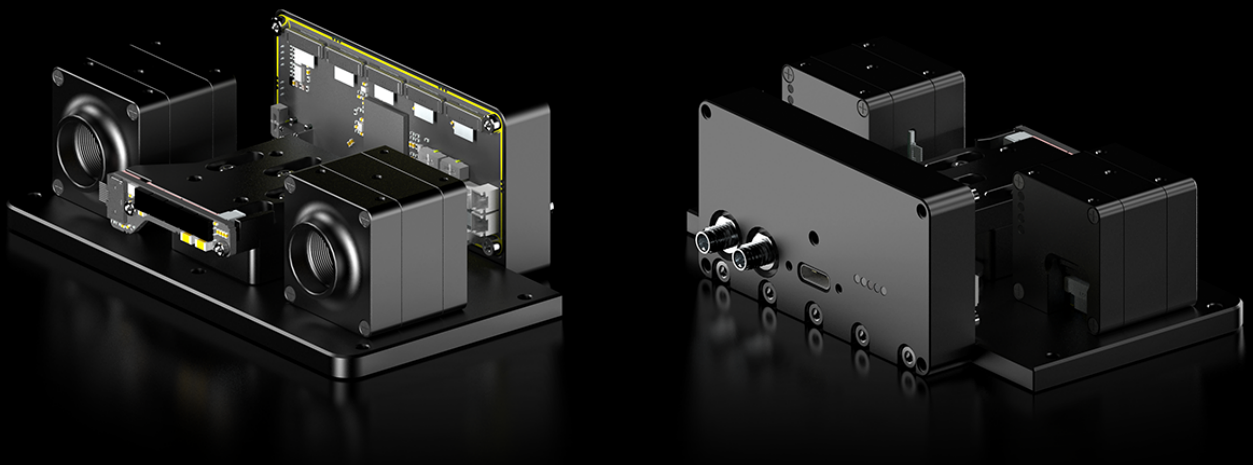
ximea



AR-TOF-SYS-HEAD
Agile Robots ToF System

XIMEA Cameras
Technical Manual
Version v250505

Introduction

About this manual

Dear customer,

Thank you for purchasing a product from XIMEA.

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

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

This document is subject to change without notice.

About XIMEA

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

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

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

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

Contact XIMEA

XIMEA is a worldwide operating company

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Support	XIMEA Support

Contents

1 AR-TOF-SYS-HEAD

1.1 General description

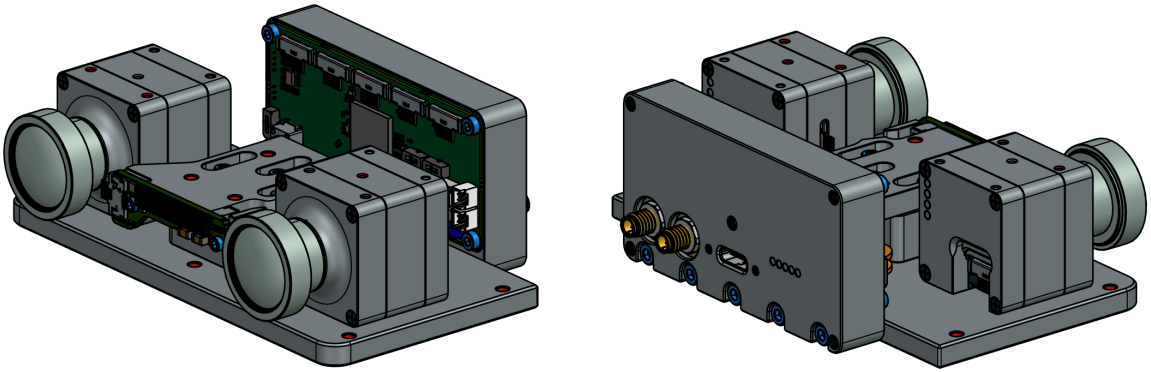


Figure 1: Isometric view of AR-TOF-SYS-HEAD

- Color camera MC051CG-SY-UC-AR
- Tof camera MU003TG-SY-UC-AR
- Switch XS-5P-U3-UC-TC
- Platform ME-TOF-PLATF-AR

Lenses are not included in the delivery.

1.2 Models and sensors overview

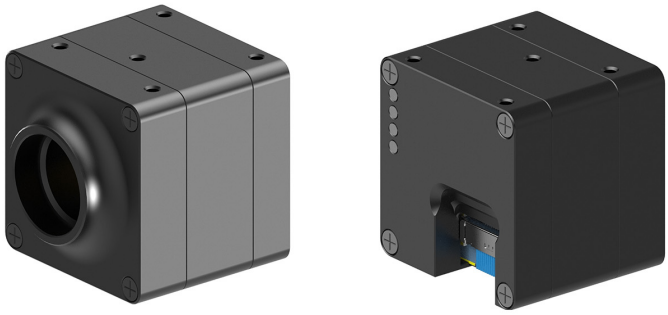


Figure 2: Isometric view of MC051CG-SY-UC-AR

Model		Resolution	Pixel size	Bits	Dynamic range[1]	Sensor diagonal	FPS
MC051CG-SY-UC-AR	Color	2472 × 2064	2.74 µm	8/10/12	71.01 dB	8.8 mm	72.1/57.9/48.6

[1]The highest possible dynamic range

Table 1: MC051CG-SY-UC-AR models overview

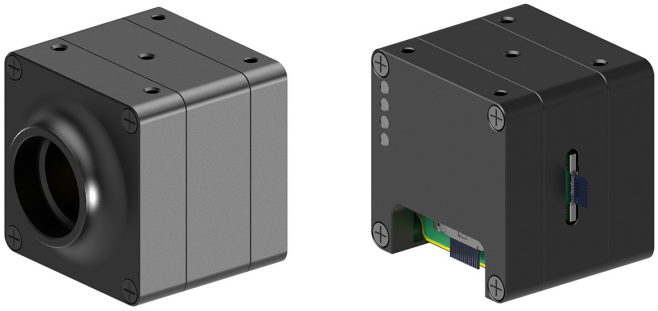


Figure 3: Isometric view of MU003TG-SY-UC-AR

Model		Resolution	Pixel size	Bits	Dynamic range[1]	Sensor diagonal	FPS
MU003TG-SY-UC-AR	b/w	640 × 480	10 µm	12	67.72 dB	8.0 mm	60

[1]The highest possible dynamic range

Table 2: MU003TG-SY-UC-AR model overview

1.3 Accessories overview

Item P/N	Description
CBL-U3-UC-0M1	10 cm USB 3.0 Micro-Coax cable
CBL-U3-UC-0M25	25 cm Micro-Coax cable
CBL-U3-UC-0M40	40 cm Micro-Coax cable
ADPT-U3-UC-U3-UB	Adapter Micro-Coax connector to USB3.0 micro-B

Table 3: accessory overview

2 Hardware specification

2.1 Power supply

Description	Value	Unit	Note
Power consumption[1]	12.9 (peak 36)	[W]	VCSEL Control Voltage 2031 mV (default)
Power consumption standby	3.9	[W]	
Power consumption max[1]	16.5 (peak 46.4)	[W]	VCSEL Control Voltage 2500 mV

[1]Power consumption values were measured for 15 V with both cameras streaming. TOF camera set to A + B mode, 60 fps, 1 ms exposure time, 100 MHz modulation frequency, recommended power supply brick is GSM60B15-P1J (60 W,15 V,4 A).

Table 4: power consumption of AR-TOF-SYS-HEAD

2.2 General specification

2.2.1 Environment

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

Table 5: Environment

Housing temperature must not exceed 65 °C.

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

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

2.3 Lens mount

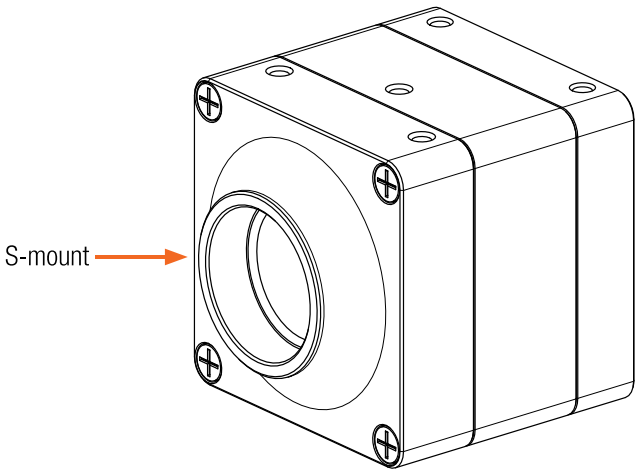


Figure 4: Location of the S-mount lens adapter

2.4 Mounting points

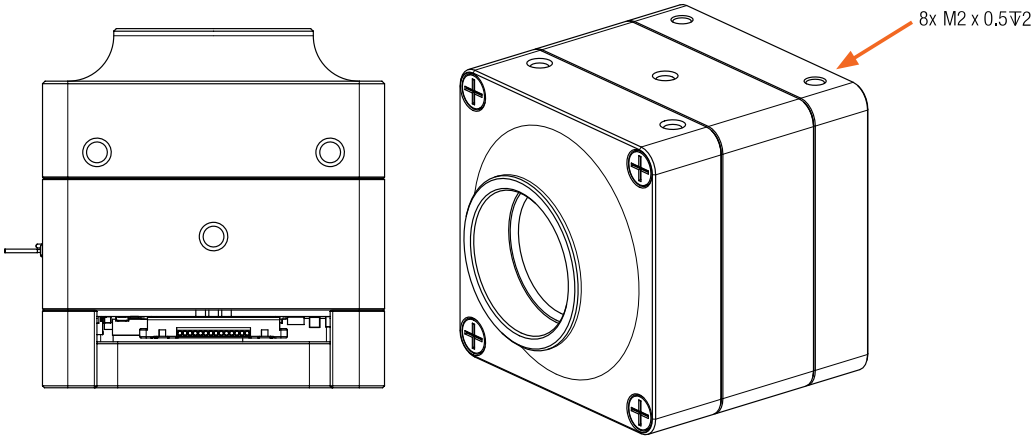


Figure 5: MU003TG-SY-UC-AR mounting points

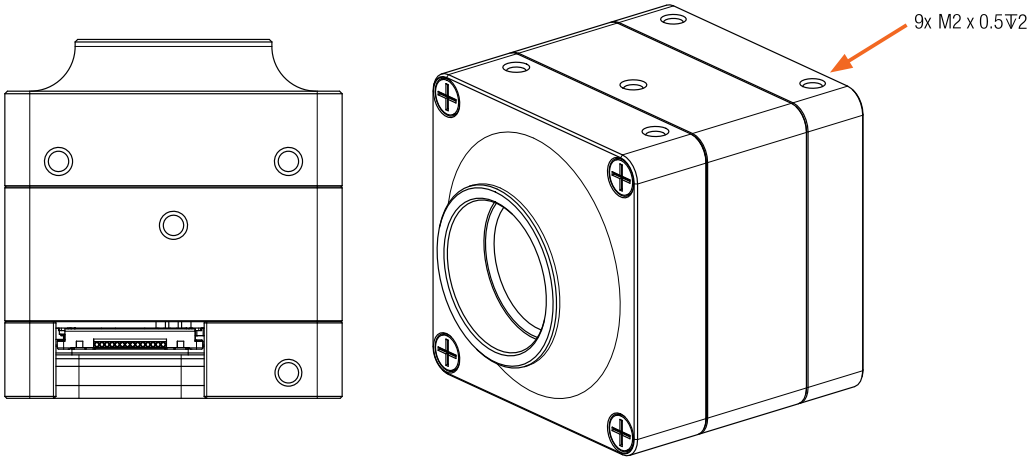


Figure 6: MC051CG-SY-UC-AR mounting points

2.5 Optical path

Do not use compressed air to clean the camera as this could damage (e.g. scratch) the glass. The flange focal distance from front part surface to the sensor active area is 16.91 mm. Distance of the S-mount M12x0.5 threaded hole + S-mount lens aligment hole is 11.55 mm.

