 3-1, environment

Housing temperature must not exceed +65°C. It is recommended to mount the camera on heat conductive structure to improve heat dissipation. The following parameters are not guaranteed if the camera is operated outside the optimum range:

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

Please refer to chapter *3.12 Heat Dissipation*.

3.2.2. Firmware / Host driver / API features

Description	Value
Interpolation methods	Proprietary
White balance coefficients ranges	0.0 to 3.9
Sharpness filter	-400 to 400 %
Gamma	0.3 to 1.0
Full color correction matrix (3+1)x3 coefficients ranges	-3.9 to 3.9

table 3-2, firmware / API features

More details on API/SDK features are available at XIMEA support pages: https://www.ximea.com/support/wiki/apis/APIs

3.3. Lens Mount

The xiC cameras are compatible with C-mount and CS-mount lenses.

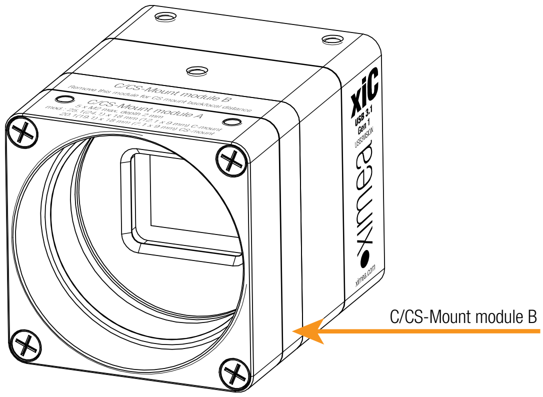


figure 3-1, position C/CS-Mount module B

The cameras are delivered with C-mount back focal length. By removing the "C/CS-Mount module B" (see the figure above) the camera can be rebuilt to CS-mount compatibility. Effectively reducing the back focal distance and overall length of camera by 5mm. The required M2x8mm special screws are part of the camera delivery. The length of the lens thread is 6.5 mm. Please read the chapter *3.4 Optical path* carefully. Conversion between those two options is described:
https://www.ximea.com/support/projects/usb3/wiki/Convert_C_to_CS_Mount

Note: The distance between the threaded flange and the surface of the filter glass is 11.9 mm in case of C-Mount and 6.9 mm in case of CS-Mount. To avoid damaging of the filter glass, nothing may extend deeper into the housing.

Lens mount adapter configuration:

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

3.3.1. Screws

All mounting screws are customized M2 screws with different lengths.

Technical details:

Material	Surface	Thread	Driver	Avail. Lengths
Steel	Black zinc	M2	PH 00	3mm – 24 mm

table 3-3, custom screws, technical details

Drawings, e.g., with 10mm length:

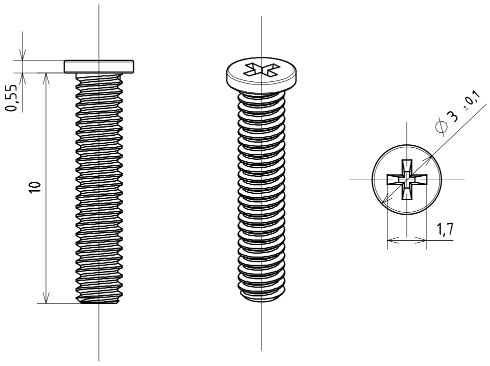


figure 3-2, xiC mounting screws

Note: Never exceed a maximum torque of 0.3Nm when fastening the M2 mounting screws.

3.4. Optical path

3.4.1. Filter glasses

A filter glass is part of the optical path of the camera. This glass is placed on a layer of silicone, to keep dust out of the camera, but not glued. The conversion of C-mount to CS-mount (see section 3.3 Lens Mount) must be carried out carefully. Operating the camera without a lens mount is not intended and can lead to dropping out of the filter glass and the entry of dust. Do not use compressed air to clean the camera as this could push dust into the camera. Distance from the flange to sensor is designed so the optical distance is 17.526mm - 0.2mm (tolerance).

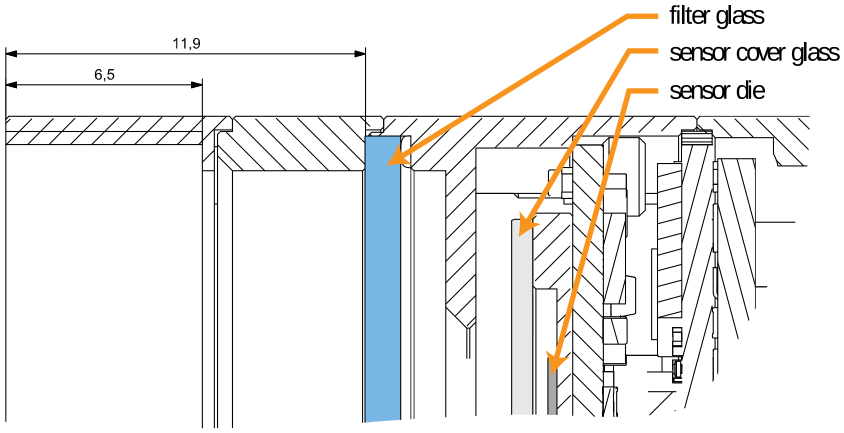


figure 3-3, Optical path section

3.4.2. Monochrome and near infrared extended camera models

Used filter brand	Thickness	Coating
BK7 AR2x	1.0±0.1 mm	Anti-reflex both sides

table 3-4, monochrome camera - filter glass parameter

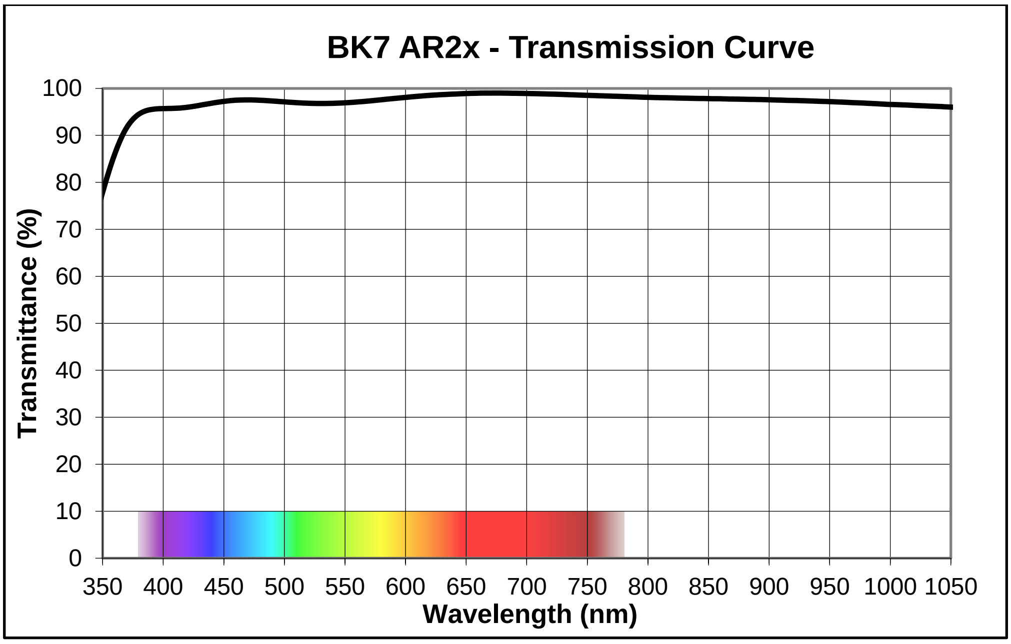


figure 3-4, monochrome camera - filter glass transmission curve

3.4.3. Color camera models

Used filter brand	Thickness	Coating
ICR650	1.0±0.1 mm	Anti-reflex both sides

table 3-5, color camera - filter glass parameter

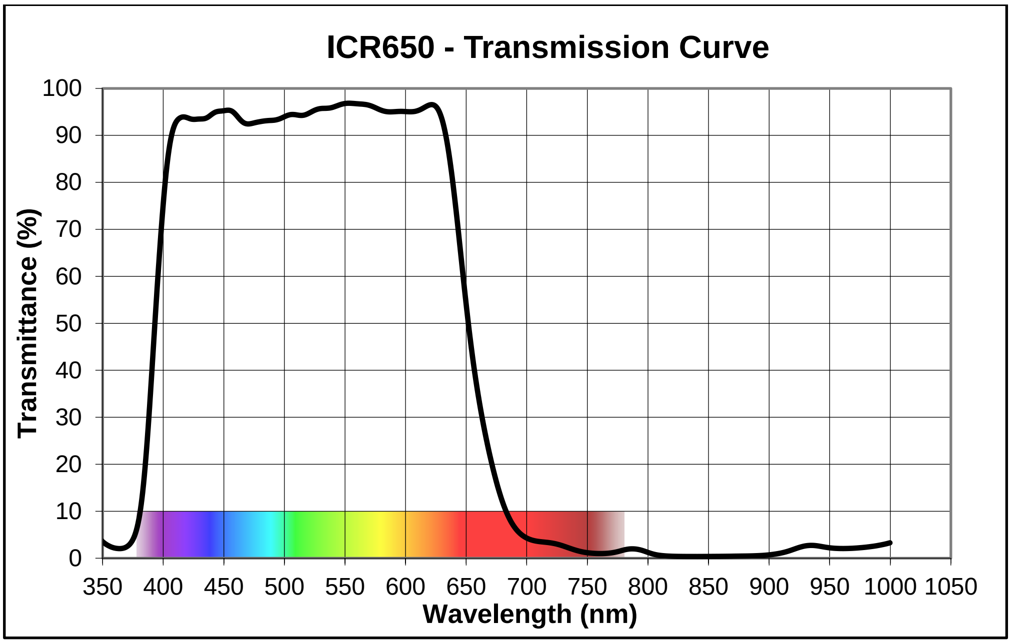


figure 3-5, color camera - filter glass transmission curve

3.5. Model Specific Characteristics

3.5.1. MC023xG-SY

3.5.1.1. Sensor and camera parameters

xiC model		MC023CG-SY	MC023MG-SY
Sensor parameters			
Model name		IMX174LQJ-C	IMX174LLJ-C
Color filter		RGB Bayer mosaic	None
Technology		1st Gen Pregius	
Shutter type		Global	
Pixel Resolution (H × V)	[pixel]	1936 x 1216	
Active area size (H × V)	[mm]	11.314 x 7.12	
Sensor diagonal	[mm]	13.39	
Optical format	[inch]	1/1.2	
Pixel Size (H × V)	[µm]	5.86 x 5.86	
Image quality parameters (EMVA 1288)			
ADC resolution	[bit]	10, 12	
Saturation capacity	[ke-]	30.5	
Dynamic range	[dB]	71.7	
SNR_{max}	[dB]	45	
Conversion gain	[e-/LSB_{12}]	8.1	
Dark noise	[e-]	7.36	
Dark current	[e-/s]	3	
DSNU	[e-]	1.1	
PRNU	[%]	0.4	
Linearity	[%]	0.5	
Camera parameters			
Digitization	[bit]	10, 12	
Supported bit resolutions	[bit/pixel]	8, 10, 12	
Exposure time (EXP)		19µs to 30sec, in steps of 4.96µs [1]	
Variable Gain Range (VGA)	[dB]	0-24	
Refresh rate (MRR)	[fps]	165	
Power consumption			
Typical / Maximum	[W]	2.2 / 2.5	
Dimensions/Mass			
height	[mm]	26.4	
width	[mm]	26.4	
depth (-TC/-UB/-FL/-FV)	[mm]	42.3/42.0/28.9/29.4(with C/CS Mount module B) 37.3/37.0/23.9/24.4 (without C/CS Mount module B)	
mass (-TC/-UB/-FL/-FV)	[g]	38.3/37.5/28.3/28.3 (with C/CS Mount module B) 34.1/33.3/24.1/24.1 (without C/CS Mount module B)	

table 3-6, MC023xG-SY, sensor and camera parameters

Notes:

1) Defined for maximal bandwidth. Minimal Exposure and exposure step (Line Period) could be calculated in: Camera performance calculator:
https://www.ximea.com/support/wiki/allprod/Industrial-scientific-camera-sensor-fps-frames-speed-calculator#/camera/MC023CG-SY

Binning/Decimation	pixels	fps	Bit/px
1x1	1936 x 1216	165	8
1x1	1936 x 1216	129	10
1x1	1936 x 1216	108	12

table 3-7, MC023xG-SY, supported standard readout modes

3.5.1.2. Quantum efficiency curves [%]

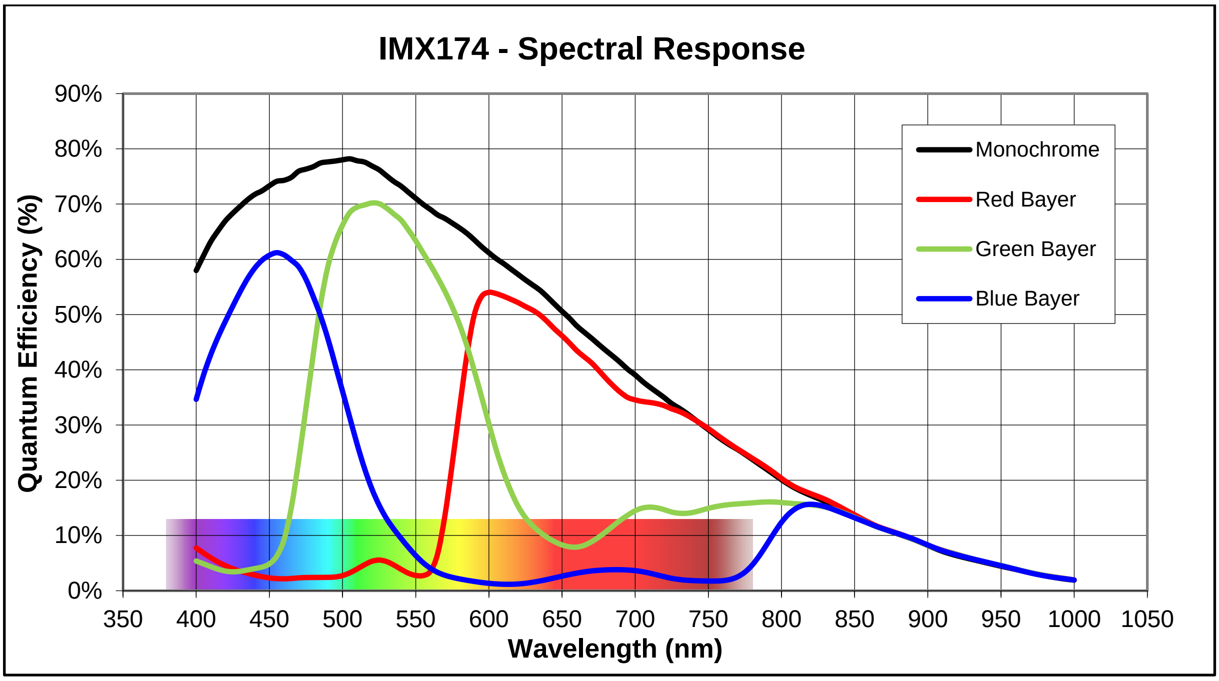


figure 3-6, IMX174-mono, quantum efficiency curve, ©SONY

3.5.1.3. Drawings MC023xG-SY-TC (C-mount [with C/CS mount module B])

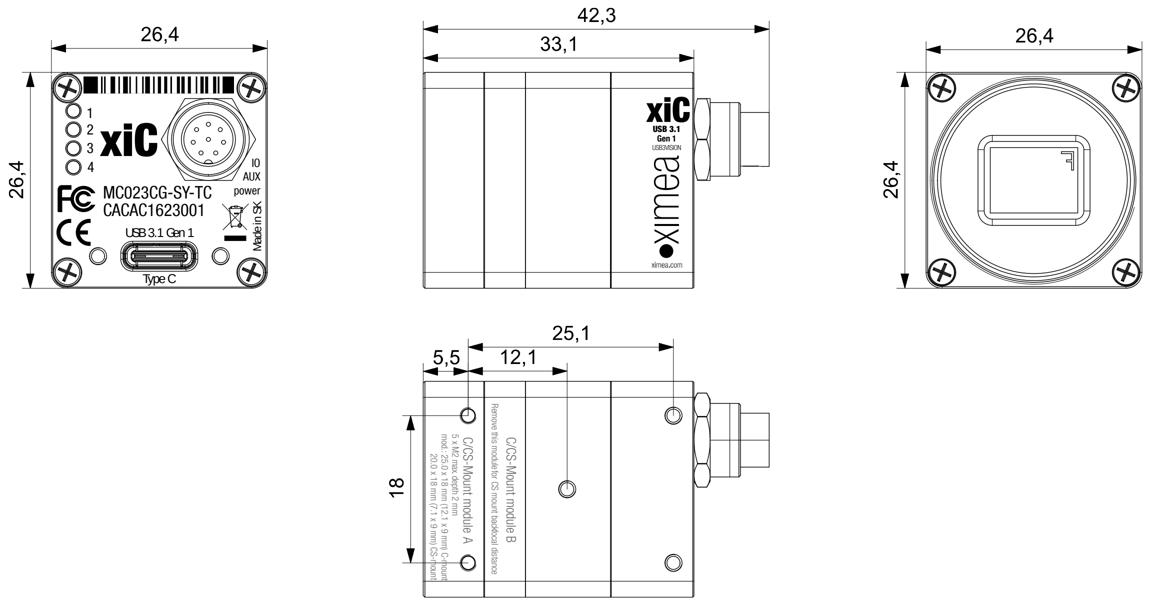


figure 3-7, dimensional drawing MC023xG-SY-TC, C-Mount housing

3.5.1.4. Drawings MC023xG-SY-UB (C-mount [with C/CS mount module B])

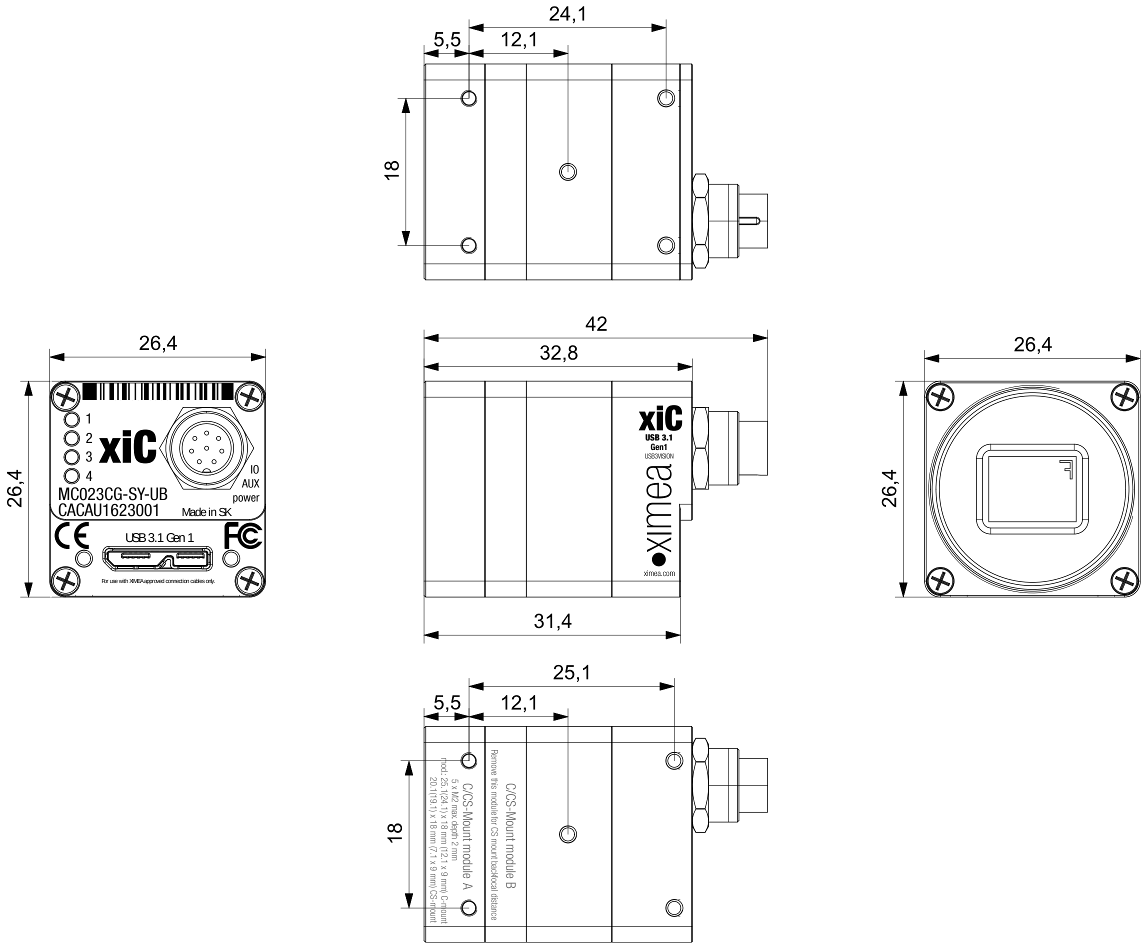


figure 3-8, dimensional drawing MC023xG-SY-UB, C-Mount housing

3.5.1.5. Drawings MC023xG-SY-FL (C-mount [with C/CS mount module B])

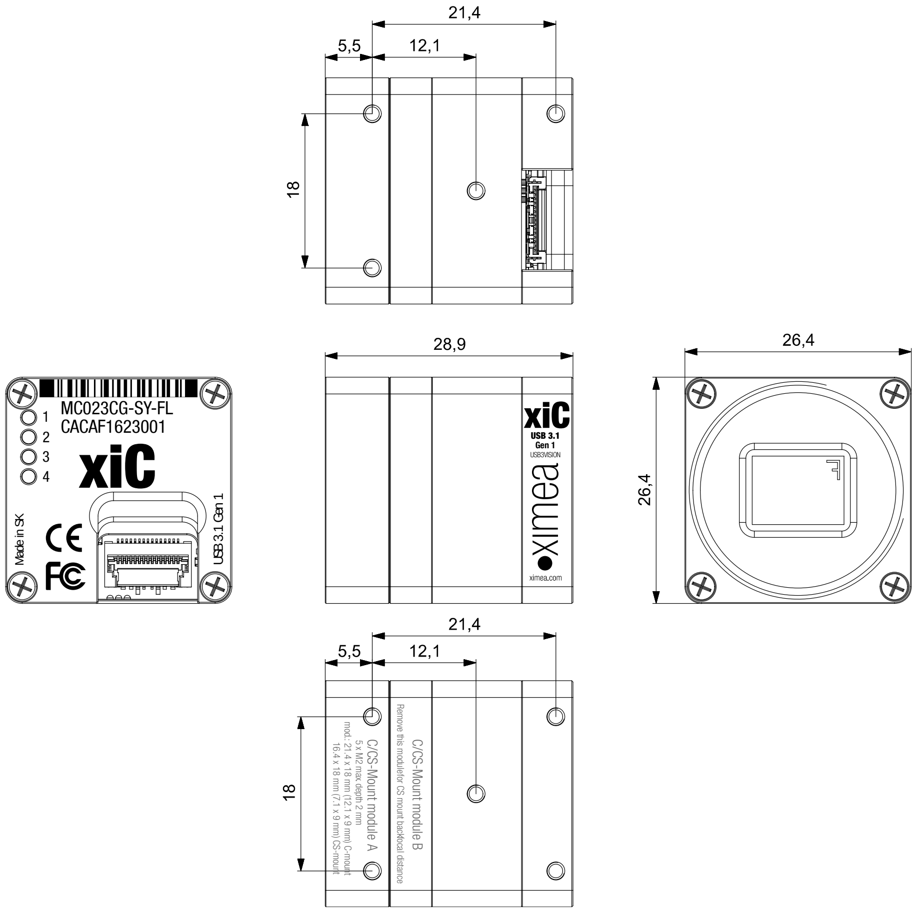


figure 3-9 dimensional drawing MC023xG-SY-FL, C-Mount housing

3.5.1.6. Drawings MC023xG-SY-FV (C-mount [with C/CS mount module B])

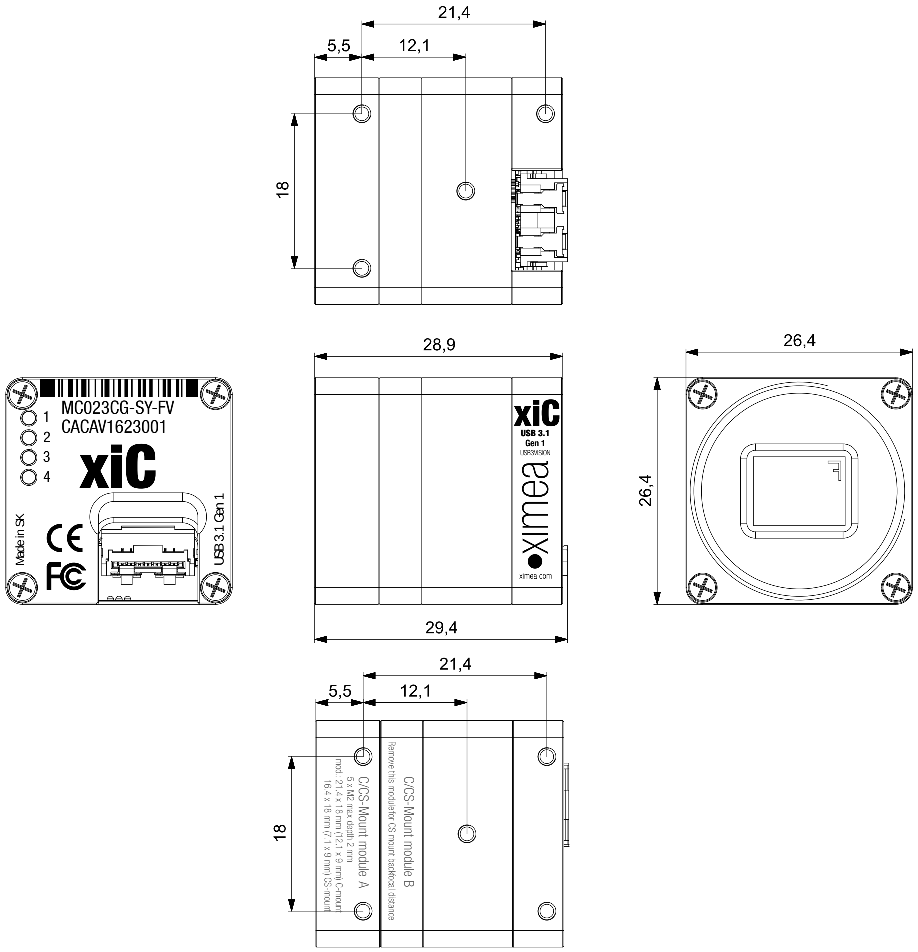


figure 3-10 dimensional drawing MC023xG-SY-FV, C-Mount housing

3.5.1.7. Referenced documents

Sony Datasheet IMX174LQJ-C_E_TechnicalDatasheet_REv0.3 (01/06/14)

Sony Datasheet IMX174LLJ-C_E_data_sheet_E14315 (01/06/14)

3.5.1.8. Sensor features

feature	Note
Binning	No
Decimation	Not supported
ROI	Vertical cropping results in increased read speed, horizontal reduces data transfer
HW Trigger	Trigger with overlap (see <u>*4.3.2.1 Triggered acquisition - single frame*</u>)
Overlap mode	Exposure of next frame can start during the readout of the previous frame

table 3-8, sensor features available

3.5.2. MC031xG-SY

3.5.2.1. Sensor and camera parameters

xiC model	MC031CG-SY	MC031MG-SY
Sensor parameters		
Model name	IMX252LQR-C	IMX252LLR-C
Color filter	RGB Bayer mosaic	None
Technology	2nd Gen Pregius	
Shutter type	Global	
Pixel Resolution (H × V) [pixel]	2064 x 1544	
Active area size (H × V) [mm]	7.12 x 5.33	
Sensor diagonal [mm]	8.89	
Optical format [inch]	1/1.8	
Pixel Size (H × V) [µm]	3.45 × 3.45	
Image quality parameters (EMVA 1288)		
ADC resolution [bit]	8, 10, 12	
Saturation capacity [ke-]	9.9	
Dynamic range [dB]	70.9	
SNR_{max} [dB]	40.3	
Conversion gain [e-/LSB_{12}]	2.67	
Dark noise [e-]	2.32	
Dark current [e-/s]	2.1	
DSNU [e-]	0.7	
PRNU [%]	0.65	
Linearity [%]	0.5	
Camera parameters		
Digitization [bit]	8[3], 10, 12	
Supported bit resolutions [bit/pixel]	8, 10, 12	
Exposure time (EXP)	1µs[2] to 30sec, in steps of 5.29µs [1]	
Variable Gain Range (VGA) [dB]	0-24	
Refresh rate (MRR) [fps]	122	
Power consumption		
Typical / Maximum [W]	2.75 / 2.85	
Dimensions/Mass		
height [mm]	26.4	
width [mm]	26.4	
depth (-TC/-UB/-FL/-FV) [mm]	42.2/41.9/28.8/29.3(with C/CS Mount module B) 37.3/36.9/23.8/24.3 (without C/CS Mount module B)	
mass (-TC/-UB/-FL/-FV) [g]	38.3/37.5/28.3/28.3 (with C/CS Mount module B) 34.1/33.3/24.1/24.1 (without C/CS Mount module B)	

table 3-9, MC031xG-SY, sensor and camera parameters

Notes:

1) Defined for maximal bandwidth. Minimal Exposure and exposure step (Line Period) could be calculated in: Camera performance calculator:
https://www.ximea.com/support/wiki/allprod/Industrial-scientific-camera-sensor-fps-frames-speed-calculator#/camera/MC031CG-SY
2) From 1 µs to 14 µs the step is 1µs and the sensor is operating in special mode. This exposure times are not achievable for exposure controlled by trigger pulse length.
3) Saturation capacity in 8-bit digitization is only ¼ of 10-bit and 12-bit mode (see *4.2.5 Digitization bit depth*)

Binning/Decimation	pixels	fps	Bit/px
1x1 / 1x1	2064 x 1544	122	8
1x1 / 1x1	2064 x 1544	96	10
1x1 / 1x1	2064 x 1544	80	12
1x1 / 1x2	2064 x 772	241	8
1x1 / 2x1	1032 x 1544	218	8
1x1 / 2x2	1032 x 772	426	8
1x2 [1] / 1x1	2064 x 772	241	8
1x2 [1] / 2x1	1032 x 772	426	8
1x1 / 2x2	1032 x 772	377	10
1x1 / 2x2	1032 x 772	233	12

table 3-10, MC031xG-SY, supported standard readout modes

Notes:

1) Available only for mono camera model

3.5.2.2. Quantum efficiency curves [%]

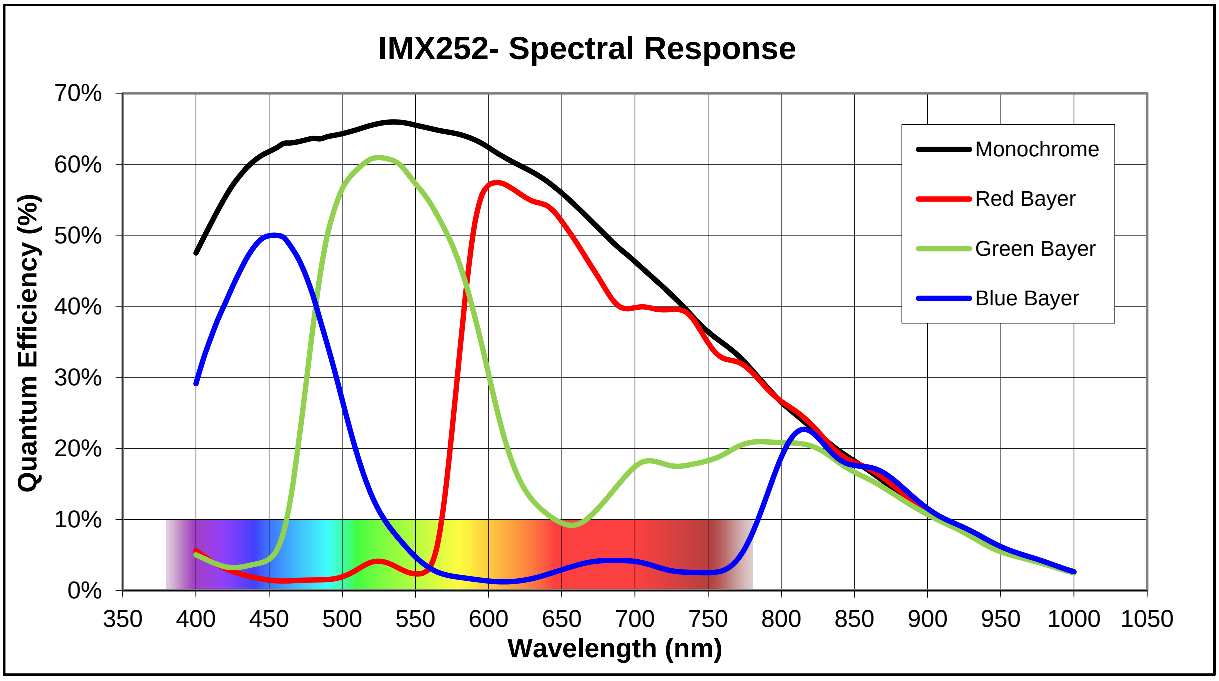


figure 3-11, IMX252-mono and color, quantum efficiency curves, ©SONY

3.5.2.3. Drawings MC031xG-SY-TC (C-mount [with C/CS mount module B])

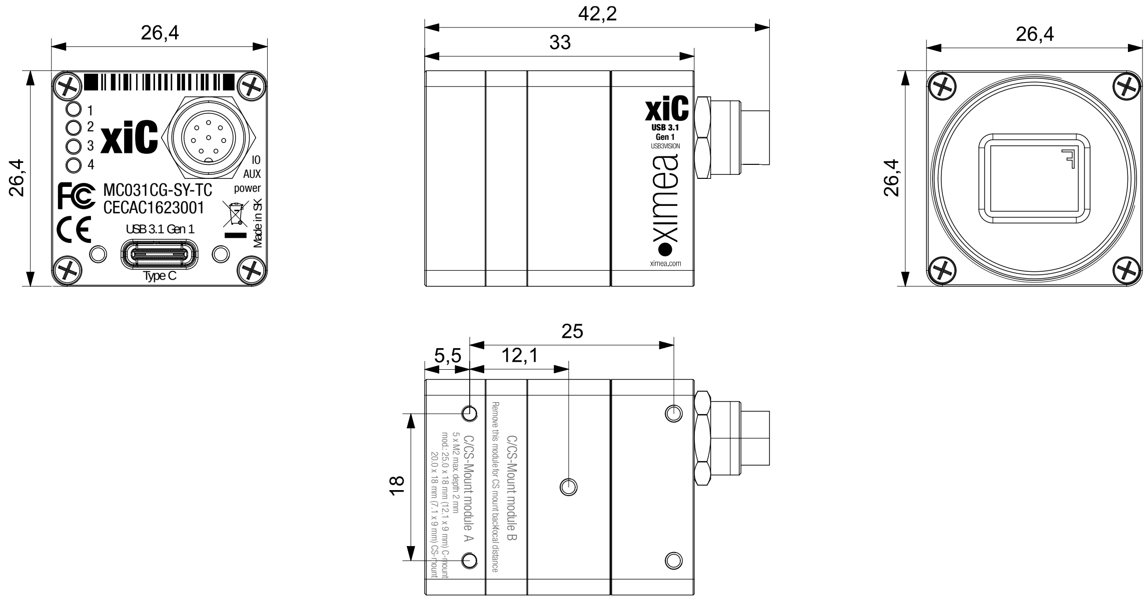


figure 3-12, dimensional drawing MC031xG-SY-TC, C-Mount housing

3.5.2.4. Drawings MC031xG-SY-UB (C-mount [with C/CS mount module B])

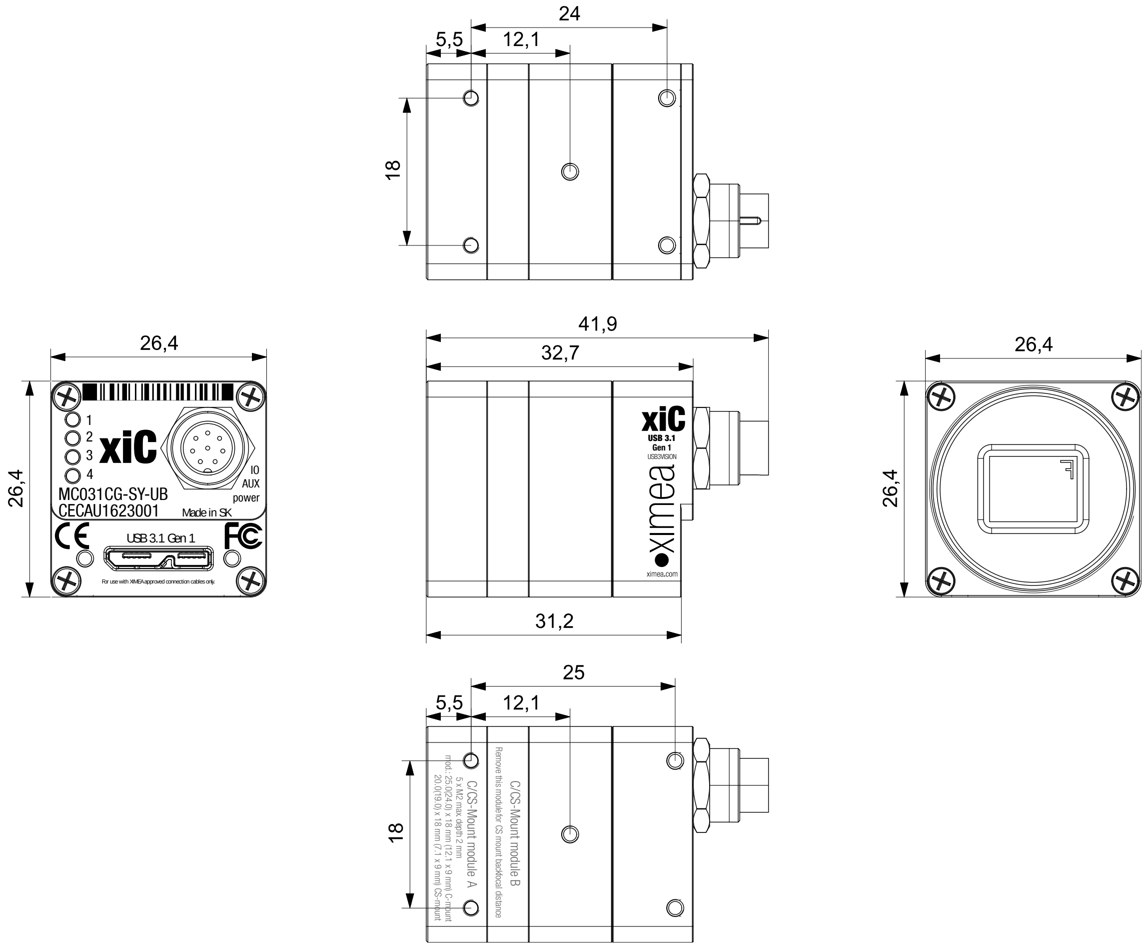


figure 3-13, dimensional drawing MC031xG-SY-UB, C-mount housing

3.5.2.5. Drawings MC031xG-SY-FL (C-mount [with C/CS mount module B])

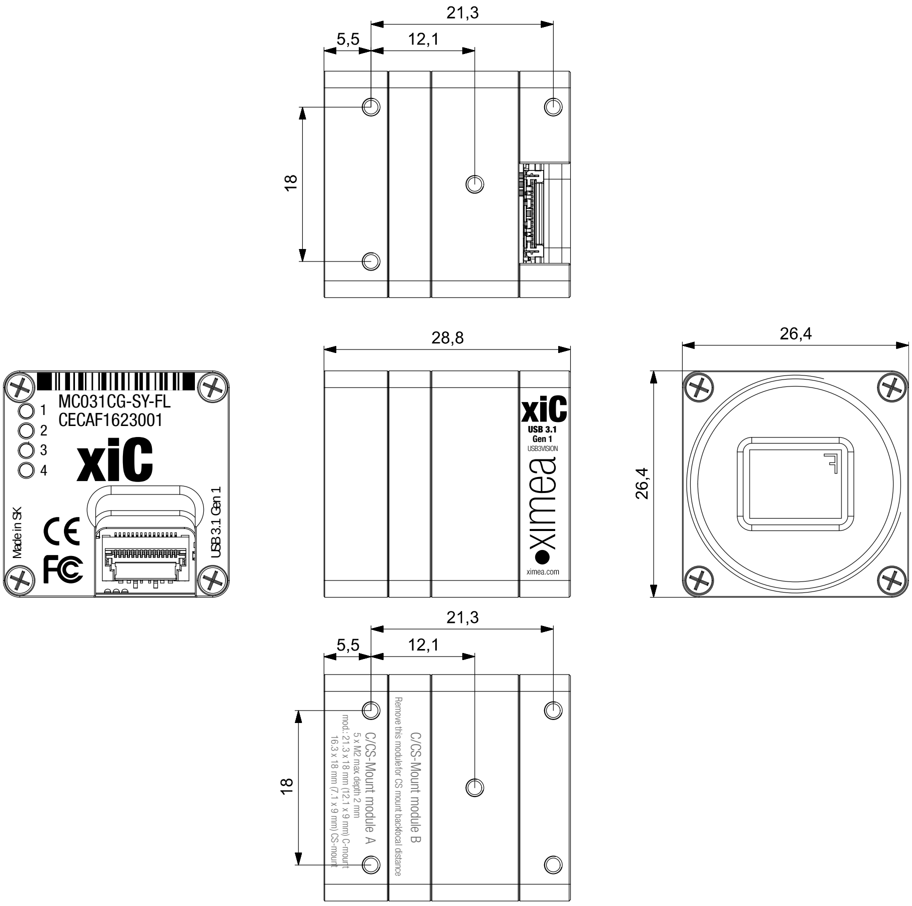


figure 3-14, dimensional drawing MC031xG-SY-FL, C-mount housing

3.5.2.6. Drawings MC031xG-SY-FV (C-mount [with C/CS mount module B])

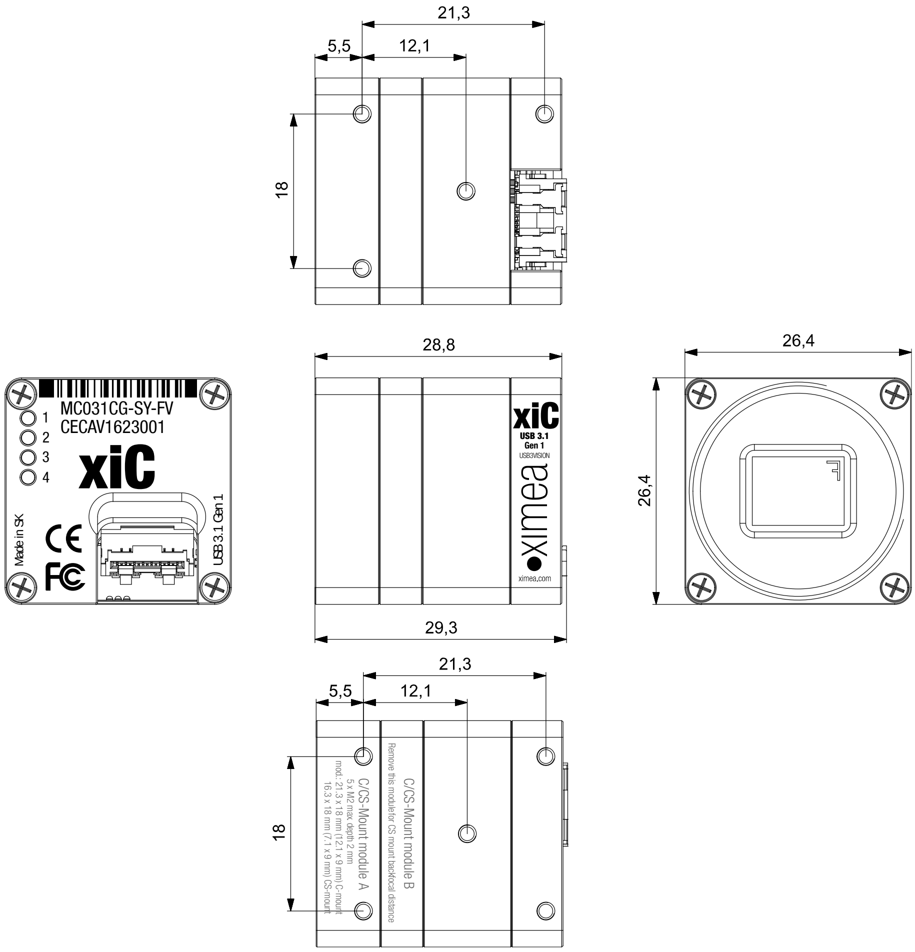


figure 3-15, dimensional drawing MC031xG-SY-FV, C-mount housing

3.5.2.7. Referenced documents

Sony Datasheet IMX252LLR-C_Data_Sheet(E)_E15903 (03/09/15)

Sony Datasheet IMX252LQR-C_Data_Sheet(E)_E15911 (11/09/15)

3.5.2.8. Sensor features

feature	Note
Binning	Yes, 1x2 (H x V) binning supported on monochrome only.
Decimation	Yes, 2x2
ROI	Vertical cropping results in increased read speed, horizontal reduces data transfer
HW Trigger	Trigger with overlap (see 4.3.2.1 Triggered acquisition - single frame)
Overlap mode	Exposure of next frame can start during the readout of the previous frame

table 3-11, sensor features available

3.5.3. MC050xG-SY

3.5.3.1. Sensor and camera parameters

xiC model		MC050CG-SY	MC050MG-SY
Sensor parameters			
Model name		IMX250LQR-C	IMX250LLR-C
Color filter		RGB Bayer mosaic	None
Technology		2nd Gen Pregius	
Shutter type		Global	
Pixel Resolution (H × V)	[pixel]	2464 x 2056	
Active area size (H × V)	[mm]	8.5 x 7.09	
Sensor diagonal	[mm]	11.1	
Optical format	[inch]	2/3	
Pixel Size (H × V)	[µm]	3.45 x 3.45	
Image quality parameters (EMVA 1288)			
ADC resolution	[bit]	8, 10, 12	
Saturation capacity	[ke-]	9.8	
Dynamic range	[dB]	70.8	
SNR_{max}	[dB]	40.3	
Conversion gain	[e-/LSB_{12}]	2.66	
Dark noise	[e-]	2.32	
Dark current	[e-/s]	3.9	
DSNU	[e-]	0.75	
PRNU	[%]	0.61	
Linearity	[%]	0.5	
Camera parameters			
Digitization	[bit]	8[3], 10, 12	
Supported bit resolutions	[bit/pixel]	8, 10, 12	
Exposure time (EXP)		1µs[2] to 30sec, in steps of 6.32µs [1]	
Variable Gain Range (VGA)	[dB]	0-24	
Refresh rate (MRR)	[fps]	76	
Power consumption			
Typical / Maximum	[W]	2.85 / 3.0	
Dimensions/Mass			
height	[mm]	26.4	
width	[mm]	26.4	
depth (-TC/-UB/-FL/-FV)	[mm]	42.2/41.9/28.8/29.3(with C/CS Mount module B) 37.3/36.9/23.8/24.3 (without C/CS Mount module B)	
mass (-TC/-UB/-FL/-FV)	[g]	38.3/37.5/28.3/28.3 (with C/CS Mount module B) 34.1/33.3/24.1/24.1 (without C/CS Mount module B)	

table 3-12, MC050xG-SY, sensor and camera parameters

Notes:

1) Defined for maximal bandwidth. Minimal Exposure and exposure step (Line Period) could be calculated in: Camera performance calculator:
https://www.ximea.com/support/wiki/allprod/Industrial-scientific-camera-sensor-fps-frames-speed-calculator#/camera/MC050CG-SY
2) From 1 µs to 14 µs the step is 1µs and the sensor is operating in special mode. This exposure times are not achievable for exposure controlled by trigger pulse length.
3) Saturation capacity in 8-bit digitization is only ¼ of 10-bit and 12-bit mode (see 4.2.5 Digitization bit depth)

Binning/Decimation	pixels	fps	Bit/px
1x1 / 1x1	2464 x 2056	76	8
1x1 / 1x1	2464 x 2056	60	10
1x1 / 1x1	2464 x 2056	50	12
1x1 / 1x2	2464 x 1028	152	8
1x1 / 2x1	1232 x 2056	152	8
1x1 / 2x2	1232 x 1028	304	8
1x2 [1] / 1x1	2464 x 1028	152	8
1x2 [1] / 2x1	1232 x 1028	304	8
1x1 / 2x2	1232 x 1028	243	10
1x1 / 2x2	1232 x 1028	177	12

table 3-13, MC050xG-SY, supported standard readout modes

Notes:

1) Available only for mono camera model

3.5.3.2. Quantum efficiency curves [%]

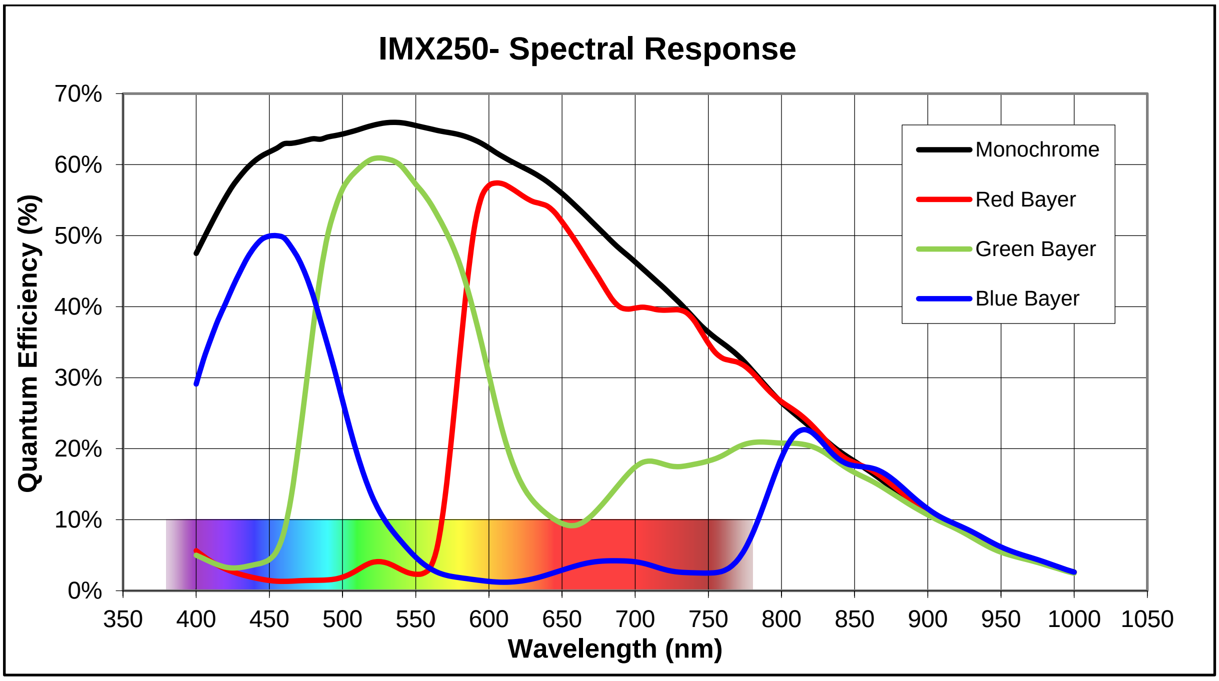


figure 3-16 IMX250 mono and color, quantum efficiency curves, ©SONY

3.5.3.3. Drawings MC050xG-SY-TC (C-mount [with C/CS mount module B])

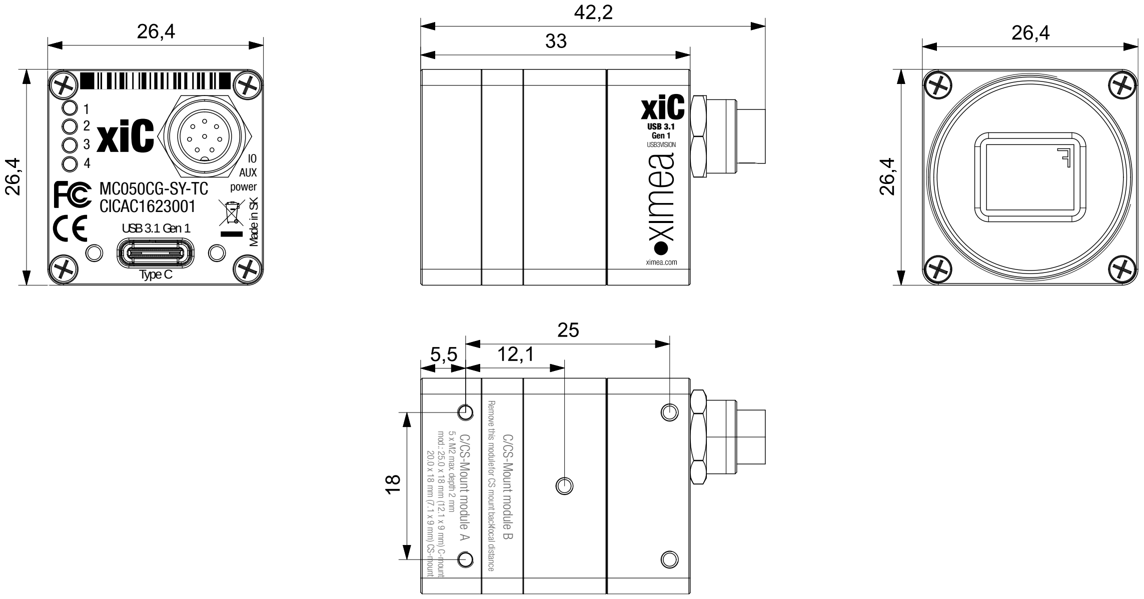


figure 3-17, dimensional drawing MC050xG-SY-TC, C-Mount housing

3.5.3.4. Drawings MC050xG-SY-UB (C-mount [with C/CS mount module B])

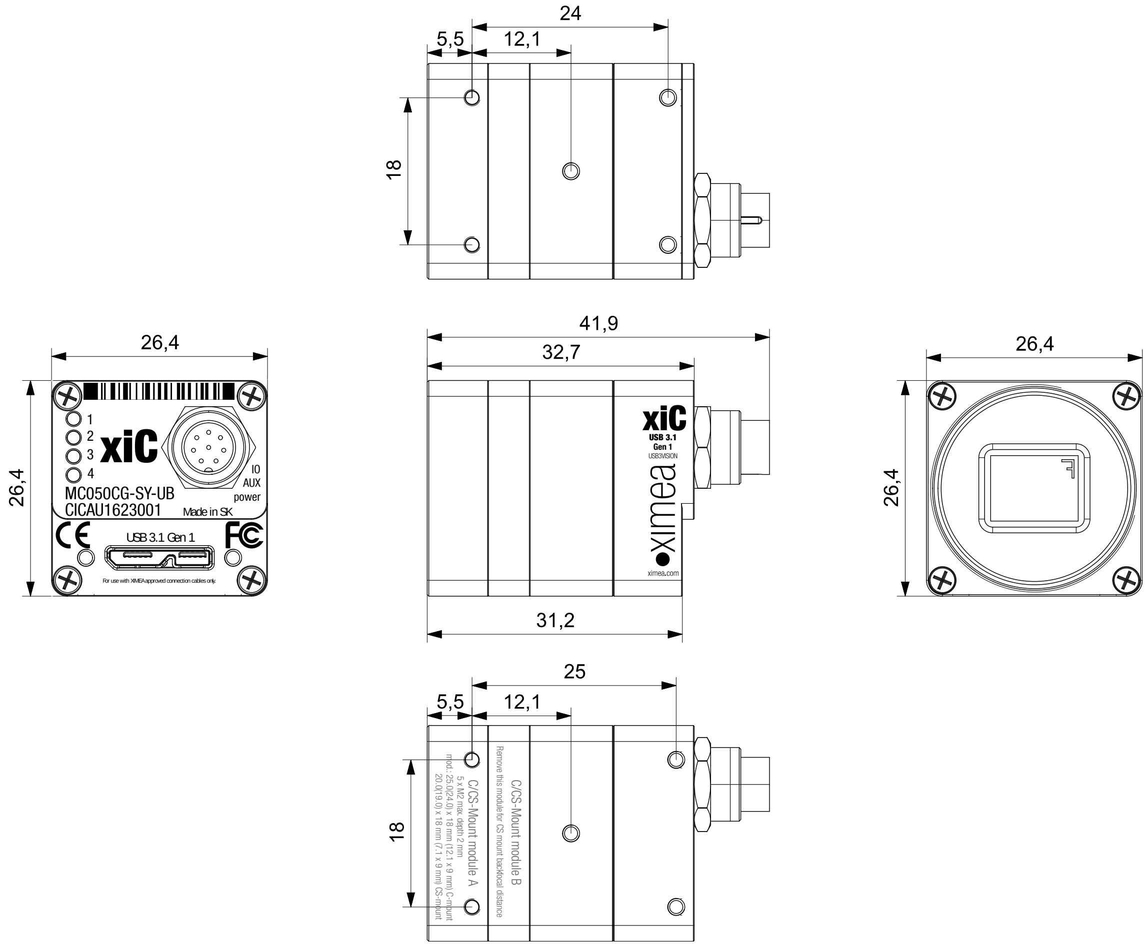


figure 3-18, dimensional drawing MC050xG-SY-UB, C-Mount housing

3.5.3.5. Drawings MC050xG-SY-FL (C-mount [with C/CS mount module B])

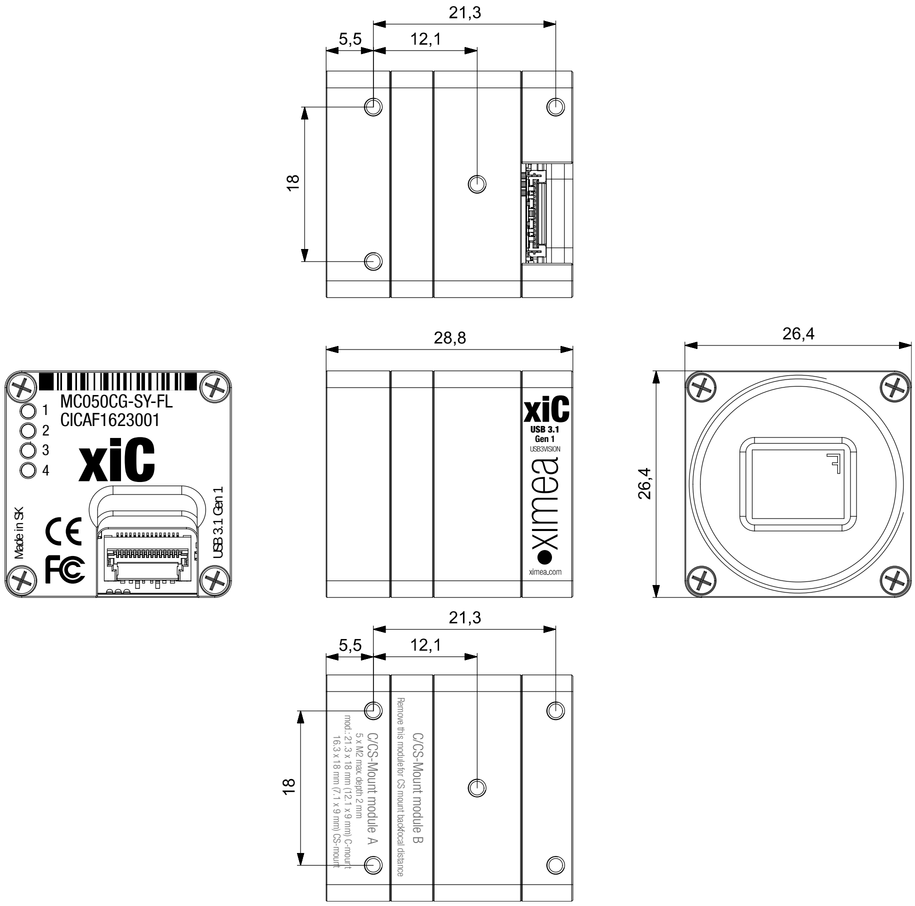


figure 3-19, dimensional drawing MC050xG-SY-FL, C-Mount housing

3.5.3.6. Drawings MC050xG-SY-FV (C-mount [with C/CS mount module B])

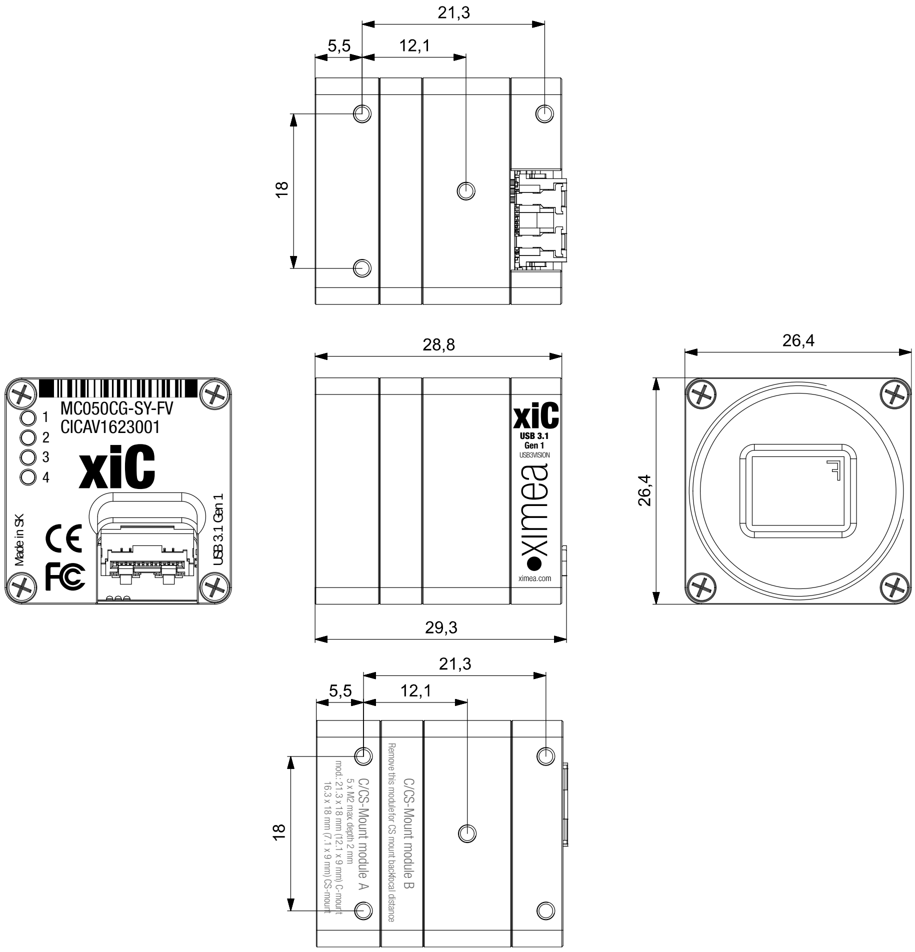


figure 3-20, dimensional drawing MC050xG-SY-FV, C-Mount housing

3.5.3.7. Referenced documents

Sony Datasheet IMX250LLR-C_Data_Sheet(E)_E15902 (02/09/15)

Sony Datasheet IMX250LQR-C_Data_Sheet(E)_E15910 (10/09/15)

3.5.3.8. Sensor features

feature	Note
Binning	Yes, 1x2 (H x V) binning supported on monochrome only.
Decimation	Yes, 2x2
ROI	Vertical cropping results in increased read speed, horizontal reduces data transfer
HW Trigger	Trigger with overlap (see <u>*4.3.2.1 Triggered acquisition - single frame*</u>)
Overlap mode	Exposure of next frame can start during the readout of the previous frame

table 3-14, sensor features available

3.5.4. MC089xG-SY

3.5.4.1. Sensor and camera parameters

xiC model		MC089CG-SY	MC089MG-SY
Sensor parameters			
Model name		IMX255LQR-C	IMX255LLR-C
Color filter		RGB Bayer mosaic	None
Technology		2nd Gen Pregius	
Shutter type		Global	
Pixel Resolution (H × V)	[pixel]	4112 x 2176	
Active area size (H × V)	[mm]	14.2 x 7.5	
Sensor diagonal	[mm]	16	
Optical format	[inch]	1"	
Pixel Size (H × V)	[µm]	3.45 x 3.45	
Image quality parameters (EMVA 1288)			
ADC resolution	[bit]	8, 10, 12	
Saturation capacity	[ke-]	9.8	
Dynamic range	[dB]	70.5	
SNR_{max}	[dB]	40.3	
Conversion gain	[e-/LSB_{12}]	2.67	
Dark noise	[e-]	2.4	
Dark current	[e-/s]	3.9	
DSNU	[e-]	0.75	
PRNU	[%]	0.61	
Linearity	[%]	0.5	
Camera parameters			
Digitization	[bit]	8[3], 10, 12	
Supported bit resolutions	[bit/pixel]	8, 10, 12	
Exposure time (EXP)		1µs[2] to 30sec, in steps of 10.54µs [1]	
Variable Gain Range (VGA)	[dB]	0-24	
Refresh rate (MRR)	[fps]	43	
Power consumption			
Typical / Maximum	[W]	3.3 / 3.5	
Dimensions/Mass			
height	[mm]	26.4	
width	[mm]	26.4	
depth (-TC/-UB/-FL/-FV)	[mm]	42.3/42.0/28.9/29.4(with C/CS Mount module B) 37.3/37.0/23.9/24.4 (without C/CS Mount module B)	
mass (-TC/-UB/-FL/-FV)	[g]	38.3/37.5/28.5/28.5 (with C/CS Mount module B) 34.1/33.3/24.3/24.3 (without C/CS Mount module B)	

table 3-15, MC089xG-SY, sensor and camera parameters

Notes:

1) Defined for maximal bandwidth. Minimal Exposure and exposure step (Line Period) could be calculated in: Camera performance calculator:
https://www.ximea.com/support/wiki/allprod/Industrial-scientific-camera-sensor-fps-frames-speed-calculator#/camera/MC089CG-SY
2) From 1 µs to 14 µs the step is 1µs and the sensor is operating in special mode. This exposure times are not achievable for exposure controlled by trigger pulse length.
3) Saturation capacity in 8-bit digitization is only ¼ of 10-bit and 12-bit mode (see 4.2.5 Digitization bit depth)

Binning/Decimation	pixels	fps	Bit/px
1x1 / 1x1	4112 x 2176	43	8
1x1 / 1x1	4112 x 2176	34	10
1x1 / 1x1	4112 x 2176	28	12
1x1 / 1x2	4112 x 1088	86	8
1x1 / 2x1	2056 x 2176	86	8
1x1 / 2x2	2056 x 1088	172	8
1x2 [1] / 1x1	4112 x 1088	86	8
2x2 [1] / 1x1	2056 x 1088	172	8
2x2 [1] / 1x1	2056 x 1088	137	10
2x2 [1] / 1x1	2056 x 1088	114	12
1x1 / 2x2	2056 x 1088	137	10
1x1 / 2x2	2056 x 1088	114	12

table 3-16, MC089xG-SY, supported standard readout modes

Notes:

1) Available only for mono camera model

3.5.4.2. Quantum efficiency curves [%]

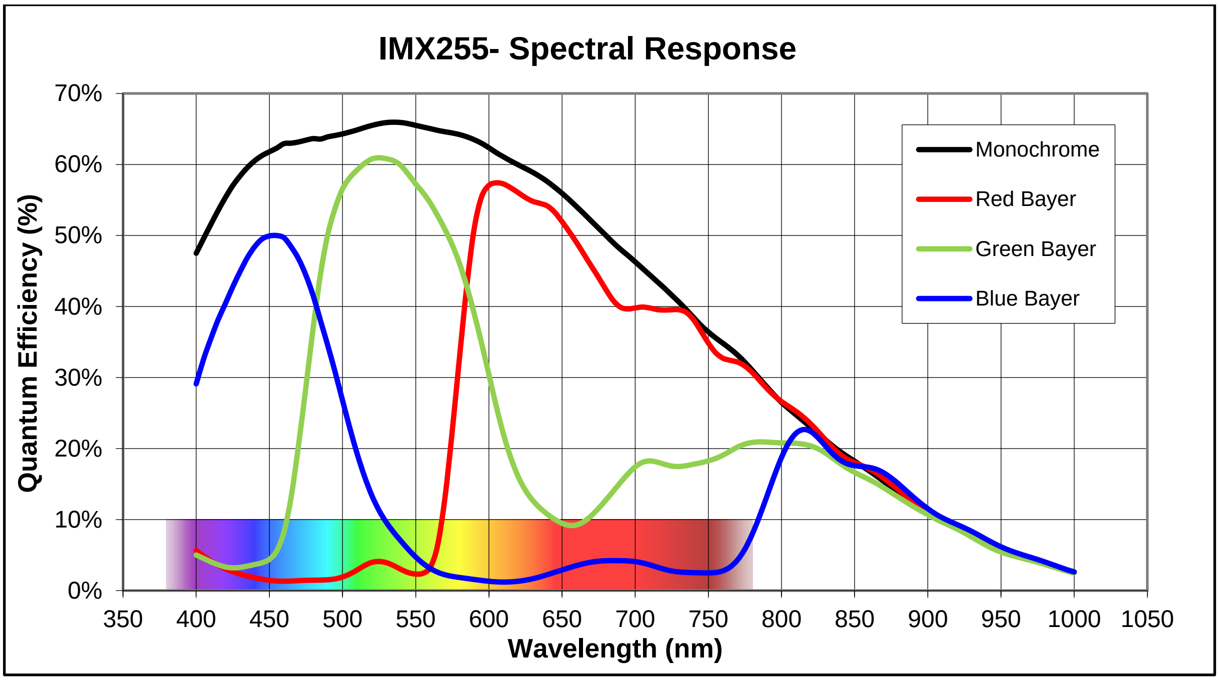


figure 3-21, IMX255 mono and color, quantum efficiency curve, ©SONY

3.5.4.3. Drawings MC089xG-SY-TC (C-mount [with C/CS mount module B])

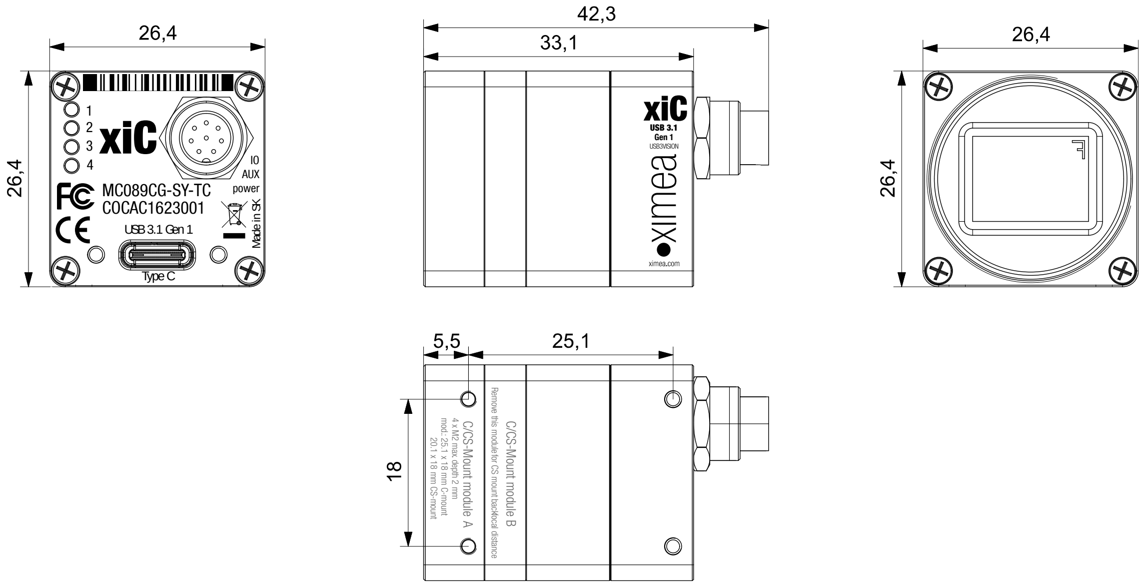


figure 3-22, dimensional drawing MC089xG-SY-TC, C-Mount housing

3.5.4.4. Drawings MC089xG-SY-UB (C-mount [with C/CS mount module B])

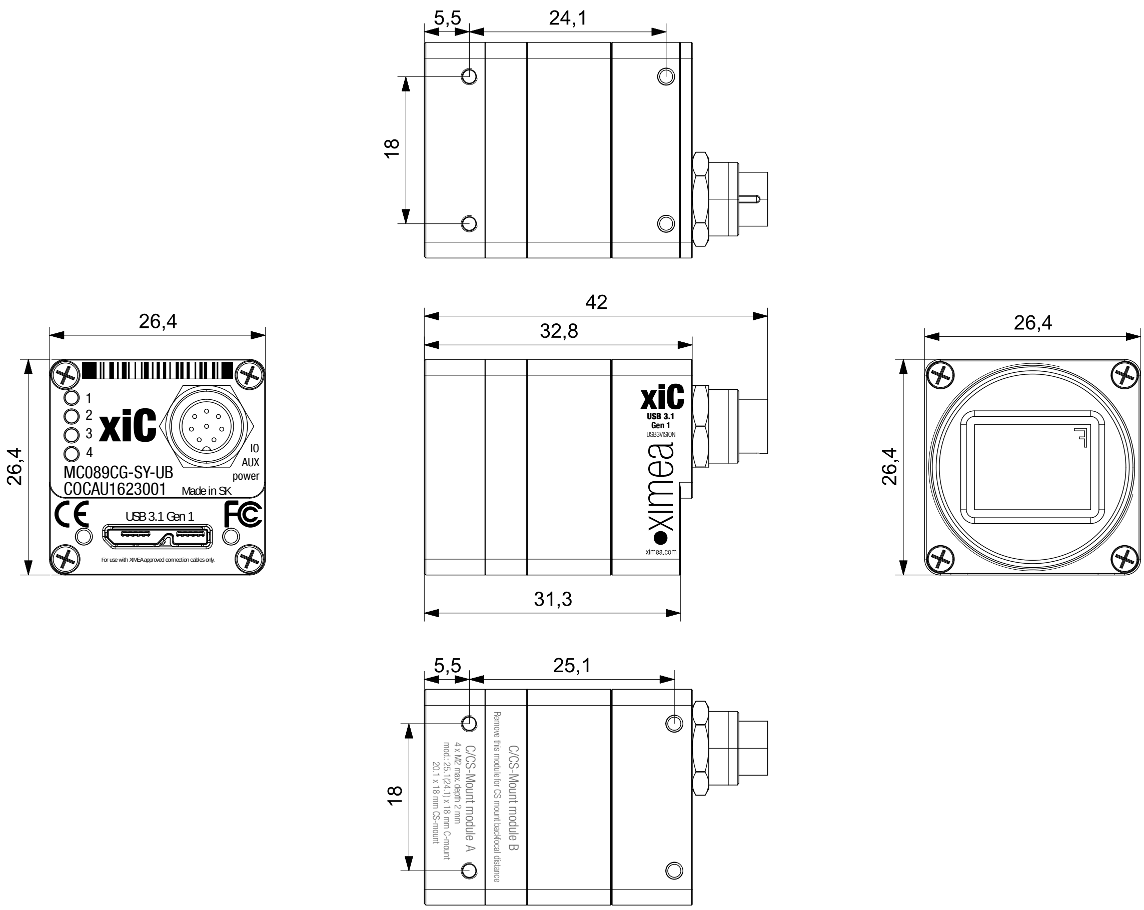


figure 3-23, dimensional drawing MC089xG-SY-UB, C-Mount housing

3.5.4.5. Drawings MC089xG-SY-FL (C-mount [with C/CS mount module B])

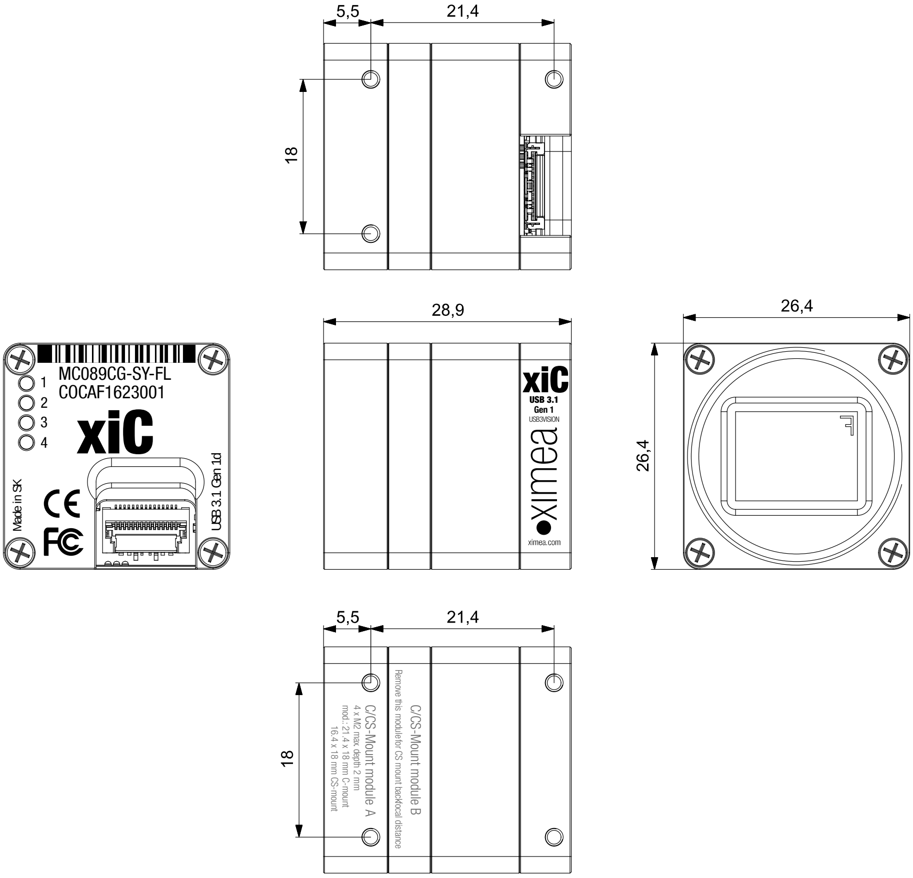


figure 3-24, dimensional drawing MC089xG-SY-FL, C-Mount housing

3.5.4.6. Drawings MC089xG-SY-FV (C-mount [with C/CS mount module B])

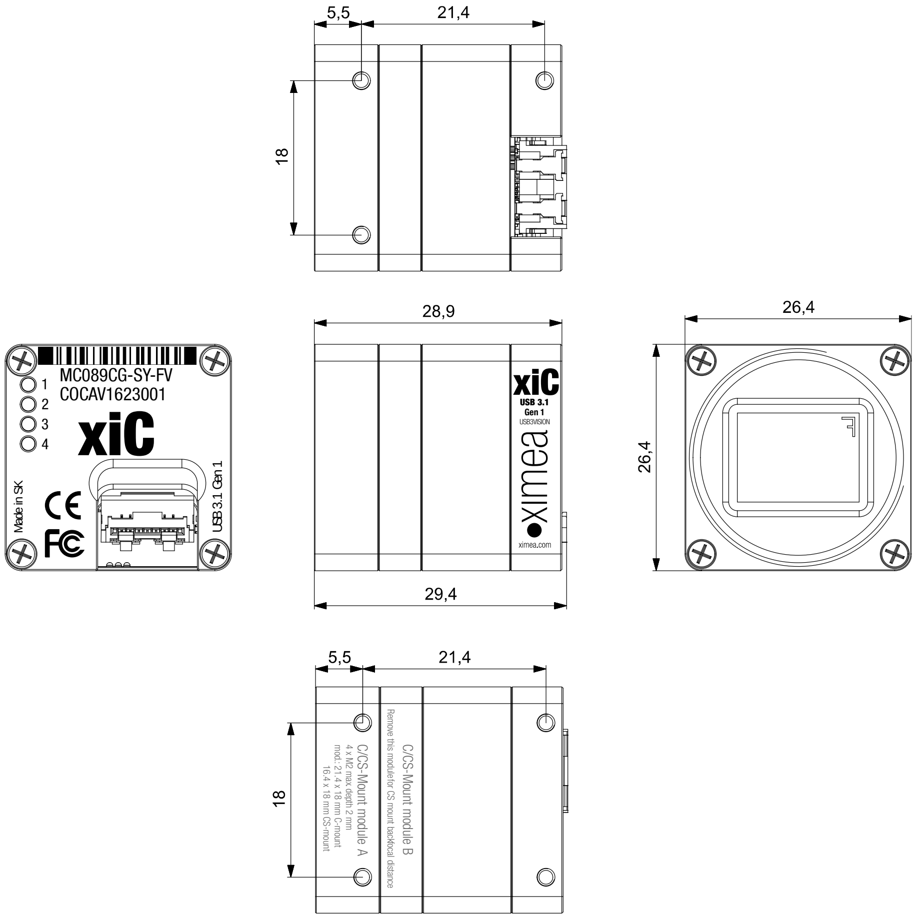


figure 3-25, dimensional drawing MC089xG-SY-FV, C-Mount housing

3.5.4.7. Referenced documents

Sony Datasheet IMX255LLR-C_TechnicalDatasheet_E_Rev0.1 (29/01/16)

Sony Datasheet IMX255LQR-C_TechnicalDatasheet_E_Rev0.1 (29/01/16)

3.5.4.8. Sensor features

feature	Note
Binning	Yes, up to 2x2 binning supported on monochrome only.
Decimation	Yes, up to 1x2
ROI	Vertical cropping results in increased read speed, horizontal reduces data transfer
HW Trigger	Trigger with overlap (see *4.3.2.1 Triggered acquisition - single frame*)
Overlap mode	Exposure of next frame can start during the readout of the previous frame

table 3-17, sensor features available

3.5.5. MC124xG-SY

3.5.5.1. Sensor and camera parameters

xiC model		MC124CG-SY	MC124MG-SY
Sensor parameters			
Model name		IMX253LQR-C	IMX253LLR-C
Color filter		RGB Bayer mosaic	None
Technology		2^{nd} Gen Pregius	
Shutter type		Global	
Pixel Resolution (H × V)	[pixel]	4112 x 3008	
Active area size (H × V)	[mm]	14.2 x 10.4	
Sensor diagonal	[mm]	17.6	
Optical format	[inch]	1.1”	
Pixel Size (H × V)	[µm]	3.45 x 3.45	
Image quality parameters (EMVA 1288)			
ADC resolution	[bit]	8, 10, 12	
Saturation capacity	[ke-]	9.9	
Dynamic range	[dB]	70.4	
SNR_{max}	[dB]	40.45	
Conversion gain	[e-/LSB_{12}]	2.67	
Dark noise	[e-]	2.4	
Dark current	[e-/s]	3.9	
DSNU	[e-]	0.75	
PRNU	%	0.61	
Linearity	[%]	0.5	
Camera parameters			
Digitization	[bit]	8[3], 10, 12	
Supported bit resolutions	[bit/pixel]	8, 10, 12	
Exposure time (EXP)		1µs[2] to 30sec, in steps of 10.54µs [1]	
Variable Gain Range (VGA)	[dB]	0-24	
Refresh rate (MRR)	[fps]	31	
Power consumption			
Typical / Maximum	[W]	3.3 / 3.5	
Dimensions/Mass			
height	[mm]	26.4	
width	[mm]	26.4	
depth (-TC/-UB/-FL/-FV)	[mm]	42.3/42.0/28.9/29.4(with C/CS Mount module B) 37.3/37.0/23.9/24.4 (without C/CS Mount module B)	
mass (-TC/-UB/-FL/-FV)	[g]	38.3/37.5/28.5/28.5 (with C/CS Mount module B) 34.1/33.3/24.3/24.3 (without C/CS Mount module B)	

table 3-18, MC124xG-SY, sensor and camera parameters

Notes:

1) Defined for maximal bandwidth. Minimal Exposure and exposure step (Line Period) could be calculated in: Camera performance calculator:
https://www.ximea.com/support/wiki/allprod/Industrial-scientific-camera-sensor-fps-frames-speed-calculator#/camera/MC124CG-SY
2) From 1 µs to 14 µs the step is 1µs and the sensor is operating in special mode. This exposure times are not achievable for exposure controlled by trigger pulse length.
3) Saturation capacity in 8-bit digitization is only ¼ of 10-bit and 12-bit mode (see 4.2.5 Digitization bit depth)

Binning/Decimation	pixels	fps	Bit/px
1x1 / 1x1	4112 x 3008	31	8
1x1 / 1x1	4112 x 3008	24	10
1x1 / 1x1	4112 x 3008	20	12
1x1 / 1x2	4112 x 1504	62	8
1x1 / 2x1	2056 x 3008	62	8
1x1 / 2x2	2056 x 1504	124	8
1x2 [1] / 1x1	4112 x 1504	62	8
2x2 [1] / 1x1	2056 x 1504	124	8
2x2 [1] / 1x1	2056 x 1504	99	10
2x2 [1] / 1x1	2056 x 1504	83	12
1x1 / 2x2	2056 x 1504	99	10
1x1 / 2x2	2056 x 1504	83	12

table 3-19, MC124xG-SY, supported standard readout modes

Notes:

1) Available only for mono camera model

3.5.5.2. Quantum efficiency curves [%]

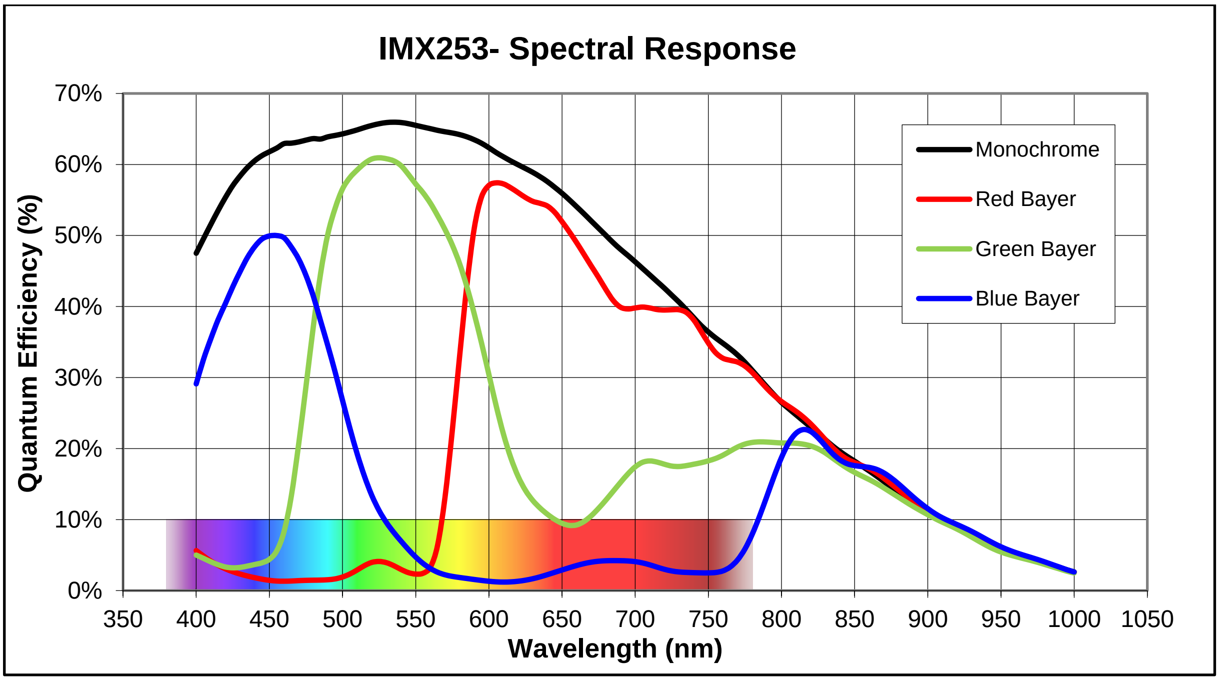


figure 3-26, IMX253 mono and color, quantum efficiency curve, ©SONY

3.5.5.3. Drawings MC124xG-SY-TC (C-mount [with C mount module B])

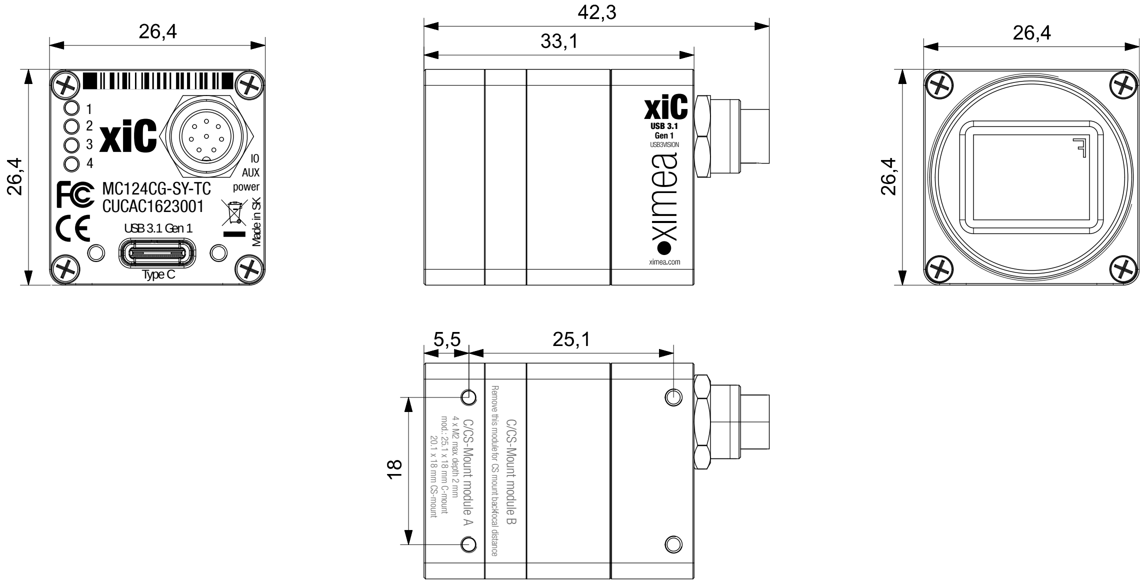


figure 3-27, dimensional drawing MC124xG-SY-TC C-Mount housing

3.5.5.4. Drawings MC124xG-SY-UB (C-mount [with C mount module B])

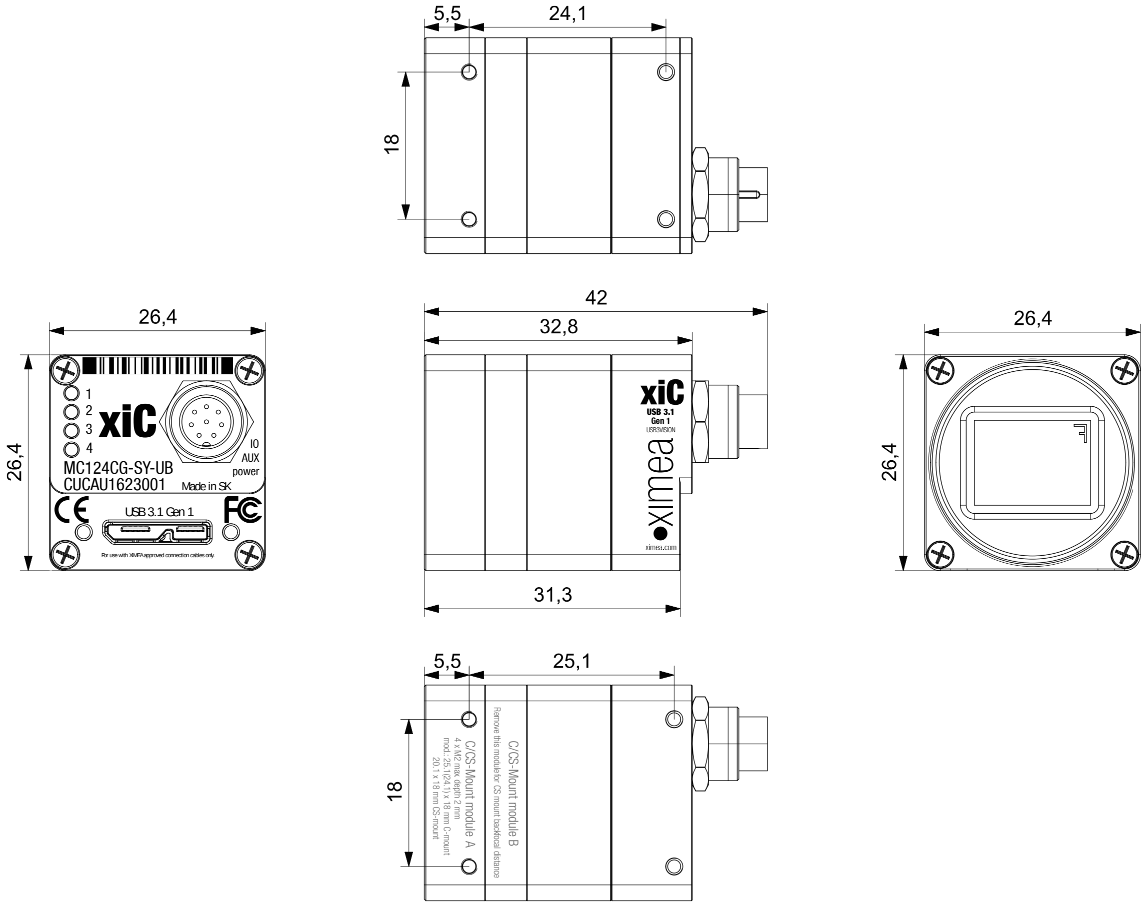


figure 3-28, dimensional drawing MC124xG-SY-UB, C-Mount housing

3.5.5.5. Drawings MC124xG-SY-FL (C-mount [with C/CS mount module B])

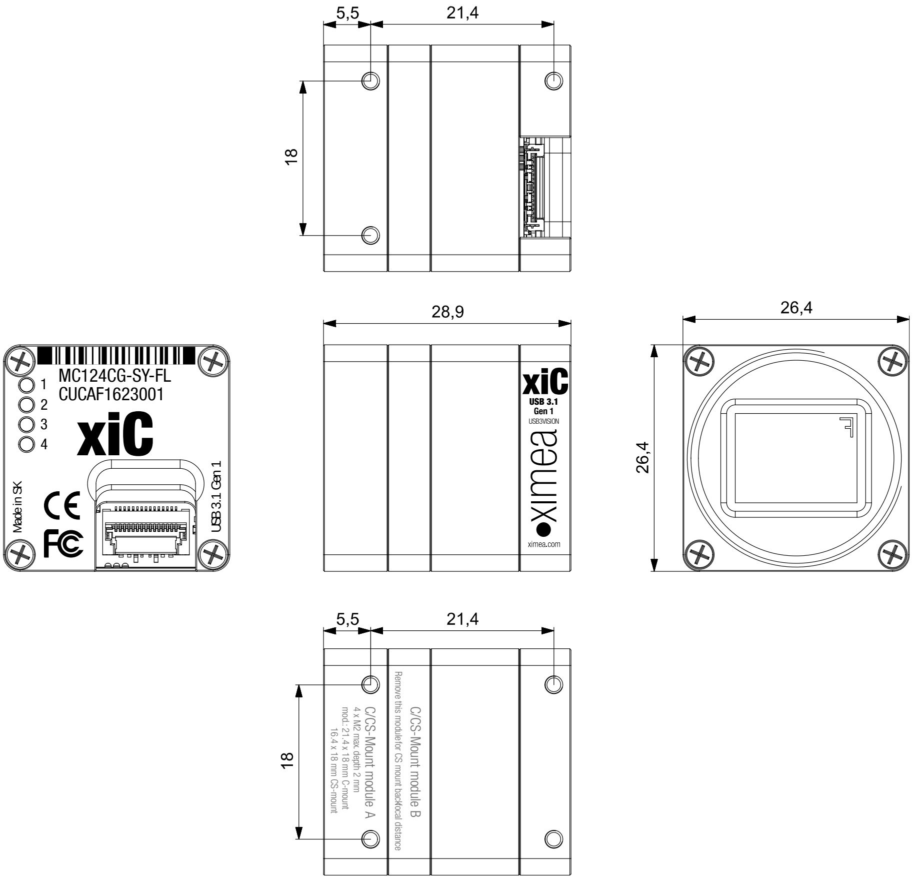


figure 3-29, dimensional drawing MC124xG-SY-FL, C-Mount housing

3.5.5.6. Drawings MC124xG-SY-FV (C-mount [with C mount module B])

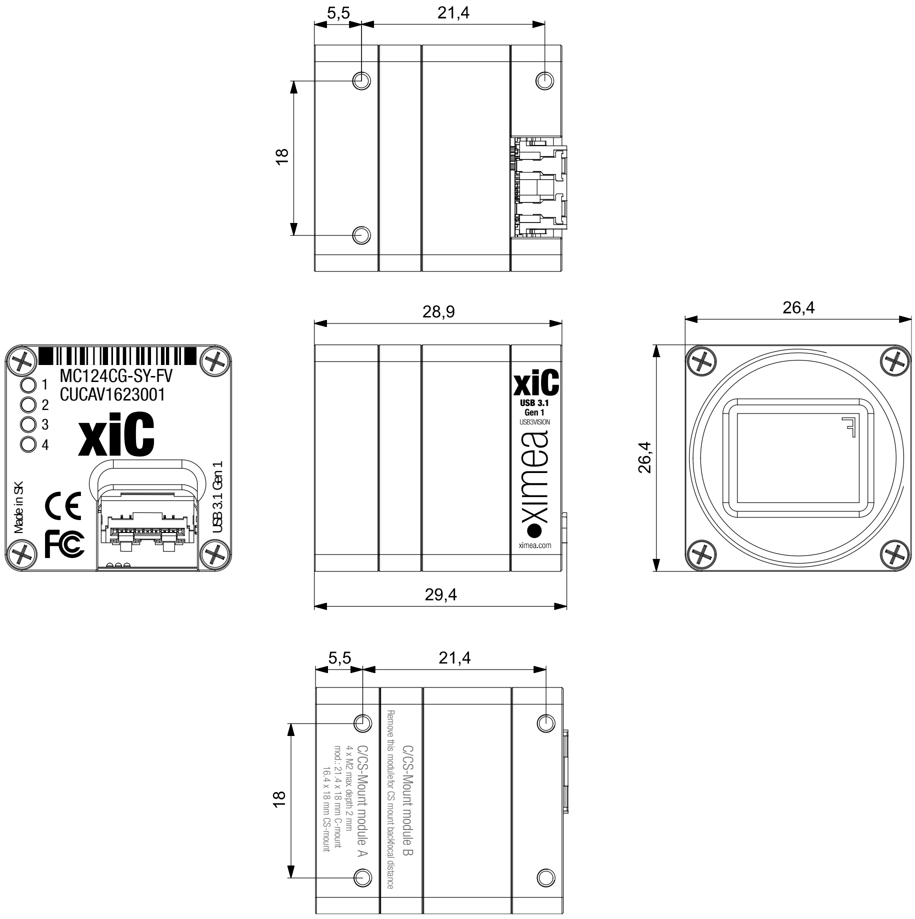


figure 3-30, dimensional drawing MC124xG-SY-FV, C-Mount housing

3.5.5.7. Referenced documents

Sony Datasheet IMX253LLR-C_TechnicalDatasheet_E_Rev0.3 (29/01/16)

Sony Datasheet IMX253LQR-C_TechnicalDatasheet_E_Rev0.1 (29/01/16)

3.5.5.8. Sensor features

feature	Note
Binning	Yes, up to 2x2 binning supported on monochrome only.
Decimation	Yes, up to 2x2
ROI	Vertical cropping results in increased read speed, horizontal reduces data transfer
HW Trigger	Trigger with overlap (see <u>*4.3.2.1 Triggered acquisition - single frame*</u>)
Overlap mode	Exposure of next frame can start during the readout of the previous frame

table 3-20, sensor features available

3.5.6. MC161xG-SY

3.5.6.1. Sensor and camera parameters

xiC model		MC161CG-SY		MC161MG-SY
Sensor parameters				
Model name		IMX542AAQJ-C		IMX542AAMJ-C
Color filter		RGB Bayer mosaic		None
Technology		4th Gen Pregius S		
Shutter type		Global		
Pixel Resolution (H × V)	[pixel]	5328 x 3040		
Active area size (H × V)	[mm]	14.58 x 8.314		
Sensor diagonal	[mm]	16.78		
Optical format	[inch]	1.1”		
Pixel Size (H × V)	[µm]	2.74 x 2.74		
Image quality parameters (EMVA 1288)				
ADC resolution	[bit]	8 [1]	10	12
Saturation capacity	[ke-]	2.47	10.19	9.21
Dynamic range	[dB]	52.73	65.47	70.23
SNR_{max}	[dB]	33.88	40.34	39.98
System gain 1/K	[e-/DN] [2]	10.24	10.24	2.40
Dark noise	[e-]	5.2	4.93	2.33
Dark current @ 60°C	[e-/s]	20.47	19.07	21.5
Absolute sensitivity threshold	[e-]	5.7	5.43	2.83
DSNU	[e-]	2.28	4.31	4.49
PRNU	[%]	1.47	1.42	1.51
Linearity error	[%]	0.46	0.24	0.35
Camera parameters				
Exposure time (EXP)		16 µs to 30 s, in steps of 13.66 µs [3]		
Variable Gain Range (VGA)	[dB]	0-24		
ADC resolution	[bit/pixel]	8 [1]	10	12
Maximal framerate (MRR)	[fps]	23.2	18.6	15.5
Power consumption				
Typical / Maximum	[W]	3.2 / 3.4		
Dimensions/Mass				
height	[mm]	26.4		
width	[mm]	26.4		
depth (-TC/-UB/-FL/-FV)	[mm]	42.4/42.1/29/29 (with C/CS Mount module B) 37.4/37.1/24/24 (without C/CS Mount module B)		
mass (-TC/-UB/-FL/-FV)	[g]	38/37/28/28 (with C/CS Mount module B) 33.8/32.8/23.8/23.8 (without C/CS Mount module B)		

table 3-21, MC161xG-SY, sensor and camera parameters

Notes:

1) Saturation capacity in 8-bit digitization is only ¼ of 10-bit and 12-bit mode (see 4.2.5 Digitization bit depth)
2) DN is LSB_N where N is the ADC resolution bit depth
3) Defined for maximal bandwidth. Minimal Exposure and exposure step (Line Period) could be calculated in:
   Camera performance calculator:
   https://www.ximea.com/support/wiki/allprod/Industrial-scientific-camera-sensor-fps-frames-speed-calculator#/camera/MC161CG-SY

Binning/Decimation	pixels	Bit/px	FPS
1x1 / 1x1	5328 x 3040	8	23.2
1x1 / 1x1	5328 x 3040	10	18.6
1x1 / 1x1	5328 x 3040	12	15.5
1x1 / 2x2	2664 x 1520	8	90.6
1x1 / 2x2	2664 x 1520	10	72.5
1x1 / 2x2	2664 x 1520	12	60.7
2x2 [1] / 1x1	2664 x 1520	8	90.6
2x2 [1] / 1x1	2664 x 1520	10	72.5
2x2 [1] / 1x1	2664 x 1520	12	60.7

table 3-22, MC161xG-SY, supported standard readout modes

Notes:

1) Available only for mono camera models

3.5.6.2. Quantum efficiency curves [%]

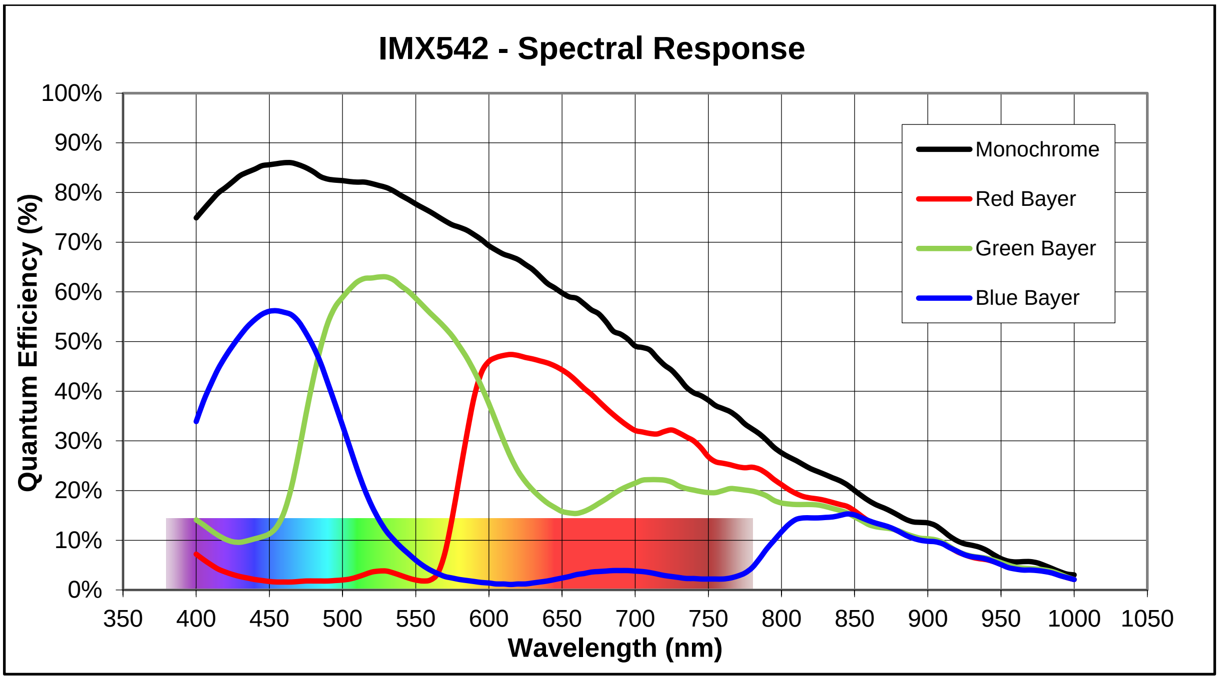


figure 3-31, IMX542 mono and color, quantum efficiency curve, ©SONY

3.5.6.3. Drawings MC161xG-SY-TC (C-mount [with C mount module B])

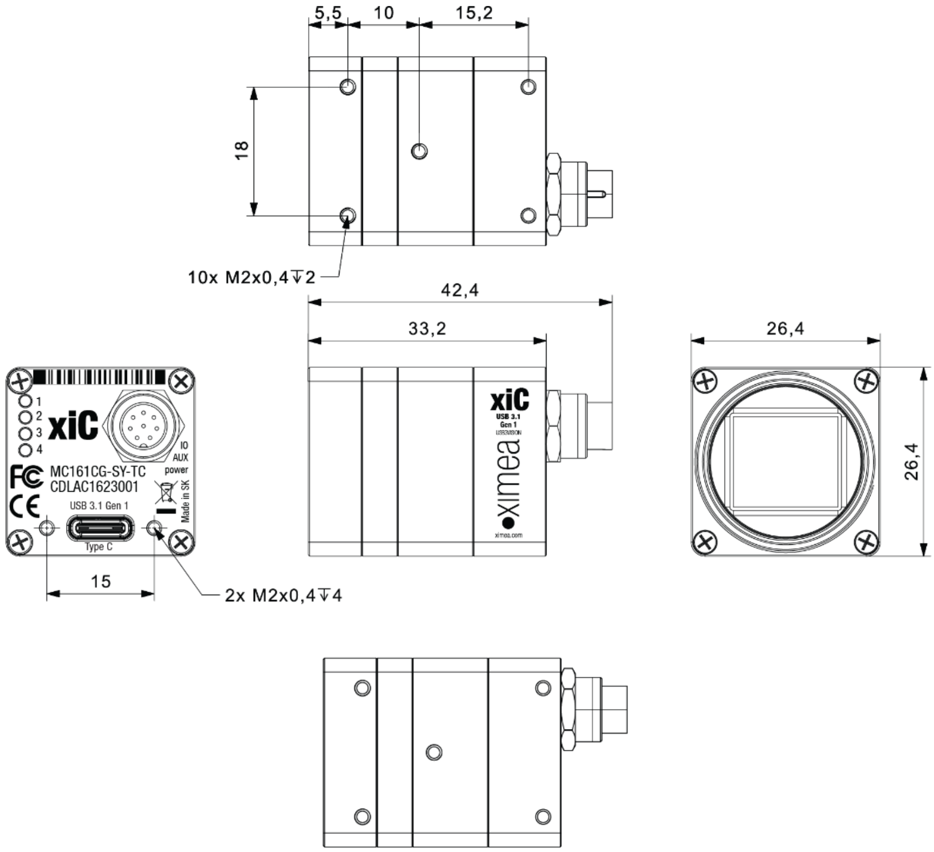


figure 3-32, dimensional drawing MC161xG-SY-TC C-Mount housing

3.5.6.4. Drawings MC161xG-SY-UB (C-mount [with C mount module B])

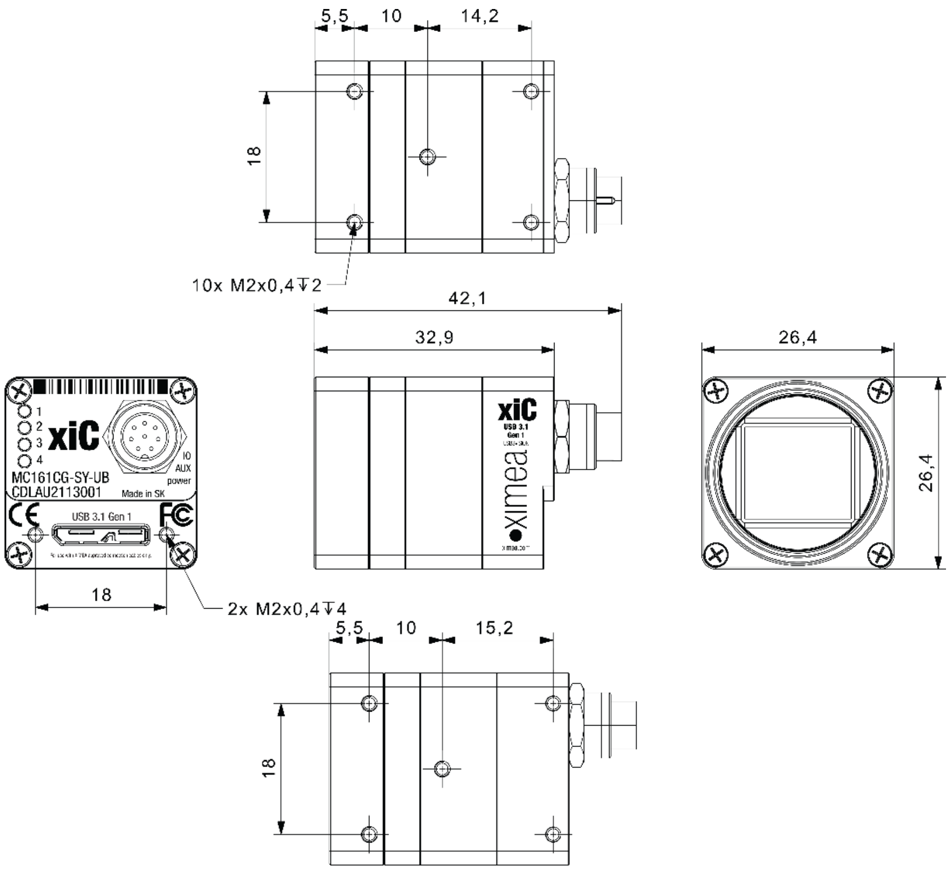


figure 3-33, dimensional drawing MC161xG-SY-UB, C-Mount housing

3.5.6.5. Drawings MC161xG-SY-FL (C-mount [with C/CS mount module B])

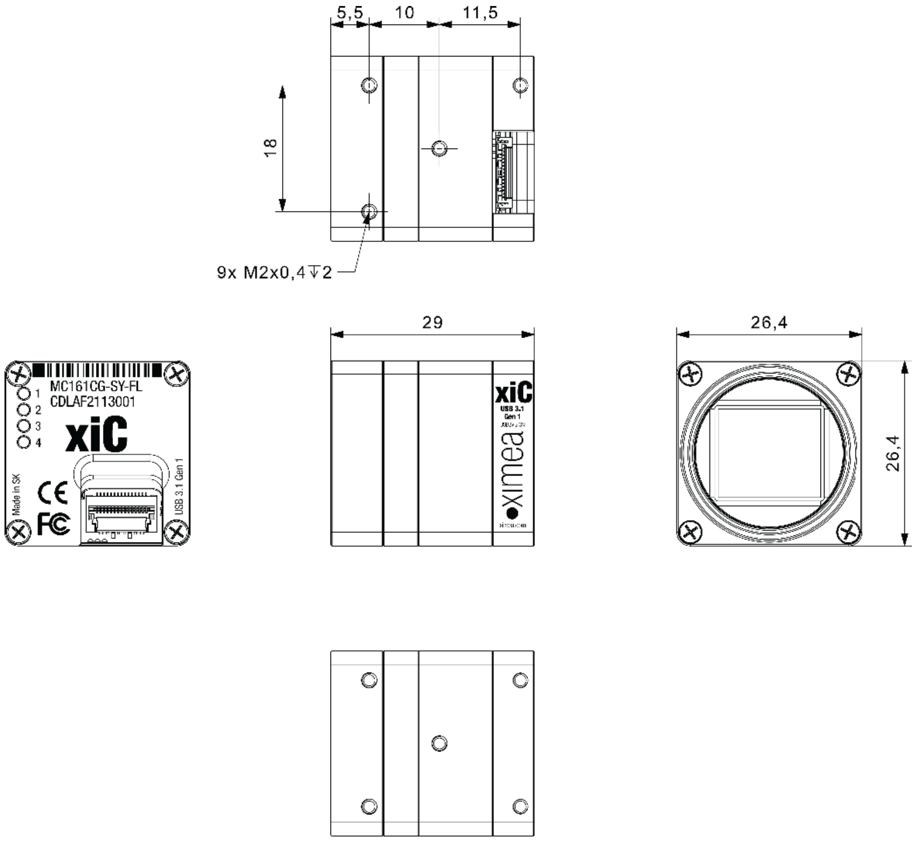


figure 3-34, dimensional drawing MC161xG-SY-FL, C-Mount housing

3.5.6.6. Drawings MC161xG-SY-FV (C-mount [with C mount module B])

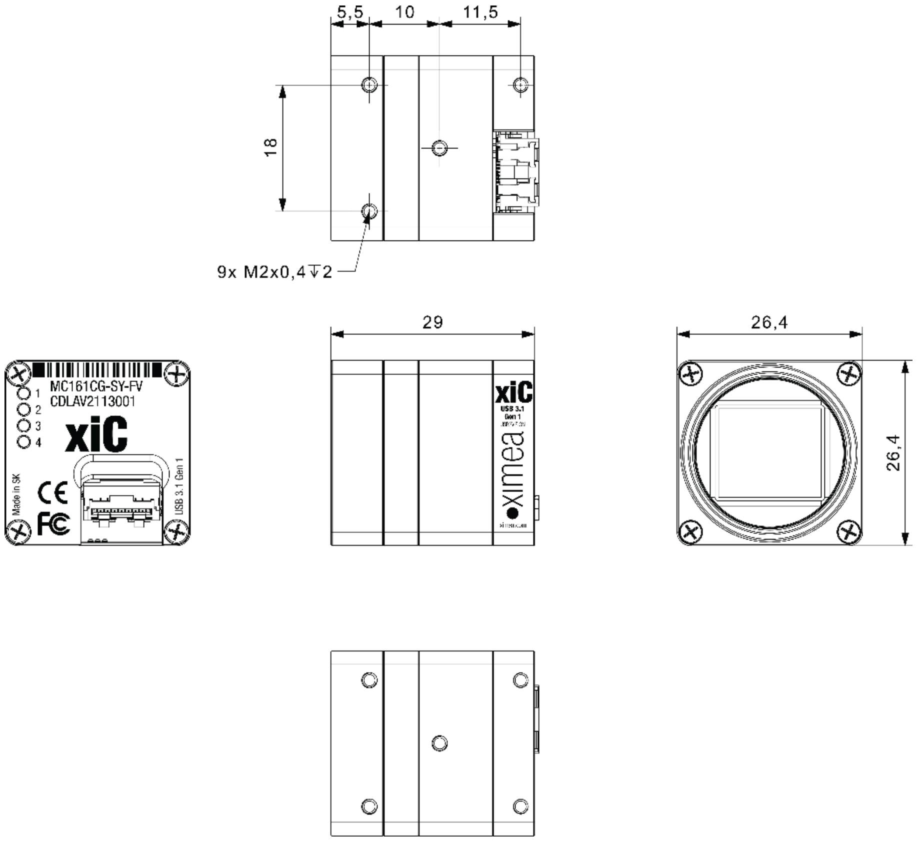


figure 3-35, dimensional drawing MC161xG-SY-FV, C-Mount housing

3.5.6.7. Referenced documents

Sony Datasheet IMX542-AAMJ-C_Data_Sheet(E)_E20516B09 (23/10/20)

Sony Datasheet IMX542-AAQJ-C_Data_Sheet(E)_E20602A09 (23/09/20)

3.5.6.8. Sensor features

feature	Note
Binning	Yes, up to 2x2 binning supported on monochrome only.
Decimation	Yes, up to 2x2
ROI	Vertical cropping results in increased read speed, horizontal reduces data transfer
HW Trigger	Trigger with overlap (see *4.3.2.1 Triggered acquisition - single frame*)
Overlap mode	Exposure of next frame can start during the readout of the previous frame

table 3-23, sensor features available

3.5.7. MC161xG-SY-HDR

3.5.7.1. Sensor and camera parameters

xiC model	MC161CG-SY-HDR			MC161MG-SY-HDR		
Sensor parameters						
Model name	IMX532AAQJ-C			IMX532AAMJ-C		
Color filter	RGB Bayer mosaic			None		
Technology	4th Gen Pregius S					
Shutter type	Global					
Pixel Resolution (H × V) [pixel]	5328 x 3040					
Active area size (H × V) [mm]	14.58 x 8.314					
Sensor diagonal [mm]	16.78					
Optical format [inch]	1.1”					
Pixel Size (H × V) [µm]	2.74 x 2.74					
Image quality parameters						
Mode	Standard			Dual ADC [1]		
ADC resolution [bit]	8 [2]	10	12	8 [2]	10	12
Saturation capacity [ke-]	2.44	9.78	9.4	2.38	9.95	9.35
Dynamic range [dB]	52.95	65.05	70.18	61.2	71.35	72.17
SNR_{max} [dB]	33.85	40.24	40.32	33.76	40.43	40.2
System gain 1/K [e-/DN][3]	10.24	10.24	2.40	0.04	0.16	0.15
Dark noise [e-]	4.99	4.97	2.41	1.57	2.19	1.8
Dark current @ 60 °C [e-/s]	21.14	27.42	22.33	10.46	21.08	22.36
Absolute sensitivity threshold [e-]	5.49	5.47	2.91	2.07	2.69	2.3
DSNU [e-]	1.46	2.99	2.77	2.15	5.04	5.02
PRNU [%]	0.57	0.46	0.47	0.56	0.45	0.46
Linearity error [%]	0.54	0.32	0.26	1	0.33	0.53
Camera parameters						
Exposure time (EXP)	16 µs to 30 s, in steps of 13.66 µs [4]					
Variable Gain Range (VGA) [dB]	0-24					
ADC resolution	8 [2]		10		12	
Maximal framerate – standard [fps]	23.1		18.5		15.4	
Maximal framerate – Dual ADC						
Non-combined [5] [fps]	11.7		9.3		7.8	
Combined [fps]	23.1 [6]		N/A		15.4 [7]	
Power consumption						
Typical / Maximum [W]	3.4 / 3.6					
Dimensions/Mass						
height [mm]	26.4					
width [mm]	26.4					
depth (-TC/-UB/-FL/-FV) [mm]	42.4/42.1/29/29 (with C/CS Mount module B) 37.4/37.1/24/24 (without C/CS Mount module B)					
mass (-TC/-UB/-FL/-FV) [g]	38/37/28/28 (with C/CS Mount module B) 33.8/32.8/23.8/23.8 (without C/CS Mount module B)					

table 3-24, MC161xG-SY-HDR, sensor and camera parameters

Notes:

1) Dual ADC non-combined modes were measured with gain ratio set to the maximum value of 24 dB
2) Saturation capacity in 8-bit digitization is only ¼ of 10-bit and 12-bit mode (see *4.2.5 Digitization bit depth*)
3) For standard modes DN is LSB_N where N is the ADC resolution bit depth and for dual ADC modes DN is LSB_{16}
4) Defined for maximal bandwidth. Minimal Exposure and exposure step (Line Period) could be calculated in: Camera performance calculator: https://www.ximea.com/support/wiki/allprod/Industrial-scientific-camera-sensor-fps-frames-speed-calculator#/camera/MC161CG-SY-HDR
5) Possibility to combine in computer (API)
6) With Dual ADC combining in sensor - 2x12 bit with 8-bit output data
7) With Dual ADC combining in sensor - 2x12 bit with 12-bit output data

Binning/Decimation	pixels	Bit/px	FPS
1x1 / 1x1 [1]	5328 x 3040	8	23.1
1x1 / 1x1 [1]	5328 x 3040	10	18.5
1x1 / 1x1 [1]	5328 x 3040	12	15.5
1x1 / 2x2 [1]	2664 x 1520	8	89.3
1x1 / 2x2 [1]	2664 x 1520	10	71.4
1x1 / 2x2 [1]	2664 x 1520	12	59.8
2x2 [1, 2] / 1x1	2664 x 1520	8	89.7
2x2 [1, 2] / 1x1	2664 x 1520	10	71.8
2x2 [1, 2] / 1x1	2664 x 1520	12	59.8
1x1 / 1x1 [3]	5328 x 3040	8	11.7
1x1 / 1x1 [3]	5328 x 3040	10	9.3
1x1 / 1x1 [3]	5328 x 3040	12	7.8
1x1 / 1x1	5328 x 3040	8 [4]	23.2
1x1 / 1x1	5328 x 3040	12 [5]	15.4

table 3-25, MC161xG-SY-HDR, supported standard readout modes

1) Standard mode
2) Available only for mono camera models
3) Dual ADC mode without in sensor combination - possibility to combine in computer (API)
4) Dual ADC mode with combining in sensor - 2x12 bit with 8-bit output data
5) Dual ADC mode with combining in sensor - 2x12 bit with 12-bit output data

3.5.7.2. Quantum efficiency curves [%]

Spectral response for IMX532 sensor is the same as for sensor IMX542. See the page 48 figure 3-31, IMX542 mono and color, quantum efficiency curve, ©SONY.

3.5.7.3. Drawings MC161xG-SY-TC-HDR (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-TC (see figure 3-32, dimensional drawing MC161xG-SY-TC C-Mount housing on page 49).

3.5.7.4. Drawings MC161xG-SY-UB-HDR (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-UB (see figure 3-33, dimensional drawing MC161xG-SY-UB, C-Mount housing 49).

3.5.7.5. Drawings MC161xG-SY-FL-HDR (C-mount [with C/CS mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-FL (see figure 3-34, dimensional drawing MC161xG-SY-FL, C-Mount housing 50).

3.5.7.6. Drawings MC161xG-SY-FV-HDR (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-FV (see figure 3-35, dimensional drawing MC161xG-SY-FV, C-Mount housing 50).

3.5.7.7. Referenced documents

Sony Datasheet IMX532-AAMJ-C_Data_Sheet(E)_E20515A0X (30/10/20)

Sony Datasheet IMX532-AAQJ-C_Data_Sheet(E)_E20601A0X (30/10/20)

3.5.7.8. Sensor features

feature	Note
Binning	Yes, up to 2x2 binning supported on monochrome only.
Decimation	Yes, up to 2x2
ROI	Vertical cropping results in increased read speed, horizontal reduces data transfer
HW Trigger	Trigger with overlap (see *4.3.2.1 Triggered acquisition - single frame*)
DualADC	Yes, allowed via special mode
Short interval shutter mode	Yes, allowed via special mode
Overlap mode	Exposure of next frame can start during the readout of the previous frame

table 3-26, sensor features available

3.5.8. MC203xG-SY

3.5.8.1. Sensor and camera parameters

xiC model		MC203CG-SY		MC203MG-SY
Sensor parameters				
Model name		IMX541AAQJ		IMX541AAMJ
Color filter		RGB Bayer mosaic		None
Technology		4th Gen Pregius S		
Shutter type		Global		
Pixel Resolution (H × V)	[pixel]	4512 x 4512		
Active area size (H × V)	[mm]	12.34 x 12.34		
Sensor diagonal	[mm]	17.45		
Optical format	[inch]	1.1”		
Pixel Size (H × V)	[µm]	2.74 x 2.74		
Image quality parameters (EMVA 1288)				
ADC resolution	[bit]	8 [1]	10	12
Saturation capacity	[ke-]	2.47	10.19	9.21
Dynamic range	[dB]	52.73	65.47	70.23
SNR_{max}	[dB]	33.88	40.34	39.98
System gain 1/K	[e-/DN] [2]	10.24	10.24	2.40
Dark noise	[e-]	5.2	4.93	2.33
Dark current @ 60°C	[e-/s]	20.47	19.07	21.5
Absolute sensitivity threshold	[e-]	5.7	5.43	2.83
DSNU	[e-]	2.28	4.31	4.49
PRNU	[%]	1.47	1.42	1.51
Linearity error	[%]	0.46	0.24	0.35
Camera parameters				
Exposure time (EXP)		14 µs to 30 s, in steps of 11.57 µs [3]		
Variable Gain Range (VGA)	[dB]	0-24		
ADC resolution	[bit/pixel]	8 [1]	10	12
Maximal framerate (MRR)	[fps]	18.7	15	12.5
Power consumption				
Typical / Maximum	[W]	3.2 / 3.4		
Dimensions/Mass				
height	[mm]	26.4		
width	[mm]	26.4		
depth (-TC/-UB/-FL/-FV)	[mm]	42.4/42.1/29/29 (with C/CS Mount module B) 37.4/37.1/24/24 (without C/CS Mount module B)		
mass (-TC/-UB/-FL/-FV)	[g]	38/37/28/28 (with C/CS Mount module B) 33.8/32.8/23.8/23.8 (without C/CS Mount module B)		

table 3-27, MC203xG-SY, sensor and camera parameters

Notes:

1) Saturation capacity in 8-bit digitization is only ¼ of 10-bit and 12-bit mode (see 4.2.5 Digitization bit depth)
2) DN is LSB_N where N is the ADC resolution bit depth
3) Defined for maximal bandwidth. Minimal Exposure and exposure step (Line Period) could be calculated in:
   Camera performance calculator:
   https://www.ximea.com/support/wiki/allprod/Industrial-scientific-camera-sensor-fps-frames-speed-calculator#/camera/MC203CG-SY

Binning/Decimation	pixels	Bit/px	FPS
1x1 / 1x1	4512 x 4512	8	18.7
1x1 / 1x1	4512 x 4512	10	15
1x1 / 1x1	4512 x 4512	12	12.5
1x1 / 2x2	2256 x 2256	8	73.5
1x1 / 2x2	2256 x 2256	10	58.9
1x1 / 2x2	2256 x 2256	12	49.3
2x2 [1] / 1x1	2256 x 2256	8	73.5
2x2 [1] / 1x1	2256 x 2256	10	58.9
2x2 [1] / 1x1	2256 x 2256	12	49.3

table 3-28, MC203xG-SY, supported standard readout modes

Notes:

1) Available only for mono camera models

3.5.8.2. Quantum efficiency curves [%]

Spectral response for IMX541 sensor is the same as for sensor IMX542. See the page 48 figure 3-31, IMX542 mono and color, quantum efficiency curve, ©SONY.

3.5.8.3. Drawings MC203xG-SY-TC (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-TC (see figure 3-32, dimensional drawing MC161xG-SY-TC C-Mount housing on page 49).

3.5.8.4. Drawings MC203xG-SY-UB (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-UB (see figure 3-33, dimensional drawing MC161xG-SY-UB, C-Mount housing 49).

3.5.8.5. Drawings MC203xG-SY-FL (C-mount [with C/CS mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-FL (see figure 3-34, dimensional drawing MC161xG-SY-FL, C-Mount housing 50).

3.5.8.6. Drawings MC203xG-SY-FV (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-FV (see figure 3-35, dimensional drawing MC161xG-SY-FV, C-Mount housing 50).

3.5.8.7. Referenced documents

Sony Datasheet IMX541-AAMJ-C_Data_Sheet(E)_E20522A09 (10/05/10)

Sony Datasheet IMX541-AAQJ-C_Data_Sheet(E)_E20603A09 (10/05/10)

3.5.8.8. Sensor features

feature	Note
Binning	Yes, up to 2x2 binning supported on monochrome only.
Decimation	Yes, up to 2x2
ROI	Vertical cropping results in increased read speed, horizontal reduces data transfer
HW Trigger	Trigger with overlap (see *4.3.2.1 Triggered acquisition - single frame*)
Overlap mode	Exposure of next frame can start during the readout of the previous frame

table 3-29, sensor features available

3.5.9. MC203xG-SY-HDR

3.5.9.1. Sensor and camera parameters

xiC model	MC203CG-SY-HDR			MC203MG-SY-HDR		
Sensor parameters						
Model name	IMX531AAQJ			IMX531AAMJ		
Color filter	RGB Bayer mosaic			None		
Technology	4th Gen Pregius S					
Shutter type	Global					
Pixel Resolution (H × V) [pixel]	4512 x 4512					
Active area size (H × V) [mm]	12.34 x 12.34					
Sensor diagonal [mm]	17.45					
Optical format [inch]	1.1”					
Pixel Size (H × V) [µm]	2.74 x 2.74					
Image quality parameters						
Mode	Standard			Dual ADC[1]		
ADC resolution [bit]	8 [2]	10	12	8 [2]	10	12
Saturation capacity [ke-]	2.35	9.64	9.41	2.32	9.88	9.37
Dynamic range [dB]	53.04	64.7	70.23	61.3	71.45	72.19
SNR_{max} [dB]	33.73	40.06	40.29	33.65	40.42	40.19
System gain 1/K [e-/DN][3]	10.24	10.24	2.40	0.04	0.16	0.15
Dark noise [e-]	4.75	5.11	2.4	1.5	2.14	1.8
Dark current @ 60 °C [e-/s]	17.71	16.45	20.72	16.41	18.23	20.76
Absolute sensitivity threshold [e-]	5.25	5.61	2.9	2	2.64	2.3
DSNU [e-]	1.78	3.34	3.35	2.97	5.9	5.93
PRNU [%]	0.54	0.45	0.45	0.51	0.41	0.42
Linearity error [%]	0.87	0.3	0.3	0.87	0.19	0.44
Camera parameters						
Exposure time (EXP)	14 µs to 30 s, in steps of 11.57 µs [4]					
Variable Gain Range (VGA) [dB]	0-24					
ADC resolution	8 [2]		10		12	
Maximal framerate – standard [fps]	18.6		14.9		12.4	
Maximal framerate – Dual ADC						
Non-combined [5] [fps]	9.4		7.5		6.3	
Combined [fps]	18.6 [6]		N/A		12.4 [7]	
Power consumption						
Typical / Maximum [W]	3.4 / 3.6					
Dimensions/Mass						
height [mm]	26.4					
width [mm]	26.4					
depth (-TC/-UB/-FL/-FV) [mm]	42.4/42.1/29/29 (with C/CS Mount module B) 37.4/37.1/24/24 (without C/CS Mount module B)					
mass (-TC/-UB/-FL/-FV) [g]	38/37/28/28 (with C/CS Mount module B) 33.8/32.8/23.8/23.8 (without C/CS Mount module B)					

table 3-30, MC203xG-SY-HDR, sensor and camera parameters

Notes:

1) Dual ADC non-combined modes were measured with gain ratio set to the maximum value of 24 dB
2) Saturation capacity in 8-bit digitization is only ¼ of 10-bit and 12-bit mode (see *4.2.5 Digitization bit depth*)
3) For standard modes DN is LSB_N where N is the ADC resolution bit depth and for dual ADC modes DN is LSB_{16}
4) Defined for maximal bandwidth. Minimal Exposure and exposure step (Line Period) could be calculated in:
   Camera performance calculator:
   https://www.ximea.com/support/wiki/allprod/Industrial-scientific-camera-sensor-fps-frames-speed-calculator#/camera/MC203CG-SY-HDR
5) Possibility to combine in computer (API)
6) With Dual ADC combining in sensor - 2x12 bit with 8-bit output data
7) With Dual ADC combining in sensor - 2x12 bit with 12-bit output data

Binning/Decimation	pixels	Bit/px	FPS
1x1 / 1x1 [1]	4512 x 4512	8	18.6
1x1 / 1x1 [1]	4512 x 4512	10	14.9
1x1 / 1x1 [1]	4512 x 4512	12	12.4
1x1 / 2x2 [1]	2256 x 2256	8	72.8
1x1 / 2x2 [1]	2256 x 2256	10	58.2
1x1 / 2x2 [1]	2256 x 2256	12	48.5
2x2 [1, 2] / 1x1	2256 x 2256	8	72.8
2x2 [1, 2] / 1x1	2256 x 2256	10	58.2
2x2 [1, 2] / 1x1	2256 x 2256	12	48.5
1x1 / 1x1 [3]	4512 x 4512	8	9.4
1x1 / 1x1 [3]	4512 x 4512	10	7.5
1x1 / 1x1 [3]	4512 x 4512	12	6.3
1x1 / 1x1	4512 x 4512	8 [4]	18.6
1x1 / 1x1	4512 x 4512	12 [5]	12.4

table 3-31, MC203xG-SY-HDR, supported standard readout modes

1) Standard mode
2) Available only for mono camera models
3) Dual ADC mode without in sensor combination - possibility to combine in computer (API)
4) Dual ADC mode with combining in sensor - 2x12 bit with 8-bit output data
5) Dual ADC mode with combining in sensor - 2x12 bit with 12-bit output data

3.5.9.2. Quantum efficiency curves [%]

Spectral response for IMX531 sensor is the same as for sensor IMX542. See the page 48 figure 3-31, IMX542 mono and color, quantum efficiency curve, ©SONY.

3.5.9.3. Drawings MC203xG-SY-TC-HDR (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-TC (see figure 3-32, dimensional drawing MC161xG-SY-TC C-Mount housing on page 49).

3.5.9.4. Drawings MC203xG-SY-UB-HDR (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-UB (see figure 3-33, dimensional drawing MC161xG-SY-UB, C-Mount housing 49).

3.5.9.5. Drawings MC203xG-SY-FL-HDR (C-mount [with C/CS mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-FL (see figure 3-34, dimensional drawing MC161xG-SY-FL, C-Mount housing 50).

3.5.9.6. Drawings MC203xG-SY-FV-HDR (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-FV (see figure 3-35, dimensional drawing MC161xG-SY-FV, C-Mount housing 50).

