xiD

[ksi-di: or sai-di:]

• USB3.0 CCD camera series

Technical Manual

Version 1.06 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 all your questions, but should you have more, 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 xiD-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

XIMEA is one of the worldwide leaders for innovative camera solutions with a 25-year history of research, development and production of digital image acquisition systems. Based in Slovakia, Germany and the US and with a global distributor network, XIMEA offers their cameras worldwide. In close collaboration with customers XIMEA has developed a broad spectrum of technologies and cutting-edge, highly competitive products.

XIMEA's camera centric technology portfolio comprises a broad spectrum of digital technologies, from data interfaces such as USB 2.0, USB 3.1 and PCIe to cooled digital cameras with CCD, CMOS and sCMOS sensors, as well as X-ray cameras.

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

XIMEA cameras find use in many industrial applications, such as motion control, robotics, or quality control in manufacturing. The broad spectrum of cameras also includes thermally stabilized X-ray cameras, and specialty cameras for medical applications, research, surveillance and defense.

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	XIMEA Corp. 12600 W Colfax Ave., Suite A-130 Lakewood, CO 80215 USA	XIMEA s.r.o. Lesna 52 900 33 Marianka Slovakia
Tel: +49 (251) 202 408-0 Fax: +49 (251) 202 408-99	Tel: +1 (303) 389-9838 Fax: +1 (303) 202-6350	

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 xiD cameras have been tested using the following equipment:

- CCD Camera with lens AZURE Photonics, AZURE-1620MX5M 4/3" 16mm C-Mount,
- Notebook HP EliteBook 8570p, Windows 7 Professional 64-bit, SN: 5CB22201WQ,
- USB 3.0 cable, with thumbscrews on Micro B connector, type CBL-U3-3M0, 3 m long,
- MD series sync cable, thread lock, 8-poles: ground, 2xTrigger In, 3 m long.

Warning: Changes or modifications to the product 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:

1.3.1. CE Conformity

The xiD 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

The xiD 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 in order to comply with the limits for a computing device pursuant to Subpart J of Part 15 of FCC Rules.

1.3.3. For customers in Canada

The xiD cameras comply with the Class A limits for radio noise emissions set out in Radio Interference Regulations.

1.3.4. RoHS Conformity

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

1.3.5. WEEE Conformity

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

1.3.6. 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.

1.4. Helpful Links

• Ximea Homepage	http://www.ximea.com/
• xiD product page	https://www.ximea.com/en/usb3-vision-camera/usb3-ccd-cameras-xid
• xiD support page	https://www.ximea.com/support/wiki/xid/CCD_with_USB_30_cameras_-_xiD
• xiAPI stable versions download	https://www.ximea.com/support/documents/4
• xiAPI beta versions download	https://www.ximea.com/support/documents/14
• 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 Live Support	http://www.ximea.com/support/wiki/allprod/XIMEA_Live_Support
• XIMEA General Terms & Conditions	http://www.ximea.com/en/corporate/generaltc

1.4.1. Table of Contents

2. xiD Camera Series

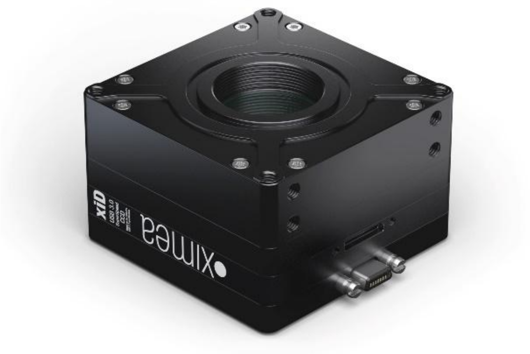


Figure 2-1 xiD camera.

2.1. What is xiD

xiD [ksi-di: or sai-di:] cameras with newest Sony EXview HAD CCD II sensors (ICX674, ICX694, ICX814, ICX834) combined with USB 3.0 interface - designed with consideration for the Scientific applications:

- Sony ICX with "EXview HAD CCD II" pixel technology
- Passive cooling of sensor
- Improved light efficiency for NIR spectrum
- Global shutter with interline transfer
- 1, 2 or 4 tap readout with 14 bit ADC
- Lowest power consumption

The board-level versions include a system integration guide for designing an optimal heatsink and enclosure. Due to the implementation of a 4 tap readout, this series supports the maximum frame rates that the sensors deliver

Off the shelf hardware can be used for camera to computer interfaces, but testing was limited to the items discussed in this manual. See section 3.10 - 3.14 for materials needed to interface your camera to the computer.

2.2. Advantages

Quality components	Sony "EXview HAD CCD II" sensors delivering 2.8, 6.1, 9.1 and 12 Mpix
Fastest	Highest speed using full 4 TAP readout potential
Industry standard interface	Compliant with USB 3.0 SuperSpeed specification
Versatile mini camera	Subtle 60 x 60 x 39 mm, 320 grams
Power	Lowest power consumption starting at 3 Watt, bus powered with USB3 cable
Cool	Minimal heat dissipation with passive COOLing
Compatibility	USB 3.0 support for Windows, Linux, Mac OSX (planned ARM) and 30 Libraries
Connectivity and Synchronization	Programmable opto-isolated input and output, 3 status LEDs
Bandwidth potential	5Gb/s interface up to 400Mpix/s data throughput
Software interfaces	GenICam / GenTL and highly optimized xiAPI SDK for Image Processing
High grade	Quality class of sensors is combined with specially selected IR filters
Easy deployment	Range of accessories and widest hardware and software interoperability
Highly Customizable	Available in Board level

table 2-1, advantages

2.3. xiD Camera Applications

- Astronomy and Astrography
- Factory and industry automation - where high resolution or NIR is required
- Ophthalmology and Retinal imaging
- Material and Life science
- Medical Imaging and Light Microscopy
- Pharmaceutics and Healthcare
- Robotic Welding
- Industrial Automation, Machine Vision, Photovoltaics
- Intelligent Transportations Systems (ITS)
- Open road tolling and Traffic monitoring
- ANPR / ALPR
- Biometrics
- Gauging, Metrology
- Defect detection, OCV / OCR
- Astronomy, Astrography - where long exposure times are needed
- Cell Biology, sorting
- Semiconductor wafer and bonding scanning
- Flat panel inspection
- Dentistry, Dermatology
- Print and Film scanning
- Laser beam profiling
- Histology, Pathology
- Fluorescence
- Low light

2.4. Common features

Sensor Technology	CCD, Global shutter
Acquisition Modes	Continuous, software and hardware trigger, fps, triggered exposure and burst,
Partial Image Readout	ROI, Binning modes supported up to binning 5x5
Image data formats	8, 10, 12 or 14 bit RAW pixel data
SDK/API	programmable with C++ and C#
Color image processing	Host based de-Bayering, sharpening, Gamma, color matrix, true color CMS
Hot/blemish pixels correction	On camera storage of more than 5000 pixel coordinates, host assisted correction
Auto adjustments	Host based auto white balance, auto gain, auto exposure
Flat field corrections	Host assisted pixel level shading and lens corrections
Image Data and Control Interface	USB 3.0 standard Micro B
General Purpose I/O	1x opto-isolated input, 1x opto-isolated output, 1x magnetically insulated input and 1x magnetically isolated output, 3X 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. Available options are board level
Power requirements [1]	3.6-5.2W, supplied via USB 3.0 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 7 SP1 (x86 and x64), Windows 10 (x86 and x64), Linux Ubuntu, MacOS 10.8
Software support	xiAPI SDK, adapters and drivers for various image processing packages
Firmware updates	Field firmware updatable trough xiCOP

table 2-2, common features

Note: 1) Power consumption is model specific

2.5. Model Nomenclature

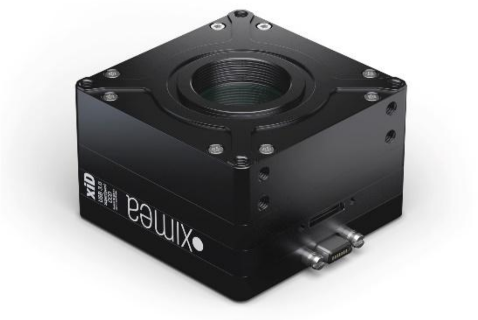
Part number convention for the different models:

xiD family

MDxxxyU-zz-OPT

MD	xiD family name
xxx:	Resolution in 0.1 MPixel. E.g. 2.8 MPixel Resolution: xxx = 028
y:	y=C: color model y=M: black & white model
U:	Uncooled
zz:	Vendor of the sensor zz = SY: SONY
[-OPT]:	Options OPT = BRD: board level camera

2.6. Models Overview, sensor and models



Model		Sensor	Resolution	Pixel size	ADC [bit]	DR	Sensor diagonal	FPS[1]
MD028MU-SY	b/w	SONY ICX674ALG	1934 x 1456	4.54 µm	14	68.6 dB	11 mm	56.9
MD028CU-SY	Color	SONY ICX674AQG						
MD061MU-SY	b/w	SONY ICX694ALG	2754 x 2204	4.54 µm	14	68.7 dB	16 mm	28.4
MD061CU-SY	Color	SONY ICX694AQG						
MD091MU-SY	b/w	SONY ICX814ALG	3384 x 2708	3.69 µm	14	64.7 dB	16 mm	19.5
MD091CU-SY	Color	SONY ICX814AQG						
MD120MU-SY	b/w	SONY ICX834ALG	4242 x 2830	3.1 µm	14	63.5 dB	15.8 mm	15.3
MD120CU-SY	Color	SONY ICX834AQG						

table 2-3, models overview

Note: 1) Full resolution, 4-TAP readout 14 bit/pixel

2.7. Options

Most models are available as a board level version, please inquire

2.8. 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
MECH-60MM-BRACKET-T	xiD series tripod mounting bracket
CBL-MD-PWR-SYNC-3M0	3.0 Trigger/Sync I/O cablel
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-U3-3M0-YP	Y-Shaped Power USB3 Cable 3.0m, thumbscrews
CBL-U3-3M0-YP-UA	Y-Shaped Power USB3 Cable 3.0m, Up Angle thumbscrews
CBL-U3-5M0-YP	Y-Shaped Power USB3 Cable 5.0m, thumbscrews
CBL-U3-5M0-YP-UA	Y-Shaped Power USB3 Cable 5.0m, Up Angle, thumbscrews

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 xiD cameras are powered via the USB Micro-B. The input voltage is 5 V DC.

The power consumption is 3.8 - 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)

For stable operation of the cameras with higher power consumption (such as model 091 and 120) it is advised to use USB3.0 cable with secondary USB connector CBL-U3-3M0-YP or similar to provide enough power to the camera

3.2. General Specification

3.2.1. Environment

Description	Value
Optimal ambient temperature operation	+10 to +25 °C
Ambient temperature operation	+0 to +50 °C
Ambient temperature for storage and transportation	-30 to +70 °C
Relative Humidity, non-condensing	80 %

table 3-1, environment

Housing temperature must not exceed +65°C. 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

3.2.2. Firmware / Host driver / API features

Description	Value
Interpolation	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: http://www.ximea.com/support

3.3. Lens Mount

The xiD cameras C-mount lenses.

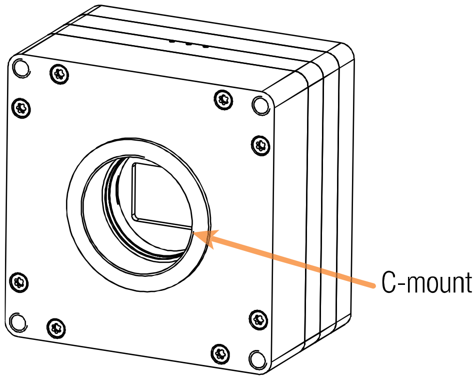


figure 3-1, xiD lens mount

3.4. Mounting points

Mounting points available to the customer are shown below. All are M4 thread.

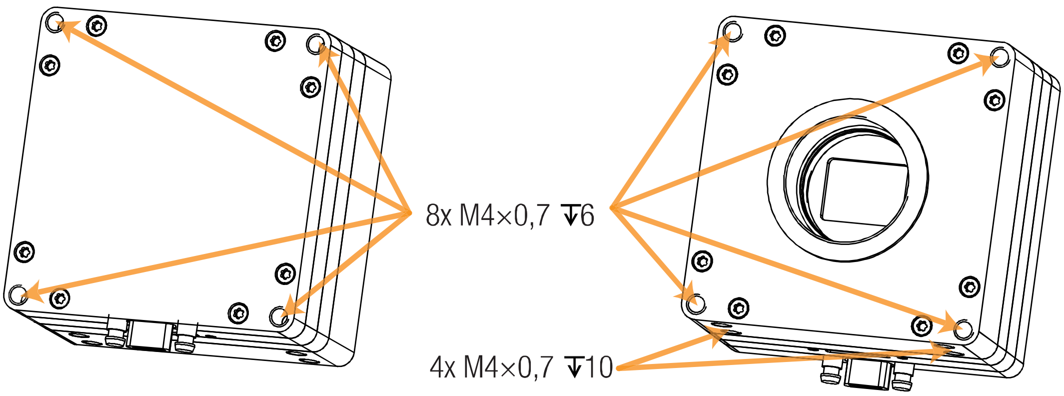


Figure 3-2, drawing demonstrating the mounting hole positions.

3.5. Optical path

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. 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 sensor chamber.