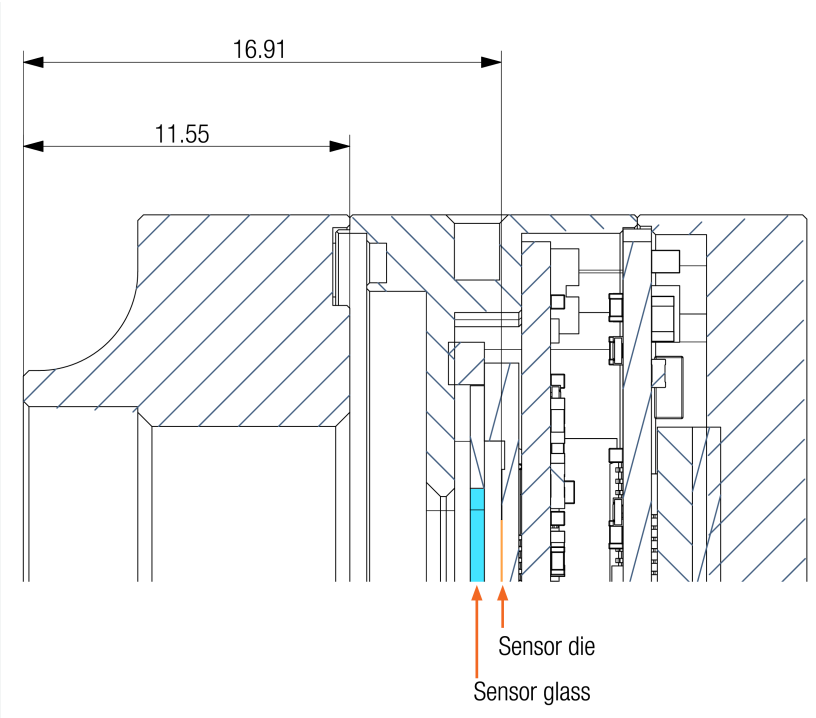


Figure 7: MU003TG-SY-UC-AR optical path

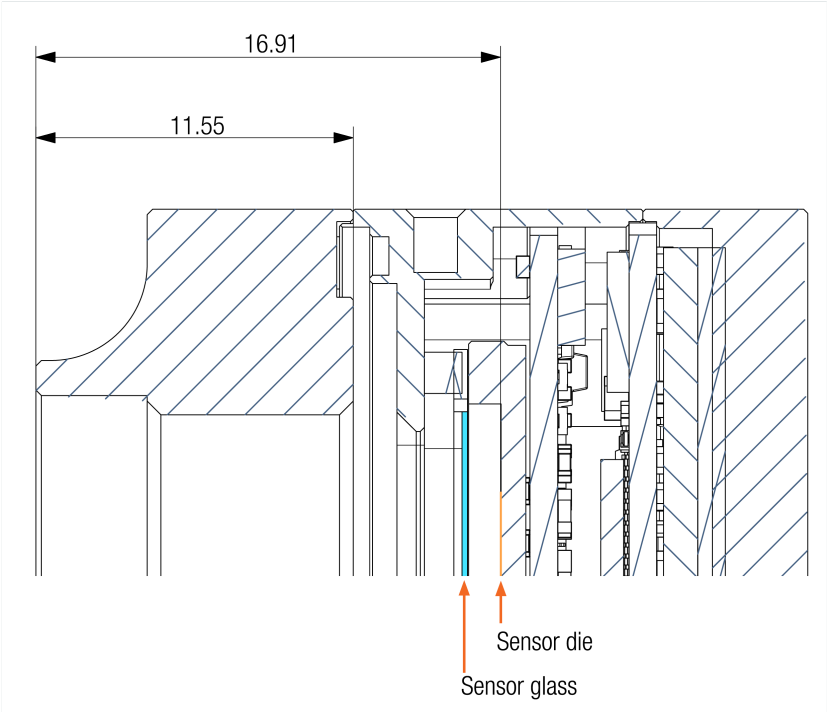


Figure 8: MC051CG-SY-UC-AR optical path

2.6 Sensor and camera characteristics

Camera model	Sensor model	Sensor type	Filter
MU003TG-SY-UC-AR	Sony IMX556	Monochrome	None
MC051CG-SY-UC-AR	Sony IMX547	Color	BayerBG

Table 6: list of camera models and their respective sensor models and filters

2.6.1 Sensor and camera parameters of particular models

Sensor parameters of:
MC051CG-SY-UC-AR

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	2472 x 2064	[px]
Active area size (H X V)	6.773 x 5.655	[mm]
Sensor diagonal	8.8	[mm]
Pixel size (H x V)	2.74 x 2.74	[µm]

Table 7: Sensor parameters of the specific models

Sensor parameters of:
MU003TG-SY-UC-AR

Description	Value	Unit
Technology	CMOS	None
Pixel resolution (H x V)	640 x 480	[px]
Active area size (H X V)	6.4 x 4.8	[mm]
Sensor diagonal	8.0	[mm]
Pixel size (H x V)	10 x 10	[µm]

Table 8: Sensor parameters of the specific models

2.6.2 Image quality parameters

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

Image quality parameters of:
MC051CG-SY-UC-AR

Mode		Standard	Standard	Standard
ADC resolution	[bit]	8	10	12
Saturation capacity	[ke^-]	2.14	9.53	9.53
Dynamic range	[dB]	52.46	65.6	71.01
SNR Max	[dB]	33.31	40.21	40.19
Gain 1/K	[e^-/DN]	9.64	9.77	2.45
Median read noise	[e^-]	4.89	4.95	2.62
Dark current	[e^-/s]	10.91	15.46	16.98
DSNU	[e^-]	0.87	1.0	1.07
PRNU	[%]	0.85	0.82	0.82
Linearity	[%]	0.29	0.26	0.37
Camera parameters				
Exposure time (EXP)	[µs]		9 to 30 000 000	
Analog gain range	[dB]		0 to 24	
Refresh rate (MMR)	[fps]	72.13	57.94	48.66

Table 9: Image quality parameters of the specific models

Image quality parameters of:
MU003TG-SY-UC-AR

Mode		A	A + B	B
ADC resolution	[bit]	12	12	12
Saturation capacity	[ke^-]	138.29	271.82	134.54
Dynamic range	[dB]	64.78	67.72	64.62
SNR Max	[dB]	51.51	54.44	51.34
Gain 1/K	[e^-/DN]	92.14	90.86	91.27
Median read noise	[e^-]	79.35	111.28	78.57
DSNU	[e^-]	1162.73	1716.06	1152.79
PRNU	[%]	5.88	4.56	5.73
Linearity	[%]	1.59	1.4	1.27
Camera parameters				
Exposure time (EXP)	[µs]		0.25 to 1000	
Refresh rate (MMR)	[fps]	60	60	60

Table 10: Image quality parameters of the specific models

2.6.3 Sensor read-out modes

Sensor Read-out modes of:
MC051CG-SY-UC-AR

Binning	Decimation	Output resolution	Sensor bit/px	fps
1 x 1	1 x 1	2472 x 2064	12	48.66
1 x 1	1 x 1	2472 x 2064	10	57.94
1 x 1	1 x 1	2472 x 2064	8	72.13
1 x 1	2 x 2	1236 x 1032	12	161.25
1 x 1	2 x 2	1236 x 1032	10	221.8
1 x 1	2 x 2	1236 x 1032	8	237.82

Table 11: Sensor read-out modes of the specific models

Sensor Read-out modes of:
MU003TG-SY-UC-AR

TOF mode	TOF phases	Downsampling (Hor.x Ver.)	Sensor bit/px	Resolution (Wid x Hei)	Transport bit/px	Frame rate[1]
A / B / A-B / A+B	1 / 2 / 4	1 x 1	12	640 x 480	12	60.0
A / B / A-B / A+B	1 / 2 / 4	Bin.2 x 2	12	320 x 240	12	60.0
A / B / A-B / A+B	1 / 2 / 4	Bin.4 x 4	12	160 x 120	12	60.0
A&B	1 / 2 / 4	1 x 1	12	640 x 480	12	50.5
A&B	1 / 2 / 4	Bin.2 x 2	12	320 x 240	12	60.0
A&B	1 / 2 / 4	Bin.4 x 4	12	160 x 120	12	60.0

[1]Frame rate was measured using the transport format at bandwidth limit 290.0 MB/s

Table 12: Sensor read-out modes of the specific models

2.6.4 Quantum efficiency curves

Quantum efficiency curves for models:
MC051CG-SY-UC-AR

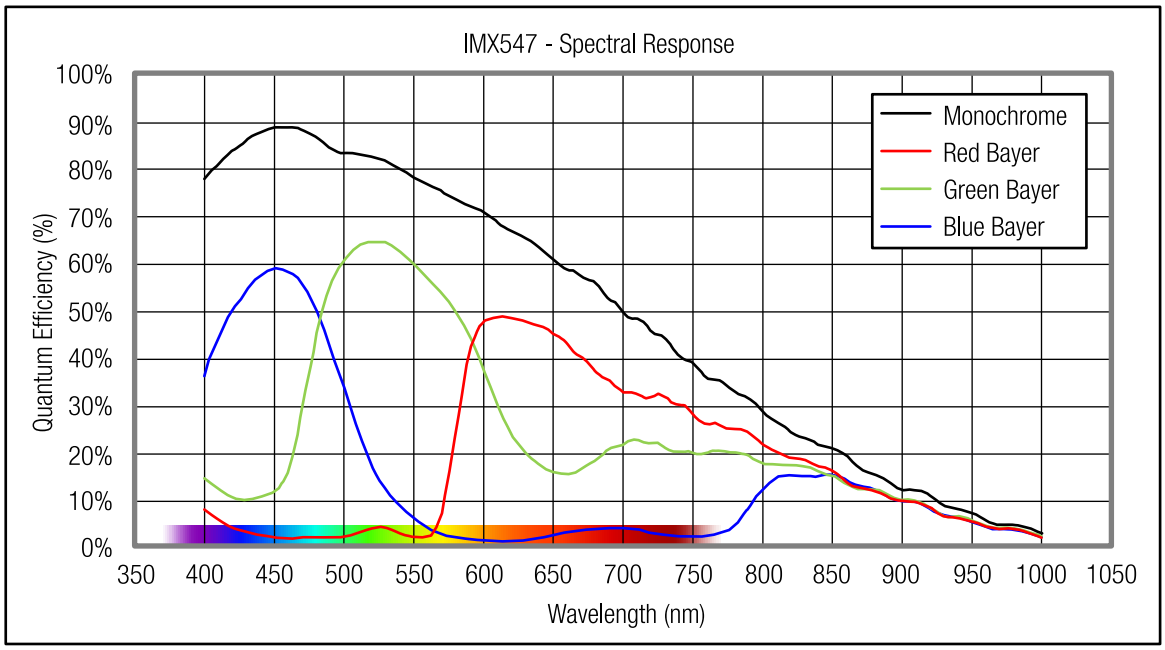


Figure 9: Graph quantum efficiency of Sony IMX547

Quantum efficiency curves for models:
MU003TG-SY-UC-AR

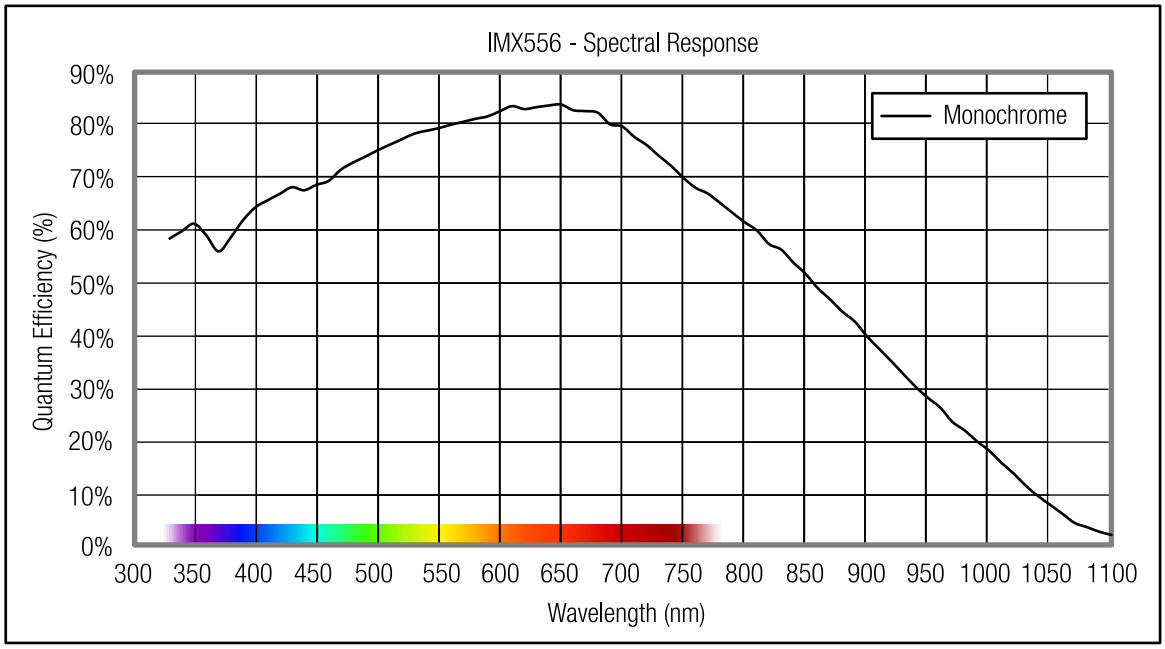


Figure 10: Graph quantum efficiency of Sony IMX556

2.7 Mechanical characteristics

2.7.1 Dimensions and mass

Dimensions and mass of models:
MC051CG-SY-UC-AR

Width [W]	Height [H]	Depth [D]	Mass [M]
26.4 mm	26.4 mm	28.1 mm	32 g

Table 13: camera parameters

Dimensions and mass of models:
MU003TG-SY-UC-AR

Width [W]	Height [H]	Depth [D]	Mass [M]
26.4 mm	26.4 mm	27.7 mm	31 g

Table 14: camera parameters

Dimensions and mass of AR-TOF-SYS-HEAD:

Width [W]	Height [H]	Depth [D]	Mass [M]
105 mm	36.5 mm	77.9 mm	238 g

Table 15: AR-TOF-SYS-HEAD parameters

2.7.2 Dimensional drawings

Dimensional drawings of:
AR-TOF-SYS-HEAD

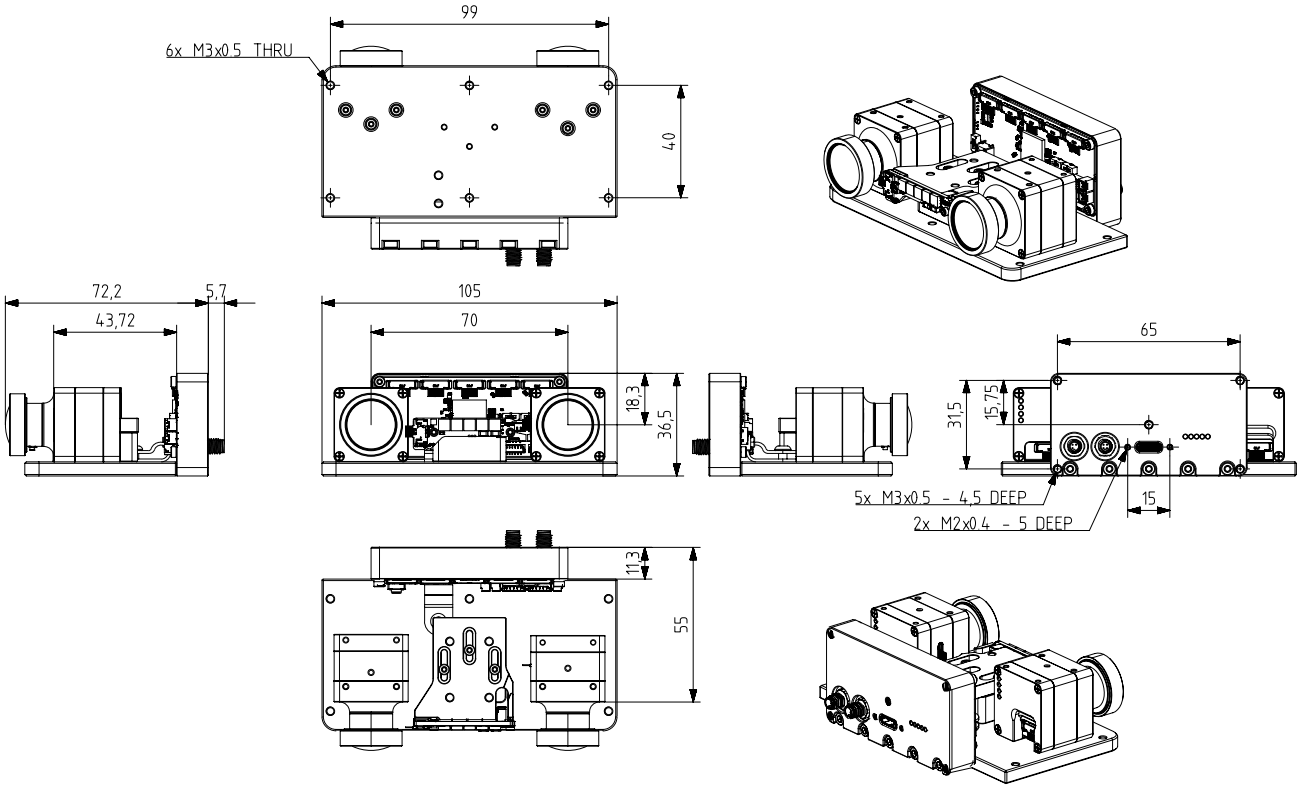


Figure 11: Dimensioanl drawings of AR-TOF-SYS-HEAD

Dimensional drawings of:
MC051CG-SY-UC-AR

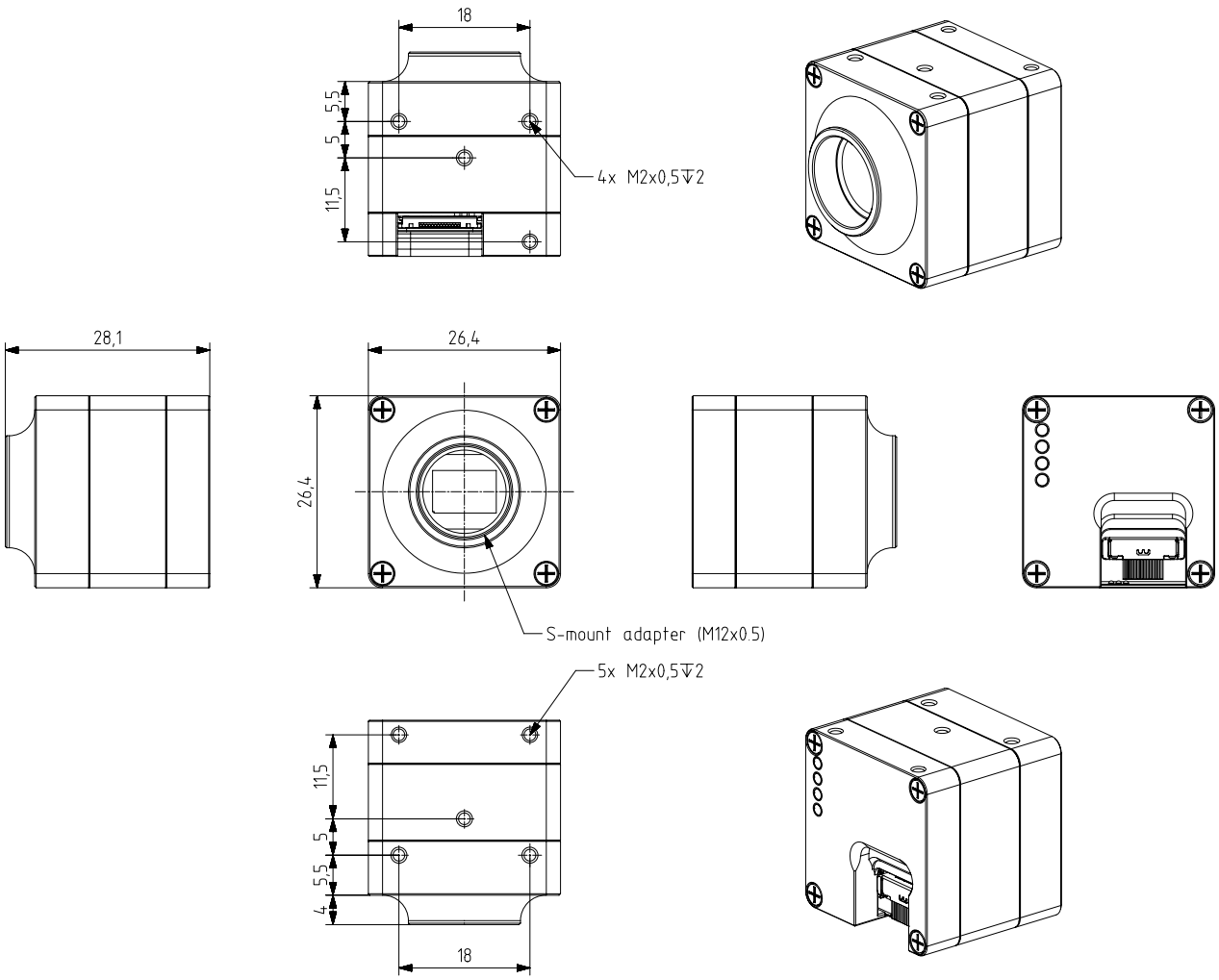


Figure 12: Dimensional drawing of MC051-SY-UC-AR

Dimensional drawings of:
MU003TG-SY-UC-AR

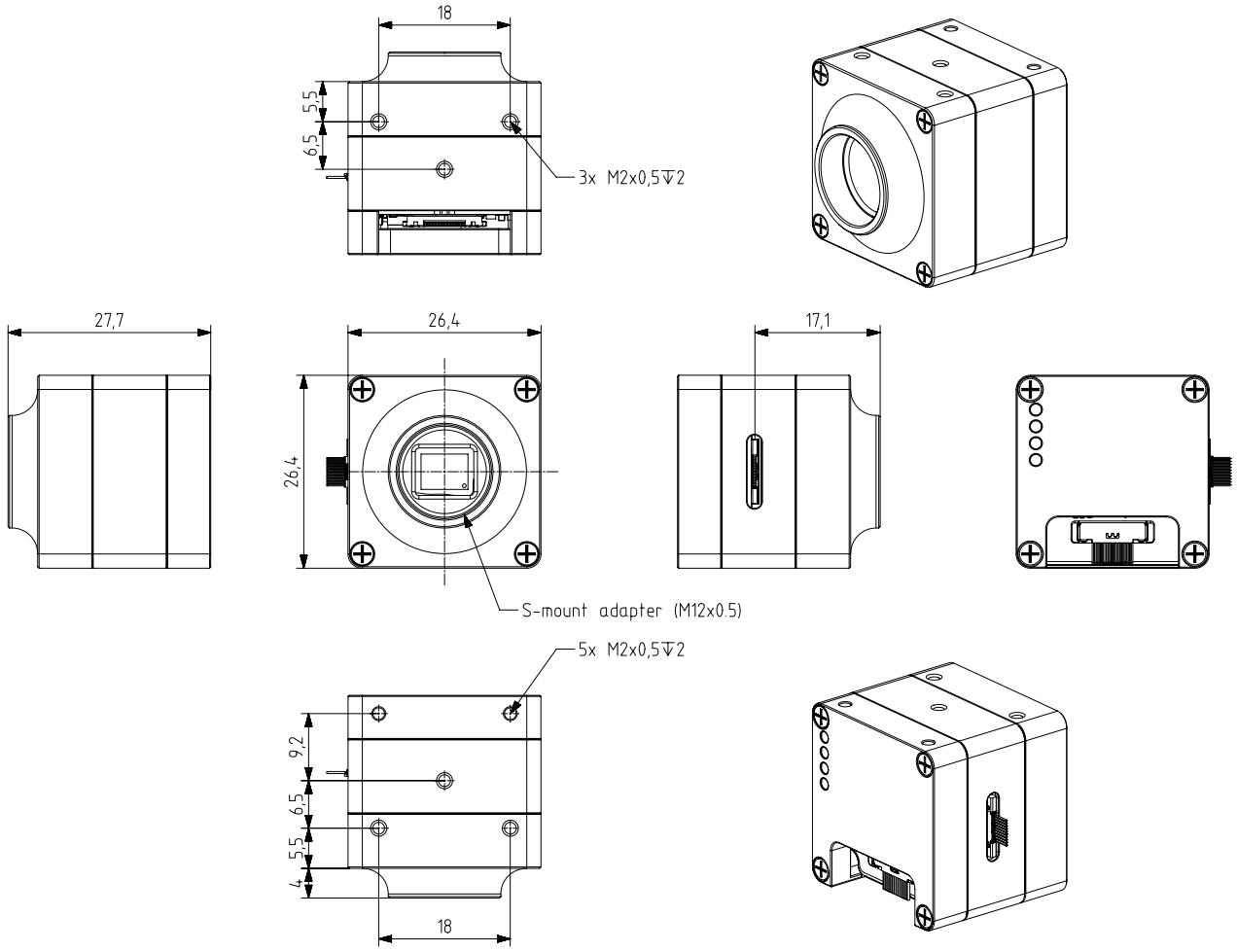


Figure 13: Dimensional drawing of MU003TG-SY-UC-AR

2.8 User interface – LEDs

LED output description MC051CG-SY-UC-AR

LED	Color	Defaults	Note
1	Red	On	User configurable
2	Green	Exposure active	User configurable
3	Blue	Frame active	User configurable
4	Orange	Connection status	User configurable

