

XS-12P-X2G2-X8G3-SFF
Multi camera platform

XIMEA Accessories
Technical Manual
Version v260903

Introductions

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 Accessories 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 Accessories for the first time. Please follow all instructions and observe the warnings.

This document is subject to change without notice.

About XIMEA

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

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

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

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

Contact XIMEA

XIMEA is a worldwide operating company

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

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

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1 General description

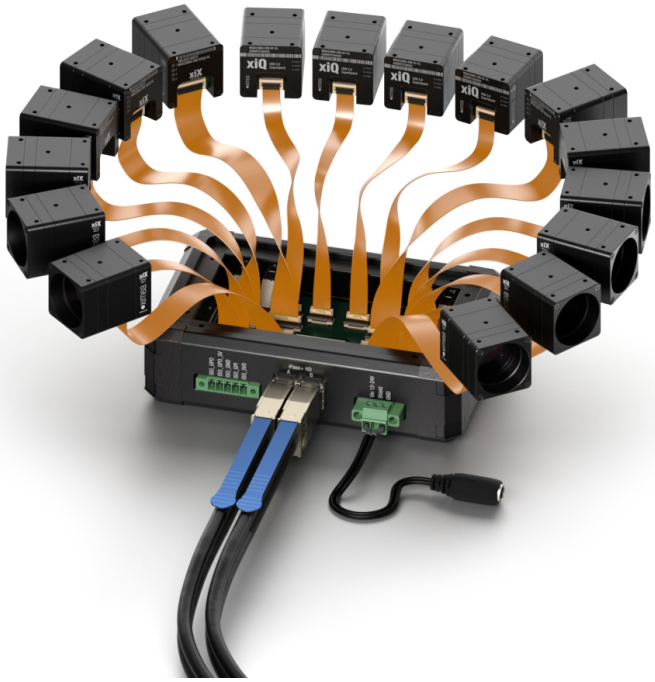


Figure 1: xSWITCH XS-12P-X2G2-X8G3-SFF

The xiSwitch XS-12P-X2G2-X8G3-SFF is a multi-camera platform designed for high-performance synchronization of up to 12 cameras equipped with PCIe connectors from xiX family.

The xiSwitch XS-12P-X2G2-X8G3-SFF features:

- Device ports: 12x PCIe X2G2 Flex connectors with 10 Gbit bandwidth each for camera connections
- Device ports: 4x USB 3 X2G2 Flex connectors with 10 Gbit bandwidth each for camera connections
- 4x USB 3 Type-A connectors with 5 Gbit bandwidth
- Host ports: 2x PCIe x4 Gen3 SFF MiniSAS HD connectors with output bandwidth of 64 Gbit
- External power for reliable operation of connected cameras
- Communication, control, and synchronization through IO connector

The power supply operates with a DC voltage range of 12 to 24 V. The power cable for connecting the switch to the power source is included in the delivery kit, see Scope of delivery for details.

The xiSwitch XS-12P-X2G2-X8G3-SFF is designed for a wide range of applications, including:

360 panorama, Augmented or Virtual Reality (AR, VR), Autonomous self-driving vehicles, Street/city mapping, Deep learning tasks, Stereo camera systems, 3D scanning, Entertainment, Photogrammetry, FACS scanning, Face and Motion capture, UAV / UAS (drones), Cinematography, Videogrammetry and more.