3.5.9.7. Referenced documents

Sony Datasheet IMX531-AAMJ-C_Data_Sheet(E)_E20521A0X (23/10/20)

Sony Datasheet IMX531-AAQJ-C_Data_Sheet(E)_E20604A0X (23/10/20)

3.5.9.8. Sensor features

feature	Note
Binning	Yes, up to 2x2 binning supported on monochrome only.
Decimation	Yes, up to 2x2
ROI	Vertical cropping results in increased read speed, horizontal reduces data transfer
HW Trigger	Trigger with overlap (see *4.3.2.1 Triggered acquisition - single frame*)
DualADC	Yes, allowed via special mode
Short interval shutter mode	Yes, allowed via special mode
Overlap mode	Exposure of next frame can start during the readout of the previous frame

table 3-32, sensor features available

3.5.10. MC245xG-SY

3.5.10.1. Sensor and camera parameters

xiC model		MC245CG-SY		MC245MG-SY
Sensor parameters				
Model name		IMX540AAQJ		IMX540AAMJ
Color filter		RGB Bayer mosaic		None
Technology		4th Gen Pregius S		
Shutter type		Global		
Pixel Resolution (H × V)	[pixel]	5328 x 4608		
Active area size (H × V)	[mm]	14.58 x 12.6		
Sensor diagonal	[mm]	19.27		
Optical format	[inch]	1.2”		
Pixel Size (H × V)	[µm]	2.74 x 2.74		
Image quality parameters (EMVA 1288)				
ADC resolution	[bit]	8 [1]	10	12
Saturation capacity	[ke-]	2.47	10.19	9.21
Dynamic range	[dB]	52.73	65.47	70.23
SNR_{max}	[dB]	33.88	40.34	39.98
System gain 1/K	[e-/DN][2]	10.24	10.24	2.4
Dark noise	[e-]	5.2	4.93	2.33
Dark current @ 60°C	[e-/s]	20.47	19.07	21.5
Absolute sensitivity threshold	[e-]	5.7	5.43	2.83
DSNU	[e-]	2.28	4.31	4.49
PRNU	[%]	1.47	1.42	1.51
Linearity error	[%]	0.46	0.24	0.35
Camera parameters				
Exposure time (EXP)		16 µs to 30 s, in steps of 13.66 µs [3]		
Variable Gain Range (VGA)	[dB]	0-24		
ADC resolution	[bit/pixel]	8 [1]	10	12
Maximal framerate (MRR)	[fps]	15.5	12.4	10.4
Power consumption				
Typical / Maximum	[W]	3.2 / 3.4		
Dimensions/Mass				
height	[mm]	26.4		
width	[mm]	26.4		
depth (-TC/-UB/-FL/-FV)	[mm]	42.4/42.1/29/29 (with C/CS Mount module B) 37.4/37.1/24/24 (without C/CS Mount module B)		
mass (-TC/-UB/-FL/-FV)	[g]	38/37/28/28 (with C/CS Mount module B) 33.8/32.8/23.8/23.8 (without C/CS Mount module B)		

table 3-33, MC245xG-SY, sensor and camera parameters

Notes:

1) Saturation capacity in 8-bit digitization is only ¼ of 10-bit and 12-bit mode (see 4.2.5 Digitization bit depth)
2) DN is LSB_N where N is the ADC resolution bit depth
3) Defined for maximal bandwidth. Minimal Exposure and exposure step (Line Period) could be calculated in:

   Camera performance calculator:

   https://www.ximea.com/support/wiki/allprod/Industrial-scientific-camera-sensor-fps-frames-speed-calculator#/camera/MC245CG-SY

Binning/Decimation	pixels	Bit/px	FPS
1x1 / 1x1	5328 x 4608	8	15.5
1x1 / 1x1	5328 x 4608	10	12.4
1x1 / 1x1	5328 x 4608	12	10.4
1x1 / 2x2	2664 x 2304	8	61.0
1x1 / 2x2	2664 x 2304	10	48.8
1x1 / 2x2	2664 x 2304	12	40.8
2x2 [1] / 1x1	2664 x 2304	8	61.0
2x2 [1] / 1x1	2664 x 2304	10	48.8
2x2 [1] / 1x1	2664 x 2304	12	40.8

table 3-34, MC245xG-SY, supported standard readout modes

Notes:

1) Available only for mono camera models

3.5.10.2. Quantum efficiency curves [%]

Spectral response for IMX540 sensor is the same as for sensor IMX542. See the page 48 figure 3-31, IMX542 mono and color, quantum efficiency curve, ©SONY.

3.5.10.3. Drawings MC245xG-SY-TC (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-TC (see figure 3-32, dimensional drawing MC161xG-SY-TC C-Mount housing on page 49).

3.5.10.4. Drawings MC245xG-SY-UB (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-UB (see figure 3-33, dimensional drawing MC161xG-SY-UB, C-Mount housing 49).

3.5.10.5. Drawings MC245xG-SY-FL (C-mount [with C/CS mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-FL (see figure 3-34, dimensional drawing MC161xG-SY-FL, C-Mount housing 50).

3.5.10.6. Drawings MC245xG-SY-FV (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-FV (see figure 3-35, dimensional drawing MC161xG-SY-FV, C-Mount housing 50).

3.5.10.7. Referenced documents

Sony Datasheet IMX540-AAMJ-C_Data_Sheet(E)_E20505B09 (10/05/20)

Sony Datasheet IMX540-AAQJ-C_Data_Sheet(E)_E20503B09 (10/05/20)

3.5.10.8. Sensor features

feature	Note
Binning	Yes, up to 2x2 binning supported on monochrome only.
Decimation	Yes, up to 2x2
ROI	Vertical cropping results in increased read speed, horizontal reduces data transfer
HW Trigger	Trigger with overlap usable (see *4.3.2.1 Triggered acquisition - single frame*)
Overlap mode	Exposure of next frame can start during the readout of the previous frame

table 3-35, sensor features available

3.5.11. MC245xG-SY-HDR

3.5.11.1. Sensor and camera parameters

xiC model	MC245CG-SY-HDR			MC245MG-SY-HDR		
Sensor parameters						
Model name	IMX530AAQJ			IMX530AAMJ		
Color filter	RGB Bayer mosaic			None		
Technology	4th Gen Pregius S					
Shutter type	Global					
Pixel Resolution (H × V) [pixel]	5328 x 4608					
Active area size (H × V) [mm]	14.58 x 12.6					
Sensor diagonal [mm]	19.27					
Optical format [inch]	1.2”					
Pixel Size (H × V) [µm]	2.74 x 2.74					
Image quality parameters						
Mode	Standard			Dual ADC[1]		
ADC resolution [bit]	8 [2]	10	12	8 [2]	10	12
Saturation capacity [ke-]	2.35	9.64	9.41	2.32	9.88	9.37
Dynamic range [dB]	53.04	64.7	70.23	61.3	71.45	72.19
SNR_{max} [dB]	33.73	40.06	40.29	33.65	40.42	40.19
System gain 1/K [e-/DN][3]	10.24	10.24	2.40	0.04	0.16	0.15
Dark noise [e-]	4.75	5.11	2.4	1.5	2.14	1.8
Dark current @ 60 °C [e-/s]	17.71	16.45	20.72	16.41	18.23	20.76
Absolute sensitivity threshold [e-]	5.25	5.61	2.9	2	2.64	2.3
DSNU [e-]	1.78	3.34	3.35	2.97	5.9	5.93
PRNU [%]	0.54	0.45	0.45	0.51	0.41	0.42
Linearity error [%]	0.87	0.3	0.3	0.87	0.19	0.44
Camera parameters						
Exposure time (EXP)	16 µs to 30 s, in steps of 13.66 µs [4]					
Variable Gain Range (VGA) [dB]	0-24					
ADC resolution	8 [2]		10		12	
Maximal framerate – standard [fps]	15.5		12.4		10.3	
Maximal framerate – Dual ADC						
Non-combined [5] [fps]	7.8		6.2		5.2	
Combined [fps]	15.5 [6]		N/A		10.3 [7]	
Power consumption						
Typical / Maximum [W]	3.4 / 3.6					
Dimensions/Mass						
height [mm]	26.4					
width [mm]	26.4					
depth (-TC/-UB/-FL/-FV) [mm]	42.4/42.1/29/29 (with C/CS Mount module B) 37.4/37.1/24/24 (without C/CS Mount module B)					
mass (-TC/-UB/-FL/-FV) [g]	38/37/28/28 (with C/CS Mount module B) 33.8/32.8/23.8/23.8 (without C/CS Mount module B)					

table 3-36, MC245xG-SY-HDR, sensor and camera parameters

Notes:

1) Dual ADC non-combined modes were measured with gain ratio set to the maximum value of 24 dB
2) Saturation capacity in 8-bit digitization is only ¼ of 10-bit and 12-bit mode (see *4.2.5 Digitization bit depth*)
3) For standard modes DN is LSB_N where N is the ADC resolution bit depth and for dual ADC modes DN is LSB_{16}
4) Defined for maximal bandwidth. Minimal Exposure and exposure step (Line Period) could be calculated in: Camera performance calculator: https://www.ximea.com/support/wiki/allprod/Industrial-scientific-camera-sensor-fps-frames-speed-calculator#/camera/MC245CG-SY-HDR
5) Possibility to combine in computer (API)
6) With Dual ADC combining in sensor - 2x12 bit with 8-bit output data
7) With Dual ADC combining in sensor - 2x12 bit with 12-bit output data

Binning/Decimation	pixels	Bit/px	FPS
1x1 / 1x1 [1]	5328 x 4608	8	15.5
1x1 / 1x1 [1]	5328 x 4608	10	12.4
1x1 / 1x1 [1]	5328 x 4608	12	10.3
1x1 / 2x2 [1]	2664 x 2304	8	60.4
1x1 / 2x2 [1]	2664 x 2304	10	48.3
1x1 / 2x2 [1]	2664 x 2304	12	40.4
2x2 [1, 2] / 1x1	2664 x 2304	8	60.4
2x2 [1, 2] / 1x1	2664 x 2304	10	48.3
2x2 [1, 2] / 1x1	2664 x 2304	12	40.4
1x1 / 1x1 [3]	5328 x 4608	8	7.8
1x1 / 1x1 [3]	5328 x 4608	10	6.2
1x1 / 1x1 [3]	5328 x 4608	12	5.2
1x1 / 1x1	5328 x 4608	8 [4]	15.5
1x1 / 1x1	5328 x 4608	12 [5]	10.3

table 3-37, MC245xG-SY-HDR, supported standard readout modes

1) Standard mode
2) Available only for mono camera models
3) Dual ADC mode without in sensor combination - possibility to combine in computer (API)
4) Dual ADC mode with combining in sensor - 2x12 bit with 8-bit output data
5) Dual ADC mode with combining in sensor - 2x12 bit with 12-bit output data

3.5.11.2. Quantum efficiency curves [%]

Spectral response for IMX530 sensor is the same as for sensor IMX542. See the page 48 figure 3-31, IMX542 mono and color, quantum efficiency curve, ©SONY.

3.5.11.3. Drawings MC245xG-SY-TC-HDR (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-TC (see figure 3-32, dimensional drawing MC161xG-SY-TC C-Mount housing on page 49).

3.5.11.4. Drawings MC245xG-SY-UB-HDR (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-UB (see figure 3-33, dimensional drawing MC161xG-SY-UB, C-Mount housing 49).

3.5.11.5. Drawings MC245xG-SY-FL-HDR (C-mount [with C/CS mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-FL (see figure 3-34, dimensional drawing MC161xG-SY-FL, C-Mount housing 50).

3.5.11.6. Drawings MC245xG-SY-FV-HDR (C-mount [with C mount module B])

Dimensions and drawings are the same as for the camera MC161xG-SY-FV (see figure 3-35, dimensional drawing MC161xG-SY-FV, C-Mount housing 50).

3.5.11.7. Referenced documents

Sony Datasheet IMX530-AAMJ-C_Data_Sheet(E)_E20506A0X (23/10/20)

Sony Datasheet IMX530-AAQJ-C_Data_Sheet(E)_E20504A0X (23/10/20)

3.5.11.8. Sensor features

feature	Note
Binning	Yes, up to 2x2 binning supported on monochrome only.
Decimation	Yes, up to 2x2
ROI	Vertical cropping results in increased read speed, horizontal reduces data transfer
HW Trigger	Trigger with overlap usable (see *4.3.2.1 Triggered acquisition - single frame*)
DualADC	Yes, allowed via special mode
Short interval shutter mode	Yes, allowed via special mode
Overlap mode	Exposure of next frame can start during the readout of the previous frame

table 3-38, sensor features available

3.6. User interface – LEDs

Four status LEDs are located on the back of the cameras, please see below.

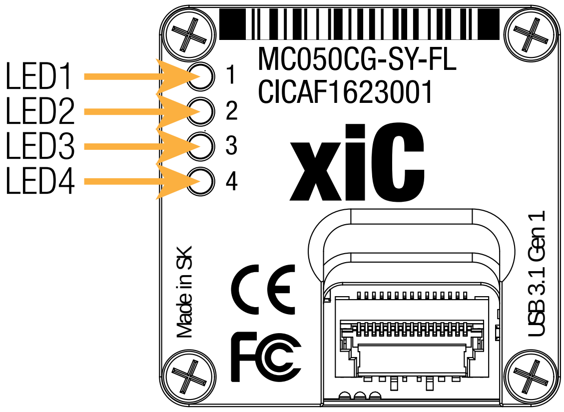


figure 3-36, position status LEDs

All LEDs can be configured similar as standard input and output lines.

Default LED function after power on

LED	Color	Power-on defaults	Note
1	Red	On	User configurable
2	Green	Exposure active	User configurable
3	Blue	Frame active	User configurable
4	Orange	Connection status	User configurable

table 3-39, LED output description

LED statuses during boot sequence

Status	LED1 (Red)	LED2 (Green)	LED3 (Blue)	LED4 (Orange)
Off	Off	Off	Off	Off
Power	On	Off	Off	Off
Booting	Off	flash ~2Hz	flash ~2Hz	Off
Boot up finished	On	Off	Off	On
USB init - wait for enumeration	flash ~1Hz	Off	Off	Off
Enumeration finished USB2	Off	Off	Off	flash ~2Hz
Enumeration finished USB3	Off	Off	Off	On
Device stop	flash ~2Hz	Off	Off	flash ~2Hz
Error	flash ~2Hz	Off	Off	flash async.

table 3-40, LED status during boot

Default LED function after xiOpenDevice

LED	Color	LED function
1	Red	On
2	Green	Exposure active
3	Blue	Frame active
4	Orange	On

table 3-41, LED output description

3.7. xiC USB 3.1 Gen1 Type-C Interface

Connector	Signals	Mating Connectors
USB 3.1	Standard USB 3.1 Gen1 Type-C Connector	Standard USB 3.1 Type C Connector with thumbscrews Screw thread M2, thread distance 15.0mm

table 3-42, USB 3.1 mating connector description

The USB 3.1 Type C connector is used for data transmission, camera control and power.

3.7.1. Type-C connector location

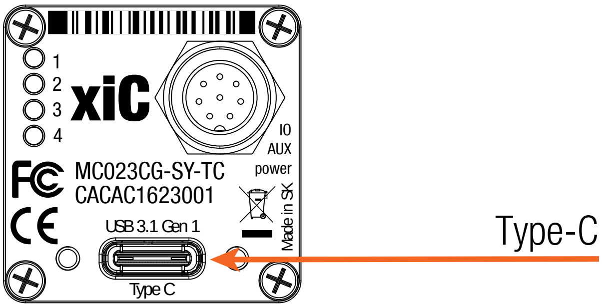


figure 3-37, position of Type-C connector

3.7.2. Pinning

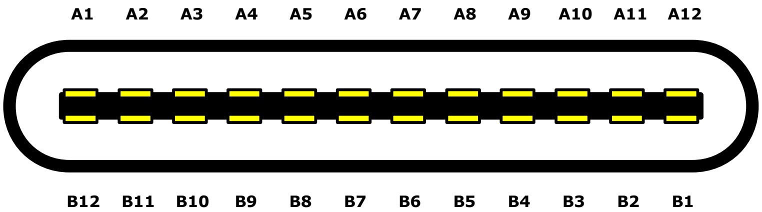


figure 3-38 pinning of Type-C connector

Pin	Signal	Description	Pin	Signal	Description
A1	GND	Ground return	B12	GND	Ground return
A2	SSTXp1	SuperSpeed differential pair #1, TX, pos.	B11	SSRXp1	SuperSpeed differential pair #2, RX, pos.
A3	SSTXn1	SuperSpeed differential pair #1, TX, neg.	B10	SSRXn1	SuperSpeed differential pair #2, RX, neg.
A4	VBUS	Bus power	B9	VBUS	Bus power
A5	CC1	Configuration channel	B8	SBU2	Sideband use (SBU)
A6	Dp1	Non-SuperSpeed diff. pair, position 1, pos.	B7	Dn2	Non-SuperSpeed diff. pair, position 2, neg.
A7	Dn1	Non-SuperSpeed diff. pair, position 1, neg.	B6	Dp2	Non-SuperSpeed diff. pair, position 2, pos.
A8	SBU1	Sideband use (SBU)	B5	CC2	Configuration channel
A9	VBUS	Bus power	B4	VBUS	Bus power
A10	SSRXn2	SuperSpeed differential pair #4, RX, neg.	B3	SSTXn2	SuperSpeed differential pair #3, TX, neg.
A11	SSRXp2	SuperSpeed differential pair #4, RX, pos.	B2	SSTXp2	SuperSpeed differential pair #3, TX, pos.
A12	GND	Ground return	B1	GND	Ground return

table 3-43 USB type C connector pin assignment

3.8. xiC USB 3.1 Gen1 micro-B Interface

Connector	Signals	Mating Connectors
USB 3.1	Standard USB 3.1 Gen 1 Micro-B Female Connector	Standard USB 3.1 Gen1 Micro-B Connector with thumbscrews Screw thread M2, thread distance 18.0mm

table 3-44, USB 3.1 micro-B mating connector description

The USB 3.1 Micro-B connector is used for data transmission, camera control and power.

3.8.1. USB 3.1 micro-B Location

The micro-B connector is located on the back side of the camera:

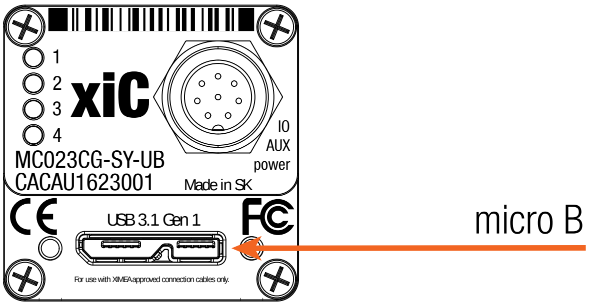


figure 3-39, position USB 3.1 Gen1 interface

3.8.2. Pinning

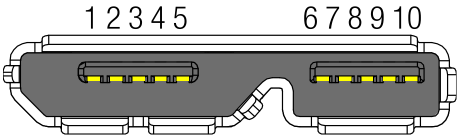


figure 3-40, pinning USB 3.1 / USB 3.0 connector

USB 3.1 Micro-B connector (powered) Pin Assignment

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

table 3-45, USB 3.0 connector, pin assignment

The USB 3.1 / USB 3.0 standard is backward compatible with the USB 2.0 interface.

3.9. xiC 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.

Camera model	Connector	Camera model	Connector
-FL	Molex 502244-1530	-FV	Molex 502231-1500

table 3-46 Connector part numbers

3.9.1. Flex Connection Location

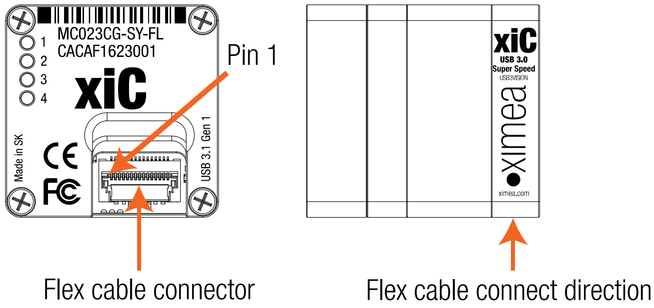


figure 3-41 Flex connector location FL version

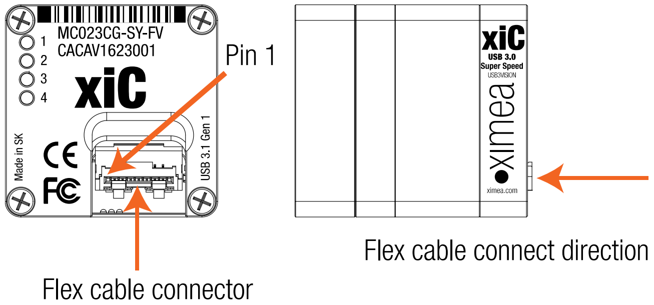


figure 3-42 Flex connector location FV version

3.9.2. Pinning

Pin	Signal	Technical description
1	GND	Ground for power return and for SuperSpeed signal return
2	SSRX-	SuperSpeed receiver dif. pair (accepts reverse polarity)
3	SSRX+	SuperSpeed receiver dif. pair (accepts reverse polarity)
4	GND	Ground for power return and for SuperSpeed signal return
5	SSTX+	SuperSpeed transmitter dif. pair (accepts reverse polarity)
6	SSTX-	SuperSpeed transmitter dif. pair (accepts reverse polarity)
7	GND	Ground for power return and for SuperSpeed signal return
8	D+	USB 2.0 differential pair
9	D-	USB 2.0 differential pair
10	GND	Ground for power return and for SuperSpeed signal return
11	VBUS	+5V Power input
12	VBUS	+5V Power input
13	OUT1	Trigger/sync digital Output (GPO) - Open collector NPN
14	IN/OUT GND	Common pole (IO Ground
15	IN1	Trigger/sync digital Input (GPI) Current limited input
Ground pins	SGND	Shield of FPC cable connected to shield of host controller

table 3-47 Pin list for flex cable

3.9.3. Inserting / detaching FPC cable

When inserting or detaching cables increased caution need to be taken, to prevent connector or cable damage. MC cameras interface connectors are equipped with locking mechanism. When locked pulling the cable may lead to damage of connector or camera. When manipulating with cable the power supply for the camera must be turned off.

⚠ Cables PN: CBL-MQ-FL-xxx (gold) 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 can cause damage to camera. It is important that the power is turned off when inserting/detaching the cable.

figure 3-43, MC FPC cable CBL-MQ-FL-xxx laser marking

Cables PN: CBL-USB3FLEX-xxx (white) are not polarized therefore the orientation of the cable between camera and host is not important.

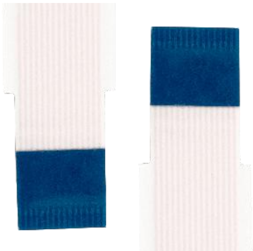


figure 3-44, MC FPC cable CBL-USB3FLEX-xxx ends

Inserting FPC cable MC option -FL

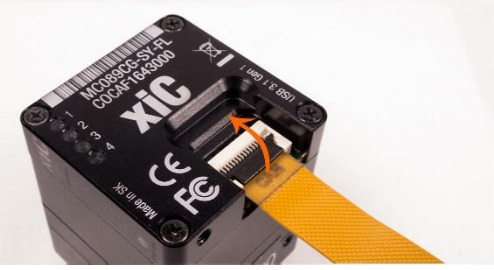
Open connector lock

Insert cable (contact on cable facing down)

Close connector lock

figure 3-45, MC FPC insert procedure option -FL

Detaching FPC cable MX X2G2 option –FL



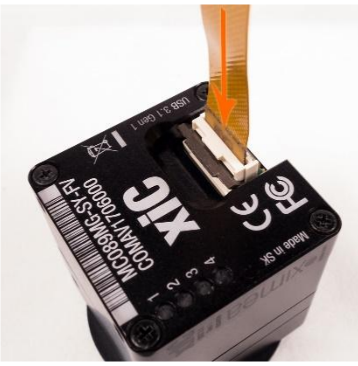
Open connector lock

Pull cable gently in marked direction.

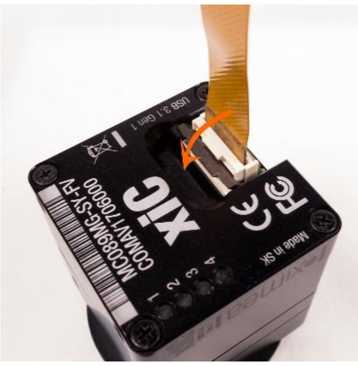
figure 3-46, MC FPC detach procedure option -FL

Inserting FPC cables MC option -FV

Open connector lock



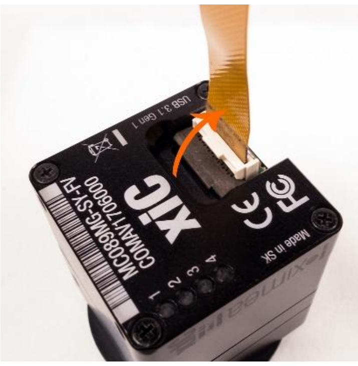
Insert cable



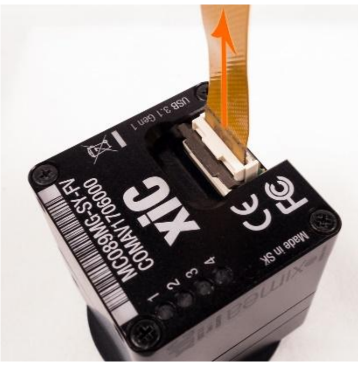
Close connector lock.

figure 3-47 MC FPC insert procedure option -FV

Detaching FPC cable MX X2G2 option –FV



Open connector lock



Pull gently the cable out as marked.

figure 3-48, MC FPC detach procedure option -FV

3.10. xiC Digital Input / Output (GPIO) Interface

USB xiC cameras use the 8-pin connector for the GPIO interface and external power supply (AUX) connection and have multiple options for inputs and outputs. The flex line cameras have one input and one output available through the flex line (see pin-out above).

Connector	Signals	Mating Connectors
I/O & Sync 8-pin	Opto-isolated trigger input and non-isolated I/O	Binder 8-pin PN: 79 1426 15 08
Flex cable	One input and one output opto-isolated	

table 3-48, GPIO mating connector description

3.10.1. Location

IO interface receptacle (for USB cameras only) is located on the back of the camera:

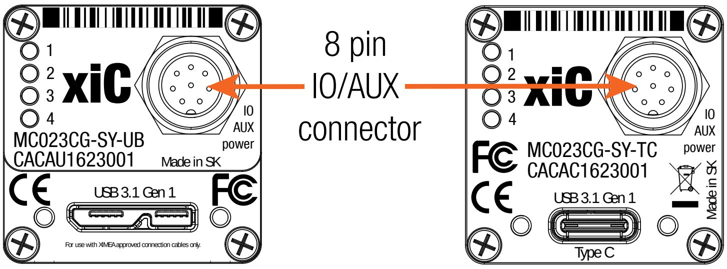


figure 3-49, position GPIO connector

3.10.2. IO Connector Pinning

Pinning of the IO connector (camera):

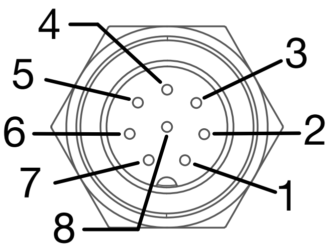


figure 3-50, pinning GPIO connector

I/O connector Pin Assignment:

Pin	Name	Signal	Technical description	GPI/GPO index API
1	AUX PWR	Power supply input	5V	
2	INOUT2	Non-isolated I/O	LVTTL (3V, 50µA)	3/3
3	OUT1	Opto- isolated Output 1	Open collector	-/1
4	OUT GND	Ground for Opto-Isolated Out (OUT1)		
5	IN1	Opto-isolated Input 1	(<0.8V low; 4-24V high)	1/-
6	IN GND	Ground for Opto-Isolated Input (IN1)		
7	GND	Ground for power and non-isolated I/O		
8	INOUT1	Non-isolated I/O	LVTTL (3V, 50µA)	2/2

table 3-49, I/O connector Pin Assignment

3.10.3. Optically isolated Digital Input

3.10.3.1. Optically isolated Digital Input - General info

Item	Parameter / note

Maximal input voltage	24V
Common pole	No
Effect of incorrect input terminal connection	Reverse voltage polarity protected
Effects when withdrawing/inserting input module under power	No damage, no lost data
Maximum recommended cable length	5m
Input level for logical 0	Voltage < 2.0V/Current 0mA to 0.3mA
Input level for logical 1	Voltage > 4.0V/Current 4mA to 6mA
Input debounce filter	No
Input delay – rising edge	1.7 +/-0.2µs (V_{INPUT}=10V, $T_{AMBIENT}$=25°C)
Input delay – falling edge[1]	10.7 +/-0.2µs (V_{INPUT}=10V, $T_{AMBIENT}$=25°C)
Number of inputs	1
External trigger mapping	Yes
Input functions	Trigger, get current level (rising or falling edge are supported)

table 3-50, Optically isolated digital input, general info

Note: – 1) Propagation delay depends on voltage level, propagation jitter is significantly lower.

3.10.3.2. Digital Input – signal levels

Input levels are not IEC 61131-2, Type 1 as the ON state has been extended to support 5V TTL

V-in-min [V]	V-in-max [V]	State	I-max [mA]
-24.0	2.0	Off (0)	0.0 – 0.3 mA (0mA nominal)
2.0	4.0	Transient	4
4.0	24.0	On (1)	4 – 6 mA (5mA nominal)

table 3-51, digital info, signal levels

Note:

- Input level **Vin** represents amplitude of the input signal.
- Voltage levels referenced to common ground GND

3.10.3.3. Digital Input – Internal Schematic

The internal scheme of Digital Input signal flow inside the camera is below.

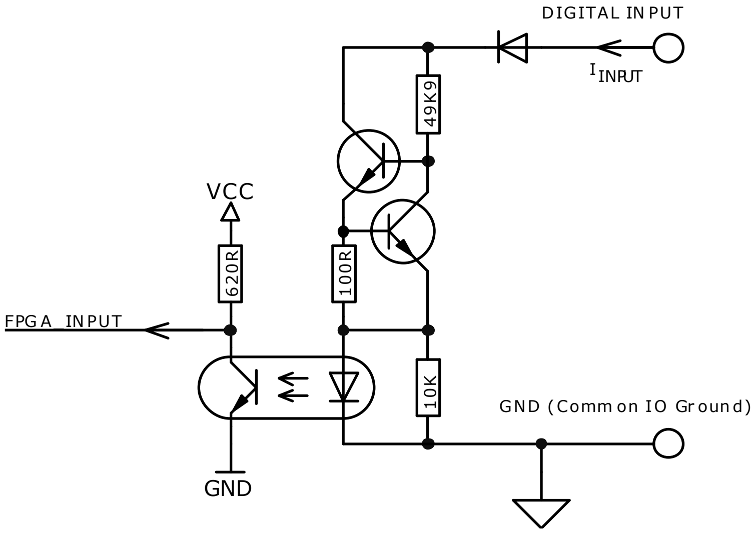


figure 3-51, digital input, interface schematic

3.10.3.4. Digital Input – Wiring

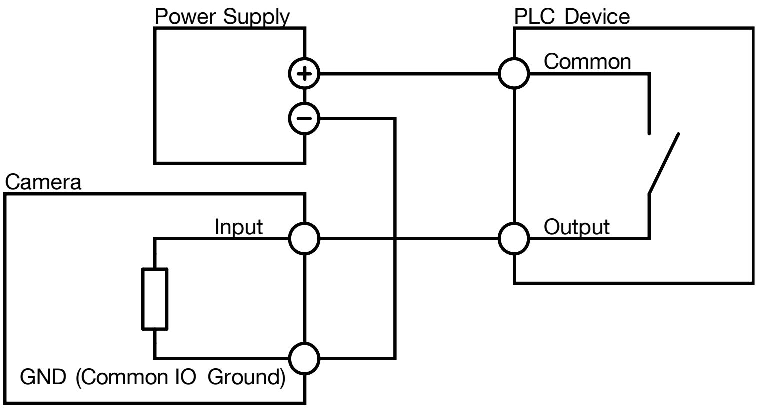


figure 3-52, digital input, interface wiring

3.10.3.5. Digital Input – Timing

Typical measured input delay between Digital Input to FPGA Input

Measurements of input delays:

Edge Type	Input Voltage [V]	Typ. delay [µs]
Rising	5	1.6
Rising	10	1.7
Falling	5	7.8
Falling	10	10.7
Falling	24	12.7

table 3-52, digital input, timing

Note:

- Measured at: Ambient Temperature 25°C

3.10.4. Optically isolated Digital Output

3.10.4.1. Optically isolated Digital Output - General info

Item	Parameter / note
Maximal open circuit voltage	24V
Output port type	Open collector NPN
Protection	short-circuit / over-current / Reverse voltage
Protection circuit	PTC Resettable Fuse
Maximal sink current	25mA
Trip current	50mA – self restarting when failure mode current disconnected
Inductive loads	No
Effect of incorrect output terminal connection	Protected against reverse voltage connection
Maximal output dropout	1.7V, sink current 25mA
Number of outputs	1
Strobe output mapping	Yes

table 3-53, Optically isolated digital output, general info

3.10.4.2. Optically isolated Digital Output Delay

Output current	OFF -> ON	ON -> OFF	Note
2mA	0.55 µs	41 µs	V_{OUTPUT}=5V, $T_{AMBIENT}$=25°C
5mA	0.6 µs	43 µs	V_{OUTPUT}=5V, $T_{AMBIENT}$=25°C
10mA	0.88 µs	51 µs	V_{OUTPUT}=11V, $T_{AMBIENT}$=25°C
25mA	1.4 µs	51 µs	V_{OUTPUT}=13V, $T_{AMBIENT}$=25°C

table 3-54, Optically isolated digital output, delay

3.10.4.3. Optically isolated Digital Output – Internal schematic

Following scheme is the internal scheme of the Digital Output signal flow inside the camera.