Table 16: LED output description during camera power up

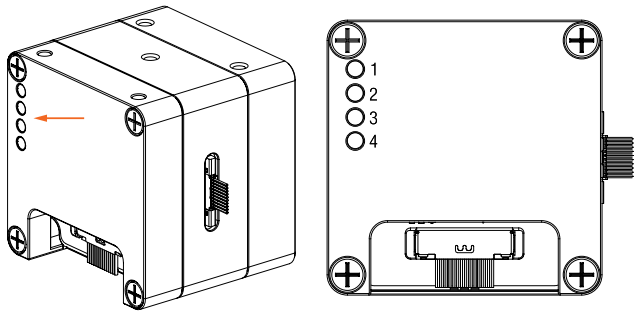


Figure 14: Position of LEDs on MC051-SY-UC-AR camera

LED statuses during boot sequence

Status	LED1	LED2	LED3	LED4
OFF	Off	Off	Off	Off
Power	On	Off	Off	Off
Booting	Off	flash 2 Hz	flash 2 Hz	Off
Boot up finished	On	Off	Off	On
USB init - wait for enumeration	flash 1 Hz	Off	Off	Off
Enumeration finished USB2	Off	Off	Off	flash 2 Hz
Enumeration finished USB3	Off	Off	Off	On
Device stop	flash 2 Hz	Off	Off	flash 2 Hz
Error	flash 2 Hz	Off	Off	flash async

Table 17: LED output description during camera power up

LED output description MU003TG-SY-UC-AR

LED	Color	Defaults	Note
1	Red	On	User configurable
2	Green	Off	User configurable
3	Blue	Off	User configurable
4	Orange	Off	User configurable

Table 18: LED output description during camera power up

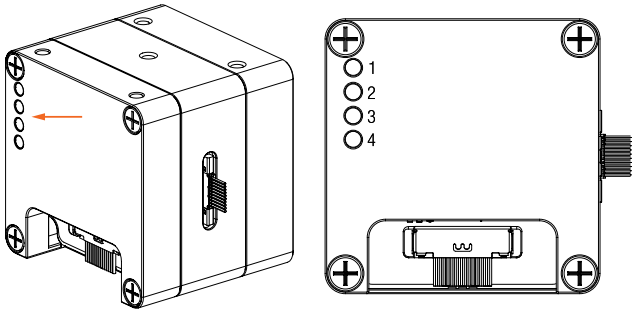


Figure 15: Position of LEDs on MU003TG-SY-UC-AR camera

LED statuses during boot sequence

Status	LED1	LED2	LED3	LED4
OFF	Off	Off	Off	Off
Power	Off	Off	On	On
Boot up finished	Off	Off	Off	On

Table 19: LED output description during camera power up

2.9 Camera interface

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

The following section applies to:
MC051CG-SY-UC-AR.

2.9.1 Micro-Coaxial connector

The USB 3.1 Micro-Coaxial connector is used for data transfer, camera control and power, also -UC MC camera has two outputs (GPO) and two in-outs (GPIO) available through the same Micro-Coaxial connector (see section Digital inputs / outputs (GPIO) interface for pinout description).

Item	Value
Connector	CONN-20374-R14E-31
Signals	USB 3.1 Gen1, power, IO
Mating Connectors	CBL-CSS-14-100-50-R1

Table 20: USB 3.1 Micro-Coaxial mating connector description

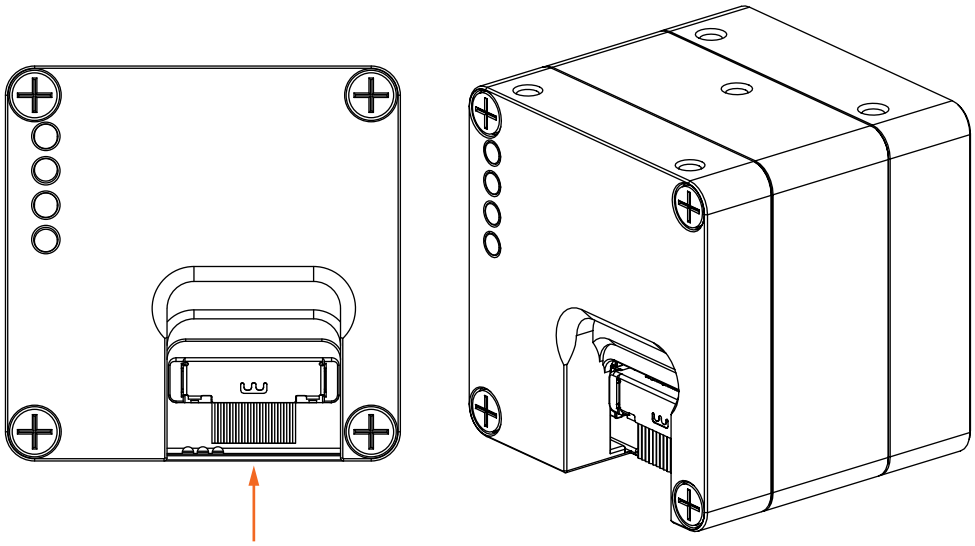


Figure 16: Data/power/IO connector location

The following section applies to:
MU003TG-SY-UC-AR.

2.9.2 Micro-Coaxial connector

The USB 3.1 Micro-Coaxial connector is used for data transfer, camera control and power, also -UC MU camera has two in-outs (GPIO) available through the same Micro-Coaxial connector (see section Digital inputs / outputs (GPIO) interface for pinout description).

Item	Value
Connector	CONN-20374-R14E-31
Signals	USB 3.1 Gen1, power, IO
Mating Connectors	CBL-CSS-14-100-50-R1

Table 21: USB 3.1 Micro-Coaxial mating connector description

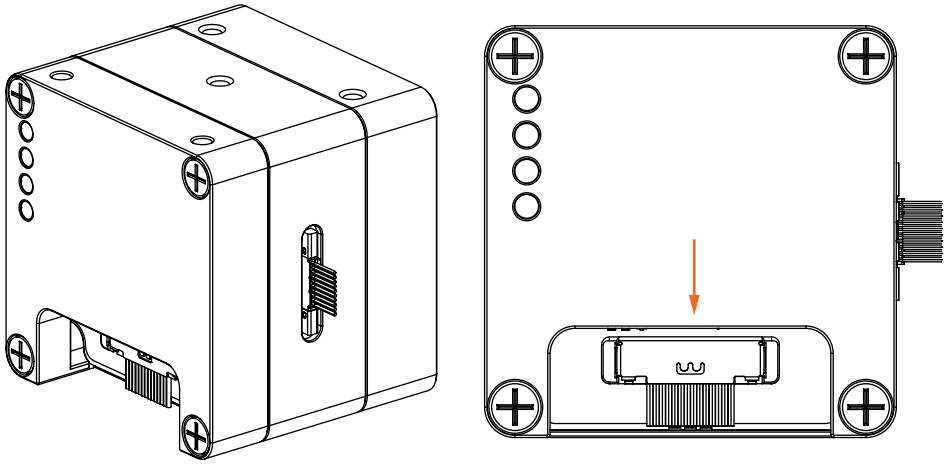


Figure 17: Data/power/IO connector location

2.10 Digital inputs / outputs (GPIO) interface

The description of the GPIO interface below applies to:
MC051CG-SY-UC-AR

Item	Value
Connector	CONN-20374-R14E-31
Signals	USB 3.1 Gen1, power, IO
Mating Connectors	CBL-CSS-14-100-50-R1

Table 22: GPIO mating connector description

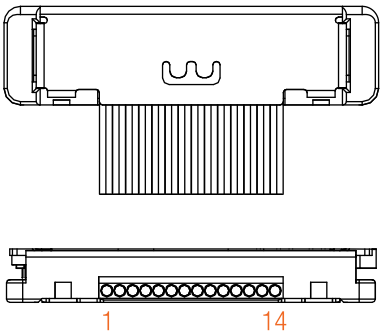


Figure 18: IO connector pinning

Pin	Name	GPI/GPO index API	Type
1	VBUS	None	Power input
2	VBUS	None	Power input
3	INOUT2	3/3	Non-isolated digital lines - Digital Input-Output (INOUT)
4	OUT2	-/1	Optically isolated Digital Output (OUT)
5	SSRX+	None	SuperSpeed receiver differential pair
6	SSRX-	None	SuperSpeed receiver differential pair
7	D+	None	USB 2.0 differential pair
8	D-	None	USB 2.0 differential pair
9	SSTX+	None	SuperSpeed transmitter differential pair
10	SSTX-	None	SuperSpeed transmitter differential pair
11	INOUT1	2/2	Non-isolated digital lines - Digital Input-Output (INOUT)
12	OUT1	-/1	Optically isolated Digital Output (OUT)
13	VBUS	None	Power input
14	VBUS	None	Power input

Table 23: I/O connector pin assignment

The description of the GPIO interface below applies to:
MU003TG-SY-UC-AR

Item	Value
Connector	CONN-20374-R14E-31
Signals	USB 3.1 Gen1, power, IO
Mating Connectors	CBL-CSS-14-100-50-R1

Table 24: GPIO mating connector description

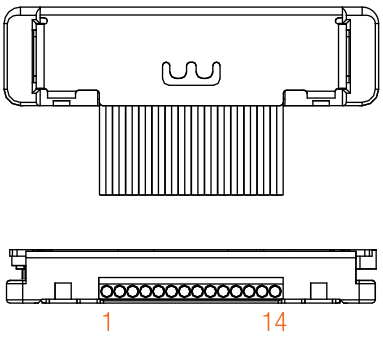


Figure 19: IO connector pinning

Pin	Name	GPI/GPO index API	Type
1	VBUS	None	Power input
2	VBUS	None	Power input
3	INOUT2	2/2	Non-isolated digital lines - Digital Input-Output (INOUT)
4	OUT2	-/4	Non-isolated digital lines - Digital Output (OUT)
5	SSRX+	None	SuperSpeed receiver differential pair
6	SSRX-	None	SuperSpeed receiver differential pair
7	D+	None	USB 2.0 differential pair
8	D-	None	USB 2.0 differential pair
9	SSTX+	None	SuperSpeed transmitter differential pair
10	SSTX-	None	SuperSpeed transmitter differential pair
11	INOUT1	1/1	Non-isolated digital lines - Digital Input-Output (INOUT)
12	OUT1	-/3	Non-isolated digital lines - Digital Output (OUT)
13	VBUS	None	Power input
14	VBUS	None	Power input

Table 25: I/O connector pin assignment

2.10.1 Digital outputs

General info

The description of digital outputs below applies to:
MC051CG-SY-UC-AR

Item	Parameter / Note
Common pole	YES
Effects when withdrawing/inserting input module under power	May damage camera electronics
Protection ESD and short	ESD HBM ANSI/ESDA/JEDEC JS-001 Class 2 exceeds 2 kV [1]
Maximal output sink current	20 mA
Inductive loads	NO
Output Level logical 0	< 0.8 V, Load 100 kΩ
Output Level logical 1	> 4.5 V, Load 100 kΩ
Output delay - rising edge	<20 ns, Load 100 kΩ threshold 1.5 V
Output delay - falling edge	<20 ns, Load 100 kΩ threshold 0.5 V
Output functions	Off, On, Exposure active, Frame active, signal inversion supported

[1] CDM JESD22-C101E exceeds 1000 V

Table 26: Digtal outputs MC051CG-SY-UC-AR

2.10.2 Non-isolated digital lines

General info

The description of optically non-isolated digital lines below applies to:
MU003TG-SY-UC-AR and MC051CG-SY-UC-AR

Item	Parameter / Note
Maximal input voltage	24 V DC
Common pole	YES
Effect of incorrect input terminal connection	reverse voltage polarity protected
Effects when withdrawing/inserting input module under power	no damage, no lost data
Protection	reverse voltage
Input Impedance- minimum	15 kΩ
Input Level for logical 0	< 0.3 V
Input Level for logical 1	> 1.3 V
Input debounce filter	NO
Input delay - rising edge	<300 ns VINPUT=2 V
Input delay - falling edge	<450 ns VINPUT=2 V
Input functions	trigger, rising or falling edge are supported for trigger

Table 27: Digtal inputs/outputs MU003TG-SY-UC-AR and MC051CG-SY-UC-AR

2.11 Accessories

2.11.1 XS-5P-U3-UC-TC

XS ximea switch - Multifunctional USB Hub.