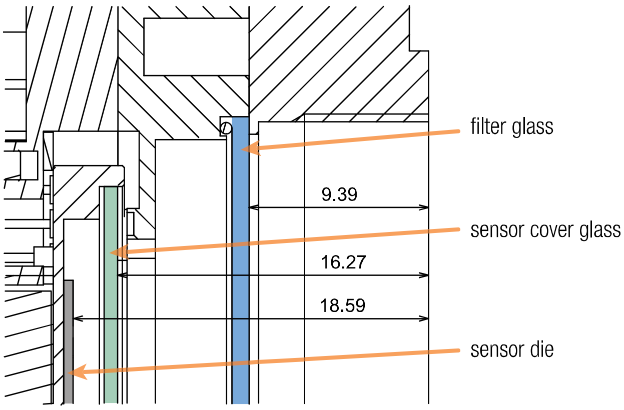


figure 3-3, Optical path section

3.5.1. Monochrome and near infrared extended camera models

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

table 3-3, monochrome camera - filter glass parameter

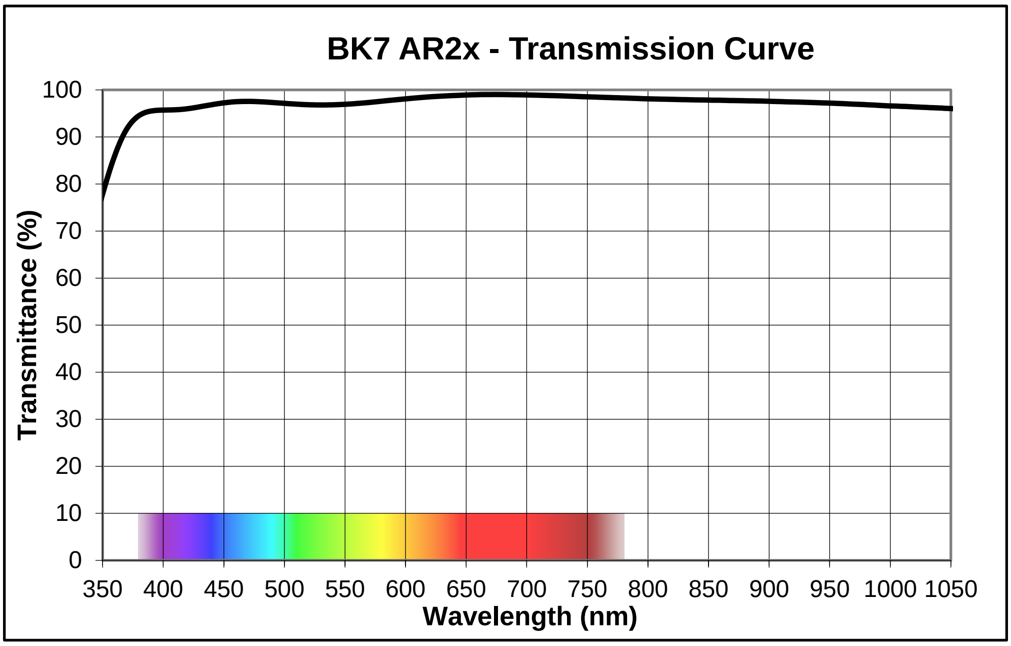


figure 3-4, monochrome camera - filter glass transmission curve

3.5.2. Color camera models

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

table 3-4, color camera - filter glass parameter

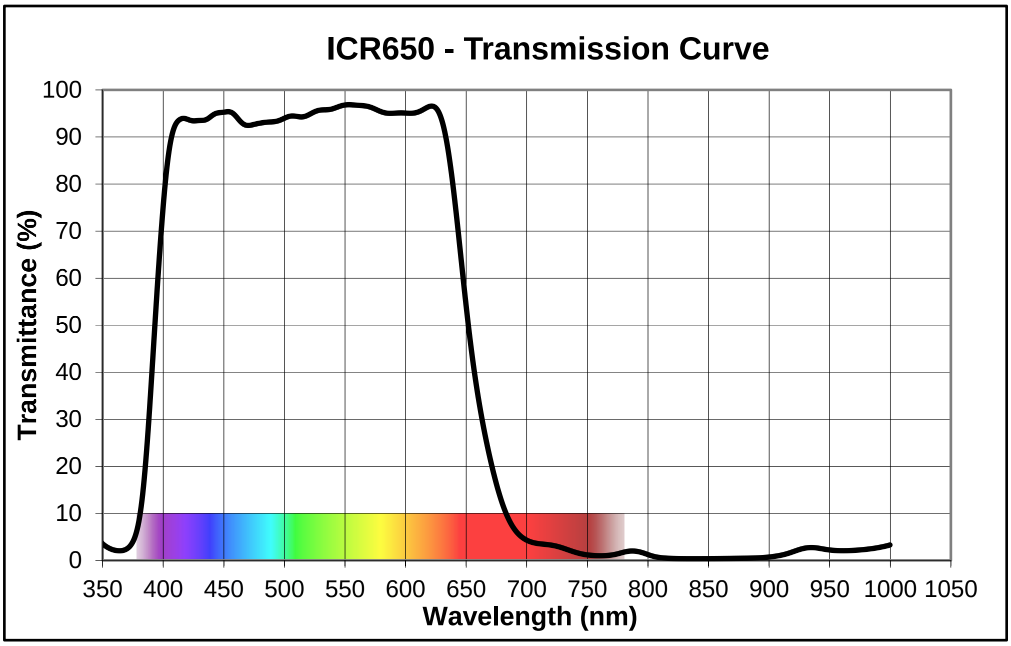


figure 3-5, color camera - filter glass transmission curve

3.6. Model Specific Characteristics

3.6.1. MD028xU-SY

3.6.1.1. Sensor and camera parameters

xiD model		MD028CU-SY	MD028MU-SY
Sensor parameter			
Part number		ICX674AQG	ICX674ALG
Color filter		RGB Bayer mosaic	None
Type		CCD progressive scan	
Pixel Resolution (W x H)	[pixel]	1934 x 1456	
Active area size (W x H)	[mm]	8.78 x 6.61mm	
Sensor diagonal	[mm]	11 mm	
Optical format	[inch]	2/3"	
Pixel Size	[µm]	4.54µm	
ADC resolution	[bit]	14	
FWC	[ke-]	20	
Dynamic range	[dB]	68.1	
SNR Max	[dB]	43.7	
Conversion gain	[e-/LSB_{14}]	1.34	
Dark noise	[e-]	8.8	
Dark current	[e-/s]	TBD	
DSNU	[e-]	TBD	
PRNU	%	TBD	
Linearity	[%]	<1	
Micro lenses		Yes	
Camera parameters			
Digitization	[bit]	14	
Supported bit resolutions	[bit/pixel]	8, 10, 12, 14	
Exposure time (EXP)		0.047ms – 712 s	
Variable Gain Range (VGA)	[dB]	-3 – 41	
Refresh rate (MRR)	[fps]	56.9	
Power consumption[1]			
Stand by	[W]	0.76	
Maximum	[W]	3.6	
Dimensions/Mass			
height	[mm]	60	
width	[mm]	60	
depth	[mm]	37.2	
mass	[g]	320	

table 3-5, MD028xU-SY, sensor and camera parameters

Notes: 1) Measured at 4TAP/52MHz readout

Binning(readout)	TAPs	MD028CU-SY	MD028MU-SY	Pixels	Bit/px	fps
1x1	1	Color	B/W	1936 x 1456	14	15.8
2x2	1	B/W[1]	B/W	966 x 726	14	28.7
3x3	1	B/W[1]	B/W	644 x 482	14	39.3
4x4	1	B/W[1]	B/W	482 x 360	14	48.3
5x5	1	B/W[1]	B/W	384 x 288	14	55.9
1x1	2	Color	B/W	1936 x 1456	14	28.7
2x2	2	B/W[1]	B/W	966 x 726	14	48.2
3x3	2	B/W[1]	B/W	644 x 482	14	62.5
4x4	2	B/W[1]	B/W	482 x 360	14	73.3
5x5	2	B/W[1]	B/W	384 x 288	14	81.5
1x1	4	Color	B/W	1936 x 1456	14	56.9
2x2	4	B/W[1]	B/W	966 x 726	14	95.0
3x3	4	B/W[1]	B/W	644 x 482	14	122.8
4x4	4	B/W[1]	B/W	482 x 360	14	143.3
5x5	4	B/W[1]	B/W	384 x 288	14	159.0

table 3-6, MD028xU-SY, standard readout modes

Notes: 1) Image data contains some part of color information depending on binning

3.6.1.2. Quantum efficiency curves [%]

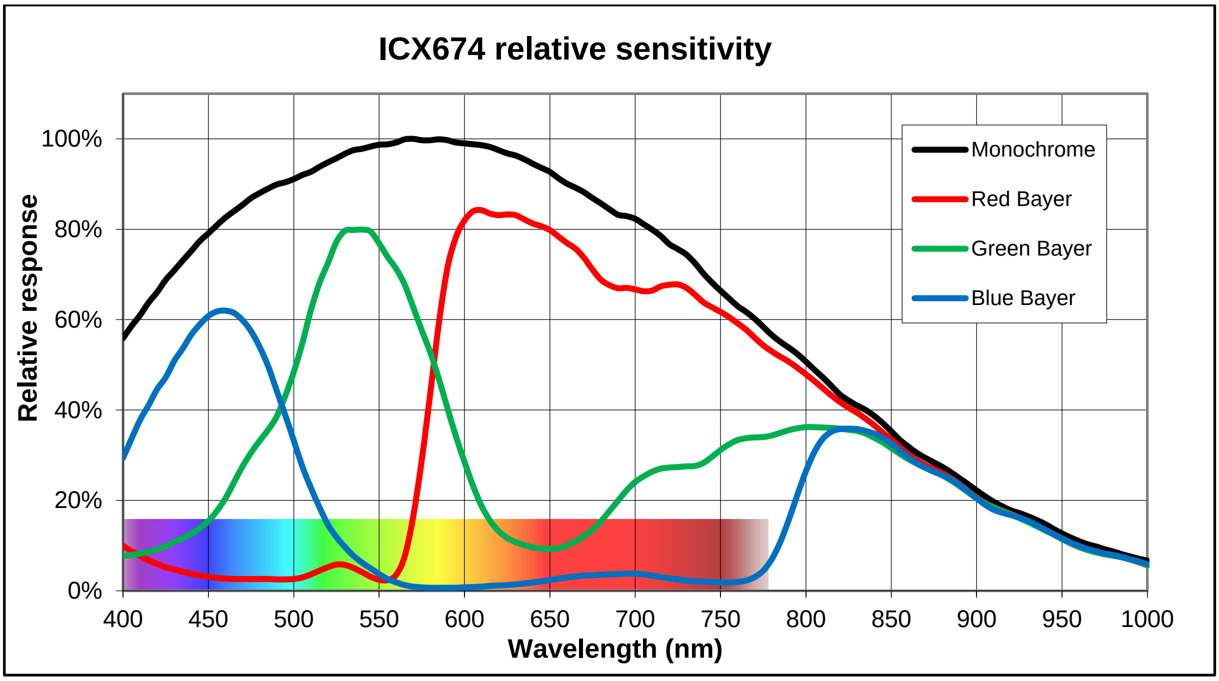


figure 3-6, ICX674-mono, color; quantum efficiency curve, ©SONY

3.6.1.3. Dimensional drawings MD028xU-SY

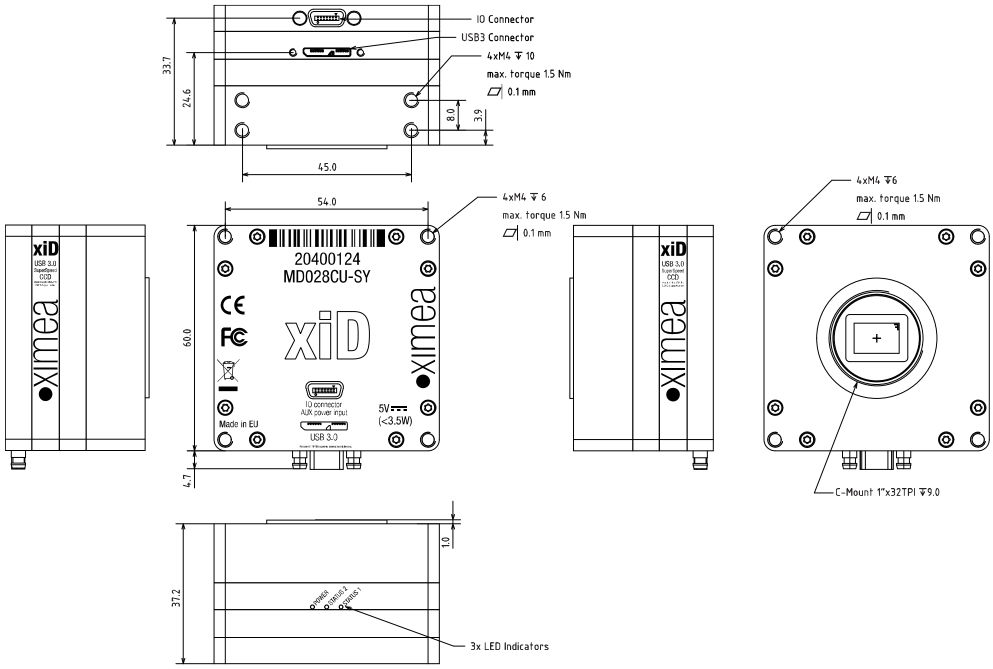


figure 3-7, dimensional drawing MD028xU-SY

3.6.1.4. Referenced documents

ICX674 Datasheets, Sony Corp.

3.6.1.5. Sensor features

feature	Note
Binning	Yes, up to 5x5
Skipping	No
ROI	Vertical cropping results in increased read speed.
HW Trigger	Trigger without overlap
HDR	Not available

table 3-7, sensor features available

3.6.2. MD061xU-SY

3.6.2.1. Sensor and camera parameters

xiD model		MD061CU-SY	MD061MU-SY
Sensor parameter			
Part number		ICX694AQG	ICX694ALG
Color filter		RGB Bayer mosaic	None
Type		CCD progressive scan	
Pixel Resolution (W x H)	[pixel]	2752 x 2204	
Active area size (W x H)	[mm]	12.5 x 10.0mm	
Sensor diagonal	[mm]	16 mm	
Optical format	[inch]	1"	
Pixel Size	[µm]	4.54µm	
ADC resolution	[bit]	14	
FWC	[ke-]	19.5	
Dynamic range	[dB]	67.4	
SNR Max	[dB]	43.5	
Conversion gain	[e-/LSB_{14}]	1.28	
Dark noise	[e-]	8.9	
Dark current	[e-/s]	TBD	
DSNU	[e-]	TBD	
PRNU	%	TBD	
Linearity	[%]	<1	
Micro lenses		Yes	
Camera parameters			
Digitization	[bit]	14	
Supported bit resolutions	[bit/pixel]	8, 10, 12, 14	
Exposure time (EXP)		0.054ms – 974.4 s	
Variable Gain Range (VGA)	[dB]	-2.8 – 41.5	
Refresh rate (MRR)	[fps]	28.4	
Power consumption[1]			
Stand by	[W]	0.76	
Maximum	[W]	4.1	
Dimensions/Mass			
height	[mm]	60	
width	[mm]	60	
depth	[mm]	37.2	
mass	[g]	320	

table 3-8, MD061xU-SY, sensor and camera parameters

Notes: 1) Measured at 4TAP/52MHz readout

Binning(readout)	TAPs	MD061CU-SY	MD061MU-SY	Pixels	Bit/px	fps
1x1	1	Color	B/W	2752 x 2204	14	7.7
2x2	1	B/W[1]	B/W	1372 x 1100	14	14.3
3x3	1	B/W[1]	B/W	912 x 732	14	20.0
4x4	1	B/W[1]	B/W	684 x 548	14	25.0
5x5	1	B/W[1]	B/W	548 x 438	14	29.4
1x1	2	Color	B/W	2752 x 2204	14	14.3
2x2	2	B/W[1]	B/W	1372 x 1100	14	25.0
3x3	2	B/W[1]	B/W	912 x 732	14	33.4
4x4	2	B/W[1]	B/W	684 x 548	14	40.1
5x5	2	B/W[1]	B/W	548 x 438	14	45.8
1x1	4	Color	B/W	2752 x 2204	14	28.4
2x2	4	B/W[1]	B/W	1372 x 1100	14	49.6
3x3	4	B/W[1]	B/W	912 x 732	14	66.0
4x4	4	B/W[1]	B/W	684 x 548	14	78.9
5x5	4	B/W[1]	B/W	548 x 438	14	90.4

table 3-9, MD061xU-SY, standard readout modes

Notes: 1) Image data contains some part of color information depending on binning