2 Dimensional drawings

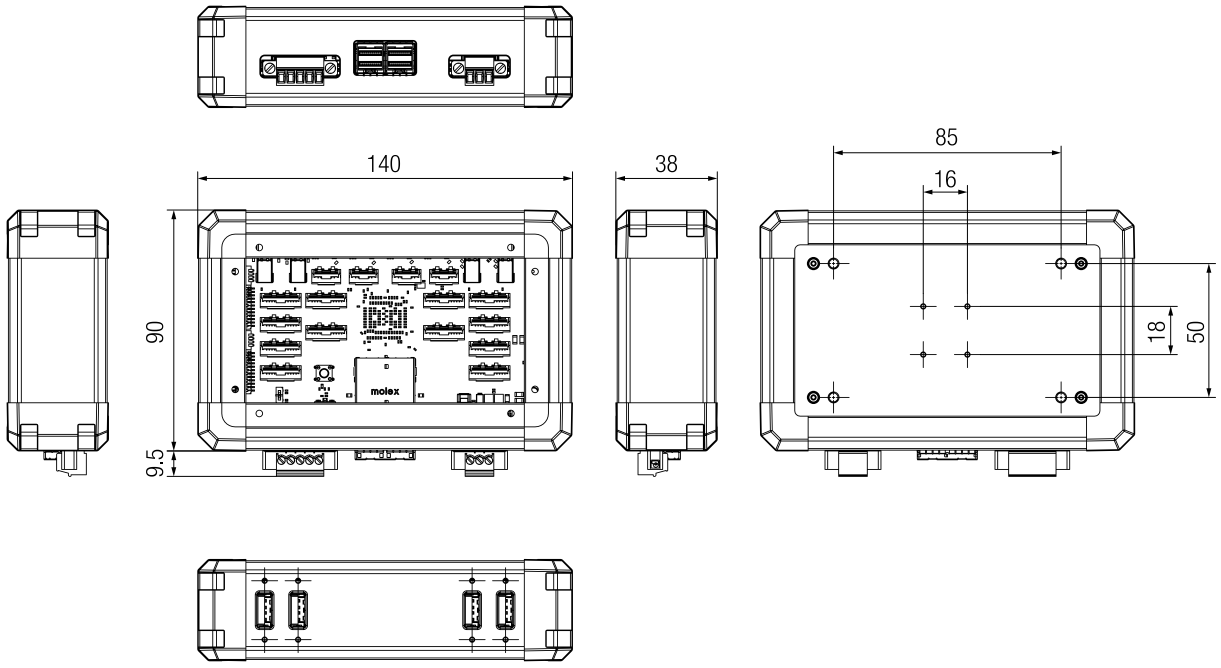


Figure 2: Dimensional drawing of XS-12P-X2G2-X8G3-SFF

Width [W]	Height [H]	Depth [D]	Mass [M]
140 mm	99.5 mm	38 mm	399.2 g

Table 1: Parameters and mass of XS-12P-X2G2-X8G3-SFF

3 Configuration

3.1 DIP switches

The numbering of the camera ports correspond to the number of the respective GPI and GPO dip switches.

The DIP switches have annotation on their body. The description of DIP switches (GPI, GPO) is written directly on the PCB top layer.