- UFP (upstream facing port) connector: USB3.2 Gen1, Type-C
- DFP (downstream facing port) connectors: 5 x USB3.2 Gen1, I-PEX Cabline SS 14pos

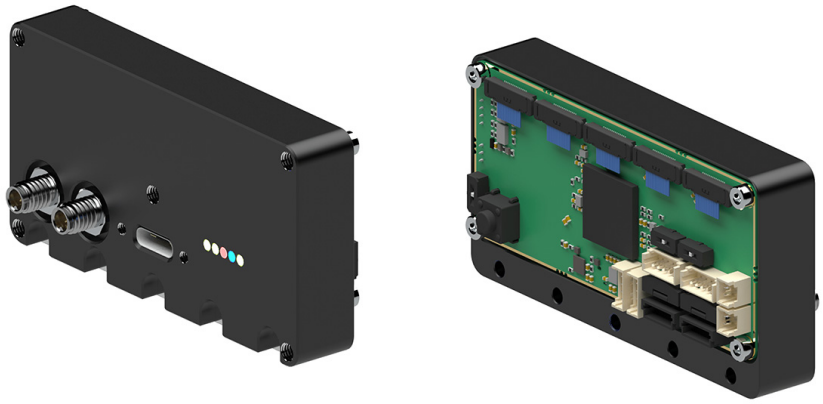


Figure 20: Isometric view of XS-5P-U3-UC-TC

Dimensional drawing

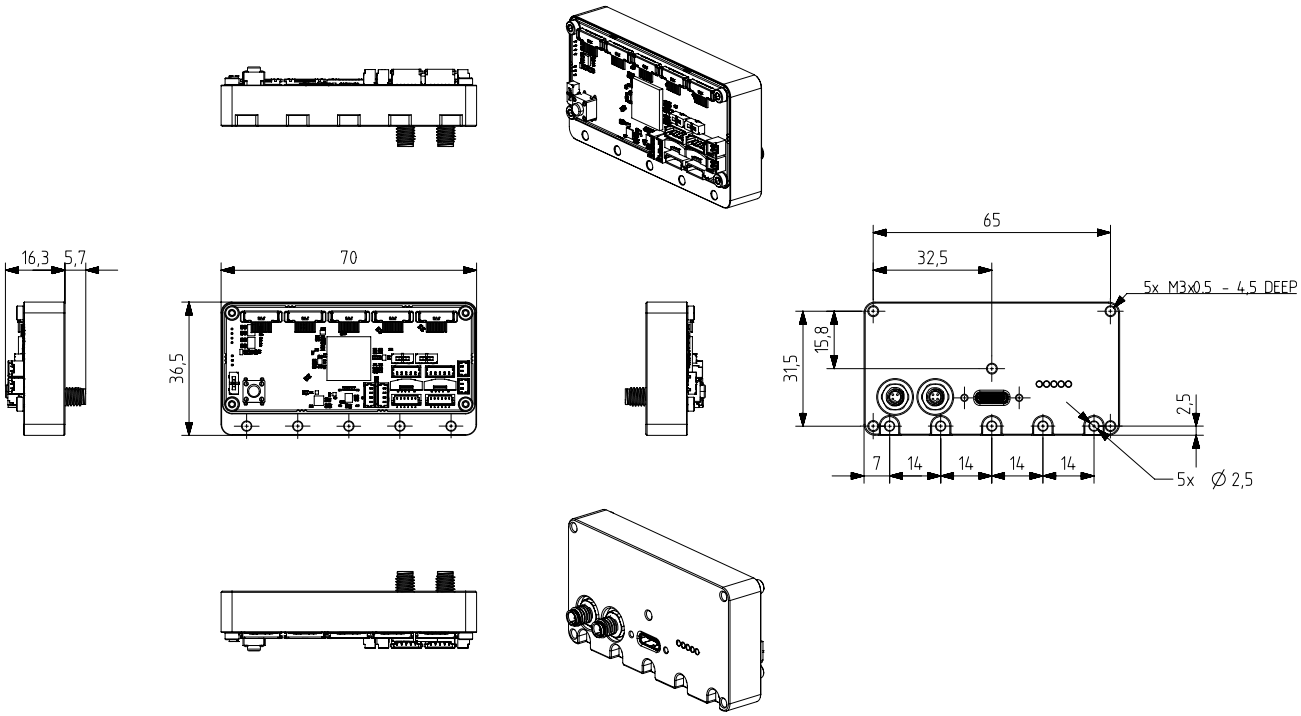


Figure 21: Dimensional drawing of XS-5P-U3-UC-TC

DIP switch

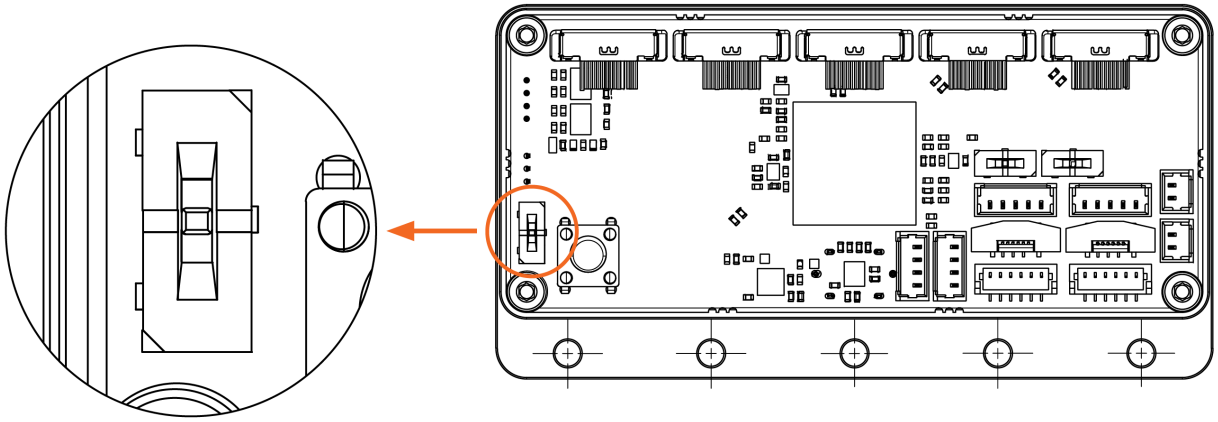


Figure 22: DIP switch location

DIP switch upper position: External trigger mode - trigger signal generated from the IO connector GPI_EXT signal

DIP switch lower position: Master-Slave mode - trigger signal generated from the DFP camera connector GPO1 signal

In both cases, the trigger signal is distributed across all 5 DFP camera connectors to GPIO1 singal, see image below.

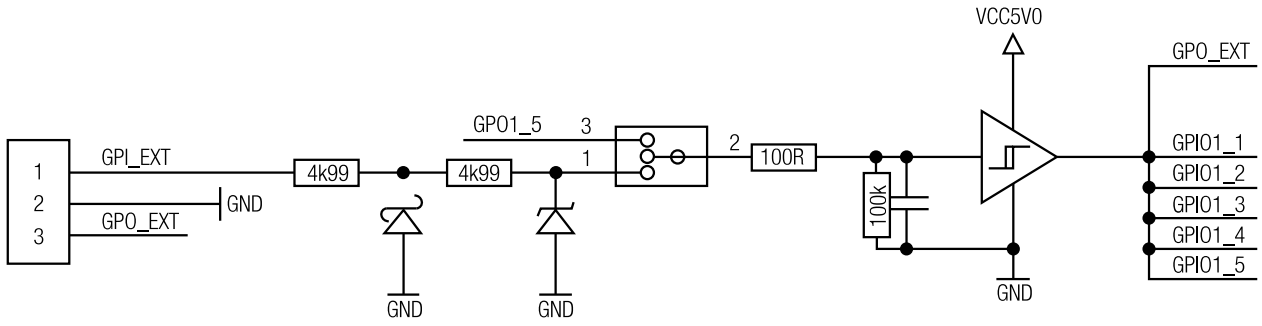


Figure 23: I-PEX Cabline SS, 14pos connectors GPIO1 signal scheme

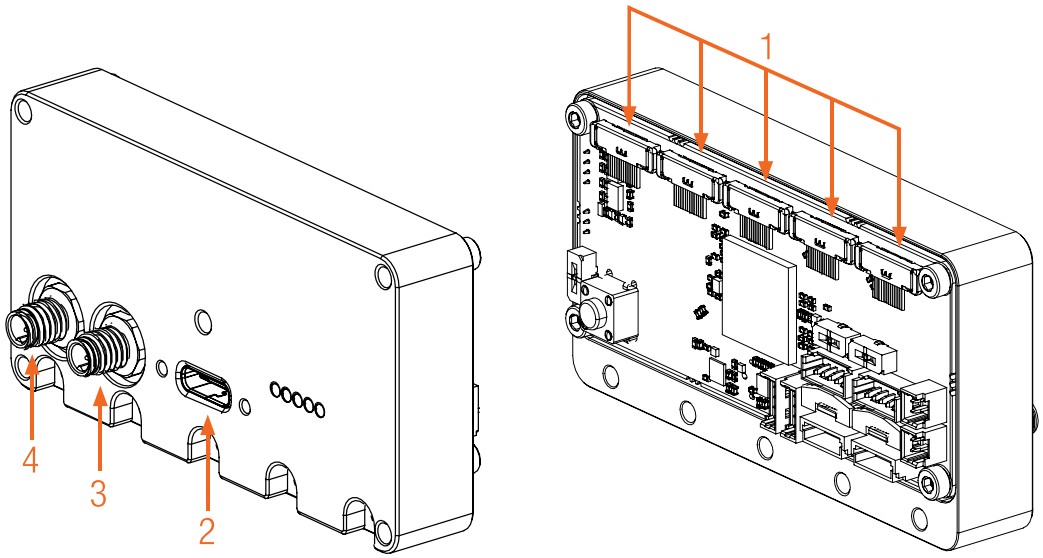


Figure 24: XS-5P-U3-UC-TC connectors location

Num	Connector
1	5 x USB3.2 Gen1, I-PEX Cabline SS 14pos
2	USB3.2 Gen1, Type-C
3	Power connector
4	IO connector

Table 28: XS-5P-U3-UC-TC connectors description

Item	Value
Connector	CONN-20374-R14E-31
Signals	Camera connector
Mating cables	CBL-U3-PSD-UC-0M10