3.6.2.2. Quantum efficiency curves [%]

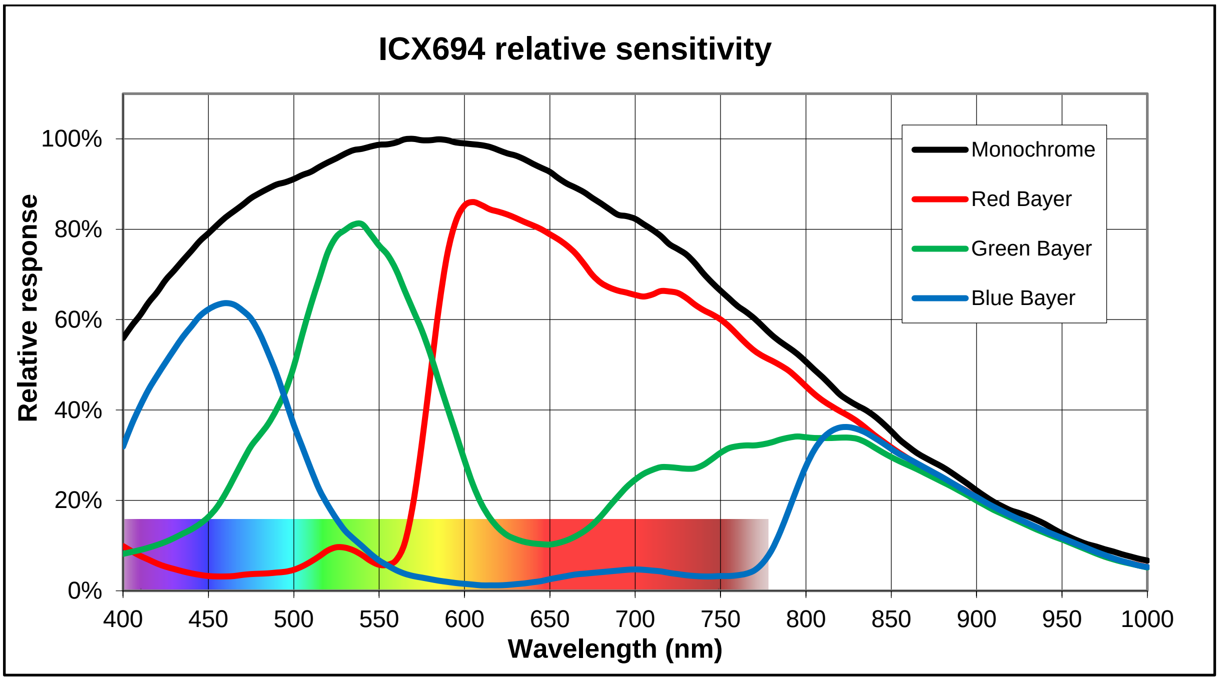


figure 3-8, ICX694-mono, color; quantum efficiency curve, ©SONY

3.6.2.3. Dimensional drawings MD061xU-SY

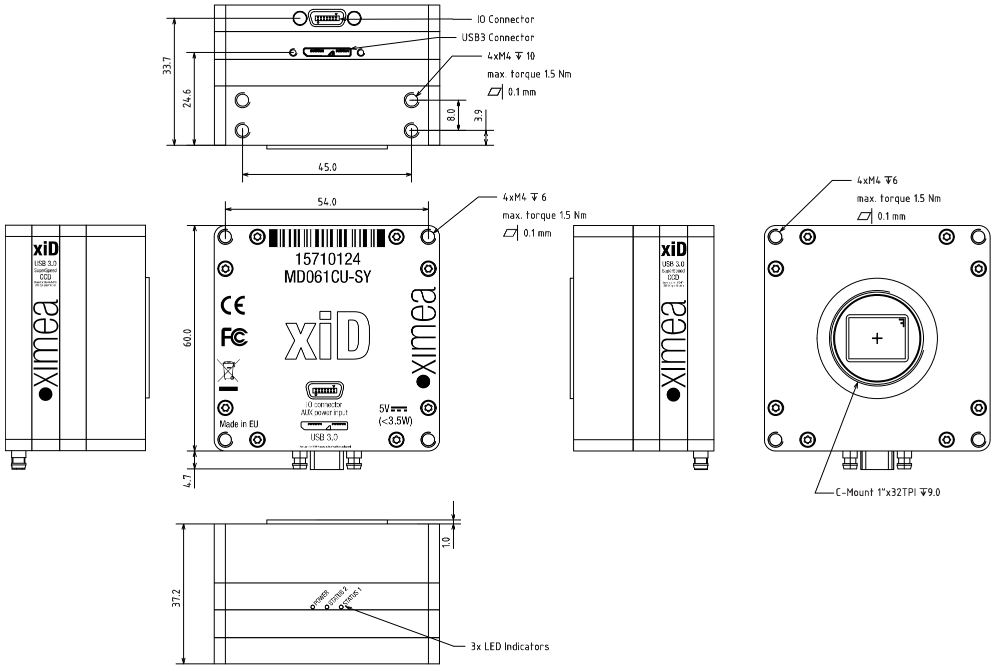


figure 3-9, dimensional drawing MD061xU-SY

3.6.2.4. Referenced documents

ICX694 Datasheets, Sony Corp.

3.6.2.5. Sensor features

feature	Note
Binning	Yes, up to 5x5
Skipping	No
ROI	Vertical cropping results in increased read speed.
HW Trigger	Trigger without overlap
HDR	Not available

table 3-10, sensor features available

3.6.3. MD091xU-SY

3.6.3.1. Sensor and camera parameters

xiD model		MD091CU-SY	MD091MU-SY
Sensor parameter			
Part number		ICX814AQG	ICX814ALG
Color filter		RGB Bayer mosaic	None
Type		CCD progressive scan	
Pixel Resolution (W x H)	[pixel]	3384 x 2708	
Active area size (W x H)	[mm]	12.5 x 10.0mm	
Sensor diagonal	[mm]	16 mm	
Optical format	[inch]	1"	
Pixel Size	[µm]	3.69µm	
ADC resolution	[bit]	14	
FWC	[ke-]	12	
Dynamic range	[dB]	64.5	
SNR Max	[dB]	43.0	
Conversion gain	[e-/LSB_{14}]	0.926	
Dark noise	[e-]	9.4	
Dark current	[e-/s]	TBD	
DSNU	[e-]	TBD	
PRNU	%	TBD	
Linearity	[%]	<1	
Micro lenses		Yes	
Camera parameters			
Digitization	[bit]	14	
Supported bit resolutions	[bit/pixel]	8, 10, 12, 14	
Exposure time (EXP)		0.061ms – 1177 s	
Variable Gain Range (VGA)	[dB]	-6.7 – 37.6	
Refresh rate (MRR)	[fps]	19.5	
Power consumption[1]			
Stand by	[W]	0.76	
Maximum	[W]	4.6	
Dimensions/Mass			
height	[mm]	60	
width	[mm]	60	
depth	[mm]	37.2	
mass	[g]	320	

table 3-11, MD091xU-SY, sensor and camera parameters

Notes: 1) Measured at 4TAP/52MHz readout

Binning(readout)	TAPs	MD091CU-SY	MD091MU-SY	Pixels	Bit/px	fps
1x1	1	Color	B/W	3384 x 2708	14	5.2
2x2	1	B/W[1]	B/W	1690 x 1352	14	9.8
3x3	1	B/W[1]	B/W	1124 x 900	14	13.8
4x4	1	B/W[1]	B/W	842 x 674	14	17.5
5x5	1	B/W[1]	B/W	672 x 538	14	20.8
1x1	2	Color	B/W	3384 x 2708	14	9.8
2x2	2	B/W[1]	B/W	1690 x 1352	14	17.5
3x3	2	B/W[1]	B/W	1124 x 900	14	23.7
4x4	2	B/W[1]	B/W	842 x 674	14	28.9
5x5	2	B/W[1]	B/W	672 x 538	14	33.2
1x1	4	Color	B/W	3384 x 2708	14	19.5
2x2	4	B/W[1]	B/W	1690 x 1352	14	34.8
3x3	4	B/W[1]	B/W	1124 x 900	14	47.0
4x4	4	B/W[1]	B/W	842 x 674	14	57.3
5x5	4	B/W[1]	B/W	672 x 538	14	65.6

table 3-12, MD091xU-SY, standard readout modes

Notes: 1) Image data contains some part of color information depending on binning

3.6.3.2. Quantum efficiency curves [%]

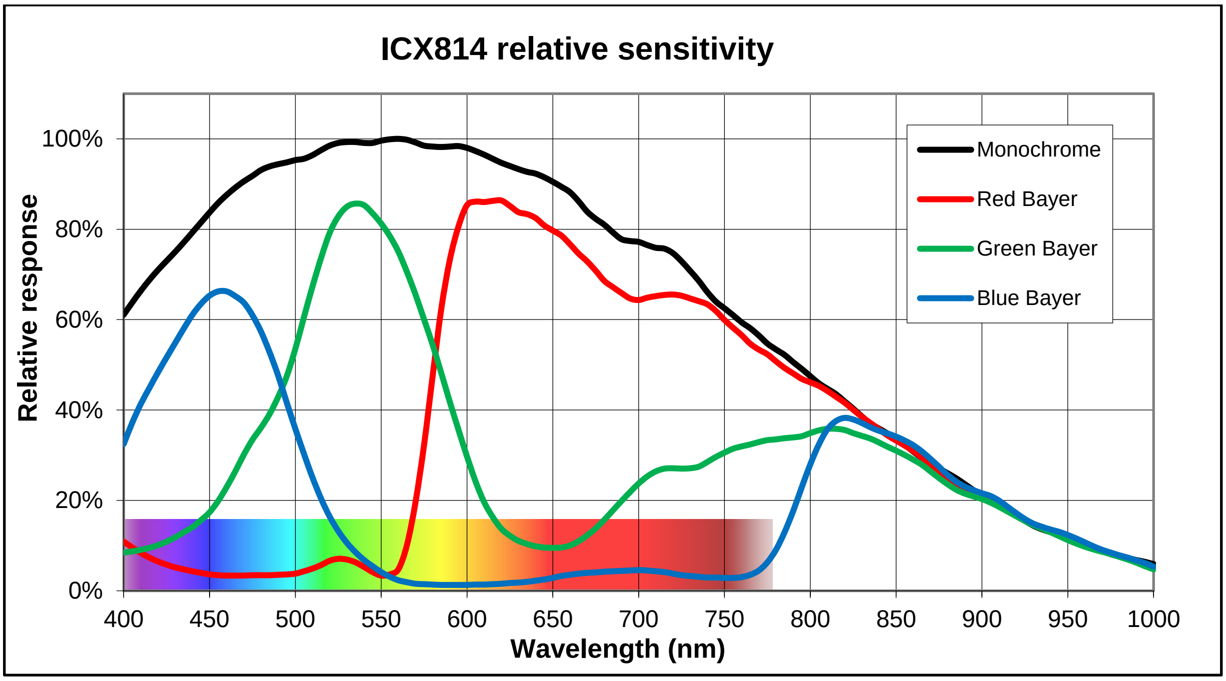


figure 3-10, ICX814-mono, color; quantum efficiency curve, ©SONY

3.6.3.3. Dimensional drawings MD091xU-SY

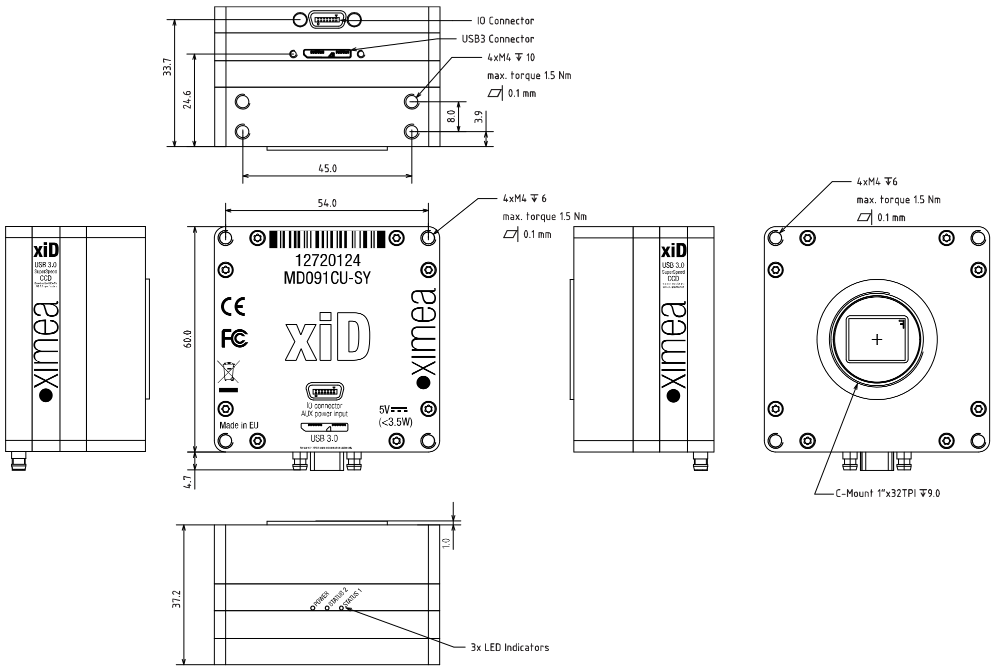


figure 3-11, dimensional drawing MD091xU-SY

3.6.3.4. Referenced documents

ICX814 Datasheets, Sony Corp.

3.6.3.5. Sensor features

feature	Note
Binning	Yes, up to 5x5
Skipping	No
ROI	Vertical cropping results in increased read speed.
HW Trigger	Trigger without overlap
HDR	Not available

table 3-13, sensor features available

3.6.4. MD120xU-SY

3.6.4.1. Sensor and camera parameters

xiD model		MD120CU-SY	MD120MU-SY
Sensor parameter			
Part number		ICX834AQG	ICX834ALG
Color filter		RGB Bayer mosaic	None
Type		CCD progressive scan	
Pixel Resolution (W x H)	[pixel]	4244 x 2832	
Active area size (W x H)	[mm]	13.16 x 8.78mm	
Sensor diagonal	[mm]	15.8 mm	
Optical format	[inch]	1"	
Pixel Size	[µm]	3.1µm	
ADC resolution	[bit]	14	
FWC	[ke-]	10	
Dynamic range	[dB]	61.7	
SNR Max	[dB]	41.1	
Conversion gain	[e-/LSB_{14}]	0.704	
Dark noise	[e-]	9.3	
Dark current	[e-/s]	TBD	
DSNU	[e-]	TBD	
PRNU	%	TBD	
Linearity	[%]	<1	
Micro lenses		Yes	
Camera parameters			
Digitization	[bit]	14	
Supported bit resolutions	[bit/pixel]	8, 10, 12, 14	
Exposure time (EXP)		0.069ms – 1450 s	
Variable Gain Range (VGA)	[dB]	-8.8 – 35.5	
Refresh rate (MRR)	[fps]	15.8	
Power consumption[1]			
Stand by	[W]	0.76	
Maximum	[W]	4.95	
Dimensions/Mass			
height	[mm]	60	
width	[mm]	60	
depth	[mm]	37.2	
mass	[g]	320	

table 3-14, MD120xU-SY, sensor and camera parameters

Notes: 1) Measured at 4TAP/52MHz readout

Binning(readout)	TAPs	MD120CU-SY	MD120MU-SY	Pixels	Bit/px	fps
1x1	1	Color	B/W	4244 x 2832	14	4.0
2x2	1	B/W[1]	B/W	2120 x 1414	14	7.7
3x3	1	B/W[1]	B/W	1412 x 942	14	10.9
4x4	1	B/W[1]	B/W	1056 x 704	14	14.0
5x5	1	B/W[1]	B/W	844 x 562	14	16.7
1x1	2	Color	B/W	4244 x 2832	14	7.6
2x2	2	B/W[1]	B/W	2120 x 1414	14	14.0
3x3	2	B/W[1]	B/W	1412 x 942	14	19.2
4x4	2	B/W[1]	B/W	1056 x 704	14	23.8
5x5	2	B/W[1]	B/W	844 x 562	14	27.7
1x1	4	Color	B/W	4244 x 2832	14	15.2
2x2	4	B/W[1]	B/W	2120 x 1414	14	27.7
3x3	4	B/W[1]	B/W	1412 x 942	14	38.1
4x4	4	B/W[1]	B/W	1056 x 704	14	47.1
5x5	4	B/W[1]	B/W	844 x 562	14	54.6

table 3-15, MD120xU-SY, standard readout modes

Notes: 1) Image data contains some part of color information depending on binning