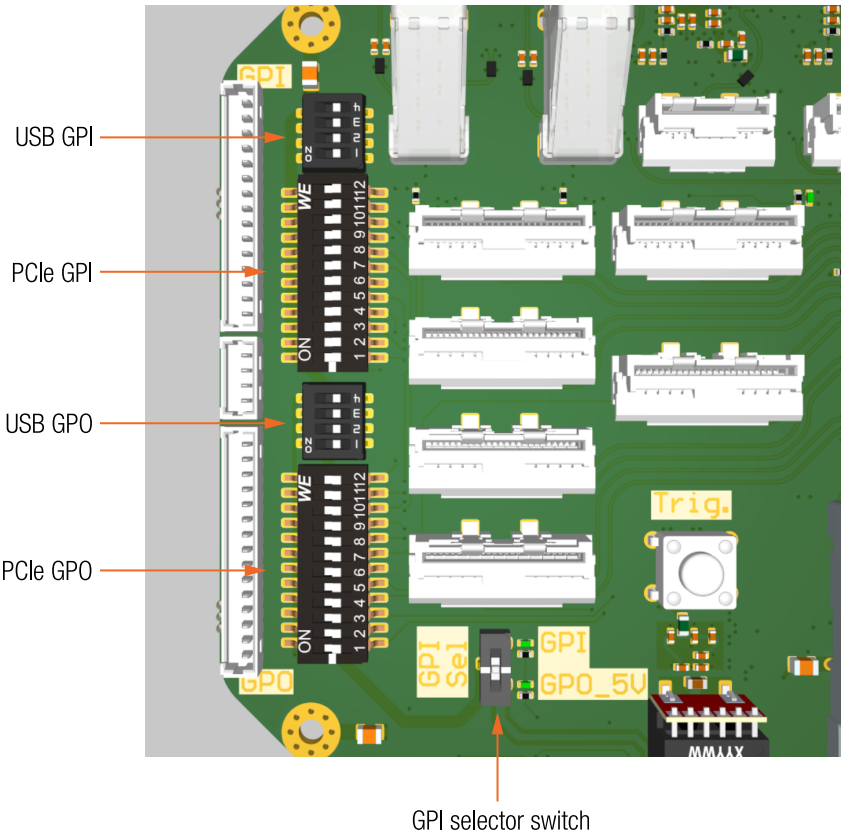


Figure 3: XS-12P-X2G2-X8G3-SFF DIP switches

The switch to select the synchronization mode is in the left bottom area, next to the annotation “GPI Sel” with two possible states - “GPI” and “GPO_5V”. For more information see Section IO-subsystem..

4 Connectors

4.1 Location of connectors

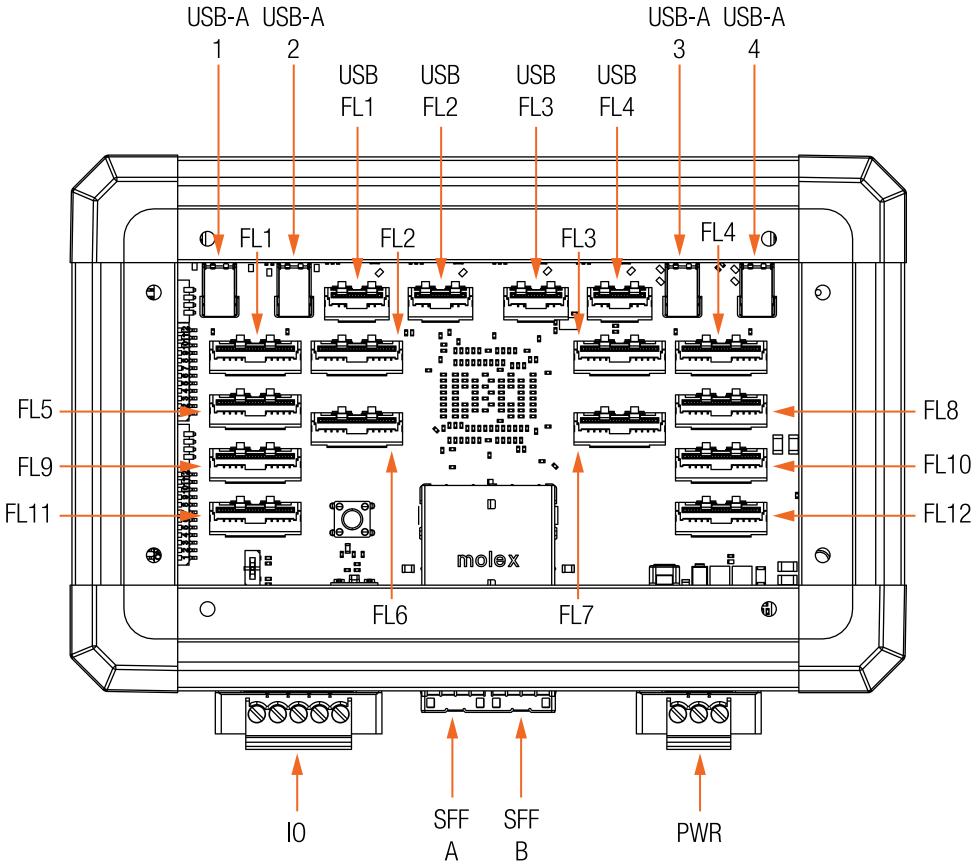


Figure 4: Connectors location

Name	Description
USB-A 1-4	USB3 Type-A USB 3.0 (USB 3.1 Gen 1, Superspeed)
USB FL1-FL4	FPC/FFC USB Flex connectors
FL1-FL12	PCIe MX-X2G2 Flex connectors
IO	5-pin IO connector, 1843826
SFF A	PCIe iPass+ HD connector, SFF-8644, connector A
SFF B	PCIe iPass+ HD connector, SFF-8644, connector B
PWR	3-pin Power input connector, 1843800