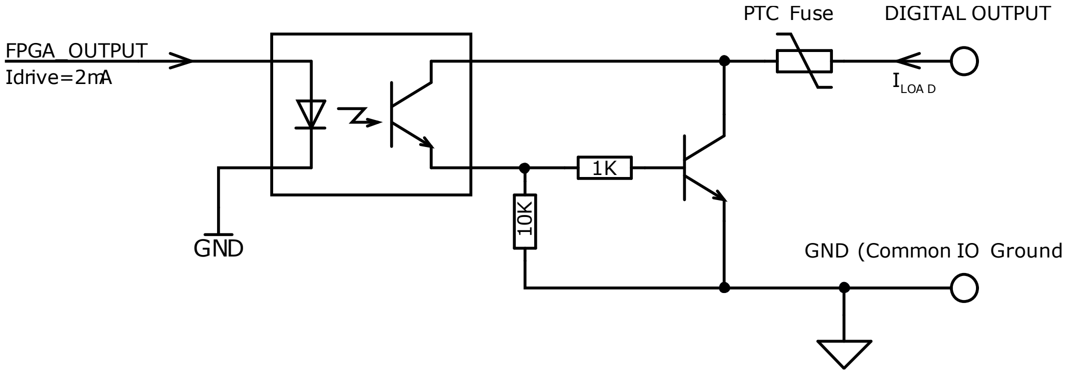


figure 3-53, digital output, interface schematic

Output Transfer Characteristic

When Output is in On state - typical transfer characteristic of output is as on following figure:

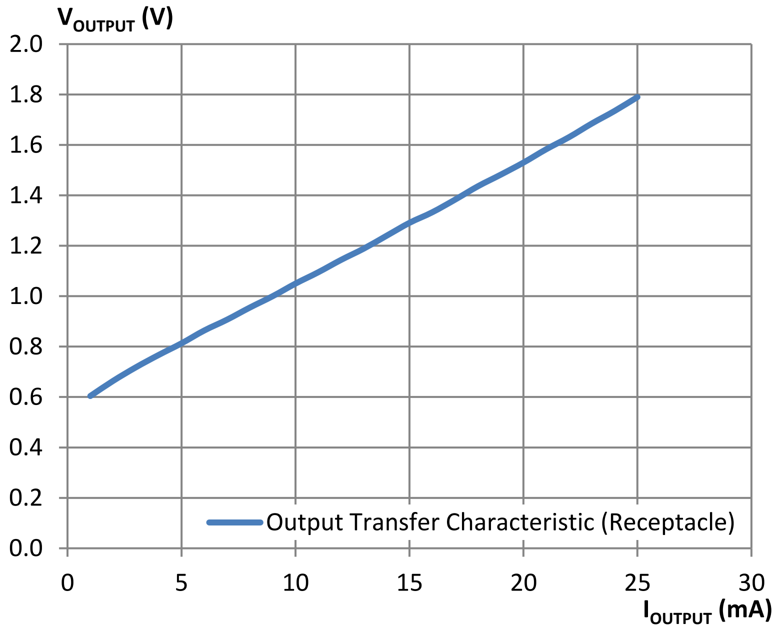


figure 3-54, digital output transfer characteristics

3.10.4.4. Digital Output – Wiring

Digital output has an open collector switching transistor with common IO Ground. In most cases a power source for external device must be provided.

3.10.4.4.1. Connecting Digital OUTPUT to an NPN-compatible PLC device input (biased)

Output state	Output switch state	Input state
ON	Sourcing current	Pull up (energized)
OFF	Relaxing	Not energized

table 3-55, Connecting Digital OUTPUT to an NPN-compatible PLC device input (biased)

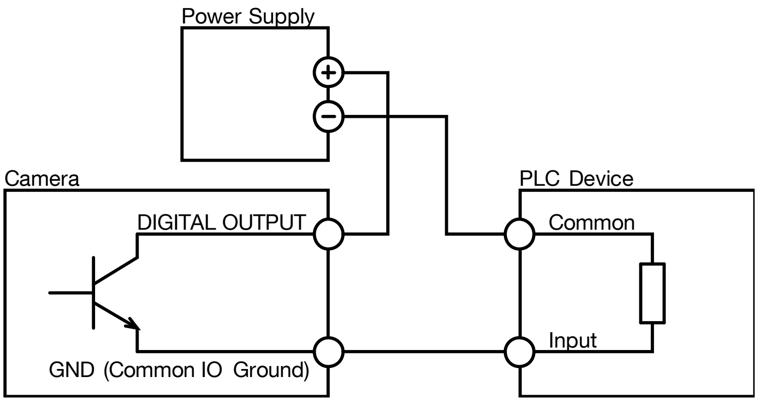


figure 3-55, Connecting Digital OUTPUT to a NPN-compatible PLC device input (biased)

Important note:

- If using this configuration, consider that Common Ground connection may be biased by power supply for Digital Input!

3.10.4.4.2. Connecting Digital OUTPUT to an NPN-compatible PLC device input

This type of connection is possible only when opto-isolated input is used (bidirectional in some cases) or when only one general opto-isolated input is used.

Output state	Output switch state	Input state
ON	Sourcing current	Pull down (energized)
OFF	Relaxing	Not energized

table 3-56, Connecting Digital OUTPUT to an NPN-compatible PLC device input

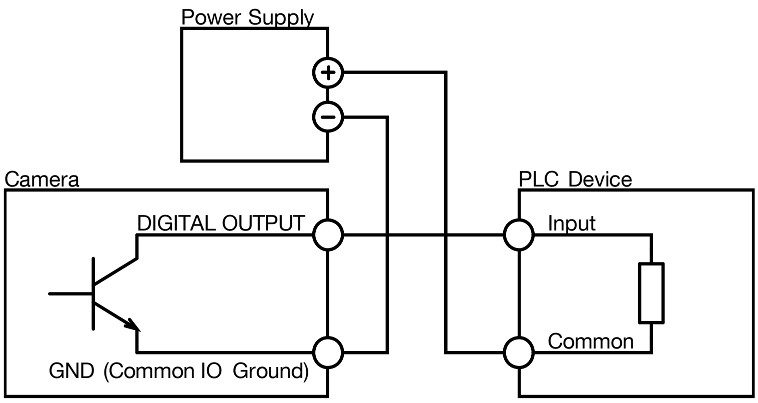


figure 3-56, Connecting Digital OUTPUT to an NPN-compatible PLC device input - more bidirectional inputs used

Note:

- In this case a bidirectional opto-isolated input must be used

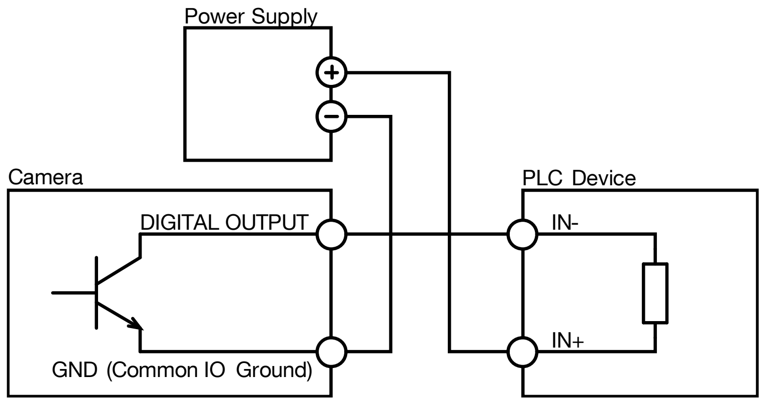


figure 3-57, Connecting Digital OUTPUT to a NPN-compatible PLC device - single input

3.10.4.4.3. Connecting Digital OUTPUT to a PNP-compatible device

Output state	Output switch state	Input state
ON	Sinking current	Not energized
OFF	Relaxing	Pull up (energized)

table 3-57, Connecting Digital OUTPUT to an PNP-compatible device

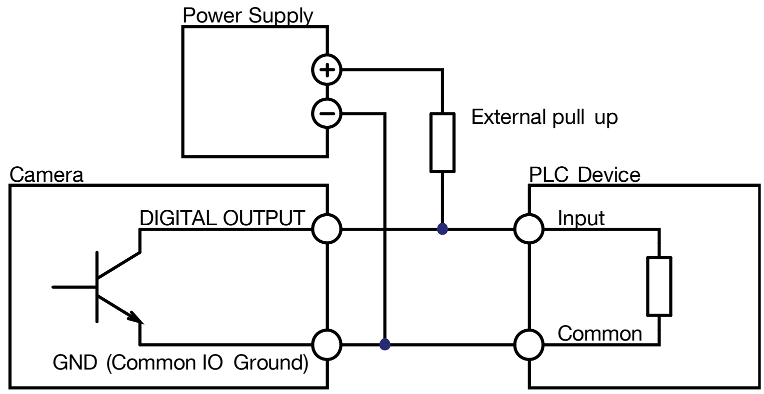


figure 3-58, Connecting Digital OUTPUT to a PNP-compatible device

Pull up resistor can be calculated as follows: $R = \frac{V_{psu} - V_{input}}{I_{input}}$

Where:

V_{psu} power supply voltage. Must be higher than required input amplitude

V_{input} required input amplitude

I_{input} input driving current (corresponding to input amplitude)

Remember to use the appropriate resistor power rating $P(R) > (V_{psu} - V_{input}) * I_{input}$

3.10.4.4.4. Output Wiring Example: LED Driving

LED can be driven directly by camera digital output. A series resistor must be used to limit LED current.

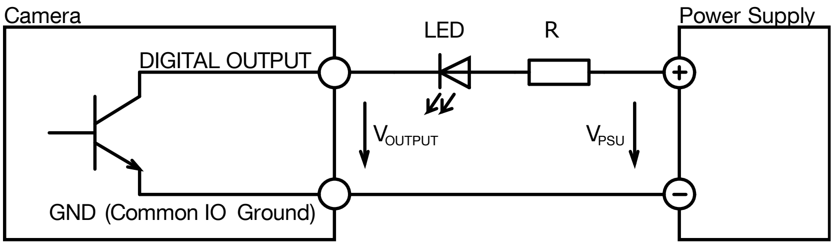


figure 3-59, LED Driving

LED series resistor can be calculated by the following equation: $R = \frac{V_{psu} - V_{output} - V_{led}}{I_{led}}$

Where:

V_{psu} power supply voltage (5V to 24V)

V_{output} voltage across digital output pins (see. *3.10.4.1 Optically isolated Digital Output - General info*)

V_{led} LED forward voltage (see table below)

I_{led} LED current

Note:

- Remember to use the appropriate resistor power rating $P(RES) = {I_{led}}^2 \times R = (V_{psu} - V_{led}) \times I_{led}$

Typical LED forward voltage

LED Color	V_{led} (typ.)	V_{led} (max.)	Note
Standard Red	1.7V	2.1V	
Super Bright Red	1.85V	2.5V	
Low power Red	1.7V	2.0V	
Orange	2.0V	2.1V	
Yellow	2.1V	2.2V	
Green	1.9V	2.5V	
Emerald Green	2.1V	2.7V	
Blue	2.5V	3.7V	
White	2.8V	3.8V	
Infra-Red	1.3V	1.8V	Opto-coupler

table 3-58, digital output, LED driving

3.10.4.4.5. Output Wiring Example: Inductive load (Relay) Driving

Do not connect inductive load RL directly to Camera Digital Output. A transistor must be used to prevent damage of the output. See image below for possible inductive load driving. Resistor R can be connected to Digital Outputs and power supply to provide the necessary bias current for transistor. You should also use an external diode to protect the transistor from over voltage while disconnecting an inductive load. Keep in mind that this connection has an inverted logic. Current will flow through the load at the start of the camera.

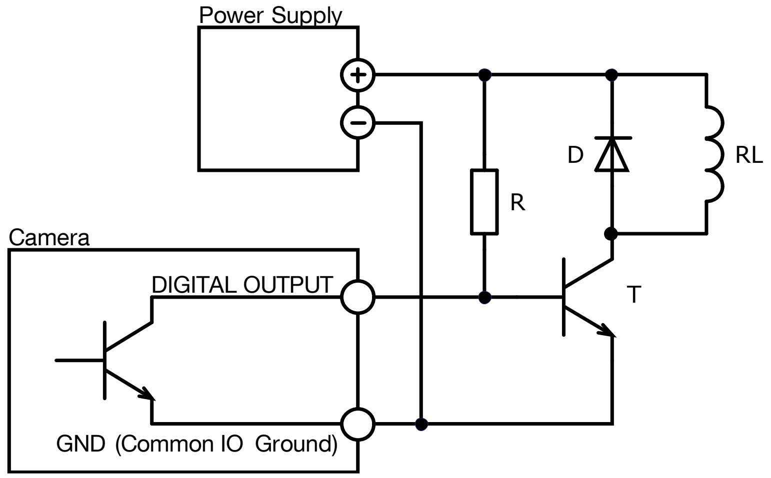


figure 3-60, Inductive load (Relay) Driving (inverted logic)

For positive logic you can use a second bipolar transistor.

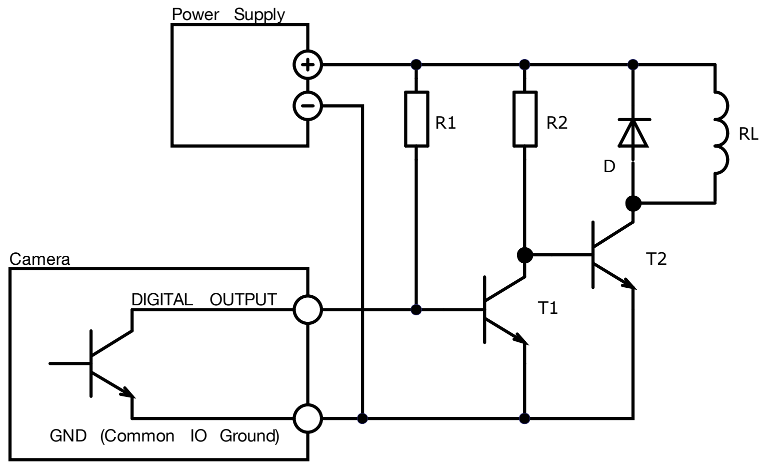


figure 3-61, Inductive load (Relay) Driving (non-inverted logic)

3.10.4.4.6. Output Wiring Example: Driving the trigger input of a strobe controller

The digital output can be used to drive a strobe controller according to the table below.

Driving the trigger input of a strobe controller

Trigger polarity	Opto-isolated controller input	Output delay	Wiring	Description
Positive edge	Yes	0.5µs	figure 3-55	
Negative edge	Yes	0.5µs	figure 3-57	
Positive edge	No	155µs	figure 3-58	Not recommended in cases when short delay time is required. Output delay is much longer than in other wiring examples. Use external pull up in case that no pull up at controller input is used.
Negative edge	No	0.5µs	figure 3-58	Note that external pull up is not used in this case. Assume that internal pull up at the controller input is used.

table 3-59, digital output, wiring examples

3.10.4.5. Digital Output – Timing

Typical input delay between FPGA Output to Digital Output

Edge Type	Typ. delay [µs]
Off -> On	0.5
On -> Off	155

table 3-60, digital output, typical timing

Note: Measured at conditions: V_{OUTPUT}=18V, $T_{AMBIENT}$=27°C

Output delay depending on output current:

Output current	OFF->ON	ON->OFF
2mA	0.55µs	184µs
5mA	0.55µs	182µs
10mA	0.55µs	133µs
25mA	0.55µs	113µs

table 3-61, digital output, current depending on timing

Note: Measured at conditions: V_{OUTPUT}=11V, $T_{AMBIENT}$=25°C

3.10.5. Non-isolated Digital Lines (-UB and -TC only)

Non isolated Digital lines can be used as inputs or outputs compatible with TTL logic. These are high impedance pins so when used as output high impedance slave input must be used.

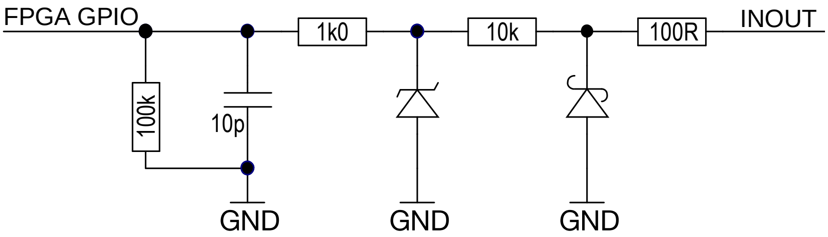


figure 3-62, non-isolated input/output, interface schematic

3.10.5.1. Non-isolated Digital Input/Output (INOUT) General info

Item	Parameter/note
Number of digital lines	2, each line can be configured by application separately as input or output
Maximum input voltage	24V DC
Common pole	Yes, AUX power GND
Effect of incorrect input terminal connection	Reverse voltage polarity protected
Effects when withdrawing/inserting input module under power	No damage, no lost data
Protection	Short-circuit/over-current/reverse voltage
Maximal output sink current	30µA, maximum advised load = 60kΩ
Inductive loads	No
Output level logical 0	<0.4V, Load 100kΩ
Output level logical 1	>2.5V, Load100kΩ
Output delay – rising edge	400ns, Load 100kΩ, threshold 2V
Output delay - falling edge	450ns, Load 100kΩ, threshold 0.5V
Input impedance – minimum	15kΩ
Input level for logical 0	<0.7V
Input level for logical 1	>3.3V
Input debounce filter	No
Input delay – rising edge	750ns, V_{INPUT}=5V, $T_{AMBIENT}$=25°C
Input delay – falling edge[1]	1200ns, V_{INPUT}=5V, $T_{AMBIENT}$=25°C
Input functions	Trigger, get current level; Rising or falling edge are supported for trigger
Output functions	Off, On, Exposure active, Frame active; Signal inversion supported

table 3-62, General info for non-isolated digital in/out trigger lines.

NOTE 1) Because of low input impedance of non-isolated input it is not possible to connect master slave of two cameras directly. Signal conditioning (buffer, opamp…) is required

3.11. External power supply input (AUX)

Item	Parameter/note
Supported voltage range	4.5-5.5V
Typical input current[1]	0.65A, @5V while acquiring
Maximum input current[1]	0.67A, @5V
Protection	Over/under voltage protection

table 3-63, External power supply input (AUX)

Note 1) Is model depended. Used values are for MC124MG-SY-TC

3.12. Heat Dissipation

XIMEA strives to offer the smallest cameras with the highest performance. Although the cameras are first in terms of power efficiency, the high packing density of components can lead to elevated temperatures, and an adequate dissipation of this heat must be ensured. The cameras rely on adequate surface contact with a thermal mass (tripod, lens, heat sink) of sufficient size for heat dissipation and this must be provided by the user.

3.13. CBL-U3-1M0 / CBL-U3-3M0 / CBL-U3-5M0

1.0m / 3.0m / 5.0m USB 3.0 cables

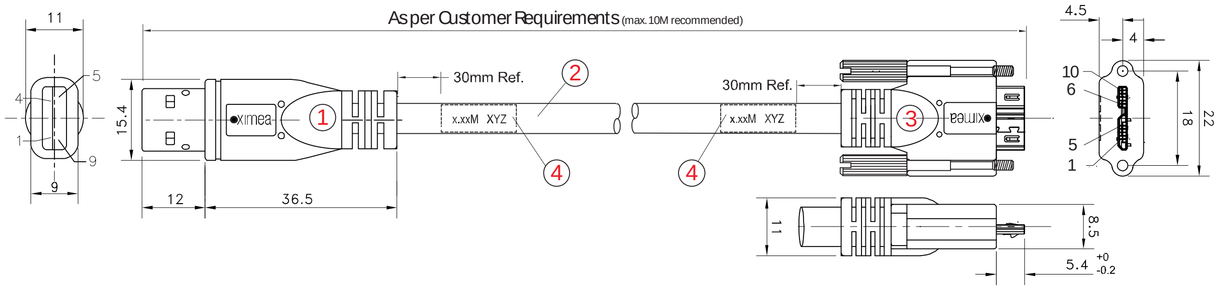


figure 3-63, drawing USB3 cable

Item	Description
1	USB A 3.0 9 pin Molded Plug <BLK>
2	MCD-USB-211 [OD= 7.3mm] <BLK>
3	3 USB MicB 3.0 sl 10 pin Molded Plug with Screw Locking <BLK>
4	Cable Label

table 3-64, USB3 cable, components

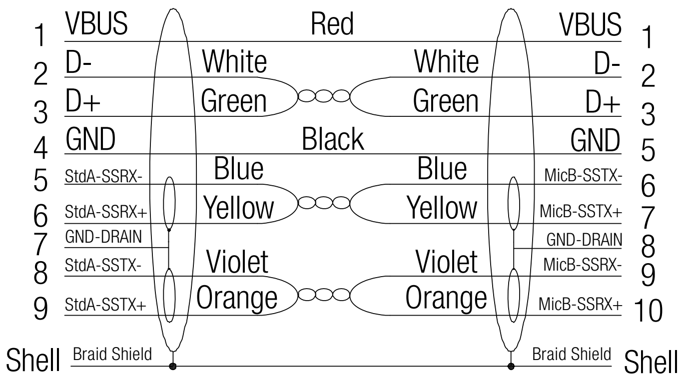


figure 3-64, wiring USB3 cable

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 3-65, USB3 connector, pin assignment

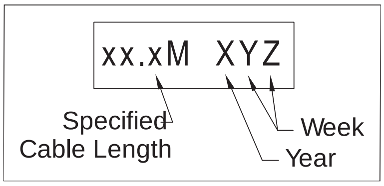


figure 3-65, label details USB3 cable

3.14. CBL-U3-3M0-ANG

3.0m USB 3.0 cable, angled micro USB3 connector

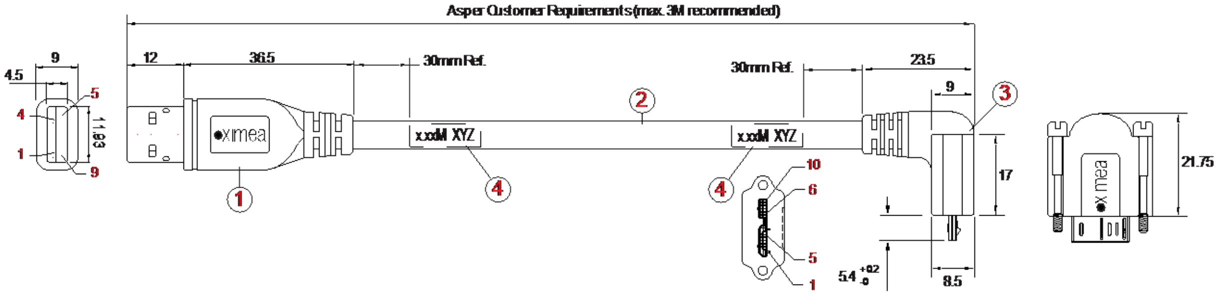


figure 3-66, drawing USB3 cable angled

Item	Description
1	USB A 3.0 9 pin Molded Plug <BLK>
2	A12-7143 [OD=5.9mm] <BLK> UL20726 2STP#30 + 1UTP#28 + 2C#26
3	USB MicB 3.0 sl 90D A1(10 pin Molded Plug) <BLK>
4	Cable Label

table 3-66, USB3 cable angled, components

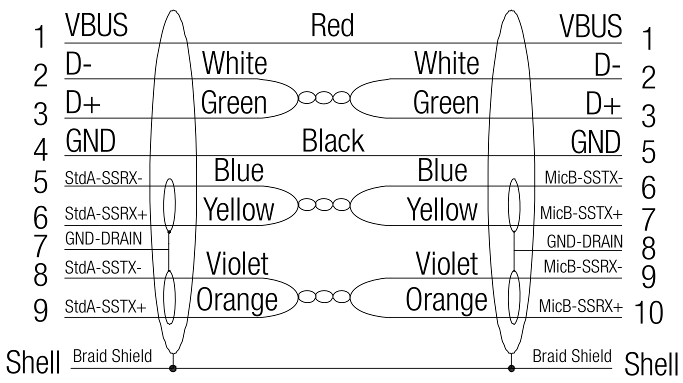


figure 3-67, wiring USB3 cable angled

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 3-67, USB3 connector, pin assignment

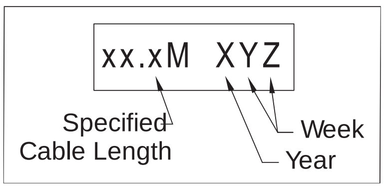


figure 3-68, label details USB3 cable angled

3.15. CBL-MQ-FL-0M1/CBL-MQ-FL-0M25

Cable FPC MQ Flex-Line, 0.1m/0.25m 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 2mm. Cable thickness 0.16mm.

figure 3-69, flex cable gold color

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.

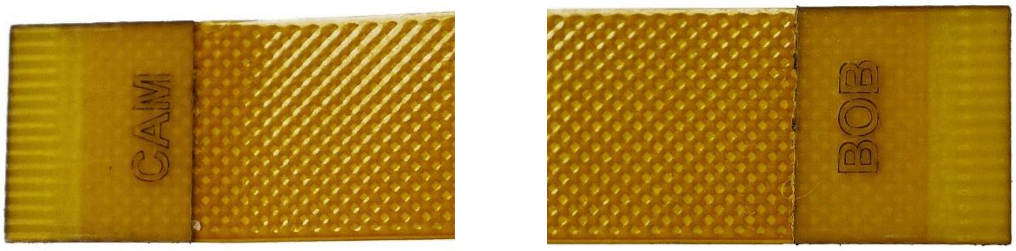


figure 3-70, flex cable ends

3.16. CBL-USB3FLEX-0M10 / CBL-USB3FLEX-0M25 / CBL-USB3FLEX-0M50

The newer generation of FFC cable with available lengths 0.1m, 0.25m and 0.5m can be used for connecting camera to carrier board or trough adapter to the host computer. Minimal advised bending radius is 5mm. Cable thickness 0.38mm. This cable is NOT polarized and either end can be used for the camera or the host.

figure 3-71, flex cable white color

3.17. BOB-MQ-FL

Break Out Board, Simple Board Level. Enables access to the opto-isolated input and output. FPC cable connector pinout is exactly mirrored from camera pinout. Please refer to *3.9.2 Pinning*

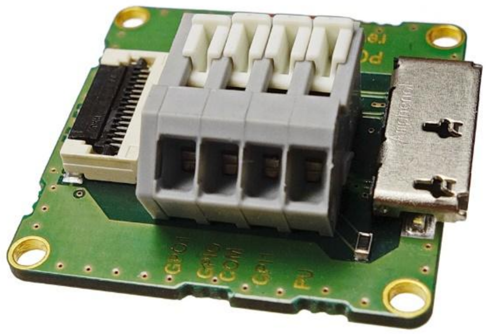


figure 3-72, drawing USB3 cable

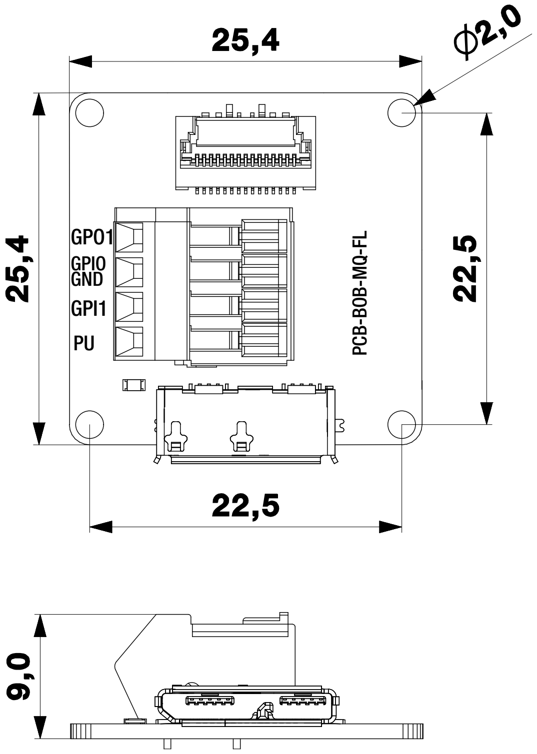


figure 3-73, BOB-MQ-FL dimensions

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 1kOhm to GPO1 – Connect power supply up to 25V if needed

table 3-68, IO connector (WAGO 218-104), pin assignment

3.18. CBL-702-8P-SYNC-5M0

5.0m xiC / xiT series I/O Sync cable 8 poles

Sync cable wiring

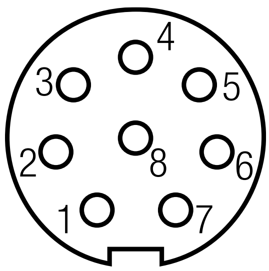


figure 3-74, IO/AUX cable pin numbering

Pin	color	Signal
1	White	AUX power supply input
2	Brown	INOUT2 - non-isolated Input/Output
3	Green	OUT1 - Opto-isolated Output
4	Yellow	OUT_GND Opto-Isolated output ground pole
5	Grey	IN1 - Opto-isolated Input
6	Pink	IN_GND Opto-Isolated input ground pole
7	Blue	External grounds for power supply and non-isolated I/O
8	Red	INOUT1 - non-isolated Input/Output

table 3-69, IO/AUX cable, pin assignment

3rd party cables compatible with xiC

Part number	Manufacturer	Link
79 1426 12 08	binder	https://www.binder-usa.com/products/partsdetail/88888
79 1426 15 08	binder	https://www.binder-usa.com/products/partsdetail/88890
79 1426 72 08	binder	https://www.binder-usa.com/products/partsdetail/88889
79 1426 75 08	binder	https://www.binder-usa.com/products/partsdetail/88892
79 1462 212 08	binder	https://www.binder-usa.com/products/partsdetail/88901
79 1462 215 08	binder	https://www.binder-usa.com/products/partsdetail/88904
79 1462 275 08	binder	https://www.binder-usa.com/products/partsdetail/88905
79 1462 272 08	binder	https://www.binder-usa.com/products/partsdetail/88906

table 3-70, alternative cables

3.19. Tripod Adapter – MECH-MC-BRACKET-KIT

xiC series tripod mounting bracket

figure 3-75, mounting tripod adapter

xiC series tripod mounting bracket with 1/4-20 thread.

Use 4x SROB-M2x4-CUST screws (included) for mounting. Bracket can be mounted on the bottom or top side of the camera.

3.19.1. Dimensional drawings

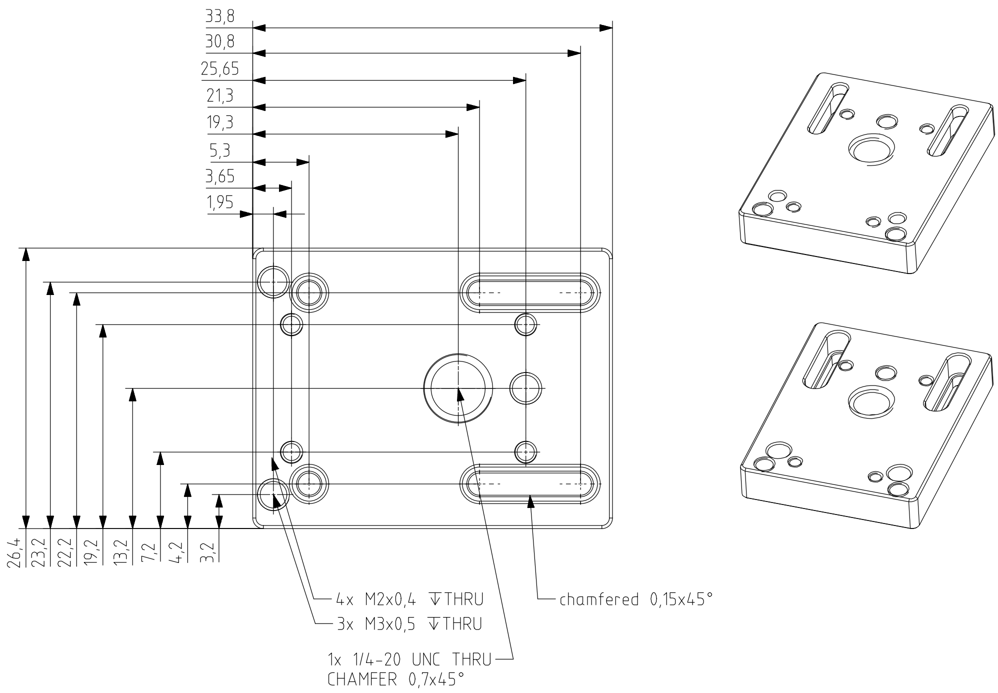


figure 3-76, dimensional drawing tripod adapter

Mass without screws: 11.4 g.

3.20. USB 3 host adapters

USB 3.0 to PCI Express x1 Gen2 Host Card

figure 3-77, USB3 host adapters

Please refer to following page https://www.ximea.com/support/projects/usb3/wiki/USB_3_Host_Adapters for more information.

System requirements

All requirements depend on selected host adapter. Please refer to host adapter specification

4. Operation

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

4.1. System Requirements

4.1.1. Software Requirements

The xiC cameras are compatible with the following operating systems:

- Windows 10
- Windows 7 SP1
- Linux Ubuntu
- MacOS 10.8 or newer

All XIMEA cameras are compatible with the most advanced Vision and Image Processing Libraries.

See chapter *5 Software* for more information about the options to access a xiC cameras, as well as a list of currently supported libraries and frameworks supported in Windows.

For more information visit page: https://www.ximea.com/support/wiki/apis/APIs

4.1.2. Hardware Requirements

The XIMEA xiC 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 at:

Recommended hardware   http://www.ximea.com/support/wiki/usb3/Compatible_hardware

4.1.2.1. System Configuration

Minimum system configuration:

For a basic operation of your xiC camera with a PC the following minimum system configuration is required. Please note that bandwidth and processing performance are tied to the hardware configuration and the minimum hardware configuration could lead to a reduced bandwidth and limited frame rate.