3.6.4.2. Quantum efficiency curves [%]

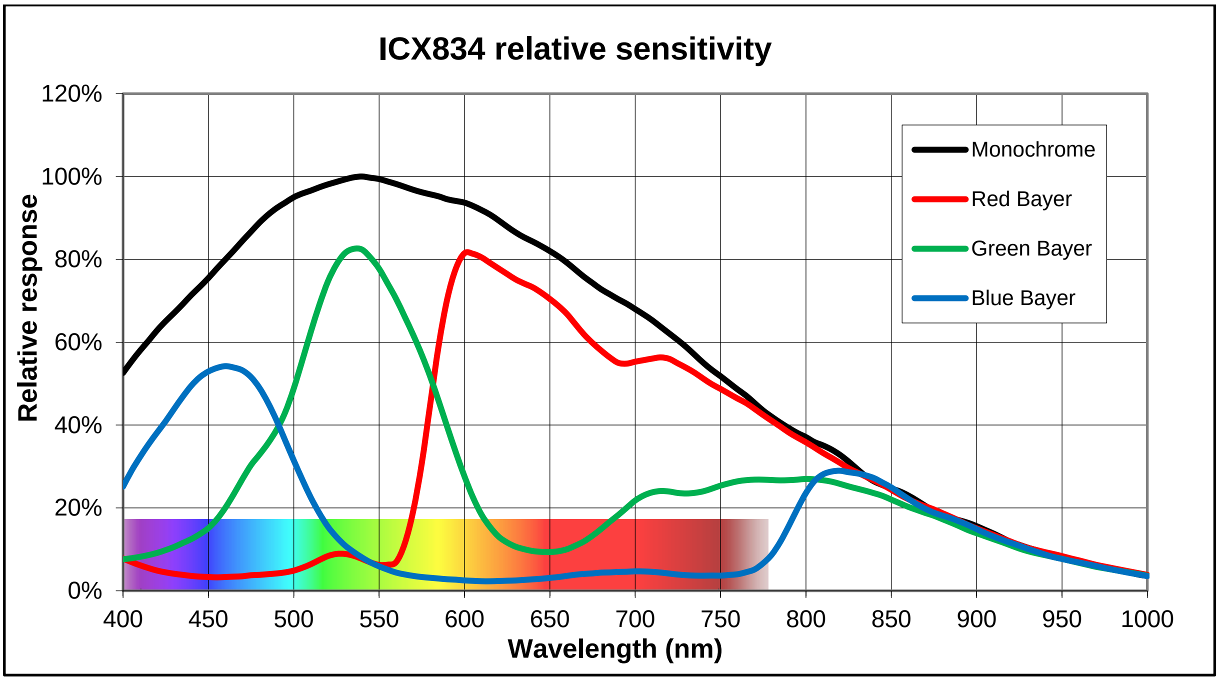


figure 3-12, ICX834-mono, color; quantum efficiency curve, ©SONY

3.6.4.3. Dimensional drawings MD028xU-SY

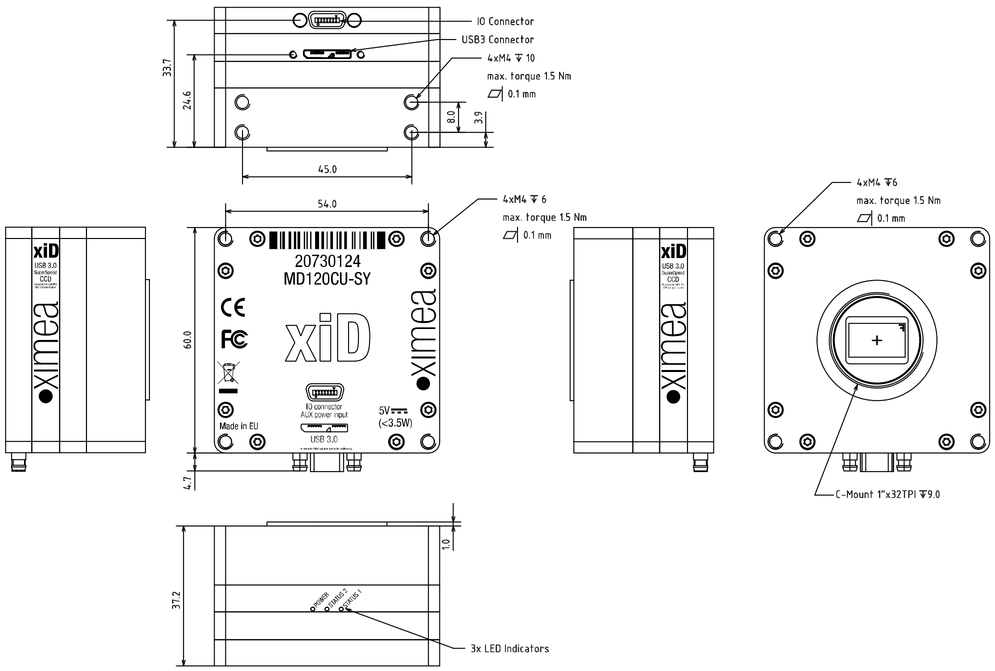


figure 3-13, dimensional drawing MD120xU-SY

3.6.4.4. Referenced documents

ICX834 Datasheets, Sony Corp.

3.6.4.5. Sensor features

feature	Note
Binning	Yes, up to 5x5
Skipping	No
ROI	Vertical cropping results in increased read speed.
HW Trigger	Trigger without overlap
HDR	Not available

table 3-16, sensor features available

3.7. User interface – LEDs

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

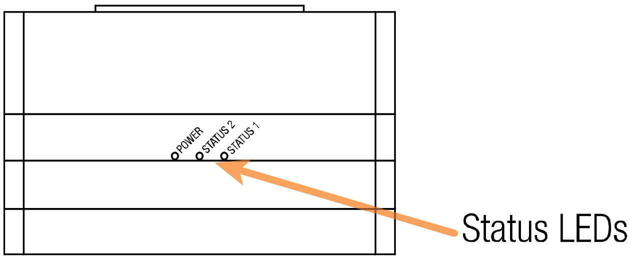


figure 3-14, position status LEDs

The LEDs are programmable. Please note the following description:

LED	Color	Defaults	Note
POWER	Orange	On	User configurable
STATUS2	Green	Connection status	User configurable
STATUS1	Red	Streaming	User configurable

table 3-17, LED output description after camera is opened in API

The LEDs Status1 and Status2 are programmable. Please note the following description:

LED	Color	Description
Power	Orange	Power indication: LED is on if the power is on (USB 3.0 cable connected) User configurable: register (set value)
Status 2	Green	USB 3.0 Enumeration USB 2.0 Enumeration (default), User configurable: register (set value) strobe busy streaming trigger level edge digital input slow blink fast blink
Status 1	Red	Streaming (default), User configurable: register (set value) strobe busy streaming trigger level edge digital output slow blink fast blink

table 3-18, LED output description

3.8. xiD USB 3.0 Interface

Connector	Signals	Mating Connectors
USB 3.0	Standard USB 3.0 Micro-B Female Connector	Standard USB 3.0 Micro-B Connector with thumbscrews Screw thread M2, thread distance 18.0mm

table 3-19, USB 3.0 mating connector description

The USB 3.0 Micro-B connector is used for data transmission, camera control and power.

3.8.1. Location

The USB 3.0 connector is located on the back side of the camera:

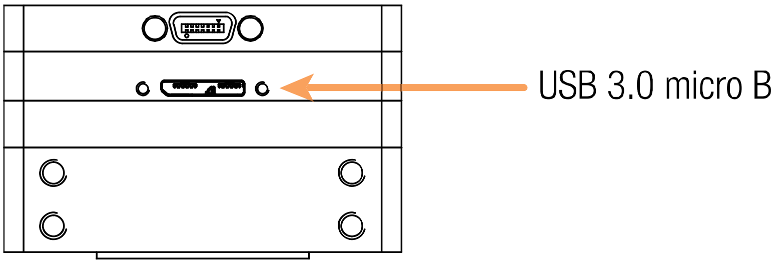


figure 3-15, position USB 3.0 interface

3.8.2. Pinning

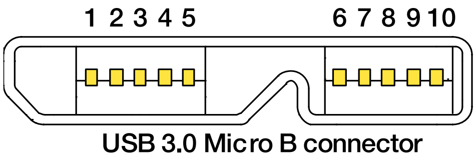


figure 3-16, pinning USB 3.0 connector

USB 3.0 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	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 3-20, USB 3.0 connector, pin assignment

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

3.9. Digital Input / Output (GPIO) Interface

xiD cameras use the 12-pin connector for the GPIO interface and power. MD features two pairs of IO ports. First one optocoupled rated for 24V systems and second insulated fast TTL. IO connector is located close to USB3.0 connector at the bottom of camera, featuring HDR-EA14LFYPG1 SLG connector.

Connector	Signals	Mating Connectors
xiD I/O 14-pin	Opto-isolated trigger input and insulated fast TTL I/O	HDR-E14 MAG1+ HDR-E14-MSG1+ IO pigtail cable Ximea PN: CBL-MD-PWR-SYNC-3M0

table 3-21, GPIO mating connector description

3.9.1. Location

IO interface receptacle is located on the underside of the camera close to USB 3.0 connector:

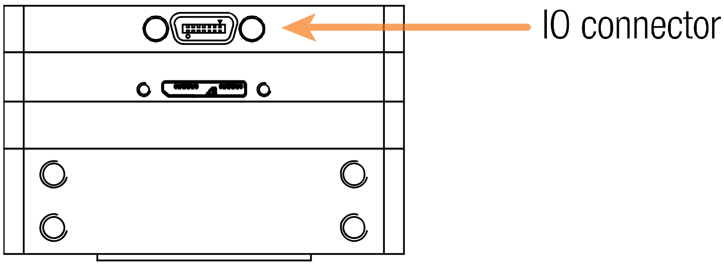


figure 3-17, position GPIO + power connector

3.9.2. IO Connector Pinning

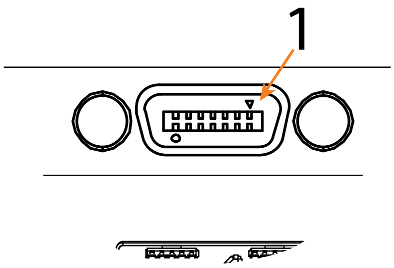


figure 3-18, xiD IO connector pinout

I/O connector Pin Assignment:

Pin	Name	Signal	Technical description
1	GPO1X	Digital Output 1 pole X	24V logic output (relay switch)
2	GPO1Y	Digital Output 1 pole Y	24V logic output (relay switch)
3	GPI1+	Digital Input 1 positive pole	(<0.8 Low; 4-24 High)
4	GPI1-	Digital Input 1 negative pole	(<0.8 Low; 4-24 High)
5	GND 2	Common Negative Pole 2 (GPI2, GPO2)	
6	GPO2	Magnetically isolated fast output	Isolated output (<0.4 Low; IO2AUX High)
7	IO2AUX	Isolator Aux Power GPIO2 (3.3V - 5.0V DC)	Isolated output up to IO2AUX voltage
14	GPI2	Magnetically isolated fast input	Isolated input (<0.8 Low; 2-5V High)
8,10,12	NC	Reserved for future use	
9,11,13	NC	Reserved for future use	
Shell		Shielding	

table 3-22, xiD I/O connector Pin Assignment

3.9.3. Optically isolated Digital Input

3.9.3.1. 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]	<2 +/-0.5µs (V_{INPUT}=10V, $T_{AMBIENT}$=25°C)
Input delay – falling edge[1]	<40 +/-0.5µs (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 3-23, Optically isolated digital input, general info

Note: – 1) Propagation delay depends on voltage level and can vary from camera to camera, propagation jitter is significantly lower.

3.9.3.2. 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 3-24, digital info, signal levels

Note:

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

3.9.3.3. Digital Input – Internal Schematic

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

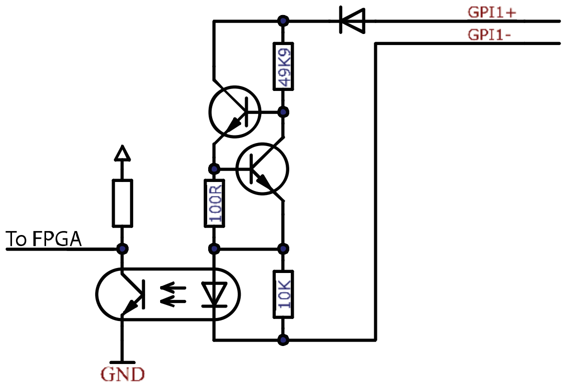


figure 3-19, digital input, interface schematic

3.9.3.4. Digital Input – Wiring

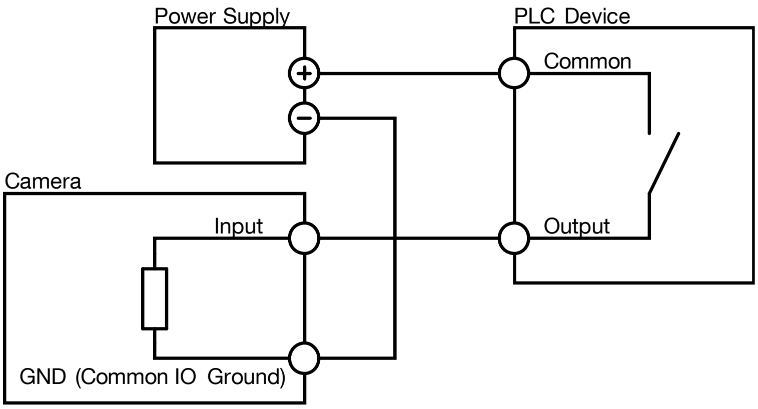


figure 3-20, digital input, interface wiring

3.9.3.5. 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	1.8
Rising	10	1.9
Falling	5	37
Falling	10	39
Falling	24	42

table 3-25, digital input, timing

Note: Measured at: Ambient Temperature 25°C

3.9.4. Optically isolated Digital Output

3.9.4.1. Optically isolated Digital Output - General info

Item	Parameter / note
Maximal open circuit voltage	24V
Output port type	relay
Protection	short-circuit / over-current
Protection circuit	PTC Resettable Fuse
Maximal sink current	100mA
Trip current	290mA – self restarting when failure mode current disconnected
Inductive loads	No
Effect of incorrect output terminal connection	The outputs are equivalent
Maximal output drop	0.5V, sink current 25mA
Number of outputs	1
Strobe output mapping	Yes

table 3-26, Optically isolated digital output, general info

3.9.4.2. Optically isolated Digital Output Delay

Output current	OFF -> ON	ON -> OFF	Note
2mA	29 µs	160 µs	V_{source}= 24V; R_{LOAD} = 12kOhm
5mA	28 µs	165 µs	V_{source}= 24V; R_{LOAD} = 4.8kOhm
10mA	26.5 µs	172 µs	V_{source}= 24V; R_{LOAD} = 2.4kOhm
24mA	26 µs	178 µs	V_{source}= 24V; R_{LOAD} = 1kOhm

table 3-27, Optically isolated digital output, general info

Note: The delay can vary from device to device.

3.9.4.3. Optically isolated Digital Output – Internal schematic

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

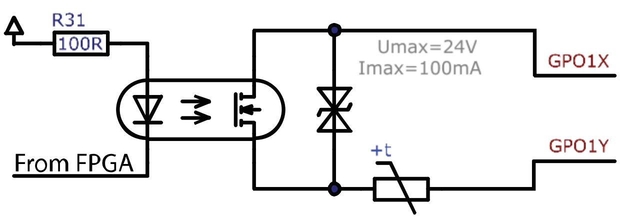


figure 3-21, digital output, interface schematic

3.9.4.4. Digital Output – Wiring

Digital output operates as relay. In most cases a power source for external device must be provided.

Connecting Digital OUTPUT to a NPN-compatible PLC device input (biased)

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

3.9.4.4.1.