Table 29: Micro-coaxial connectors description

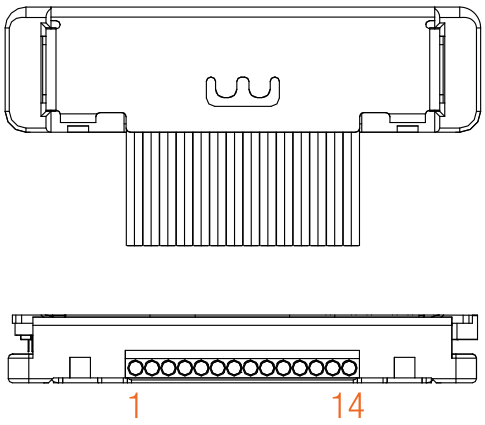


Figure 25: Micro-coaxial connectors pinout

Pin	Signal	Description
1	VBUS	+5 V Power input
2	VBUS	+5 V Power input
3	INOUT2	Non isolated Input/Ouput (<0.3 Low; > 1.3 High)
4	OUT2	Non isolated TTL Output
5	SSTX-	SuperSpeed transmitter differential pair
6	SSTX+	SuperSpeed transmitter differential pair
7	D+ USB	2.0 differential pair
8	D- USB	2.0 differential pair
9	SSRX-	SuperSpeed receiver differential pair
10	SSRX+	SuperSpeed receiver differential pair
11	INOUT1	Non isolated Input/Ouput (<0.3 Low; > 1.3 High)
12	OUT1	Non isolated TTL Output
13	VBUS	+5 V Power input
14	VBUS	+5 V Power input

Table 30: Micro-coaxial connectors pin assignment

Item	Value
Connector	USB 3.2
Signals	Standard USB 3.2 Gen1 Type-C Connector
Mating Connectors	Standard USB 3.1 Type C Connector with thumbscrewsScrew thread M2, thread distance 15.0 mm

Table 31: USB 3 Type-C connector description

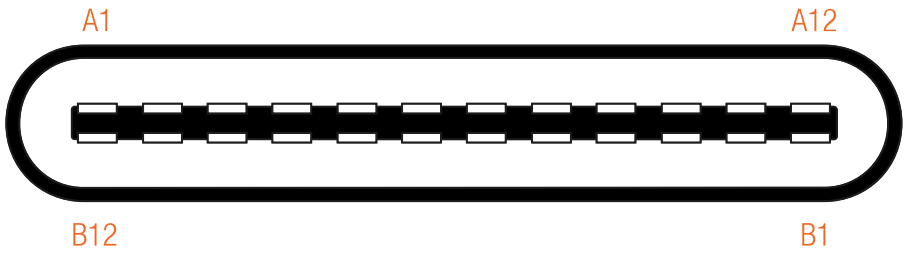


Figure 26: Pinout of Type-C connector

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

Table 32: USB Type-C connector pin assignment

Power connector

Item	Value
Connector	Binder PN: 09 3111 81 04
Signals	Power input
Mating Connectors	Binder 79 3108 52 04

Table 33: Power connector description

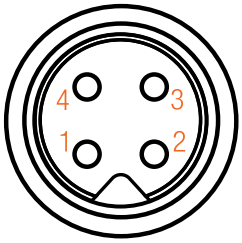


Figure 27: Power connector pinout

Pin	Name	Type
1	GND	Power ground
2	AUX PWR	Power supply input
3	AUX PWR	Power supply input
4	GND	Power ground

Table 34: Power connector pin assignment

IO connector

Cameras connected to DFP ports can be synchronized by external trigger, or in master-slave mode. This functionality is configured by a hardware DIP switch located on the bottom left corner of the the board, see DIP switch.

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

Table 35: IO connector description

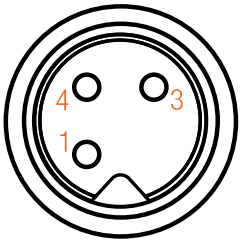


Figure 28: IO connector pinning

Pin	Name	Type
1	GPIO_GND	Common ground for Input and Output
3	IN	Digital Input (IN)
4	OUT	Digital Output (OUT)

Table 36: IO connector pin assignment

2.11.2 VCSEL-SLIM-W-AR

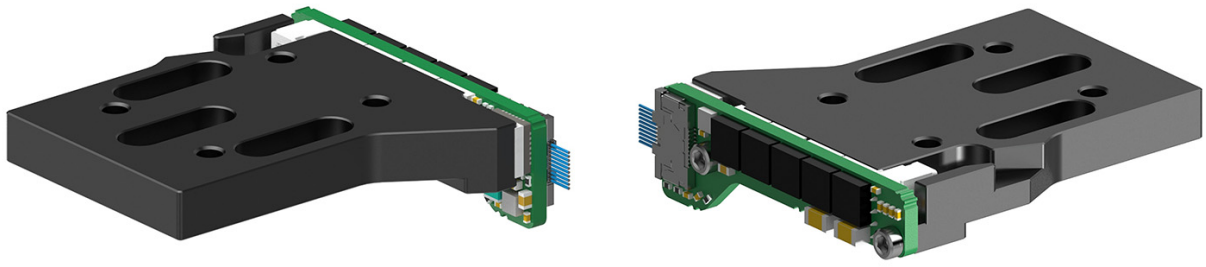


Figure 29: Isometric view of VCSEL-SLIM-W-AR

VCSEL (Vertical-cavity surface-emitting laser) based illumination board for XIMEA ToF camera.

VCSEL type:

- EGA2000-850-W Industrial High-Power Flood Illuminator

Dimensional drawing

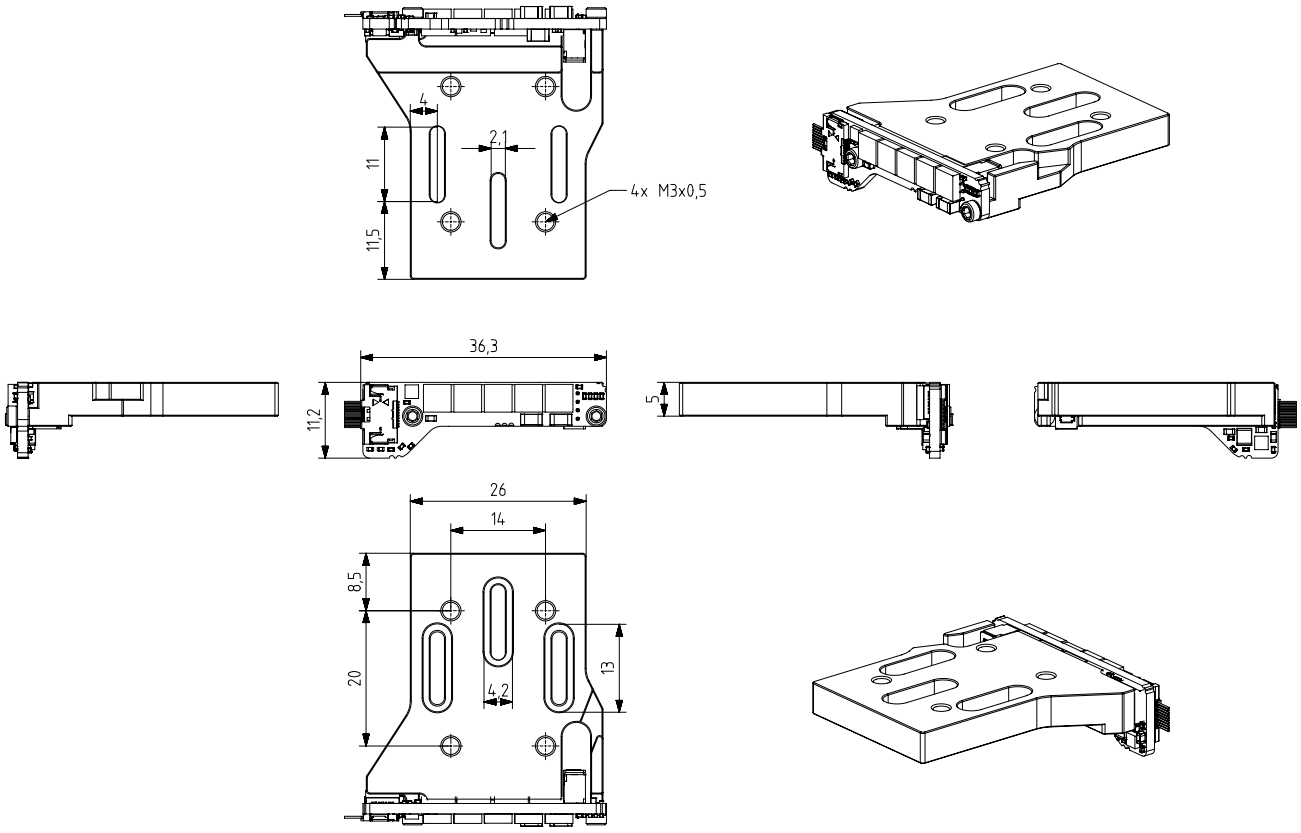


Figure 30: Dimensional drawing of VCSEL-SLIM-W-AR

Connectors

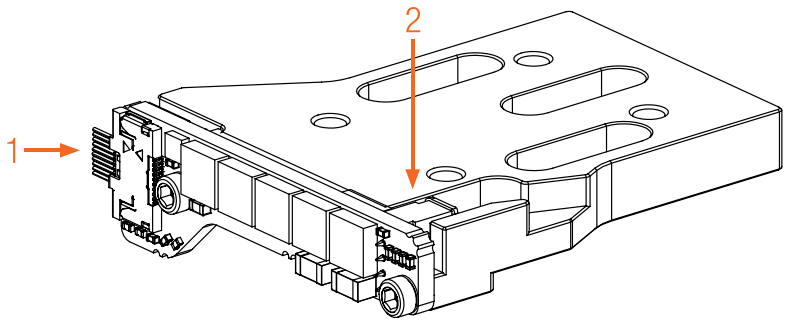


Figure 31: VCSEL-SLIM-W-AR connecotrs location

Num	Connector
1	I-PEX Cabline V Micro Coax Cable Receptacle, 10pos
2	53047-0410 Molex Picoblade 4pos, thourhg hole, vertical

Table 37: VCSEL-SLIM-W-AR connectors description

Power connector

Item	Value
Connector	53047-0410 Molex Picoblade 4pos, thourgh hole, vertical
Signals	Power input
Mating Connectors	0151340401 Molex Picoblade, 4pos, 1:n, AWG28, 100 mm

Table 38: VCSEL-SLIM-W-AR power connector

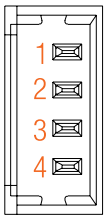


Figure 32: Power connector pinout

Pin	Name	Type
1	GND	Power ground
2	VCC_IN	Power supply for the VCSEL illumination
3	VCC_IN	Power supply for the VCSEL illumination
4	GND	Power ground

Table 39: VCSEL-SLIM-W-AR power connector pin assignment

Item	Value
Connector	I-PEX Cabline V 10pos
Signals	Conecting VCSEL assembly with camera
Mating cables	CBL-105112-1232505010 microCoax cable

Table 40: VCSEL-SLIM-W-AR control connector description

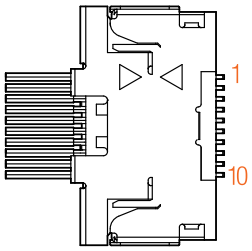


Figure 33: Control connector pinout

Pin	Name	Type
1	VCC5V0	Power for the driver circuitry and telemetric ICs
2	None	None
3	LED_p	High speed LVDS switching signal for VCSEL illumination
4	LED_n	High speed LVDS switching signal for VCSEL illumination
5	I2C_SDA	Low speed communication bus for telemetrics and illumination adjustment
6	I2C_SCL	Low speed communication bus for telemetrics and illumination adjustment
7	None	None
8	None	None
9	None	None
10	VCC5V0	Ppower for the driver circuitry and telemetric ICs

Table 41: VCSEL-SLIM-W-AR control connector pin assignment

3 Operation

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

3.1 System requirements

3.1.1 Software requirements

Cameras are compatible with the following operating systems:

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

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

3.2 XIMEA software packages

3.2.1 XIMEA Windows software package

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

Contents

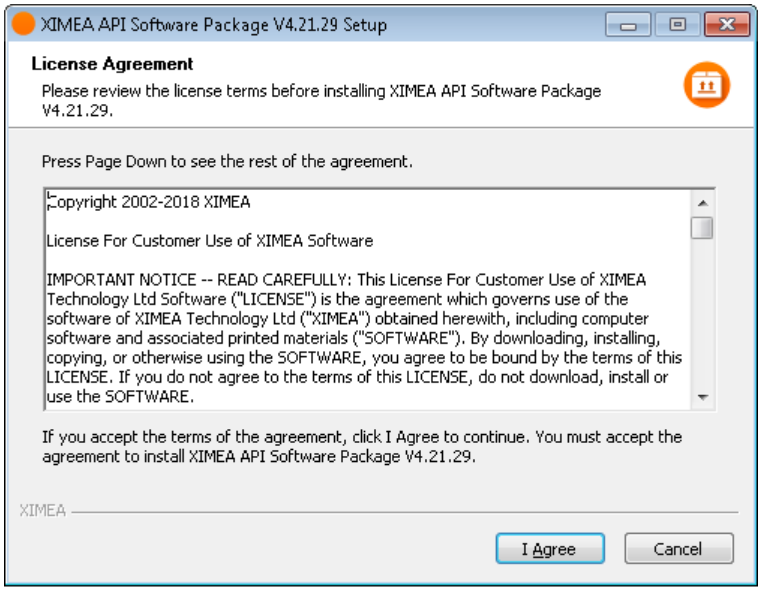
The package contains:

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

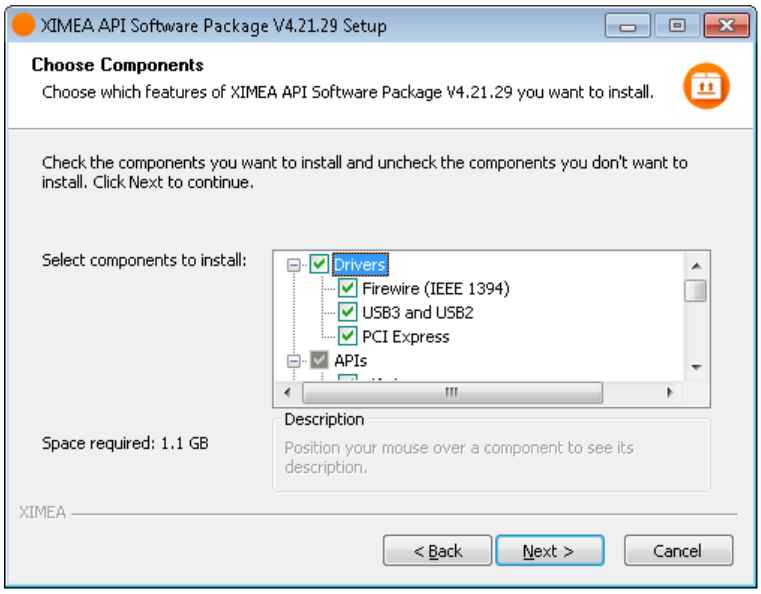
Installation

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

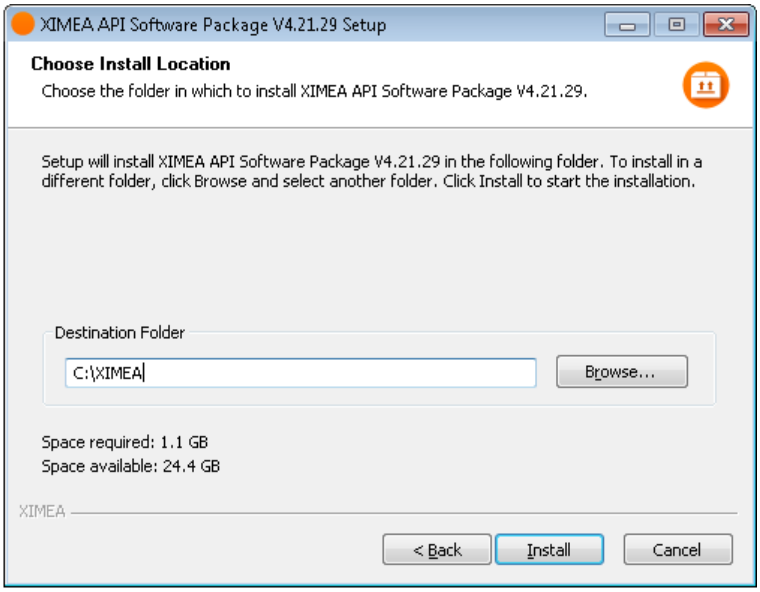
  Be sure that you have administrator privileges or start the Installer with administrator rights (right click and select “run as administrator”):



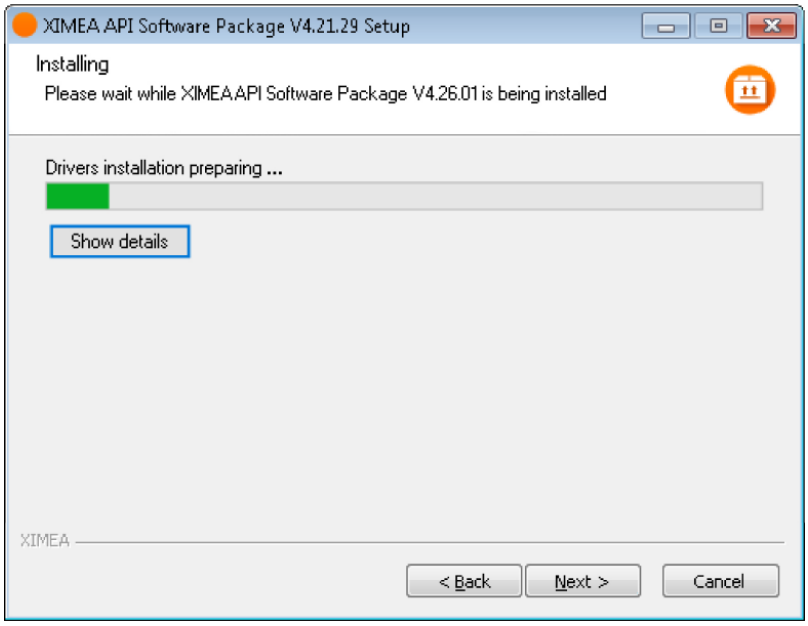
- Select the Software components you want to install. You can uncheck the components you don't want to install, but it is recommended to leave them all checked



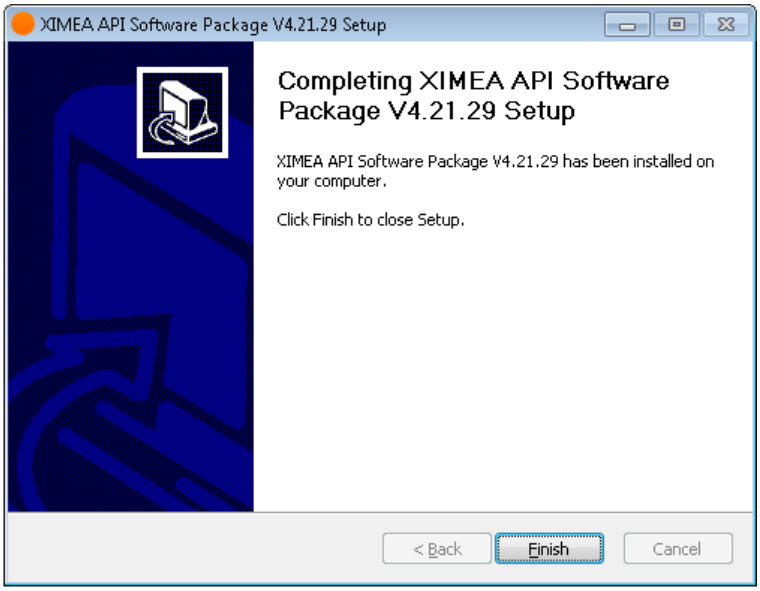
- Specify the install location - you can leave the default location or change it to your desired location



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



- Installation is completed
- Finish



3.2.2 XIMEA Linux software package

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

Contents

The package contains:

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

Instalation

- Download XIMEA Linux Software Package:

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

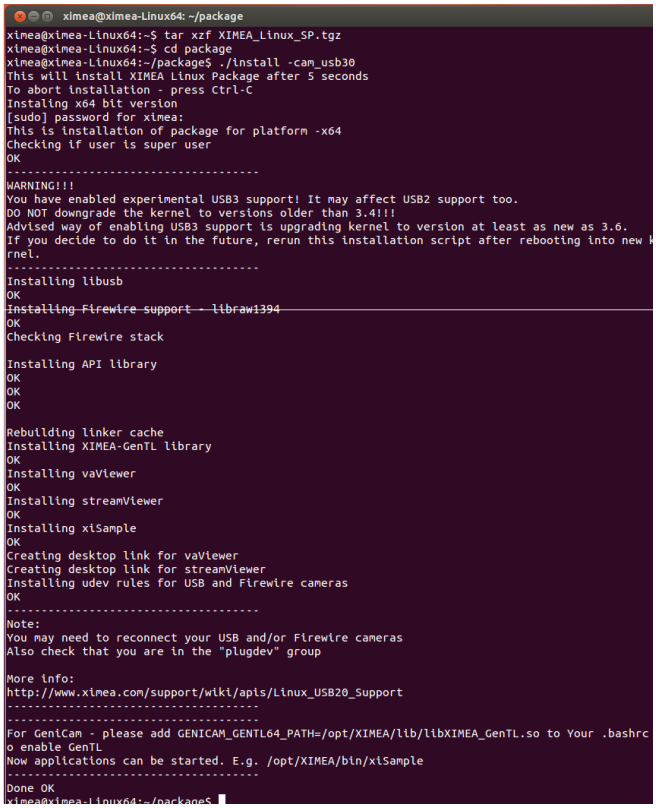
  ```
  wget http://www.ximea.com/downloads/recent/XIMEA_Linux_SP.tgz
  ```

- Untar

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

- Start installation script

  ```
  ./install
  ```



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

3.2.3 XIMEA macOS software package

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

Contents

The package contains:

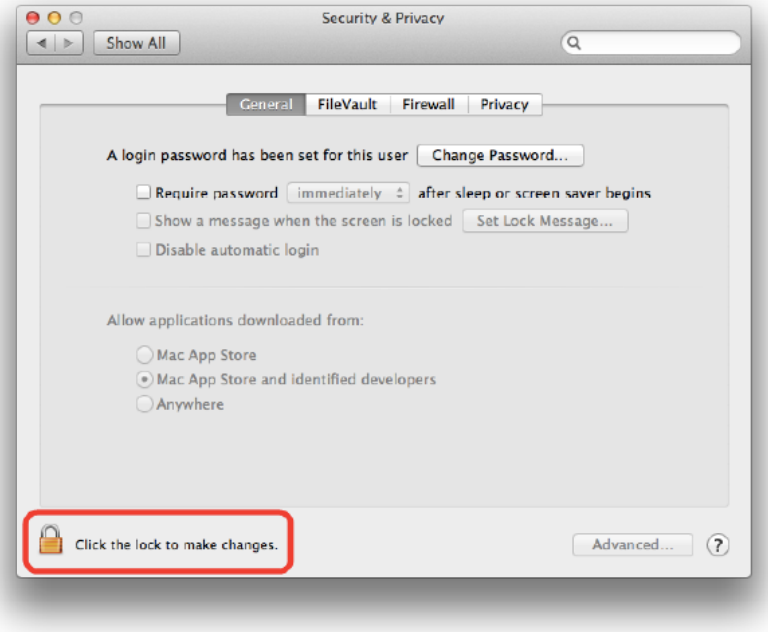
- Driver (beta version) for XIMEA USB2 and USB3 cameras
- xiAPI
- XIMEA CamTool
- Examples:
  - xiSample - sample showing basic image acquisition in xiAPI

Installation

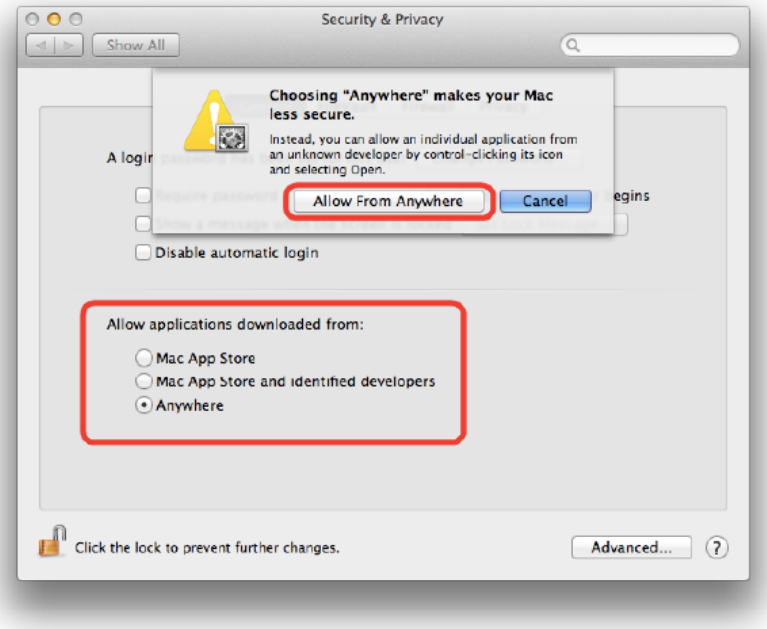
Before installing XIMEA macOS Software Package it may be necessary to modify security settings on your computer. The new feature of OS X 10.8 called GateKeeper can prevent you from using our macOS Software Package due to the fact that the current version is unsigned.