CPU:	Intel i3 or better
RAM:	2GB RAM or more
Disc Space:	200 MB of free disc space
Video:	NVIDIA or Radeon graphics card 128MB or integrated on CPU
Ports:	Motherboard with USB 2.0 or USB 3.0 port or PCIe x1-16 Gen 2 slot for compatible USB 3.0 host adapter

Recommended system configuration:

For best processing performance and bandwidth, we recommend using the following system configuration. This is essential when using the higher resolution models for achieving maximum frame rate.

CPU:	Intel i7
RAM:	4GB RAM or more
Disc Space:	200 MB of free disc space
Video:	NVIDIA or Radeon graphics card 128MB or integrated on CPU
Ports:	Motherboard with a USB 3.1 Gen1 port connected to a high-performance chipset (e.g., Intel QM77, Z77 or successors) and/or PCIe x1-16 Gen 2 slot for compatible USB 3.1 Gen1 host adapter. Some host adapters may require PCIe Gen3 ports (see next chapter for more details).

4.1.2.2. USB 3.1 Host Adapter

For a stable operation of your xiC 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: http://www.ximea.com/support/wiki/usb3/Compatible_hardware

XIMEA maintains a regularly updated overview of compatible USB 3.0 and USB 3.1 host adapters together with the available bandwidth https://www.ximea.com/support/projects/usb3/wiki/USB_3_Host_Adapters

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

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

4.1.2.3. Cables

The USB 3.1 Gen1 cable that you use with the xiC camera is responsible for the power supply and the data transfer to the PC. It is required to use an industrial USB 3.1 Gen1 cable with a proper wiring and shielding. We recommend using XIMEA industrial USB 3.1 Gen1 cables to achieve the maximum possible performance of the camera.

XIMEA offers several passive USB 3.1 Gen1 cables and a sync cables, please see *3.13 CBL-U3-1M0 / CBL-U3-3M0 / CBL-U3-5M0*, *3.14 CBL-U3-3M0-ANG* and *3.15 CBL-MQ-FL-0M.*

4.2. Video Formats

4.2.1. Full Resolution

By default, each camera outputs a full resolution image based on its sensor specification.

4.2.2. 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.

Depending on the sensor xiC cameras support the definition of one single ROI by specifying the size (width and height) as well as the position (based on upper left corner) of the of the sub-area.

Please note *3.5 Model Specific Characteristics*

4.2.3. 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.

4.2.3.1. 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.

4.2.3.2. Decimation

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

4.2.4. Image Data Output Formats

All modes are provided by the xiAPI or standard interfaces using the xiAPI (please note *5.1 Accessing the Camera*).

Each xiC cameras supports several Image Data Output Formats.

Mode	Description
RAW8	Raw sensor data, 8 Bit per pixel, single channel
RAW16	Raw sensor data, 16 Bit per pixel, single channel 10- or 12-Bit sensor output (LSB) with bit-shift up to 16 Bit
MONO8	Intensity output, 8 Bit per pixel, single channel
MONO16	Intensity output, 16 Bit per pixel, single channel
RGB24	RGB filtered output, 24 Bit per pixel, 3 channels Sequence: [Blue][Green][Red]
RGB32	RGBA filtered output, 32 Bit per pixel, 4 channels, Alpha channel equals 0. Sequence: [Blue][Green][Red][0]
RGB_PLANAR	RGB filtered output with planar-oriented channels. Format: [R][R]...[G][G]...[B][B]...
FRM_TRANSPORT_DATA	Data from transport layer (e.g., packed). This format is optimal when an efficient storage and later (offline) processing is required. Format is defined by XI_PRM_TRANSPORT_PIXEL_FORMAT

table 4-1, image formats,

Note1: For color modes **RGB32** and **RGB24** the image from sensor needs to be pre-processed (de-bayering). CPU load is higher in these modes. Setting this parameter will reset current region of interest. **RGB24** is being processed from the **RGB32** by removing the unused Alpha channel creating a slightly higher CPU load than the **RGB32** format.

Note2: The color filtering (de-bayering) relies on the interpolation of adjacent pixels in order to create pixel in the target image. Pixels on the edges of the image are missing adjacent pixels and therefore cannot be used for the interpolation process. The result is a target image that is smaller than the source image (4 pixels on all sides).

Note3: For most formats the transport data can be packed. 12-bit pixel bit depth transfers only 12-bit per pixel compared to 16bit per pixel when the data are not packed. In case of packed format, the CPU load is higher due to unpacking of the image data. Available bandwidth is however used optimally.

4.2.5. Digitization bit depth

In case of most cameras, changing the sensor digitization bit depth may increase the maximum possible frame rate, but does not affect the saturation capacity.

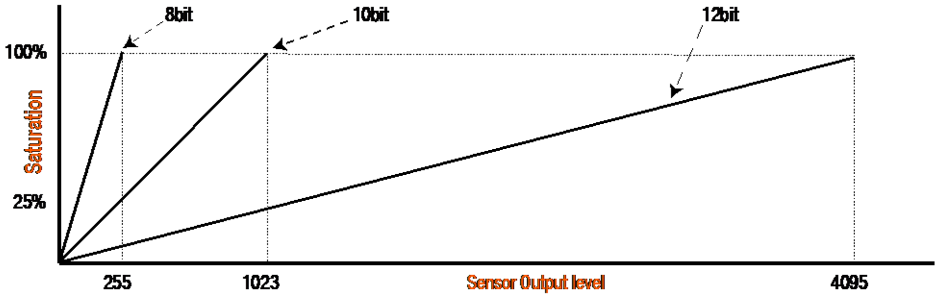


figure 4-1, Saturation vs Sensor output for different digitization bit depths

Cameras featuring 2nd and 4th generation of Sony Pregius sensors have special 8-bit digitization mode, which features the same conversion gain as 10-bit mode using only ¼ of the saturation. This leads to four times brighter images compared to 10-bit and 12-bit modes.

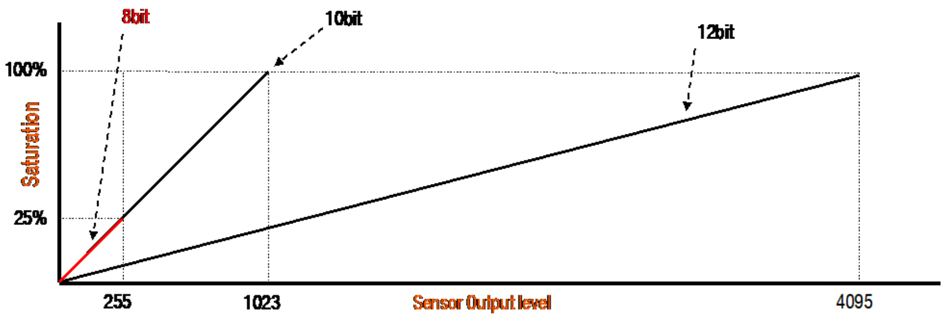


figure 4-2, Saturation vs Sensor output for different digitization bit depths 2nd generation IMX sensors

4.3. Acquisition modes

4.3.1. 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).

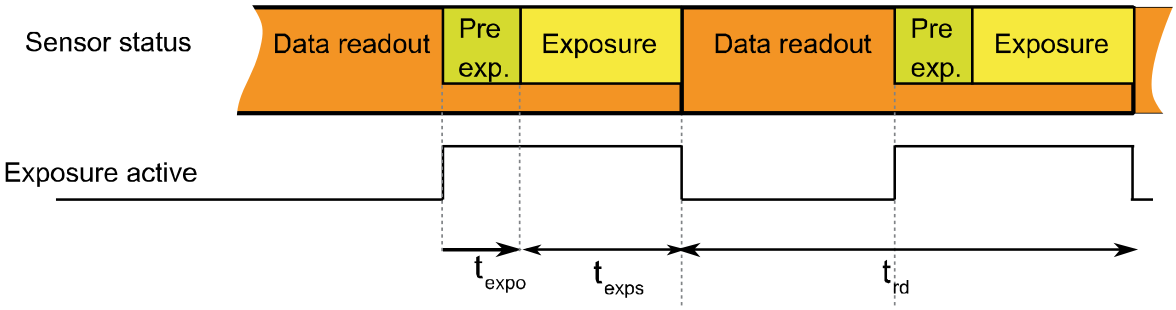


figure 4-3, acquisition mode - free run

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. (See *3.10.4 Optically isolated Digital Output*) Polarity inversion might help to make visible the separated exposure pulses.

All xiC cameras 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: https://www.ximea.com/support/wiki/allprod/Frame_Rate_Control

This is also applicable in case of triggered acquisition.

4.3.2. 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 case of level-sensitive, it can used to control length of exposure or acquisition itself.

Generally, trigger sources can be divided in to 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 described in *3.10.3 Optically isolated Digital Input*, or non-isolated ports configured as input described in *3.10.5 Non-isolated Digital Lines (-UB and -TC only)* Triggering by hardware is usually used to reduce latencies and jitter in applications that require the most accurate timing.

4.3.2.1. Triggered acquisition - single frame

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

Sensor timing in Exposure Overlap with Data Readout Mode

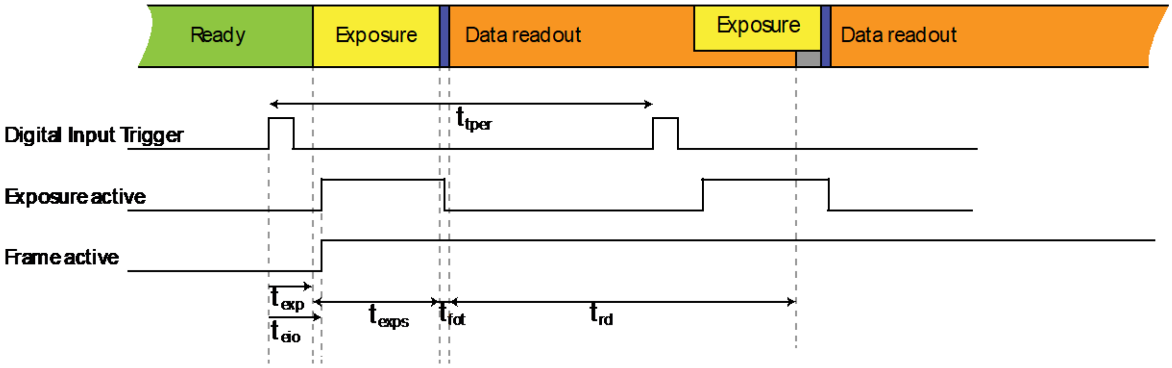


figure 4-4, acquisition mode – triggered with overlap

Description:

t_{eio} – Trigger (Digital Input) to Exposure Active (Digital Output)

t_{exp} – Trigger (Digital Input) to start of exposure

t_{exps} – Current Exposure Time set (XI_PRM_EXPOSURE)

t_{fot} – Frame overhead time (FOT) – does not necessarily equal interframe time

t_{rd} – readout time (Readout Time)

t_{row} – readout time of one row (Line period) depends on sensor settings

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

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

The delay between trigger input and start of exposure:

$$t_{exp} = 3 \times t_{row} + t_{idelay}$$

Where:

t_{idelay} – Delay inside camera caused by internal electronics. This depends on input type.

Please refer to: *3.10.3 Optically isolated Digital Input* or *3.10.5 Non-isolated Digital Lines (-UB and -TC only)*

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

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

Where:

t_{odelay} – Delay inside camera caused by internal electronics. This depends on output type.

Please refer to: *3.10.4 Optically isolated Digital Output* or *3.10.5 Non-isolated Digital Lines (-UB and -TC only)*

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

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

4.3.2.2. Triggered acquisition - burst of frames

Frame Burst Start

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

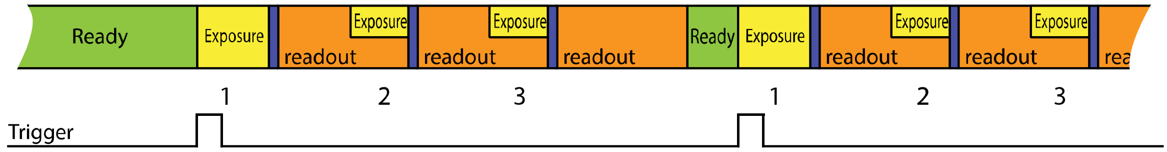


figure 4-5, triggered burst of frames – frame burst start, number of frames in burst set to 3

Frame Burst Active

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

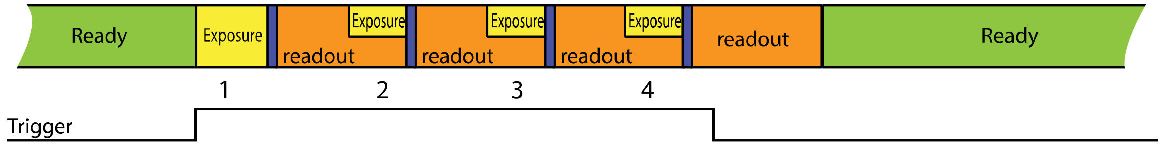


figure 4-6, triggered burst of frames – frame burst active

Please see: Frame Burst Modes: https://www.ximea.com/support/wiki/allprod/Frame_Burst_Modes

4.3.2.3. 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.

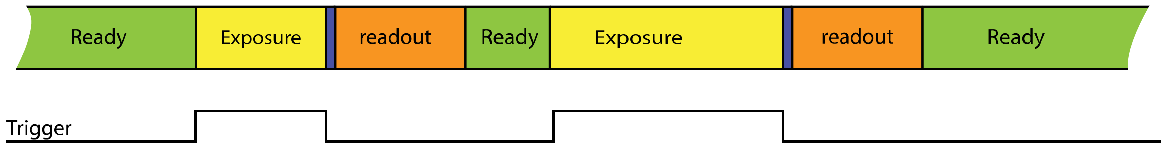


figure 4-7, Exposure defined by trigger pulse length

Please see: Exposure Defined by Trigger Pulse Length: https://www.ximea.com/support/wiki/allprod/Exposure_Defined_by_Trigger_Pulse_Length

4.3.2.4. Multiple exposures in one frame

All xiC camera models based on 2nd gen Sony Pregius sensors (except MC023xG-SY) support defined number of exposures exposed into a single frame.
In this mode the number of exposures need to be defined. The number of exposures can be defined using the xiApi parameter XI_PRM_EXPOSURE_BURST_COUNT. The readout of the frame starts after the last exposure period has finished.
It can operate in two modes:

1. Exposure defined by xiApi parameter "XI_PRM_EXPOSURE"

   In this mode the trigger defines the start of the exposure, but the length of the exposure is defined by the XI_PRM_EXPOSURE xiApi parameter. Set exposure length using XI_PRM_EXPOSURE parameter and set XI_PRM_TRG_SELECTOR to XI_TRG_SEL_EXPOSURE_START.

```
// Set exposure
xiSetParamInt(xiH, XI_PRM_EXPOSURE, 1000);
// Set the number of times of exposure in one frame
xiSetParamInt(xiH, XI_PRM_EXPOSURE_BURST_COUNT, 5);
// Set trigger selector
xiSetParamInt(xiH, XI_PRM_TRG_SELECTOR, XI_TRG_SEL_EXPOSURE_START);
```

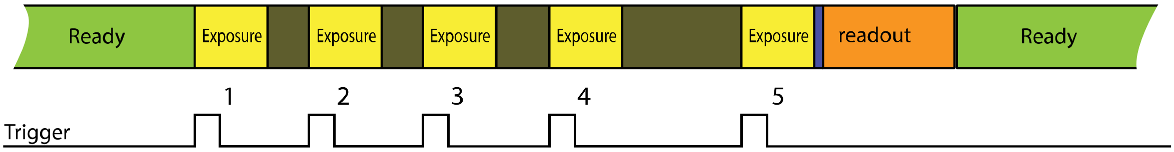


figure 4-8, Multiple exposures - defined exposure time, number of exposures set to 5

2. Exposure is defined by length of trigger pulse.

   In this mode both the start of the exposure as well as the length of the exposure is defined by the trigger pulse. Set XI_PRM_TRG_SELECTOR to XI_TRG_SEL_EXPOSURE_ACTIVE. The exposure length will be defined by trigger pulse length.

```
// Set the number of times of exposure in one frame
xiSetParamInt(xiH, XI_PRM_EXPOSURE_BURST_COUNT, 5);
// Set trigger selector
xiSetParamInt(xiH, XI_PRM_TRG_SELECTOR, XI_TRG_SEL_EXPOSURE_ACTIVE);
```

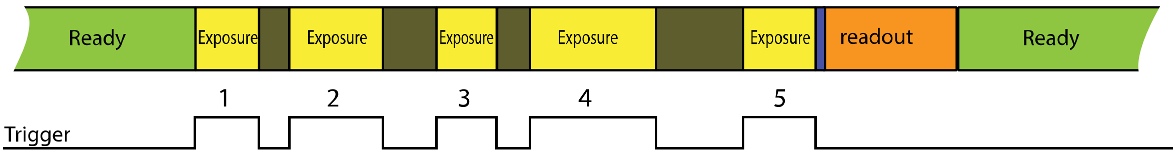


figure 4-9, Multiple exposures - exposure time defined by trigger pulse length, number of exposures set to 5

In both above modes there is a short period (FOT) after each exposure during which the next exposure cannot start. In case of the cameras with IMX sensors this period is 11*line period (the line period depends on various other parameters, see Line Period in the using Camera performance calculator).

4.4. Camera Parameters and Features

4.4.1. Short Interval Shutter Mode

Cameras based on the IMX530, IMX531, IMX532, IMX540, IMX541 and IMX542 sensors support short interval shutter mode. In this mode a pair of consecutive frames can be grabbed with virtually no gap between the end of the exposure of the first frame and start of the exposure of the second frame. This feature is particularly desired in Particle Image Velocimetry (PIV) because it allows positioning two laser pulses with short separation on sequential frames (frame straddling).

This feature is supported in free run as well as in triggered acquisition modes. In triggered mode a single trigger will result in a pair of frames.

The lengths of the exposures of both frames are fixed and their exact values depend on the camera's settings (e.g., sensor data bit depth, bandwidth limit etc.). The first exposure (texp1) is in magnitude of hundreds of microseconds and the second exposure (texp2) equals to the readout time. The time between the end of the first exposure and start of the second exposure is very short. However, the sensor manufacturer recommends a period (Flash Prohibited Period) with a magnitude of 2 - 3 microseconds during which the flash should not be fired to ensure correct operation. This period is indicated in the exposure active signal which can be forwarded to the camera's digital output. Please note that it is recommended to use the non-isolated outputs of the camera with low capacitance IO cables to ensure low distortion of the output signal.

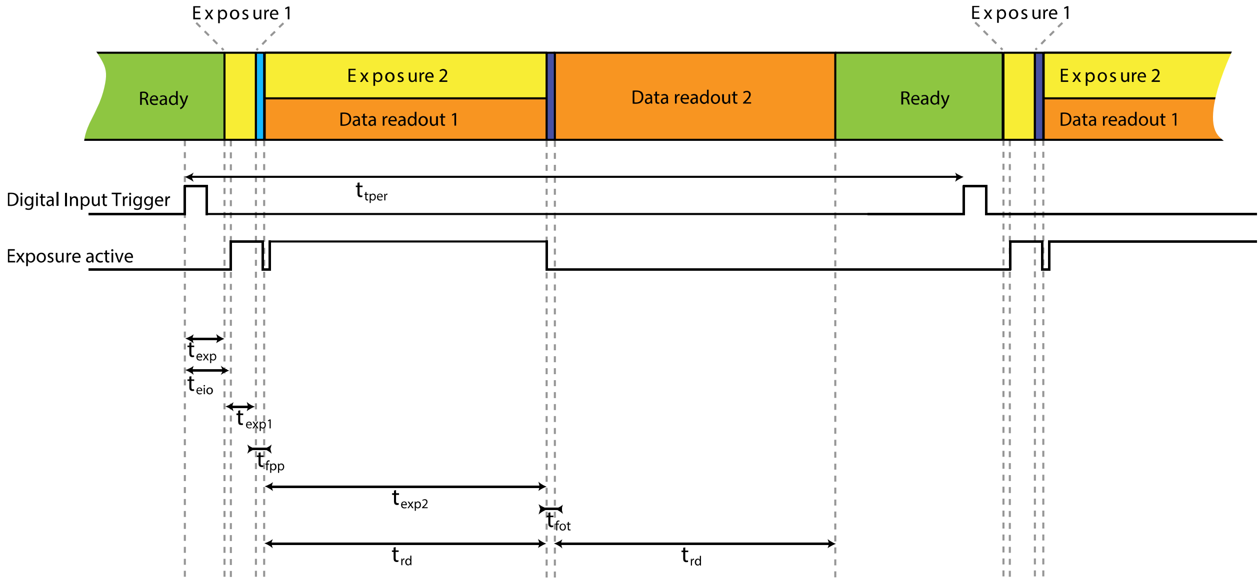


figure 4-10, short interval shutter mode – triggered

Description:

t_{exp} – Trigger (Digital Input) to start of exposure

t_{eio} – Trigger (Digital Input) to Exposure Active (Digital Output)

t_{exp1} – Exposure Time of the first image

t_{fpp} – Flash Prohibited Period

t_{exp2} – Exposure Time of the second image

t_{fot} – Frame overhead time (FOT) – does not necessarily equals interframe time

t_{rd} – readout time (Readout Time)

The timing strongly depends on camera settings.

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

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

Where:

t_{odelay} – Delay inside camera caused by internal electronics. This depends on output type.

Please refer to: *3.10.4 Optically isolated Digital Output* or *3.10.5 Non-isolated Digital Lines (-UB and -TC only)*

4.4.2. Dual ADC modes

Cameras based on the IMX530, IMX531, IMX532 sensors support Dual ADC readout modes. In these modes a single exposed frame can be read out twice via different readout channels resulting in two images with different analog gain settings. The high gain (HG) image has a lower readout noise and therefore offers better signal to noise ratio (SNR) in the low light regions of the scene. On the other hand, the low gain (LG) image offers higher SNR in the well illuminated regions of the scene as it utilizes the larger (or the whole) portion of the full well capacity.

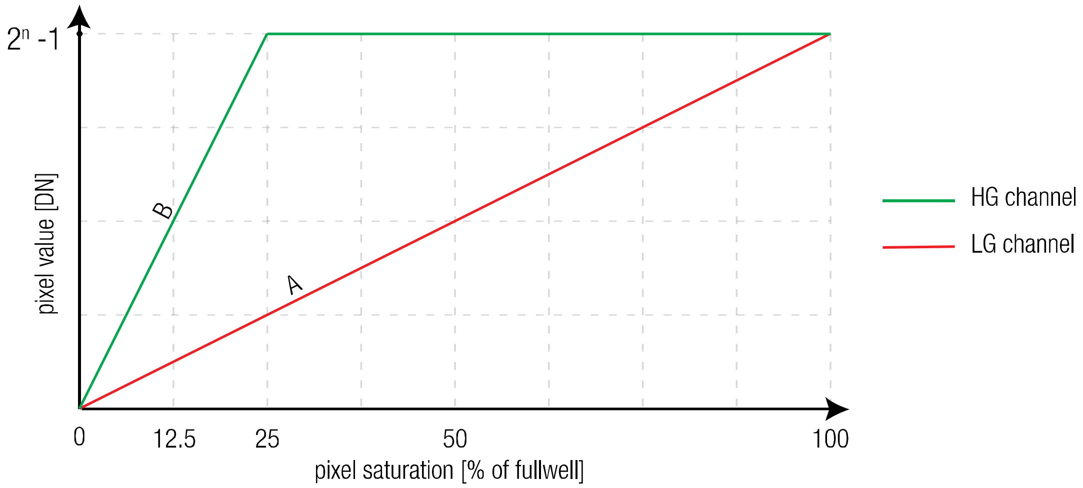


figure 4-11, Dual ADC non-combined without merging

These two images can be either read out separately from the sensor (Non-combined mode) and transported to the host PC memory or combined in the sensor into a single HDR frame with a piecewise linear response. (Combined mode).

```
// Set dual ADC mode to non-combined or combined
xiSetParamInt(xiH, XI_PRM_DUAL_ADC_MODE,XI_DUAL_ADC_MODE_NON_COMBINED);
// or
xiSetParamInt(xiH, XI_PRM_DUAL_ADC_MODE, XI_DUAL_ADC_MODE_COMBINED);
```

The gain parameter is used to define the analog gain of the low gain channel (slope A) and the dual ADC gain ratio parameter is used to adjust the offset/ratio of the analog gain of the high gain channel (slope B / slope A).

```
// Set gain selector to analog
xiSetParamInt(xiH, XI_PRM_GAIN_SELECTOR, XI_GAIN_SELECTOR_ANALOG_ALL);
// Set gain to arbitrary value
xiSetParamFloat(xiH, XI_PRM_GAIN, 0);
// Set gain ratio to arbitrary value
// depending on the gain value the range can be from 0-24 dB
// with 6 dB increment
xiSetParamFloat(xiH, XI_PRM_DUAL_ADC_GAIN_RATIO, 12);
```

4.4.2.1. Non-combined mode

In the non-combined mode both images are read out from the sensor and are transported to the host PC memory. Depending on the used image data format, these images can be either passed directly to the application or can be merged into a single linear output with extended dynamic range. The merging is performed in the xiAPI library running on the host computer's CPU and is optimized for processor's with x86 architecture.

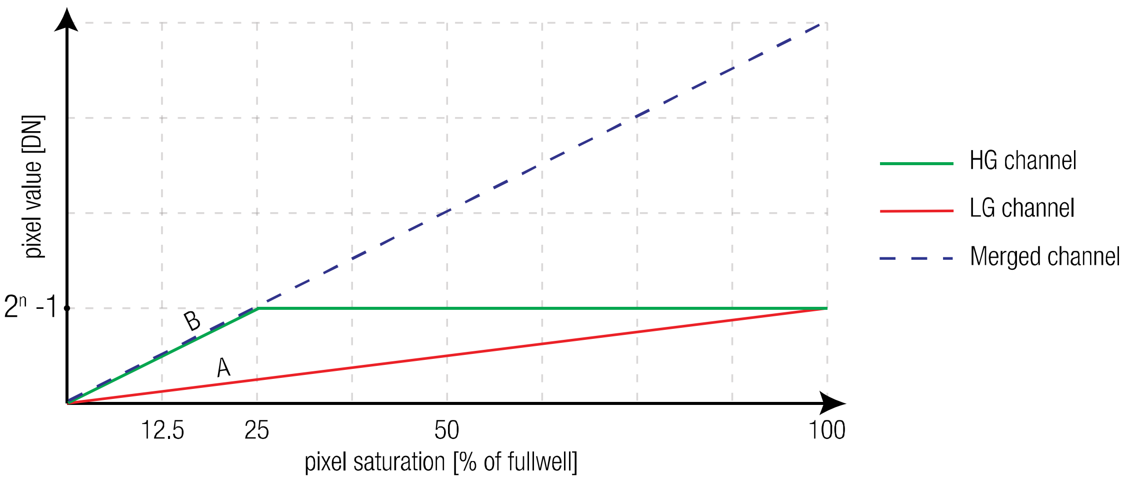


figure 4-12, Dual ADC non-combined with merging

In case of RAW8X2, RAW16X2 or TRANSPORT_DATA image data format, for each pixel a sequence of LG and the HG channel values are passed to the application ([pixel 0 LG val, pixel 0 HG val, pixel 1 LG val, pixel 1 HG val, …])

```
// Use X2 or transport format to deliver values from HG and LG channels
xiSetParamInt(xiH, XI_PRM_IMAGE_DATA_FORMAT,XI_RAW16X2);
// Set ADC bitdepth to desired value
xiSetParamInt(xiH, XI_PRM_SENSOR_DATA_BIT_DEPTH,12);
// Set image data bitdepth to desired value
xiSetParamInt(xiH, XI_PRM_IMAGE_DATA_BIT_DEPTH,12);
```

In case of all other image data formats, the data from the LG and HG channels are merged into a single linear output with extended dynamic range.

```
// or use any other formats to other to deliver merged from HG and
xiSetParamInt(xiH, XI_PRM_IMAGE_DATA_FORMAT,XI_RAW16);
// Set ADC bitdepth to desired value
xiSetParamInt(xiH, XI_PRM_SENSOR_DATA_BIT_DEPTH,12);
// Set image data bitdepth to desired value
xiSetParamInt(xiH, XI_PRM_IMAGE_DATA_BIT_DEPTH,16);
```

4.4.2.2. Combined mode

In the combined mode the HG and LG images are merged directly in the sensor. This mode usually gives a higher frame rate than the non-combined mode since instead of two (8 or 12 bit) values only one (8 or 12 bit) value is read out from the sensor and transported to the PC memory. There is also less processing overhead in the xiAPI library as the data are already merged in the sensor. Since the output data bit depth from the sensor is limited to the set ADC bit depth, the data is compressed in the sensor using a piecewise linear function.

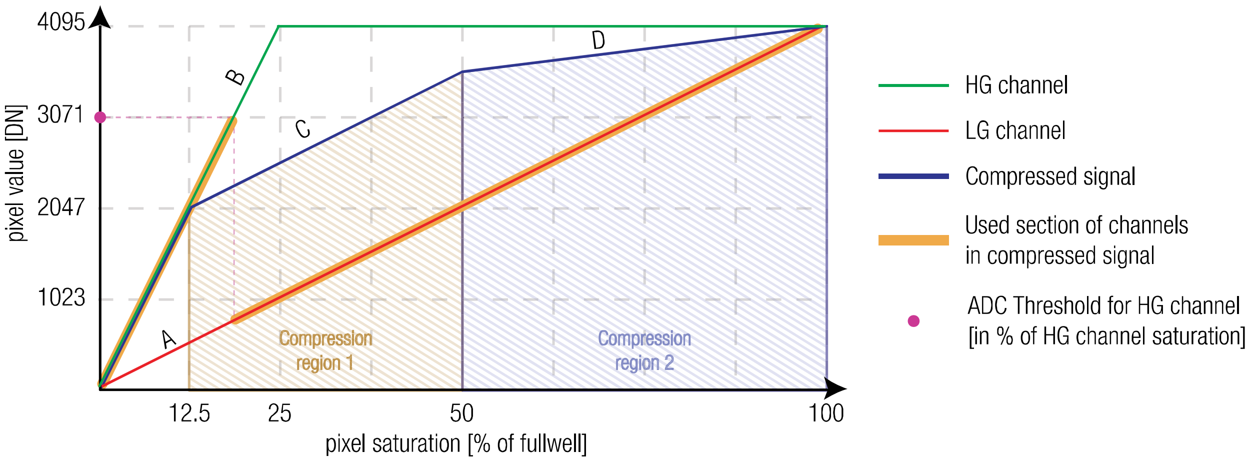


figure 4-13, Dual ADC combined mode

The threshold of the usable range of the HG channel can be set using the *dual ADC threshold* parameter.

```
// define the upper threshold of the usable HG data
xiSetParamInt(xiH, XI_PRM_DUAL_ADC_THRESHOLD,3071);
```

The starting point of the region is defined as a percentage of the maximum ADC output (can be also interpreted as a percentage of full well capacity at the given analog gain setting). It has a logarithmic increment and can have values of 50,25,12.5 … percent. The slope of the corresponding linear segment is defined as offset from the gain of the HG channel. The above diagram corresponds to the below settings:

```
// Slope B was defined earlier by setting ADC gain ratio to 12dB
// Set up the start and gain (Slope C) of compression region 1
xiSetParamInt(xiH, XI_PRM_COMPRESSION_REGION_SELECTOR,1);
xiSetParamFloat(xiH, XI_PRM_COMPRESSION_REGION_START,12.5);
xiSetParamFloat(xiH, XI_PRM_COMPRESSION_REGION_GAIN,-12);

// Set up the start and gain (Slope D) of compression region 2
xiSetParamInt(xiH, XI_PRM_COMPRESSION_REGION_SELECTOR,2);
xiSetParamFloat(xiH, XI_PRM_COMPRESSION_REGION_START,50);
xiSetParamFloat(xiH, XI_PRM_COMPRESSION_REGION_GAIN,-24);
```

4.5. Host-Assisted Image Processing Parameters Available in xiAPI.

4.5.1. Auto 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).

4.5.2. 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 to increase or decrease each channel's contribution and therefore allow the user to control the color tint of the image.

4.5.2.1. 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.

4.5.2.2. 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.

4.5.3. 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.

4.5.4. Sharpness

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

4.5.5. 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.

4.5.6. 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.

5. Software

5.1. Accessing the Camera

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.

5.1.1. Proprietary API

All XIMEA cameras are supported by the same unified APIs (application programming interface). The API is a software interface between the camera system driver and the application. Different APIs are available for different programming environments, e.g., *xiAPI* (see *5.7.1 XIMEA APIs*) for C/C++ developments, *xiAPI.Net* for C#/.Net based developments and xiApiPython for Pyhton based developments.

5.1.2. 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.

5.1.2.1. GenICam

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.

5.1.2.2. USB3 Vision

The USB3 Vision standard not only defines hardware specifications and communication protocols, but also enables a library vendor or application developer to set up a software stack including their own drivers and the GenICam programming interface. This allows the usage of any USB3 Vision compliant device while relying on mechanisms for device discovery and identification, control, and image streaming which are defined by the standard.

5.1.3. Vision Library Integration

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, to add additional functionality (e.g., image processing, communication, data storage).

5.2. XIMEA CamTool

The CamTool is a cross-platform application showcasing the features of all XIMEA camera families.