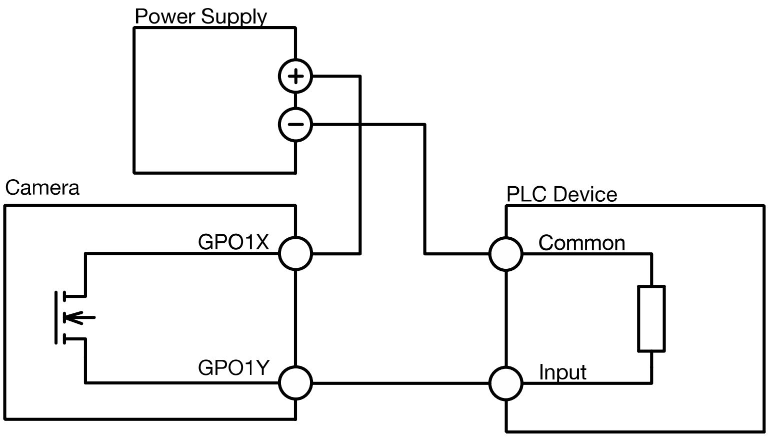


figure 3-22, Connecting Digital OUTPUT to a NPN-compatible PLC device input (biased)

Important note:

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

3.9.4.4.2. Connecting Digital OUTPUT to a 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

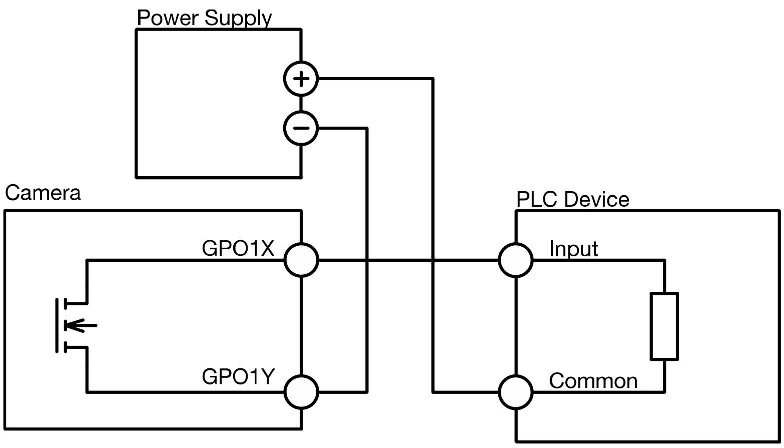


figure 3-23, Connecting Digital OUTPUT to a NPN-compatible PLC device input - more bidirectional inputs used

Note:

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

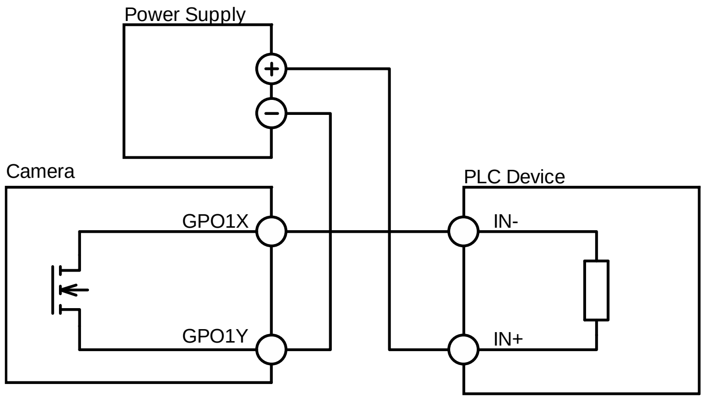


figure 3-24, Connecting Digital OUTPUT to a NPN-compatible PLC device - single input

3.9.4.4.3. 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)

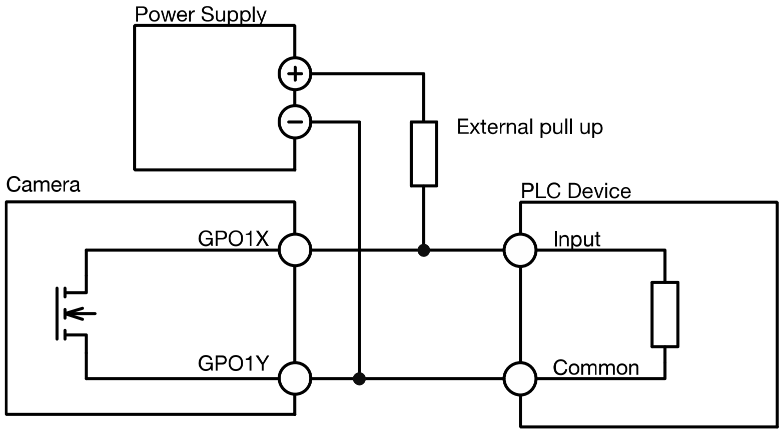


figure 3-25, Connecting Digital OUTPUT to a PNP-compatible device

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 $P(R) > (V_{psu} - V_{input}) * I_{input}$

3.9.4.4.4. ### Output Wiring Example: LED Driving

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

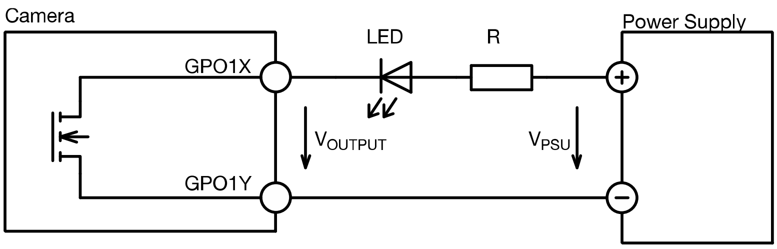


figure 3-26, LED Driving

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. 3.9.4.1 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 Colour	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 3-28, digital output, LED driving

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.

3.9.4.4.5.

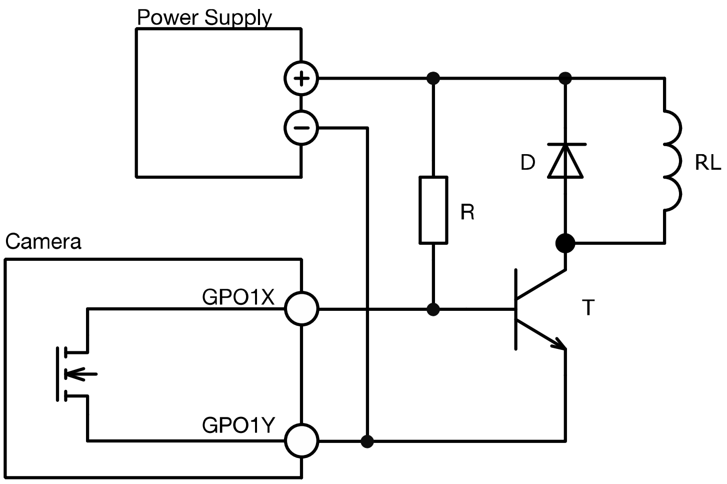


figure 3-27, Inductive load (Relay) Driving (inverted logic)

For positive logic you can use a second bipolar transistor.

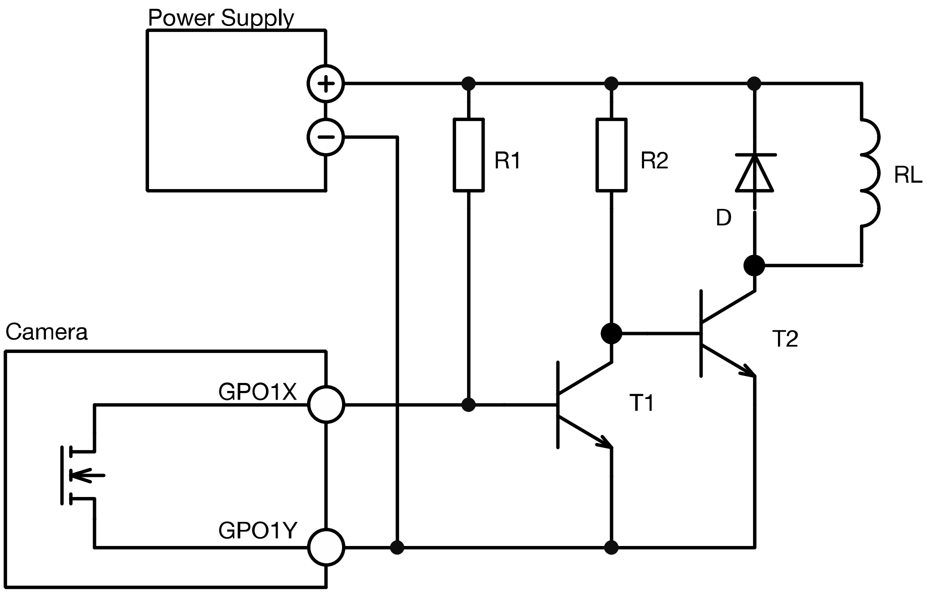


figure 3-28, Inductive load (Relay) Driving (non-inverted logic)

3.9.5. Isolated High Speed Digital Lines (GPI2, GPO2)

xiD camera features one input and one output with fast digital isolation

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 has to be used.

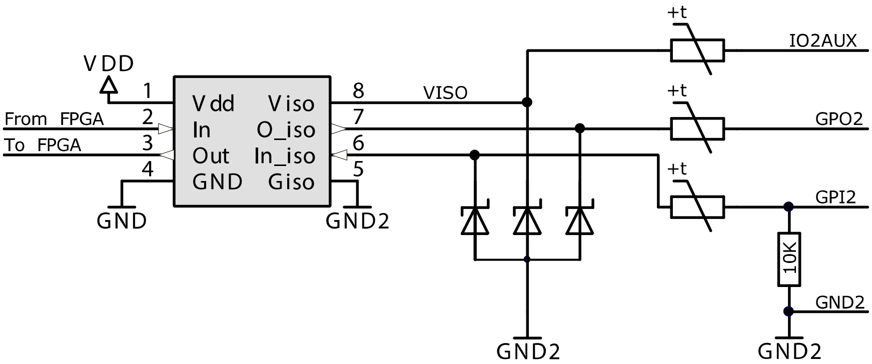


figure 3-29, Isolated low voltage Digital Lines, interface schematic

3.9.5.1. Isolated High Speed Digital Lines General info

Item	Parameter / note
Maximal input voltage IO2AUX	5.5V
Common pole	Yes
Number of inputs	1
Number of outputs	1
Protection circuit	PTC Resettable Fuse
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 < 0.8V
Input level for logical 1	Voltage > 2.6V
Input debounce filter	No
Input delay – rising edge[1]	<70ns (V_{INPUT}=3.3V, $T_{AMBIENT}$=25°C)
Input delay – falling edge[1]	<70ns (V_{INPUT}=3.3V, $T_{AMBIENT}$=25°C)
External trigger mapping	Yes
Input functions	Trigger, get current level (rising or falling edge are supported)
Output maximal sink current	10mA
Trip current	21mA – self restarting when failure mode current disconnected
Inductive loads	No
Output level for logical 0	Voltage < 0.3V (IO2AUX = 3.3V) <0.5 (IO2AUX = 5V)
Ouptut level for logical 1	Voltage > 2.5V/1mA (IO2AUX = 3.3V) >3.9V/1mA (IO2AUX = 5V)
Number of outputs	1
Strobe output mapping	Yes

Table 3-29, General info for Isolated low voltage Digital Lines.

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

1.0m / 3.0m / 5.0m USB 3.0 cables

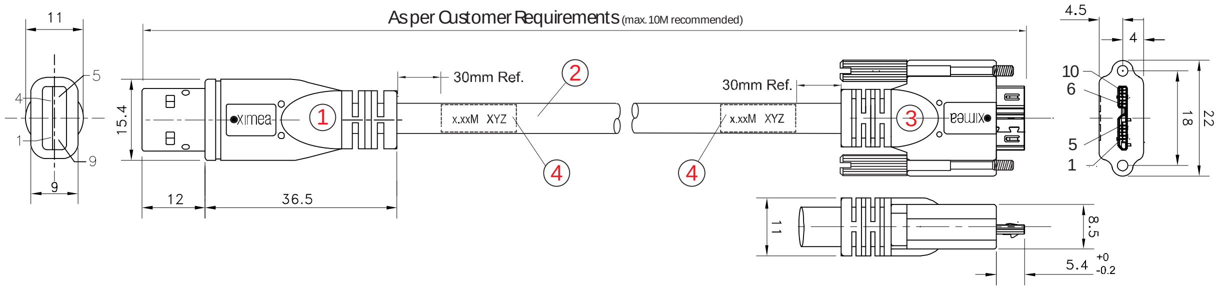


figure 3-30, drawing USB3 cable

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 3-30, USB3 cable, components

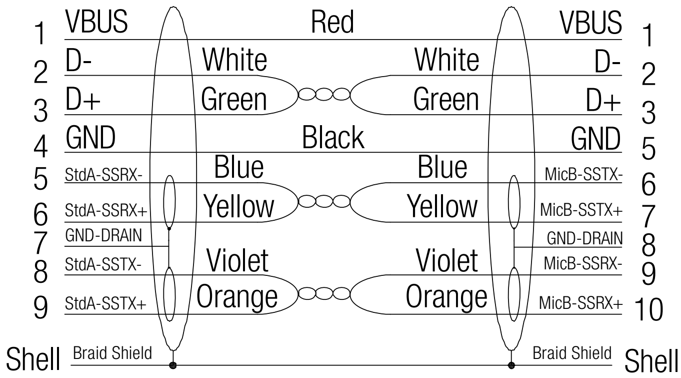


figure 3-31, wiring USB3 cable

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 3-31, USB3 connector, pin assignment

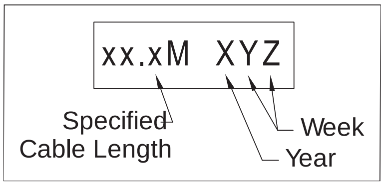


figure 3-32, label details USB3 cable

3.11. CBL-U3-3M0-ANG

3.0m USB 3.0 cable, angled micro USB3 connector

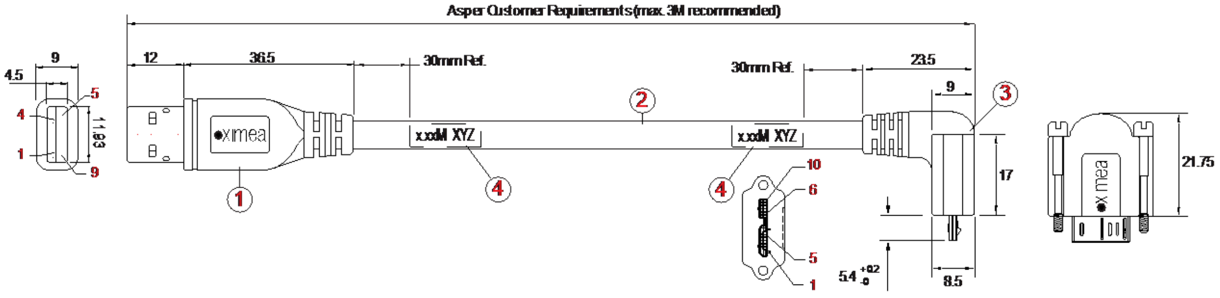


figure 3-33, drawing USB3 cable angled

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 3-32, USB3 cable angled, components

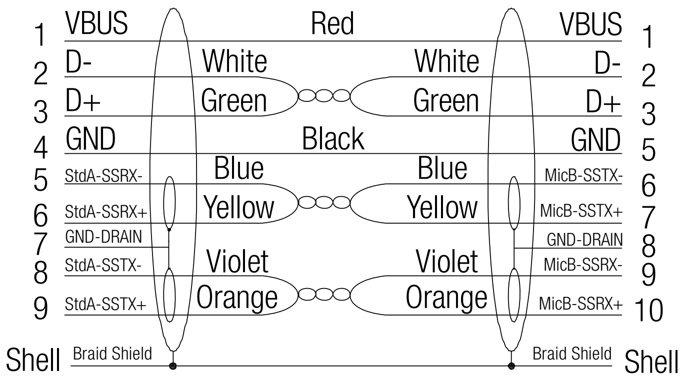


figure 3-34, wiring USB3 cable angled

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 3-33, USB3 connector, pin assignment

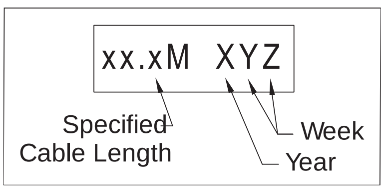


figure 3-35, label details USB3 cable angled

3.12. CBL-U3-3M0-YP / CBL-U3-5M0-YP

3.0m / 5.0m USB 3.0 Y-cables providing additional power from secondary USB port.