- Open System Preferences application and click on Security & Privacy

- Click on the lock to allow changes to be made



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



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

Start XIMEA CamTool

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

Short description

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

3.3 XIMEA CamTool

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

Figure 34: CamTool preview

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

Table 42: 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

3.4 XIMEA control panel

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

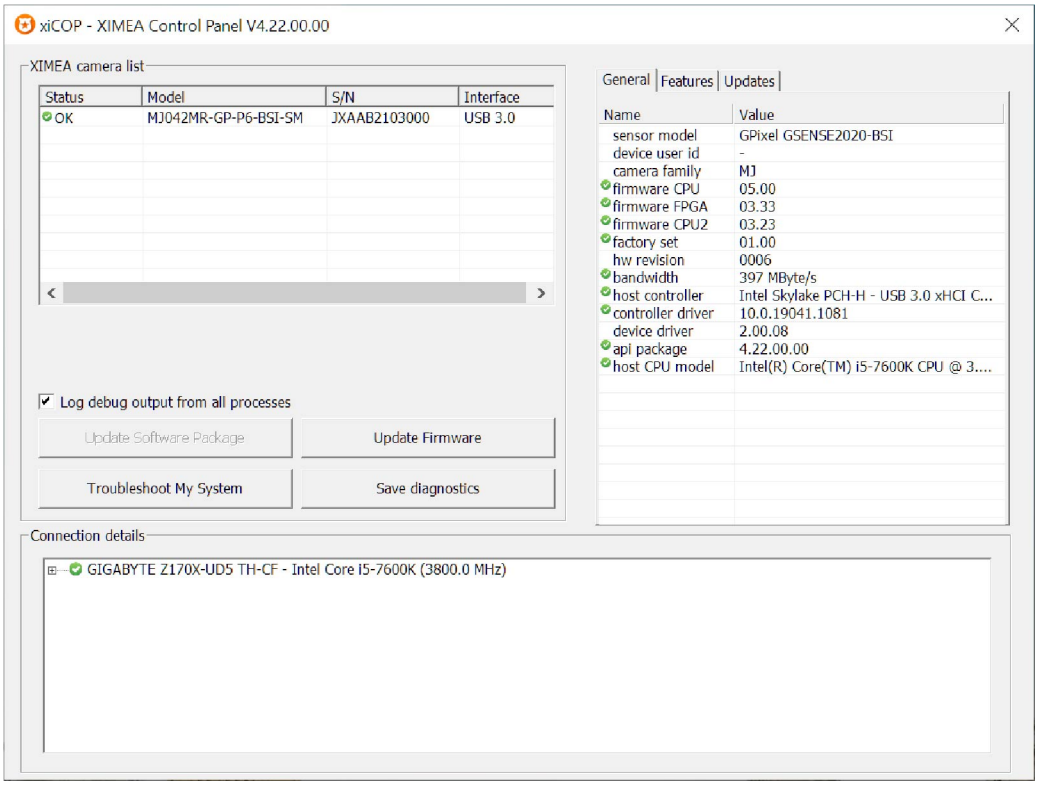


Figure 35: xiCOP example

Features

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

3.5 Supported vision libraries

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

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

3.5.1 MathWorks MATLAB

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

3.5.2 MVTec HALCON

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

3.5.3 National Instruments LabVIEW vision library

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

3.5.4 OpenCV

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

3.6 Programming

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

3.6.1 Standard interface

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

GenICam/GenTL

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

3.6.2 xiAPI

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

Architecture

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

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

Installation

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

xiAPI functions description

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

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

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

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

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

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

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

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

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

xiAPI parameters description

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

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

xiAPI examples

Connect device

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

```
HANDLE xiH = NULL;

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

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

Parameterize device

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

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

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

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

Acquire images

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

```
            xiStartAcquisition(xiH);

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

Hardware trigger and exposure active output

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

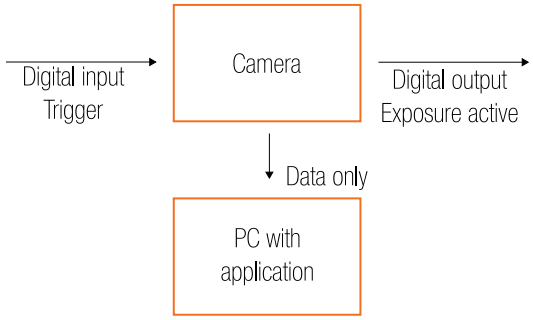


Figure 36: GPIO scheme

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

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

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

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

    xiStartAcquisition(handle1);

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

xiAPI Auto Bandwidth Calculation

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

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

xiAPI.NET

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

xiApiPython

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

4 Appendix

4.1 Troubleshooting and support

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

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

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

Please make sure, that you have connected your camera with the appropriate XIMEA cable to an appropriate port. Ensure that the connections are carefully locked. Follow the instructions described in section 3.3 (run the camera with the Ximea CamTool). In case that you still have issues, please read the following chapters.

4.1.1 Worldwide support

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

4.1.2 Before contacting technical support

There are several steps to take before contacting your local dealer for technical support. In case you cannot display images from your camera, please open the XIMEA xiCOP software (please see section 3.4). It will immediately start searching for connected cameras. Your camera will appear in the XIMEA camera list on the upper left side of the xiCOP window if it is connected properly and your USB interface meets the minimum system requirements described in section 3.1. If the camera does not appear, please proceed with the following steps:

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

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

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

4.2 Frequently Asked Questions

- Frequently Asked Questions
- Knowledge Base

4.3 Product service request (PSR)

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

Step 1 – Contact support

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

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

Step 2 – Create product service request (PSR)

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

Step 3 – Wait for PSR approval

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

Step 4 – Sending the camera to XIMEA

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

Step 5 – Waiting for service conclusion

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

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

Table 43: Service operations overview

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

Step 6 – Waiting for return delivery

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

4.4 Safety instructions and precautions

This chapter describes safety instructions and precautions valid for cameras. In order to avoid harm or damage your camera, please handle it as described in this manual, paying special attention to the following warnings:

4.4.1 Disassembly

There are no switches or parts inside the cameras that requires any kind of mechanical adjustment. Please note that the warranty is voided by opening the camera housing.

Do not disassemble the camera except to remove the lens mount or the cooling element (if the camera has one).

4.4.2 Mounting / Screws

Use only the designated threaded holes for mounting the camera. Please note the camera / bracket drawings in chapter Mechanical characteristics. Use only the specified screws and torques when fastening, see Mounting points.

4.4.3 Connections

Use only recommended connectors and cables. Please check the system requirements described in chapter System requirements.

4.4.4 Power supply

Use only the recommended electrical power supply. Camera can be bus powered or powered from external power supply, for detailed information see section Power supply .

4.4.5 Environment / protection against water

Camera may only be used in suitable environment, please note the descriptions in section Environment. Do not let camera get wet. Protect the camera against contact with water.

Damage may be caused by:

- Overheating
- Contact with water
- Operation in an environment with condensing humidity
- Mechanical shock

4.4.6 Recommended light conditions

Do not expose the camera to light sources with intense energy, e.g. laser beams or X-ray.

Light intensity or exposure time exceeding the saturation of the sensor may damage the sensor irreparably. This may occur e.g. in the following situations:

- High-energy laser light hitting the sensor directly
- Bright light sources hitting the sensor directly (burn-in)
- Camera is exposed to X-rays

The warranty does not cover damaged cameras caused by X-ray applications or very high intensity light / laser light.

4.4.7 Protection of optical components

- Do not touch the optical components with hard or abrasive objects or with chemicals other than specified blow for cleaning.
- When handling the camera, avoid touching the lenses and filter glasses. Fingerprints or other impurities may affect the image quality and may damage the surfaces.
- Mount / dismount lenses and additional filters only in a dust free environment.
- Do not use compressed air as this could push dust into the camera (and lenses).

4.4.8 Mechanical loads

Avoid excessive shaking, throwing, dropping or any kind of mishandling of the device.

4.4.9 Camera / lens cleaning

- Use only optical quality tissue / cloth (dry cotton) a standard camera lens cleaning kit, if you must clean a lens or filter. Do not apply excessive force.
- Use only optics cleaner (e.g. 60 % ethyl alcohol, 40 % ether). Never use aggressive cleaners like gasoline or spirits. Such cleaners may destroy the surface.
- Do not use compressed air.

4.4.10 Protect against static discharge (ESD)

Image sensors and the PCB are easily damaged by static discharge (ESD).

- Only handle the cameras (especially board-level cameras) in ESD controlled environments.
- Please use anti-static gloves, clothes and materials. Also use conductive shoes.
- Wear an ESD protection wrist strap.
- Install a conductive mat on the floor and/or working table to prevent the generation of static electricity.

4.4.11 Safety instruction for board level cameras

Abuse or misapplication of the board level camera may result in limited warranty or cancelation of warranty. Due to the exposed electronics, special rules apply:

- Only qualified personnel are allowed to handle, install and operate the board level cameras.
- Board level cameras are delivered without housing. Handle the PCB and the sensor with care. Do not bend the boards. Do not touch the components or contacts on a board. Hold the board by its edges only.
- Protect the board level camera against static discharge (see above Protect against static discharge (ESD) discharge (ESD)).
- Do not hold any components of your board level cameras against your clothing, even if you are wearing a wrist strap.
- Do not remove the board level camera from its anti-static packaging unless your body is grounded.
- To protect the boards from radiation of other modules or devices a housing or shielding may be required.
- Be sure that the board level camera has no contact to any electrical source before mounting or making connections to the board level camera.
- Do not connect or disconnect any cables or use the board level camera during an electrical storm.
- Avoid any mechanical forces to the board level cameras, especially torsional, tensile and compressive forces. Any of these forces may result in damage of the board level cameras.
- Make sure that only clean boards will be put into operation.
- To protect the boards from dirt like dust or liquids always use the board level cameras in clean room environment or use a protective housing.

4.5 Warranty

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

4.6 Standard Terms & Conditions of XIMEA GmbH

The Standard Terms and Conditions are available at the following XIMEA webpage: General Terms and Conditions.
If you have any problems accessing the link, please contact our Support Team.

4.7 List of Trademarks

XIMEA, xiC, xiQ, xiMU, xiB, xiB-64, xiX, xiX-XL, xiX-Xtreme, xSWITCH, xPLATFORM, xEC, xEC2, xiCool, xiRAY, xiCe, xiSpec, xiFLY, xiD, xiJ, xiLAB, xiAPI, xiCamTool, xiCOP and CURRERA are trademarks or registered trademarks of XIMEA GmbH in Germany, Slovakia, USA and other countries.

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4.8 Copyright

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

Glossary

ADC	Analog to Digital Converter 12
DSNU	Dark Signal Non-Uniformity 12
ESD	Electrostatic discharge 4, 21, 56
PCB	Printed Circuit Board (same as PWB) 56
PRNU	Photo Response Non-Uniformity 12
PSR	Product Service Request 54
SNR	Signal to Noise (Ratio) 12

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