Short description

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

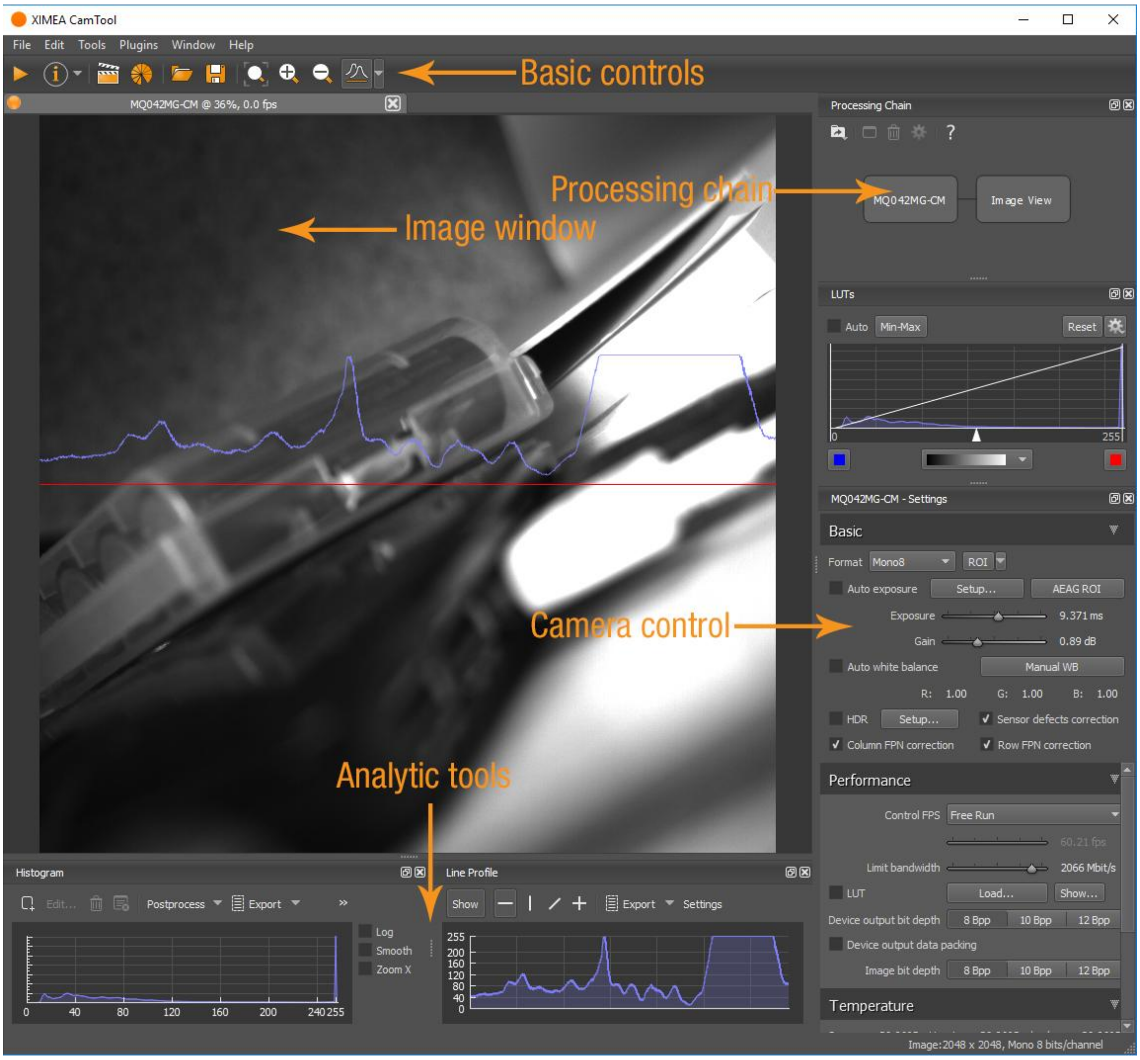


figure 5-1, CamTool Layout

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

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 refer to: https://www.ximea.com/support/wiki/allprod/XIMEA_CamTool

5.3. Supported Vision Libraries

For an up-to-date listing of the supported vision libraries and software packages, visit our web site http://www.ximea.com/support/projects/vision-libraries/wiki.

5.3.1. Libraries maintained by XIMEA

All cameras listed in the section Products are supported with these libraries.
XIMEA commits to update the API within twelve months after a new major release.
XIMEA warranties backwards compatibility of these software packages for two major releases.

5.3.1.1. MathWorks MATLAB

MathWorks® is the leading developer and supplier of software for technical computing and Model-Based Design.

More: http://www.mathworks.de/ or https://www.ximea.com/support/wiki/vision-libraries/MathWorks_Matlab

5.3.1.2. MVTec HALCON

HALCON is the comprehensive standard software for machine vision with an integrated development environment (IDE) that is used worldwide.

More: http://www.mvtec.com/halcon/ or https://www.ximea.com/support/wiki/vision-libraries/MVTec_HALCON

5.3.1.3. National Instruments LabVIEW Vision Library

LabVIEW is a graphical programming environment.

More: http://www.ni.com/labview/
https://www.ximea.com/support/wiki/vision-libraries/National_Instruments_LabVIEW

5.3.1.4. OpenCV

OpenCV is an open-source library of programming functions mainly aimed at real time computer vision, developed by Intel and now supported by Willow Garage.

More: https://opencv.org/
https://www.ximea.com/support/wiki/vision-libraries/OpenCV

5.4. XIMEA Windows Software Package

XIMEA API Software Package can be installed on: Microsoft Windows 10, Microsoft Windows 8, Microsoft Windows 7 (and Microsoft Windows 7 Embedded), Microsoft Windows Server 2008 R2.

5.4.1. Contents

The package contains:

- OS Drivers of all XIMEA camera types for OS Microsoft Windows 7 SP1 32/64 bit, Windows 8 32/64 bit, 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

5.4.2. 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):

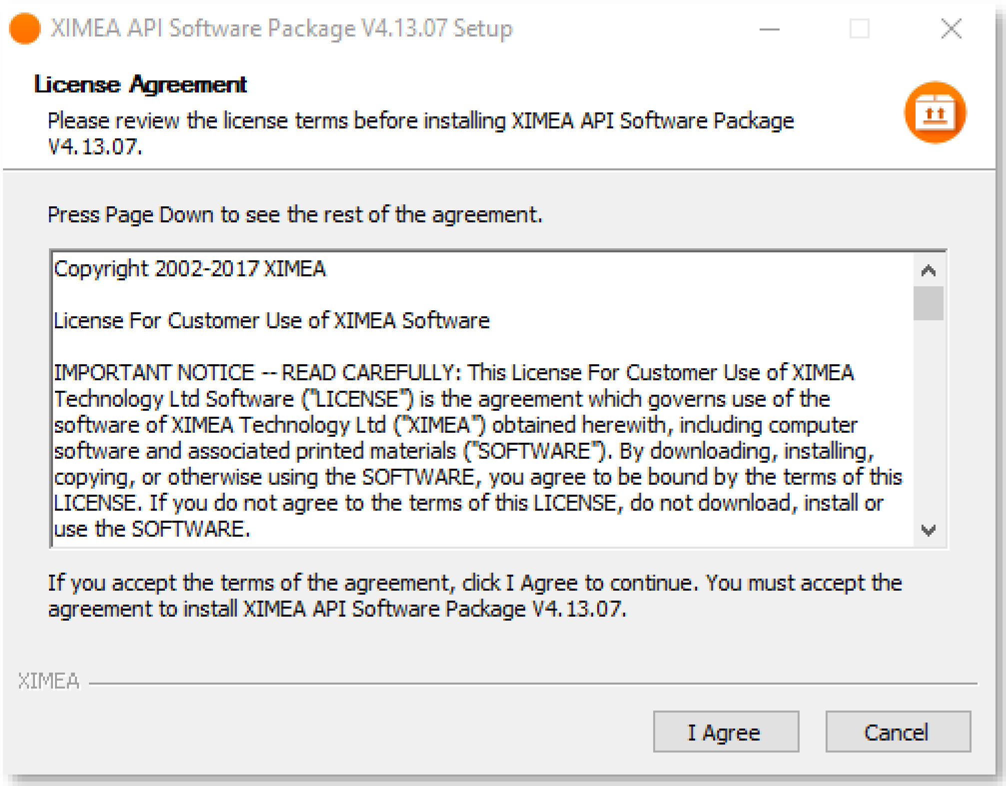


figure 5-2, XIMEA Windows Software Package installation - 1

- 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.

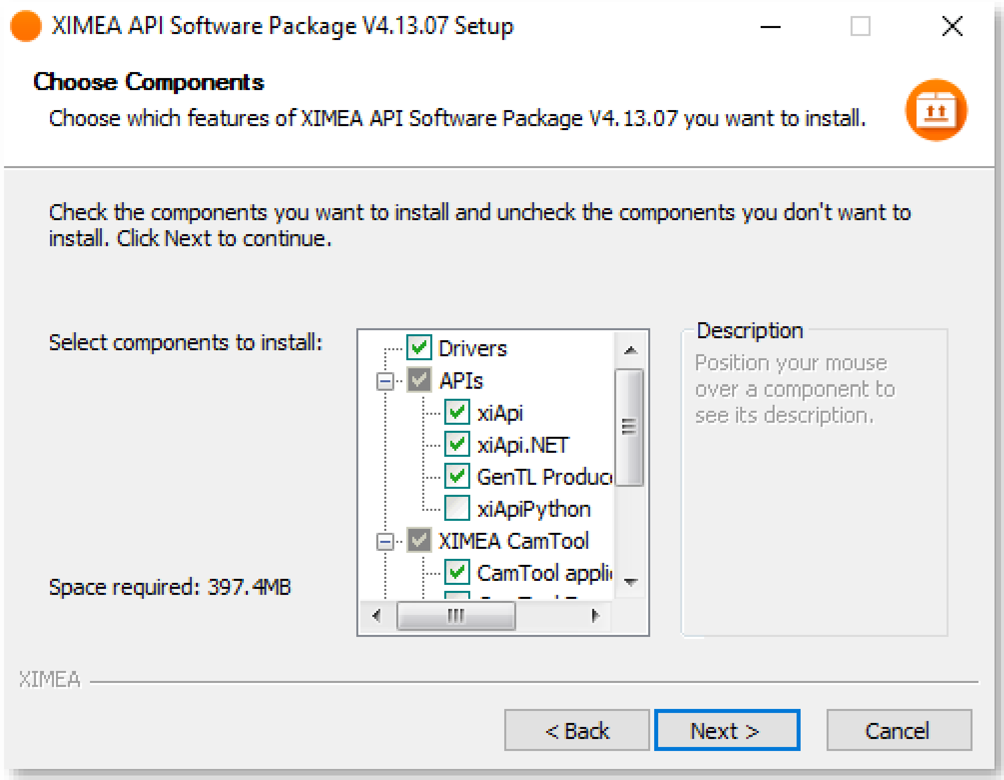


figure 5-3, XIMEA Windows Software Package installation - 2

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

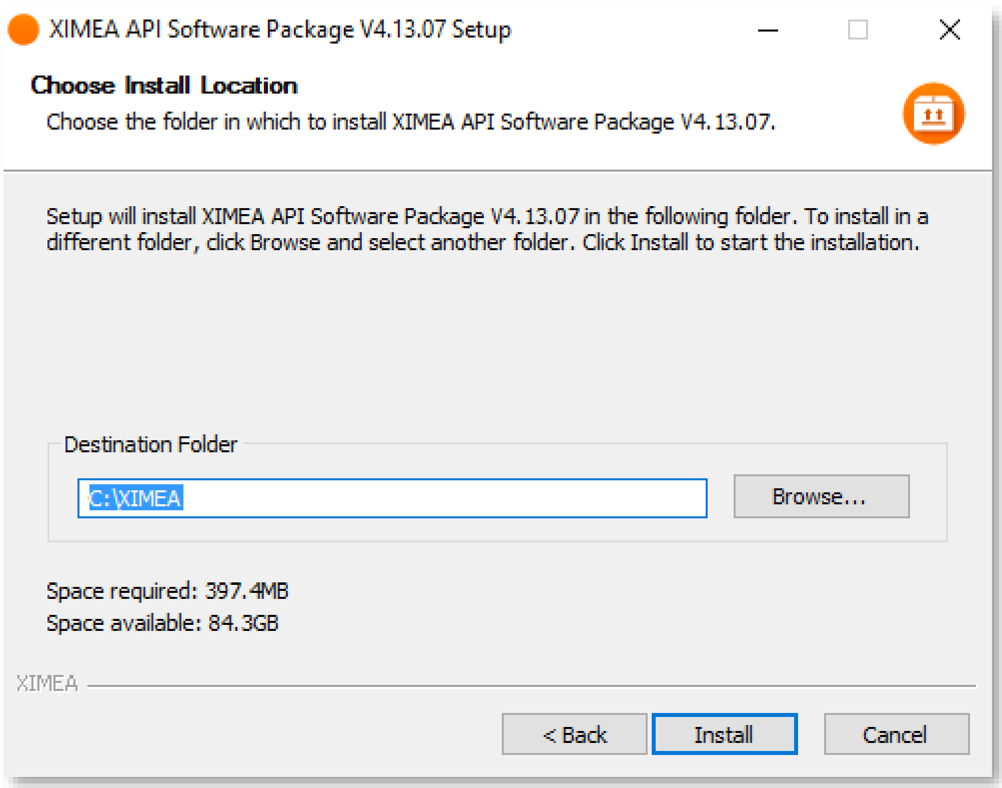


figure 5-4, XIMEA Windows Software Package installation - 3

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

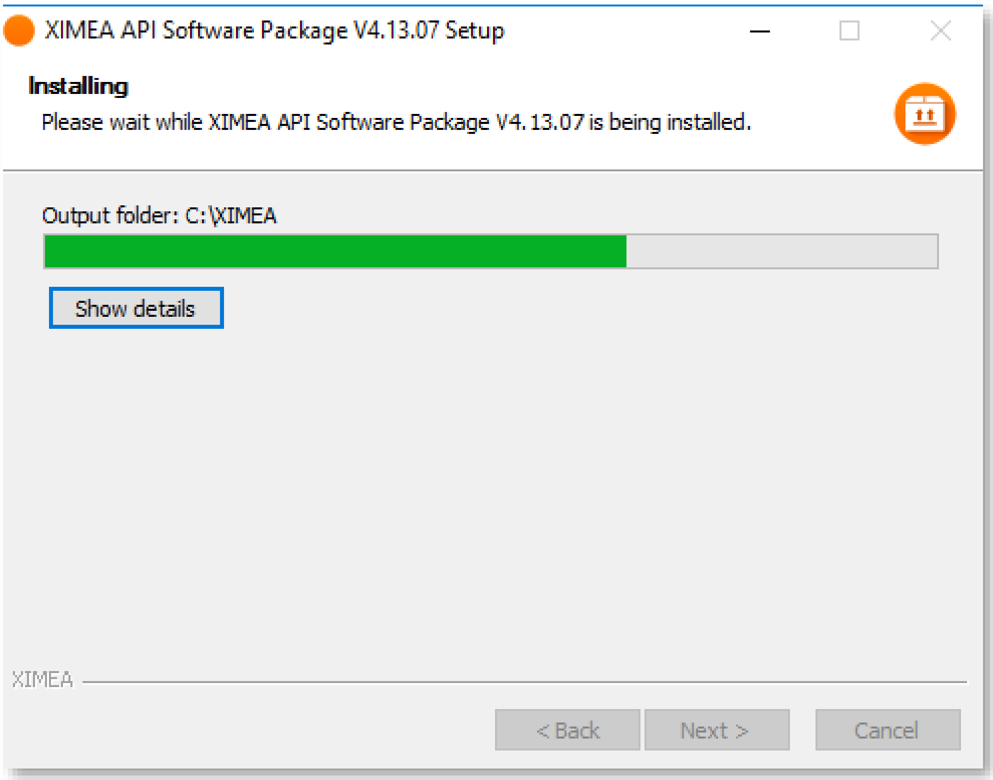


figure 5-5, xiAPI installation, Windows - 4

- Installation is completed.

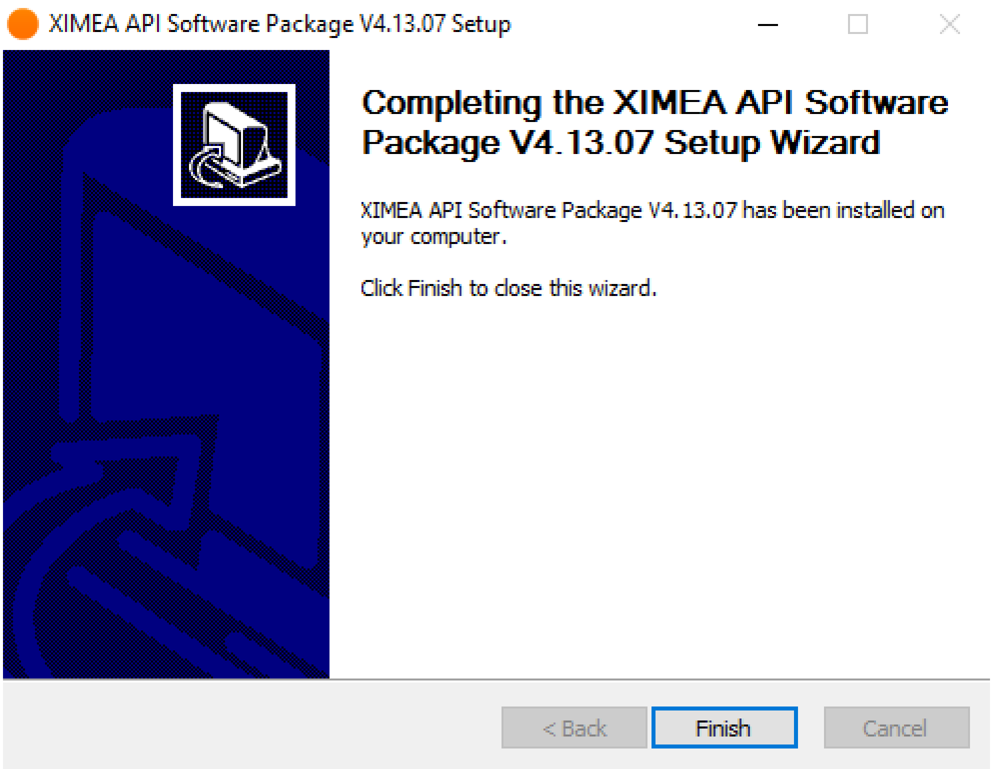


figure 5-6, xiAPI installation, Windows - 5

- Finish.

5.5. 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.

5.5.1. 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

5.5.2. Installation

- Download XIMEA Linux Software Package
  `wget http://www.ximea.com/downloads/recent/XIMEA_Linux_SP.tgz`

figure 5-7, XIMEA Linux Software Package installation - 1

- Untar
  ```
  tar xzf XIMEA_Linux_SP.tgz
  cd package
  ```
- Start installation script
  ```
  ./install
  ```

```
ximea@ximea-Linux64: ~/package
ximea@ximea-Linux64:~$ tar xzf XIMEA_Linux_SP.tgz
ximea@ximea-Linux64:~$ cd package
ximea@ximea-Linux64:~/package$ ./install -cam_usb30
This will install XIMEA Linux Package after 5 seconds
To abort installation - press Ctrl-C
Instaling x64 bit version
[sudo] password for ximea:
This is installation of package for platform -x64
Checking if user is super user
OK
-------------------------------------
WARNING!!!
You have enabled experimental USB3 support! It may affect USB2 support too.
DO NOT downgrade the kernel to versions older than 3.4!!!
Advised way of enabling USB3 support is upgrading kernel to version at least as new as 3.6.
If you decide to do it in the future, rerun this installation script after rebooting into new ke
rnel.
-------------------------------------
Installing libusb
OK
Installing Firewire support - libraw1394
OK
Checking Firewire stack

Installing API library
OK
OK
OK

Rebuilding linker cache
Installing XIMEA-GenTL library
OK
Installing vaViewer
OK
Installing streamViewer
OK
Installing xiSample
OK
Creating desktop link for vaViewer
Creating desktop link for streamViewer
Installing udev rules for USB and Firewire cameras
OK
-------------------------------------
Note:
You may need to reconnect your USB and/or Firewire cameras
Also check that you are in the "plugdev" group

More info:
http://www.ximea.com/support/wiki/apis/Linux_USB20_Support
-------------------------------------
-------------------------------------
For GeniCam - please add GENICAM_GENTL64_PATH=/opt/XIMEA/lib/libXIMEA_GenTL.so to Your .bashrc t
o enable GenTL
Now applications can be started. E.g. /opt/XIMEA/bin/xiSample
-------------------------------------
Done OK
ximea@ximea-Linux64:~/package$
```

figure 5-8, XIMEA Linux Software Package installation - 2

1) **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*.

5.6. XIMEA macOS Software Package

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

5.6.1. 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

5.6.2. 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.

figure 5-9, XIMEA macOS Software Package installation - 1

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

figure 5-10, xiAPI installation, MacOS - 2

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

5.6.3. Start XIMEA CamTool

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

5.7. Programming

5.7.1. XIMEA APIs

- xiAPI - Streamlined API. The standard API for C/C++ based projects, see *5.7.2 xiAPI Overview*.
- xiAPI.NET - Managed .NET Common Language Runtime (CLR) API.
  xiAPI.NET is designed as a wrapper around xiAPI and therefore shares most of its functionality.
- xiApiPython – Integrated API into PYTHON.

5.7.2. xiAPI Overview

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 5 Software

5.7.3. 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);
```

5.7.4. xiAPI Parameters Description

For a complete list of available parameters, please visit the xiAPI online manual at
http://www.ximea.com/support/wiki/apis/XiAPI_Manual

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.

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).*

5.7.5. xiAPI Examples

5.7.5.1. 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);
}
```

5.7.5.2. 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);
```

5.7.5.3. 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);
```

5.7.5.4. Control Digital Input / Output (GPIO)

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. This time should be less than 10µs.

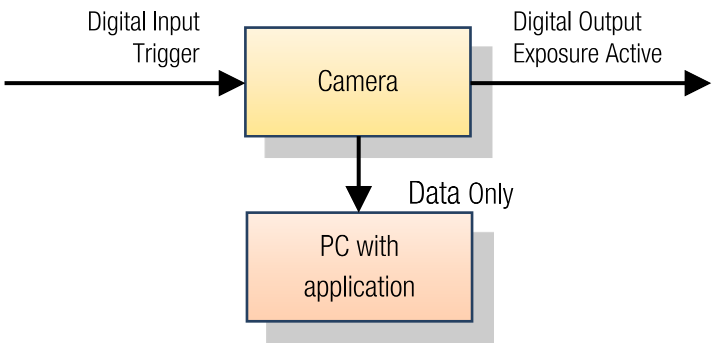


figure 5-11, GPIO - schematic

```
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…
```

5.7.6. 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.

5.7.7. USB3 Vision

For more information on programing according the USB3 VISION standard, please visit the standard's website at http://www.visiononline.org/vision-standards-details.cfm?type=11

5.7.8. GenICam

For more information on programing according the GenICam standard, please visit the standard's website at http://www.emva.org/standards-technology/genicam/

5.8. XIMEA Control Panel

The XIMEA Control Panel (xiCOP), is a diagnostics and management tool for all XIMEA cameras.

xiCOP is currently only available for Windows operating system.

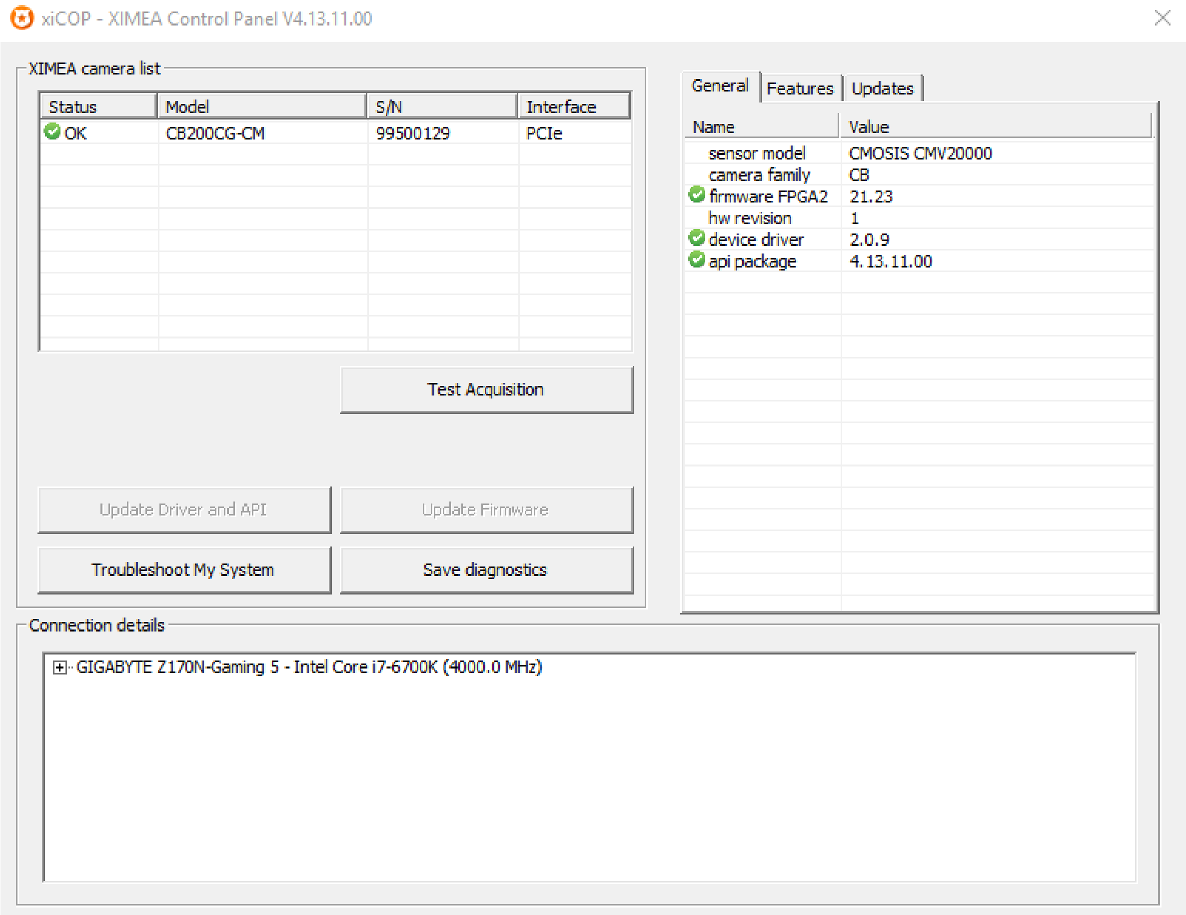


figure 5-12, xiCOP

Features

- Facilitates diagnostics of system performance bottlenecks.
  xiCOP can retrieve 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.
- List all currently attached XIMEA devices and their features.
- Suggests solution for diagnosed issues.
- One click updates to the latest XIMEA API Software Package.
- One click updates of firmware in selected cameras.

6. Appendix

6.1. Troubleshooting and Support

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

At first, please make sure, that you have installed the latest version of the following XIMEA software:

- XIMEA Windows Software Package http://www.ximea.com/downloads/recent/XIMEA_Installer.exe

Please make sure, that you have connected your xiC camera with the XIMEA USB 3.0 cable to an appropriate USB 2.0 or USB 3.0 port. Ensure that the connections are carefully locked. Follow the instructions described in chapter *5.2 XIMEA CamTool* (run the xiC camera with the XIMEA CamTool). In case that you still have issues, please read the following chapters. If this does not at first work, please check all your connections to the camera and then try the latest 'beta' version of API with the most recent fixes: https://www.ximea.com/downloads/recent_beta/XIMEA_Installer.exe

In case that you still have issues, please read the following chapters.

6.1.1. 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 xiC camera.

6.1.2. Before Contacting Technical Support

There are a few steps to take before contacting your local dealer for technical support. In case you cannot display images from your xiC camera, please open the XIMEA xiCOP software (please see *5.8 XIMEA Control Panel)*. 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 *4.1 System Requirements*. If the camera does not appear, please proceed with the following steps:

Step no:	Description
1	Click on the button “Troubleshoot My System” and follow the instructions that are suggested.
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.
3	Contact your local dealer where you bought the camera either by phone or by email for first level support. He will decide if he can help you immediately or if more information is necessary for initiating the next steps.

table 6-1, use xiCOP before contacting technical support

6.1.3. Frequently Asked Questions

In this manual, we can list only a few FAQ. For more and updated information, please also note:

- Frequently Asked Questions
  http://www.ximea.com/support/wiki/allprod/Frequently_Asked_Questions
- Knowledge Base
  http://www.ximea.com/support/wiki/allprod/Knowledge_Base

6.1.3.1. What is USB 3.1 Gen 1 SuperSpeed?

USB 3.1 Gen 1 revision of Universal Serial Bus (USB) standard boosts transfer speed of 5Gb/s and enables delivery of up to 4.5W of power to the target device. It uses communication technology similar to that of PCI Express Gen2.

6.1.3.2. What is the real transfer speed?

xiC camera can deliver up to 450Mbyte/sec. This requires that certain conditions are met, see *4.1 System Requirements.*

Maximum transfer speeds of different interfaces:

Interface	Transfer speed	Usable bandwidth	System costs
IEEE1394A	400 Mbit/s	45 MByte/sec	Medium
CameraLink base	2.04 Gbit/s	255 MByte/sec	High
GigE	1024 Mbit/s	100 MByte/sec	Medium
USB 2.0	480 Mbit/s	49 MByte/sec	Low
USB 3.0	5 Gbit/s	450 MByte/sec	Low
USB 3.1 (gen1)	5 Gbit/s	450 MByte/sec	Low

table 6-2, interface depending on transfer rates

6.1.3.3. Why can I not achieve maximum transfer speed?

In order to reliably achieve maximum transfer speed it is necessary to verify that you are using recommended hardware (please see *4.1 System Requirements)*, and that all software requirements are met.

xiCOP (please see *5.8 XIMEA Control Panel*) - XIMEA Control Panel free software tool, facilitates the task of verification of XIMEA USB3 Vision camera installations.

6.1.3.4. What voltage should be applied to Digital Input of xiC to turn it on/off?

xiC camera features two type of inputs (-UB, -TC only). First is optoisolated input only. Second is INOUT set to input function.

Following table shows different levels of Voltage on Digital Input (VDI) on xiC and their logical interpretation.

VDI (Opto-isolated)	Logical level
<2Vdc	Off (zero)
2-4Vdc	Undefined
>4Vdc	On (one)

table 6-3, voltage levels for optoisolated digital input

VDI (non-isolated)	Logical level
<0.7Vdc	Off (zero)
0.7-3.3Vdc	Undefined
>3.3Vdc	On (one)

table 6-4, voltage levels for non-isolated digital input

Maximal input voltage 24Vdc

6.1.3.5. What is the implementation of Digital Output (VDO) of xiC?

xiC cameras features two kinds of digital output:

1. Optically isolated digital output - opto-isolated NPN open collector type, max. load current 25mA, max. open voltage 24Vdc.

For more details see also: 3.10.4 Optically isolated Digital Output

2. Non isolated high impedance input/output

For more details see also: 3.10.5 Non-isolated Digital Lines (-UB and -TC only)

6.2. Product service request (PSR)

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

6.2.1. Step 1 - Contact Support

If your xiC camera is not working as expected, please contact your local dealer for troubleshooting the product and determine the eligibility of a 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 to qualify for a free repair or replacement.

6.2.2. Step 2 - Create Product Service Request (PSR)

- Read the XIMEA General Terms & Conditions http://www.ximea.com/en/corporate/generaltc
- Open the XIMEA Product Service Request form http://www.ximea.com/support/projects/service/issues/new
- Fill in all fields
- Confirm with the button „Create“

6.2.3. Step 3 - Wait for PSR Approval

Our support personnel will verify the PSR for validity.

If your PSR is valid, it will be approved for sending the camera to us. This is done usually within 24 business hours. After that you will get a PSR Approval email (sent to the email address that you have entered in the field "Contact person – email").

The email contains:

- shipping instructions
- attached document containing the Product Service Request Number (PSRN)

When you received the PSR Approval email - please continue to Step 4.

In case your PSR was rejected – please do not send your camera to XIMEA.

6.2.4. 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.

6.2.5. 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 6-5, service operations overview

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

6.2.6. 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".

6.3. Safety instructions and precautions

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

6.4. Warranty

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

6.5. List Of Trademarks

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

6.6. Standard Terms & Conditions of XIMEA GmbH

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

6.7. Copyright

6.8. Revision History

Version	Date	Notes
0.00	10/24/2016	Initial version
1.00	04/06/2017	First release
1.10	04/12/2017	Acquisition modes, updated accessories description, updated conformity description.
1.11	04/13/2017	Corrected typos and reference links
1.12	07/14/2017	Updated performance tables
1.13	08/16/2017	Added chapter 3.12 Heat dissipation, added LED status after xiOpenDevice
1.14	10/19/2017	Added connector description for –FL and –FV variants
1.15	01/17/2018	Corrected exposure time ranges, updated optical path paragraph
1.16	08/24/2018	Added 8-bit digitization mode description, FPC insertion guideline
1.17	06/26/2019	Added GPI/GPO index in API
1.18	09/09/2019	Added new generation of Flex cables, corrected flex connector pin description
2.00	12/20/2022	Added new camera models based on 4th generation Pregius S sensor
2.01	02/10/2023	Corrected typos and updated image quality data for 4th generation Pregius S sensor
2.02	01/08/2024	Corrected information about AR coating of IR650 filters

7. Glossary

Term /Abbreviation	Definition
ADC	Analog to Digital Converter
API	Application Programming Interface
AR (coating)	Anti-Reflex
B/W or B&W	Black and White
CCD	Charge-Coupled Device
CDS	Correlated double sampling
CMOS	Complementary Metal Oxide Semiconductor
DSNU	Dark Signal non-Uniformity
DR	Dynamic Range
EMC	Electro Magnetic Compatibility
ERS	Electronic rolling shutter
FPGA	Field programmable gate array
FPN	Fixed pattern noise
FPS	Frame per second
GR	Global reset
GS	Global shutter
IR	Infra-Red
LSB	Least Significant Bit
MSB	Most significant bit
N/A	Not Available
PCB	Printed Circuit Board (same as PWB)
PRNU	Photo response non-uniformity
PWB	Printed Wiring Board (same as PCB)
RGB	Red Green Blue
ROI	Region of interest
SDK	Software Development Kit
SNR	Signal To Noise (ratio)
SW	Software
TBD	To be determined – some parameters require characterization

8. List of figures

9. List of tables

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