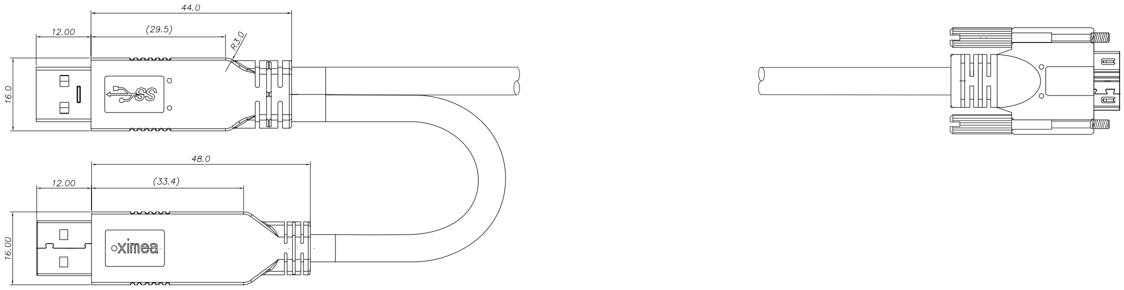


figure 3-36, drawing USB3 cable

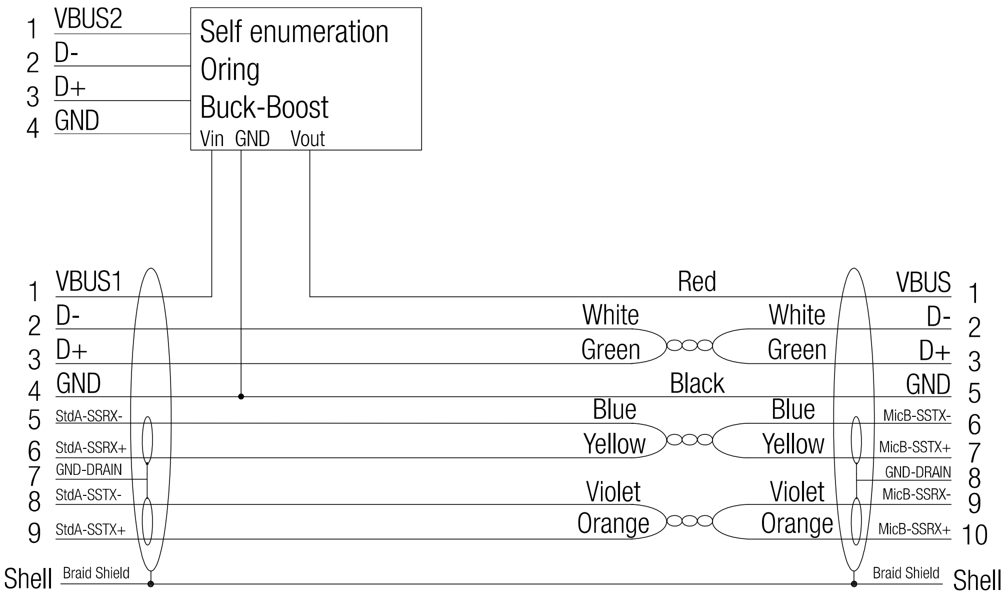


figure 3-37, wiring USB3 cable

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 3-34, USB3 connector, pin assignment

3.13. CBL-U3-3M0-YP-UA / CBL-U3-5M0-YP-UA

3.0m USB 3.0 Y-cables providing additional power from secondary USB port. Featuring angled micro USB3 connector.

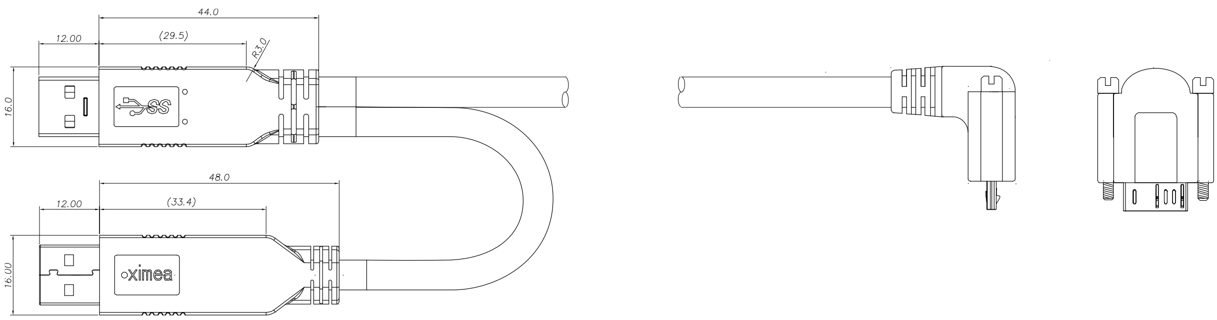


figure 3-38, drawing USB3 cable angled

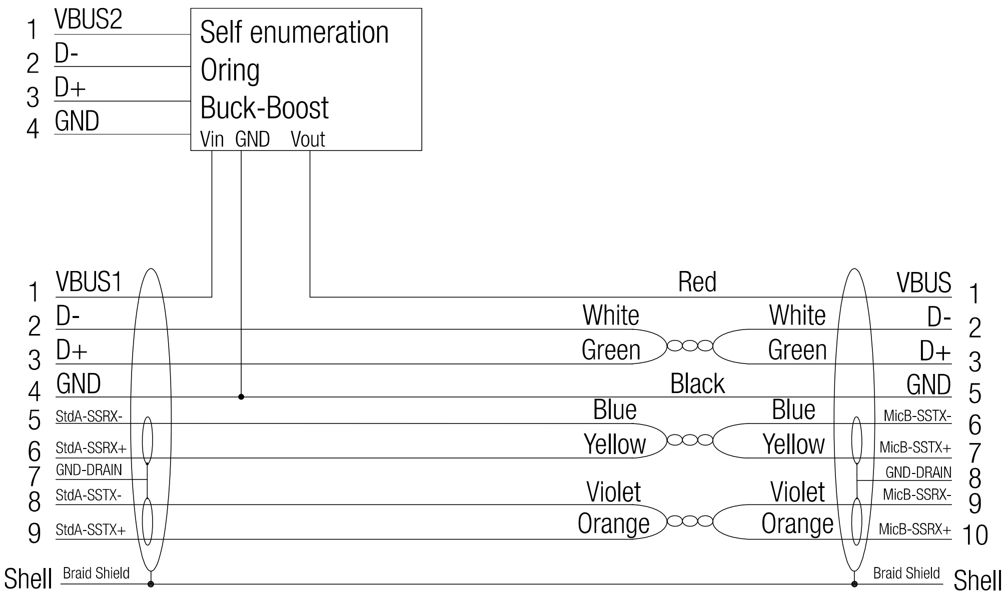


figure 3-39, wiring USB3 cable angled

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 3-35, USB3 connector, pin assignment

3.14. USB 3 host adapters

USB 3.0 to PCI Express x1 Gen2 Host Card

figure 3-40, 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

3.15. CBL-MD-PWR-SYNC-3M0

The following is a description of the sync cable for the xiD camera line.

Cable drawing

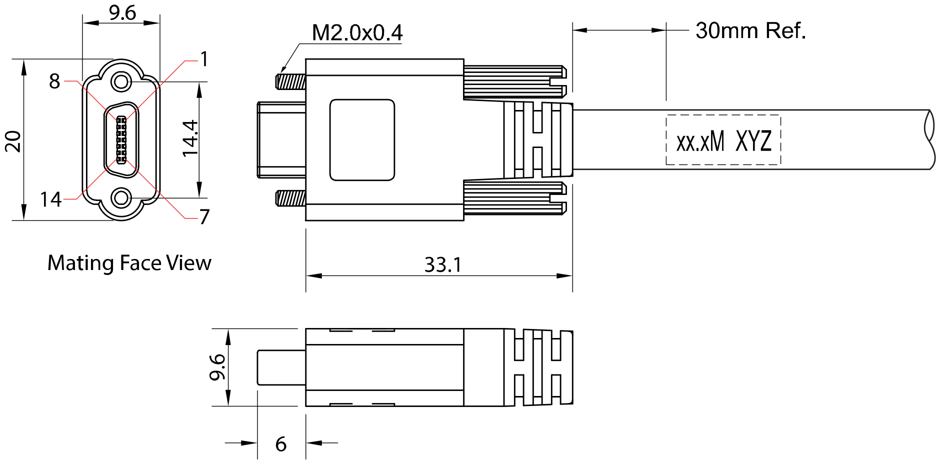


figure 3-41, drawing sync cable – current revisions of this cable are 3m in length

Pin	color	Signal
1	Blue	GPO1X - Opto-isolated Output
2	Green	GPO1Y - Opto-isolated Output
3	Violet	GPI1+ - Opto-isolated Input
4	Yellow	GPI1- - Opto-isolated Input
5	Brown	GND 2 Common Negative Pole 2 (GPI2, GPO2)
6	White	GPO2 - Magnetically isolated fast output
7	Grey	IO2AUX - Isolator Aux Power GPIO2 (3.3V - 5.0V DC)
14	Orange	GPI2 - Magnetically isolated fast input
8, 10, 12	Black	AUX power input negative pole (5.0V)
9, 11, 13	Red	AUX power input positive pole (5.0V)

table 3-36, IO/AUX cable, pin assignment

Cable wiring

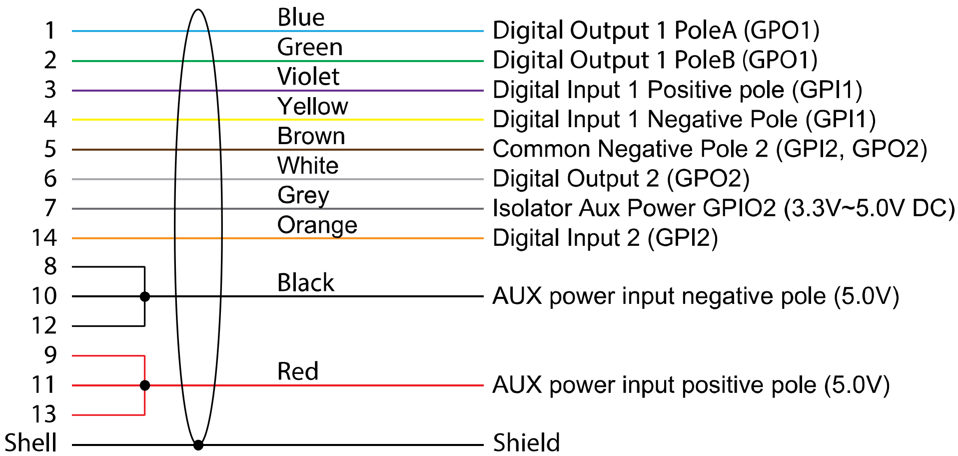


figure 3-42, wiring sync cable CBL-MD-PWR-SYNC-3M0

3.16. Tripod Adapter – MECH-60MM-BRACKET-T

xiD series tripod mounting bracket

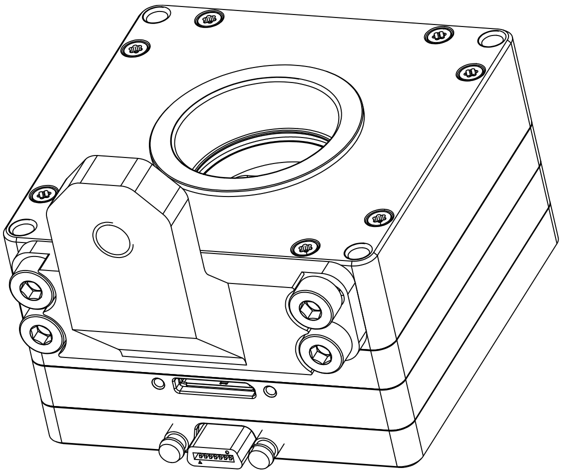


figure 3-43, mounting tripod adapter

Use 4x M4 screws provided with bracket as a kit for mounting. Bracket can be mounted on the bottom of camera.

3.16.1. Dimensional drawings

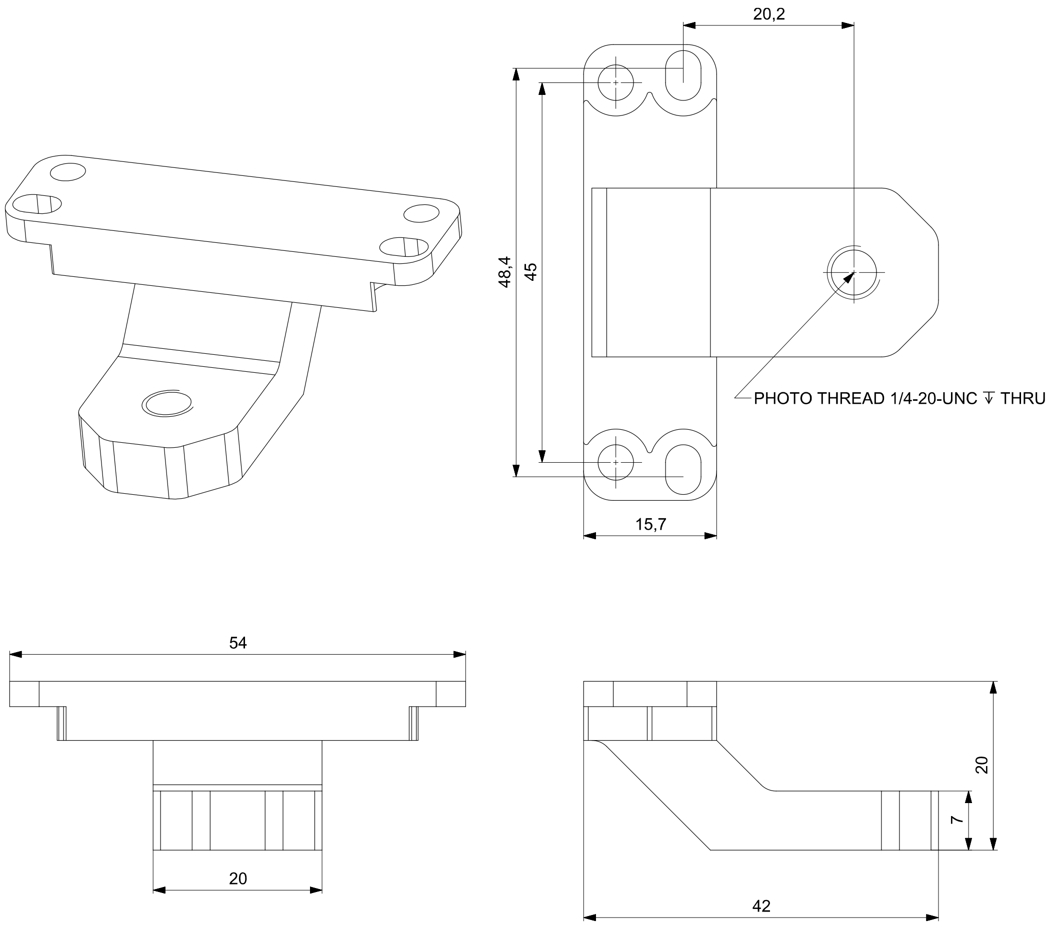


figure 3-44, dimensional drawing tripod adapter

4. Operation

For a proper operation of your xiD camera there are certain requirements that have to be met. You will read more about these requirements in the following chapters, as well as a description of how to use a xiD camera. Please check our website for the most up to date information.

4.1. System Requirements

4.1.1. Software Requirements

The xid 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 xiD 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 xiD cameras are compatible with USB 3.1, USB 3.0. Please note, that the highest performance can only be achieved by using high performance USB 3.1 or USB 3.0 ports.

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 xiD 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 See 3.14 USB 3 host adapters

Recommended system configuration:

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

CPU:	Intel i7
RAM:	8GB RAM or more
Disc Space:	400 MB of free disc space
Video:	NVIDIA or Radeon graphics card 128MB
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 See 3.14 USB 3 host adapters

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,...).

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 xiD 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 in order to achieve the maximum possible performance of the camera.

XIMEA offers several passive USB 3.1 Gen1 cables and a sync cables, please see paragraphs *3.10*, *3.11*, *3.12* and *3.13*

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 inside xiD 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 *3.6 Model Specific Characteristics*

4.2.3. Downsampling Modes

Downsampling describes the possibility of reducing the image resolution without affecting the sensors physical size, ie. 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 skipping.

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. Skipping

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

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 xiD camera 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 10,12 or 14 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 12bit 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.

4.3. 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 Overlapped mode gives the highest number of frames per second (FPS).

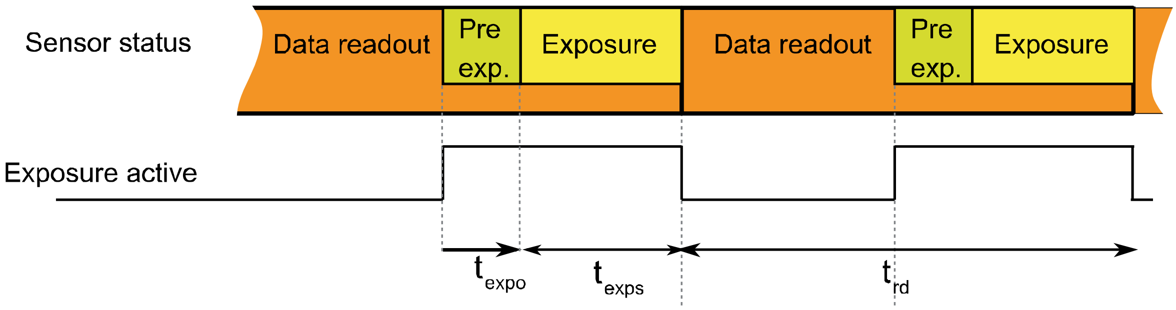


figure 4-1, acquisition mode - free run

In this mode the timing depends on the Exposure Time and Data Readout Time.

All xiD cameras support setting FPS. This however works in non-overlapped mode. When set the camera will internally generate trigger pulses with desired FPS. 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 the case of 'level sensitive', it can be used to control length of exposure or acquisition itself.

Generally trigger sources can be divided into two groups:

Software Trigger

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

Hardware Trigger

A hardware trigger can be sent to the sensor using the digital input described in *3.9.3 Optically isolated Digital Input*, or non-isolated ports configured as input described in *3.9.5 Isolated High Speed Digital Lines*. Triggering by hardware is usually used to reduce latencies and jitter in applications that require the most accurate timing.

4.3.2.1. Triggered mode without overlap - single frame

This mode gives lower FPS compared to *Free-Run* mode and lower FPS.

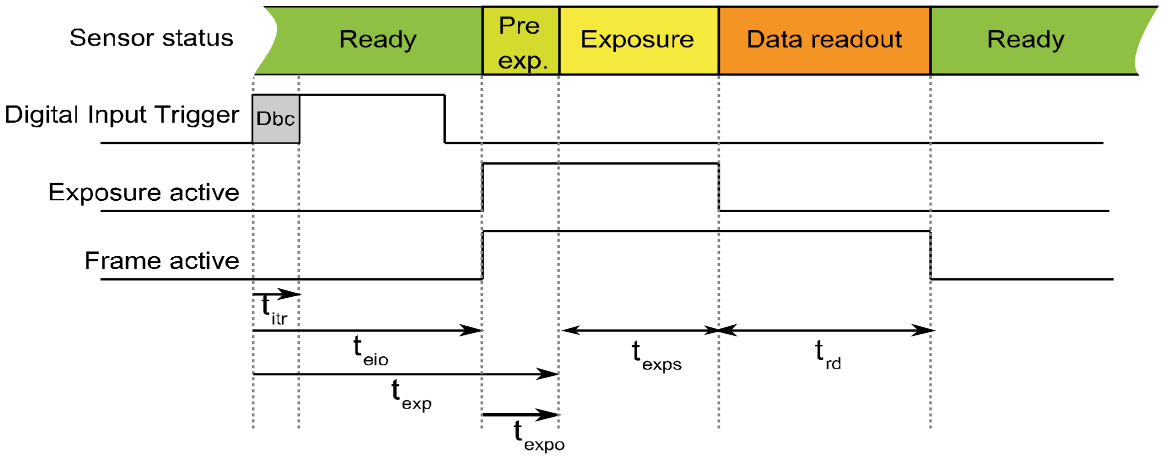


figure 4-2, acquisition mode – triggered without overlap

In this mode the timing depends on sum of:

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

Typical times for selected camera models

Camera Model	DownS	t_{itr} [µs]	t_{exp} [µs]	t_{eio} [µs]	t_{expo} [µs]	t_{rd} [µs]
MDnnnxU-SY[1]	any	x	2/40/<1/<1	See output delays[2]	0	Note 3

table 4-2, trigger mode w/o overlap, timing

Notes:

1) **nnnx** in model name means all available models where n is number and x is M or C.

2) t_{exp} GPI1 rising edge/ GPI1 falling edge/ GPI2 rising edge/ GPI2 falling edge

3) t_{rd} readout time depends on many parameters (badwidth, number of taps, readout frequency, ROI, …)

Description:

DownS = Current camera DownSampling (XI_PRM_DOWNSAMPLING)
t_{eio} = Trigger (Digital Input) to Strobe (Digital Output) (on some models is listed: Off->On change / On->Off change)
t_{exp} = Strobe (Sensor) to Digital Output (on some models is listed: Off->On change / On->Off change)
t_{expo} = Start of exposition to Exposure Active Digital Output
t_{exps} = Current Exposure Time set (XI_PRM_EXPOSURE)
Conditions: XI_PRM_DEBOUNCE_EN=0 (off).

Minimum trigger period (T_{trig_min})

Minimum trigger period can be calculated using the following formula:

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

The minimum trigger period can be calculated from XI_PRM_FRAMERATE parameter read from API after all acquisition parameters have been set. $t_{trig\_min} = 1/fps$

4.3.2.2. Triggered acquisition - burst of frames

Frame Burst Start

In this mode each trigger pulse triggers defined number of exposed frames. This mode is available only if the camera is set to frame rate mode.

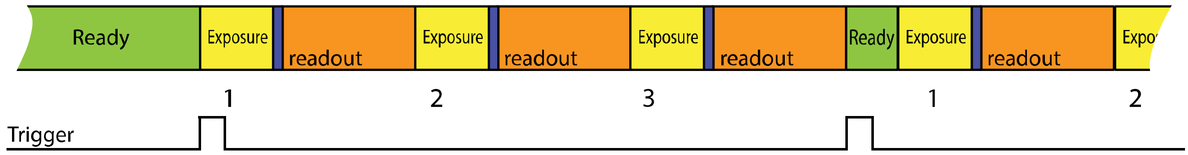


figure 4-3, triggered burst of frames – frame burst start, number of frames in burst set to 3 (maximal frame rate)

Frame Burst Active

If trigger is level sensitive it can be used to control image acquisition. This mode is available only if the camera is set to frame rate mode.

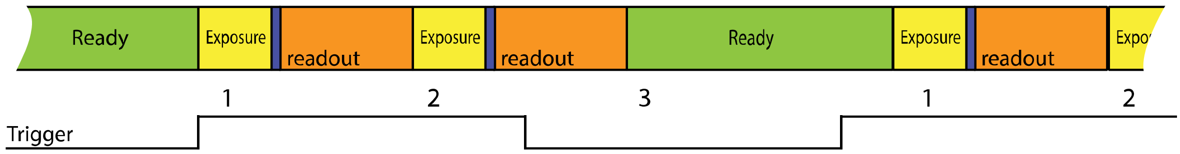


figure 4-4, triggered burst of frames – frame burst active (maximal frame rate)

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

4.4. Camera Parameters and Features

4.4.1. Exposure Time

Also known as shutter speed. This parameter defines the length of the integration period for each frame.

Most CMOS sensors generate the exposure interval internally. For some it is possible to control it by external signaling. The sensor internal timing depends on the provided system clock. Most sensors use dividers to generate slower clocks for internal usage.

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

4.4.2. Gain

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

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 in order 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. For example, this Matrix can be used 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 and *xiAPI.Net* for C#/.Net 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.

5.1.3. 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, in order 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

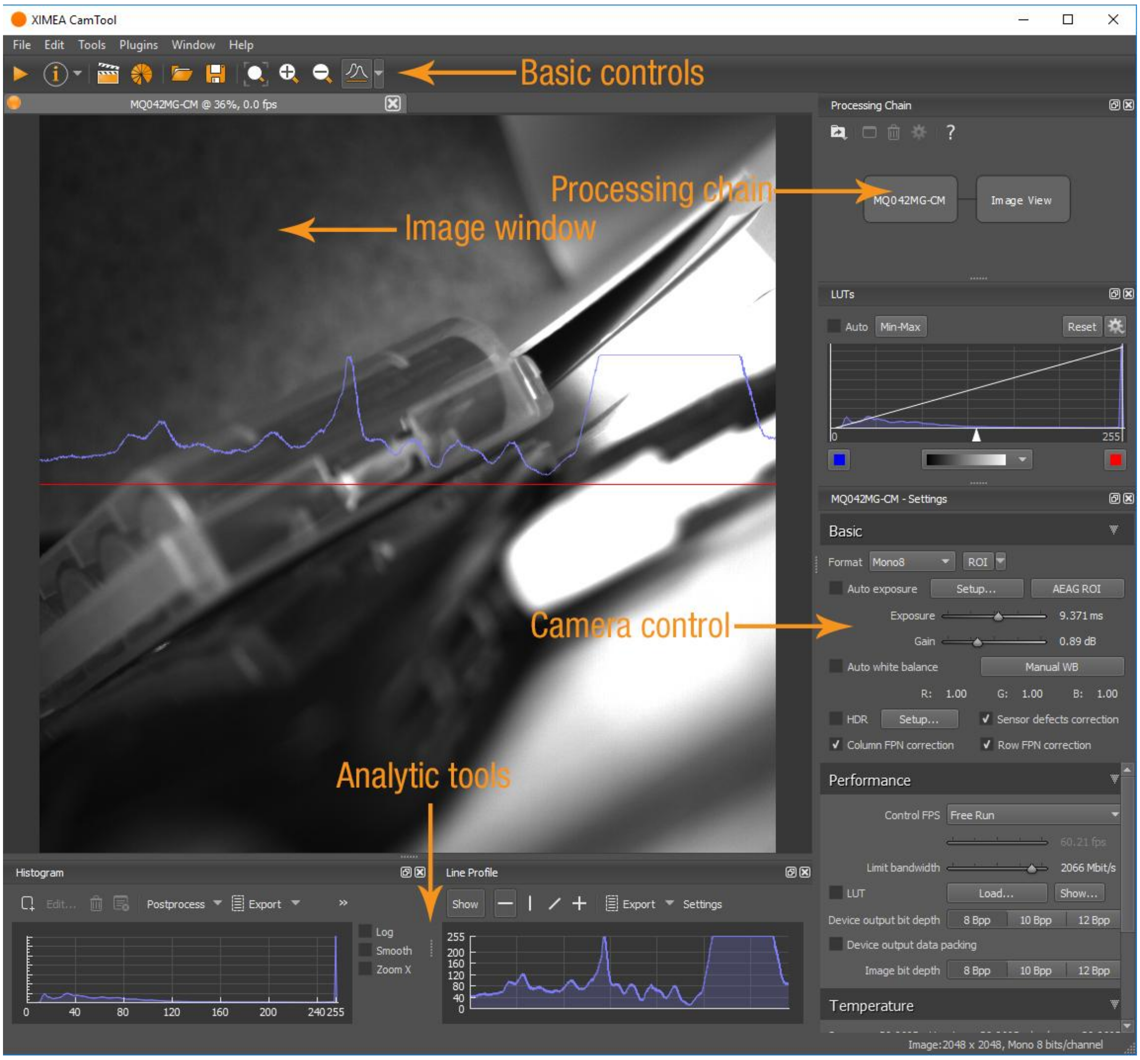


figure 5-1, CamTool Layout

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 control 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.

CamTool allows to save static images in various formats like: *.TIFF, *.BMP, *.JPEG, *.PNG, *.GIF, *.DNG and *. FITS as well as the image sequences in multipage tiff (*.tif), avi file (*.avi) and Image sequence (*.xiseq). With additional plugin it is possible to save H.264 compressed video.

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, xiApiPtyhon)
- 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):

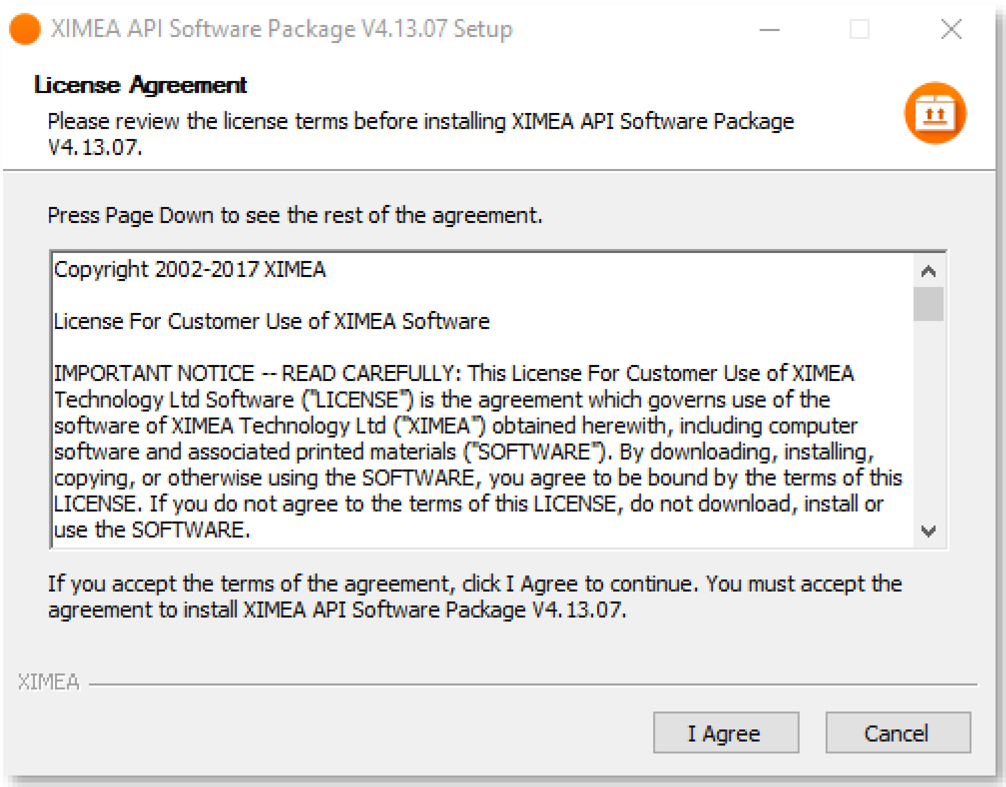


figure 5-2, XIMEA Windows Software Package installation - 1

- 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.

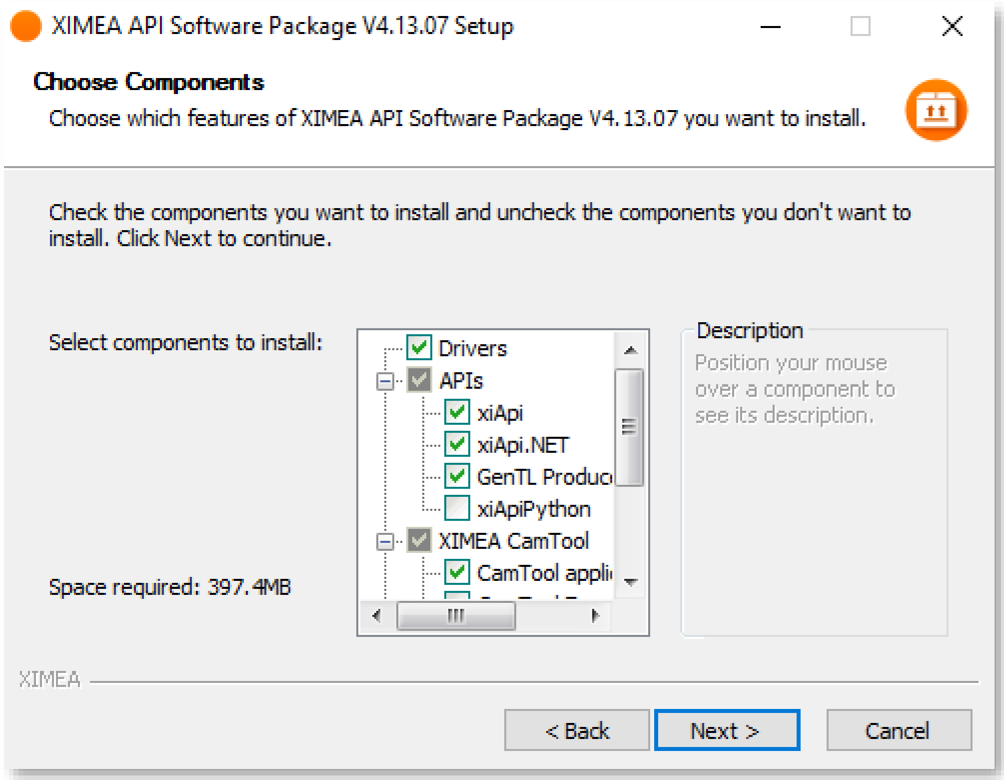


figure 5-3, XIMEA Windows Software Package installation - 2

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

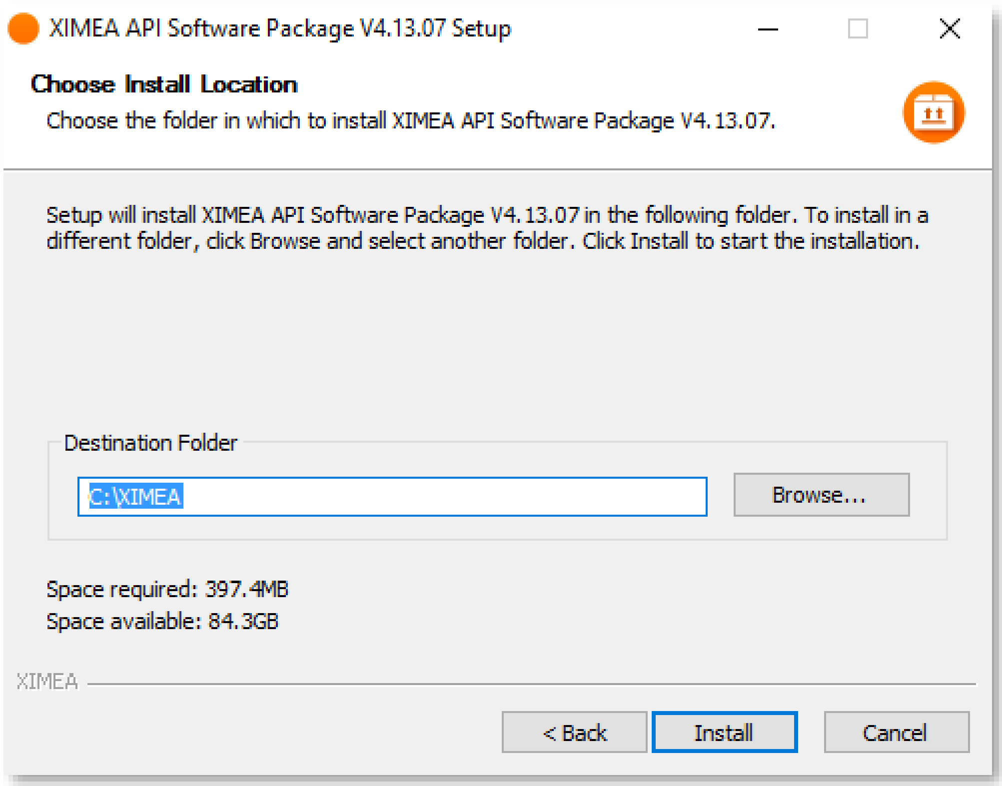


figure 5-4, XIMEA Windows Software Package installation - 3

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

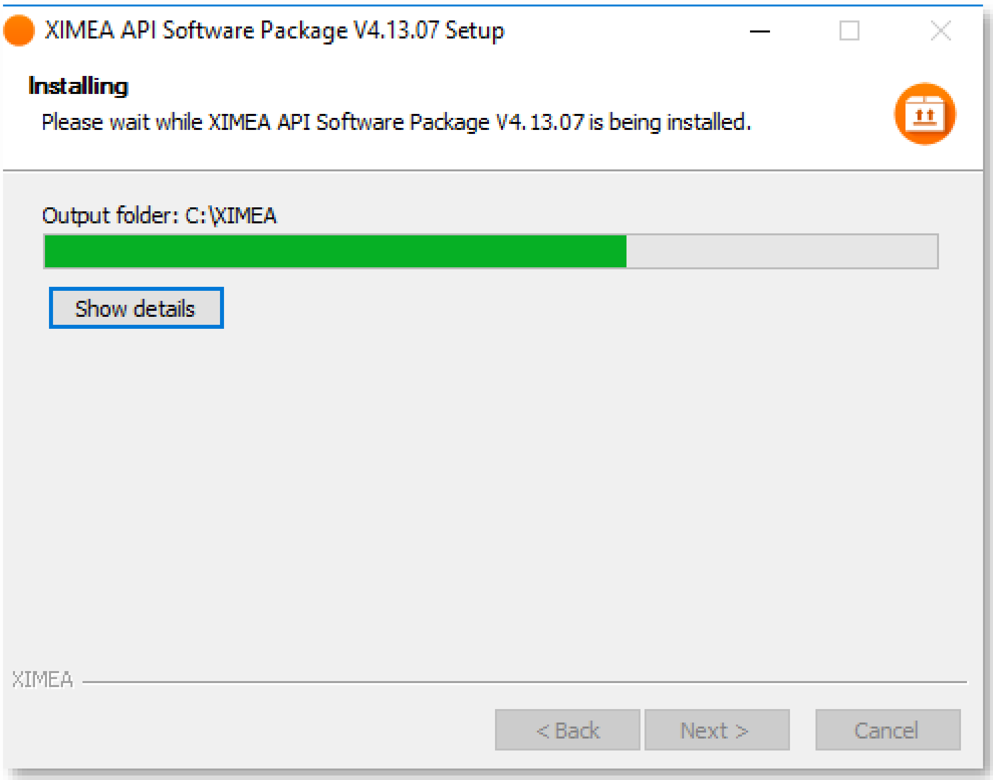


figure 5-5, xiAPI installation, Windows - 4

- Installation is completed.

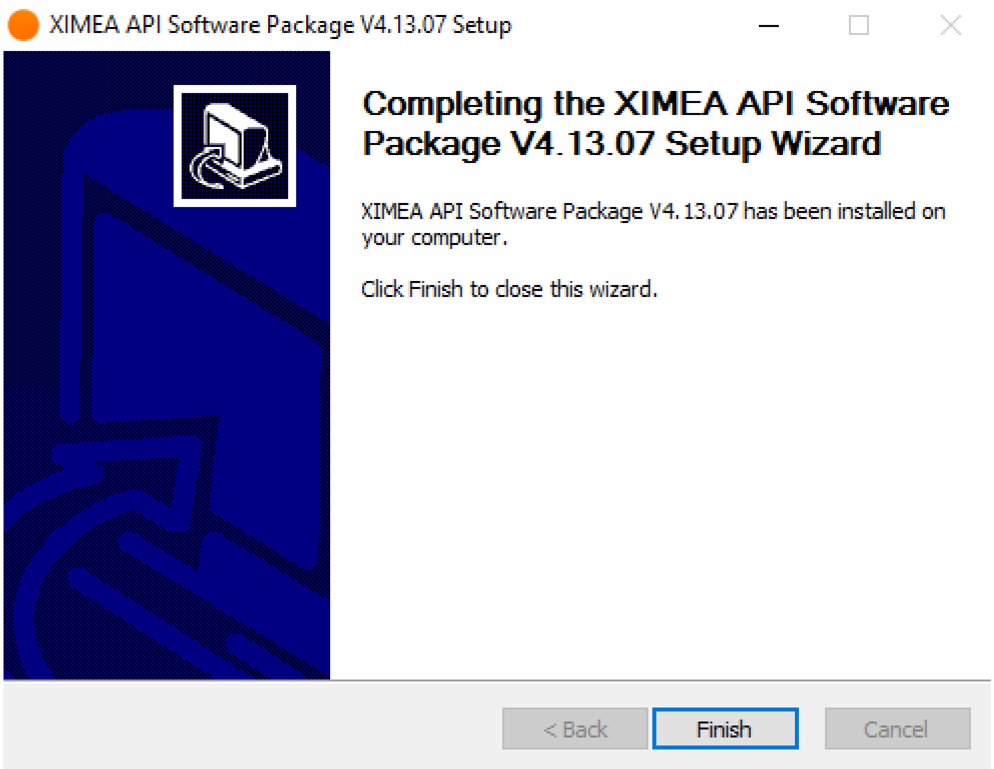


figure 5-6, xiAPI installation, Windows - 5

- 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 parameter, 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.

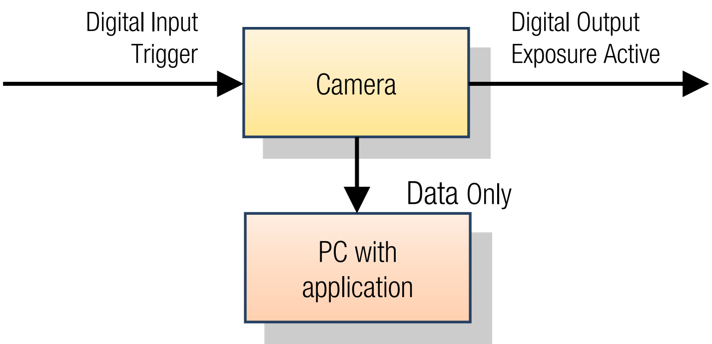


figure 5-11, GPIO - schematic

```
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. 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.

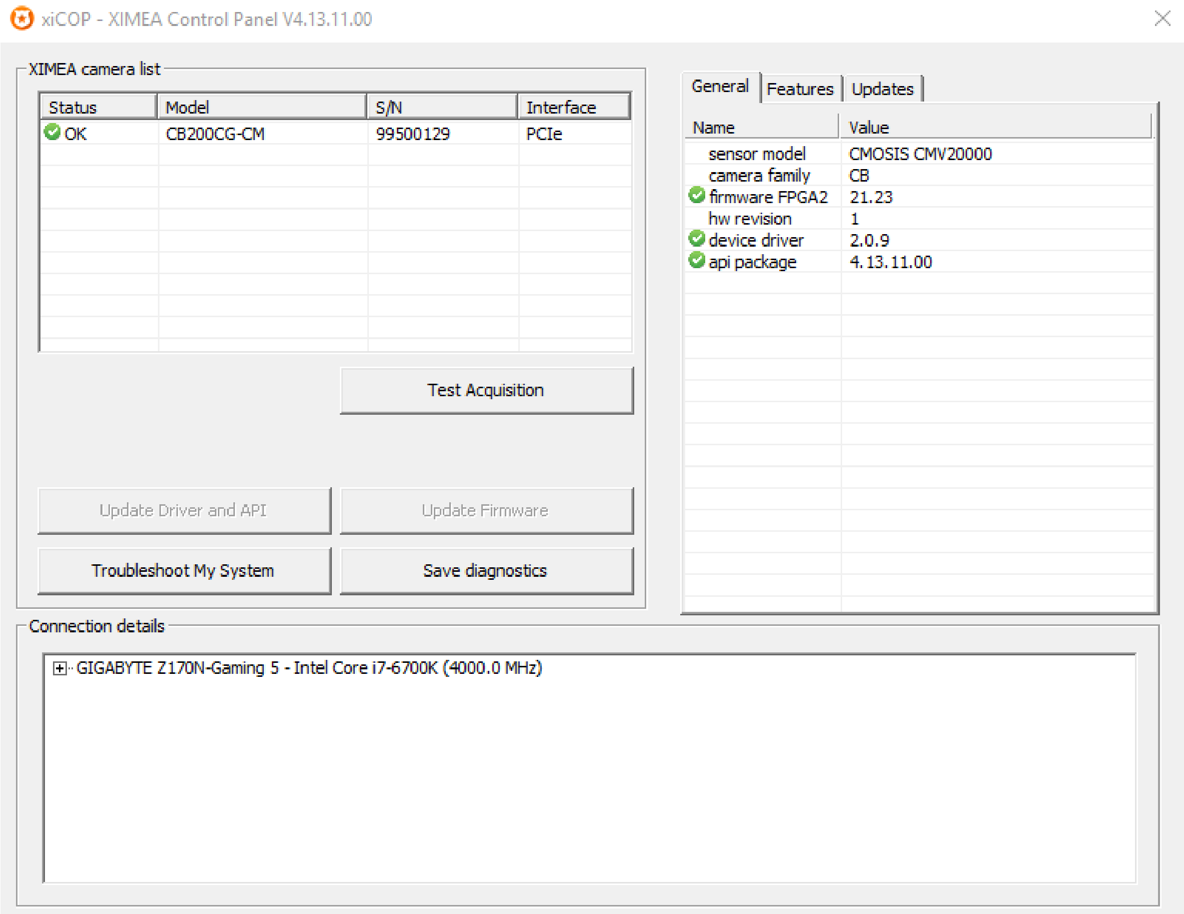


figure 5-12, xiCOP

Features

- Facilitates diagnostics of system performance bottlenecks.
  xiCOP is capable of retrieving the system's hardware tree, thus problematic hardware configurations can be identified.
- Diagnosis of firmware and software compatibility.
  xiCOP checks relevant firmware and software versions and warns if a component is not up-to-date.
- List all currently attached XIMEA devices and their features.
- Suggests solution for diagnosed issues.
- One click update to the latest XIMEA API Software Package.
- One click update 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 xiD 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 xiD camera with the XIMEA USB 3.0 cable to an appropriate USB 3.0 port. Ensure that the connections are carefully locked. Follow the instructions described in chapter *5.2 XIMEA CamTool* (run the xiD 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 xiD 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 xiD 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 the real transfer speed?

xiD camera can deliver up to 400 Mbyte/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
PCIe gen2 x2	8 Gbit/s		Low
PCIe gen2 x4	16Gbit/s		Low
PCIe gen3 x8	64Gbit/s		Low

table 6-2, interface depending transfer rates

6.1.3.2. 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 camera installations.

6.2. Product service request (PSR)

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

6.2.1. Step 1 - Contact Support

If your xiD 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 in order 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 6-3, 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

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

6.8. Revision History

Version	Date	Notes
1.00	07/14/2017	First Release
1.01	10/10/2017	Corrected typos
1.02	10/20/2017	Corrected high-speed IO specification
1.03	04/08/2018	Corrected power consumption values
1.04	26/06/2019	Updated certification
1.05	06/09/2019	Formal updates and synchronization with directives.
1.06	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
DNC	Do not connect
DSNU	Dark Signal non-Uniformity
DR	Dynamic Range
EMC	Electro Magnetic Compatibility
ERS	Electronic rolling shutter
FPN	Fixed pattern noise
FPS	Frame per second
FWC	Full Well Capacity
GR	Global reset
GS	Global shutter
IR	Infra-Red
JTAG	Joint Test Action Group
LSB	Least Significant Bit
MIMR	Multiple integration multiple ROI
MSB	Most significant bit
MSL	Moisture sensitivity level
NA	Not Available
PCB	Printed Circuit Board (same as PWB)
PGA	Programmable gain amplifier
PRNU	Photo response non-uniformity
PWB	Printed Wiring Board (same as PCB)
RGB	Red Green Blue
ROI	Region of interest
Sat	Saturation value
SDK	Software Development Kit
SIMR	Single integration multiple ROI
SNR	Signal To Noise (ratio)
SPI	Serial peripheral interface
SW	Software
TBD	To be determined – some parameters require characterization
T_{int}	Integration time

8. list of figures

9. list of tables

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