Table 2: Connectors description

4.2 Data interfaces

4.2.1 Flex cable connector (24 pin)

Item	Value
Connector	Molex 502244-2430 (-FL), Molex 502231-2400 (-FV)
Signals	PCIe x2 Gen2, GND, IO
Mating Connectors	CBL-MX-X2G2-0M07 (-0M10,-0M25), CBL-PCIEFLEX-X2G2-0M10 (-0M25,-0M50)

Table 3: Flex connector description (24 pin)

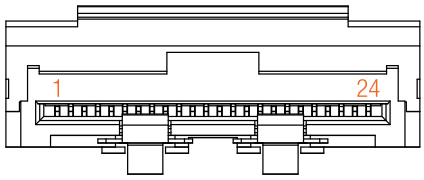


Figure 5: Flex cable connector pinnout (24 pin)

Pin	Name	GPI/GPO index API	Type
1	OUT1	-/1	Optically isolated Digital Output (OUT)
2	IN_OUT_GND	None	Common ground for opto-isolated IO
3	IN1	1/-	Optically isolated Digital Input (IN)
4	INOUT2	3/3	Non-isolated digital lines - Digital Input-Output (INOUT)
5	INOUT1	2/2	Non-isolated digital lines - Digital Input-Output (INOUT)
6	PWR	None	Power input
7	PWR	None	Power input
8	PCIe_RST0_N_IN	None	PCIe reset
9	GND	None	Ground return
10	PCIe_PERN_0	None	PCIe RX differential pair 0, neg.
11	PCIe_PERP_0	None	PCIe RX differential pair 0, pos.
12	GND	None	Ground return
13	PCIe_PERN_1	None	PCIe RX differential pair 1, neg.
14	PCIe_PERP_1	None	PCIe RX differential pair 1, pos.
15	GND	None	Ground return
16	PCIe_PETN_0	None	PCIe TX differential pair 0, neg.
17	PCIe_PETP_0	None	PCIe TX differential pair 0, pos.
18	GND	None	Ground return
19	PCIe_PETN_1	None	PCIe TX differential pair 1, neg.
20	PCIe_PETP_1	None	PCIe TX differential pair 1, pos.
21	GND	None	Ground return
22	PCIe_REFCLK_N	None	PCIe reference clock diff. pair, neg.
23	PCIe_REFCLK_P	None	PCIe reference clock diff. pair, pos.
24	GND	None	Ground return

Table 4: Flex connector 24 pin assignment

4.2.2 Flex cable connector (15 pin)

Item	Value
Connector	Molex 502244-15300 (-FL), Molex 502231-1500 (-FV)
Signals	USB 3.1 Gen1, IO, GND
Mating Connectors	CBL-MQ-FL-0M1, CBL-MQ-FL-0M25, CBL-USB3FLEX-0M10, CBL-USB3FLEX-0M25, CBL-USB3FLEX-0M50

Table 5: Flex connector description (15 pin)

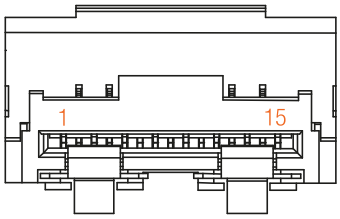


Figure 6: Flex cable connector pinout (15 pin)

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

Table 6: Flex connector 15 pin assignment

4.2.3 PCIe iPass+ HD connector

Item	Value
Connector	Conn Receptacle MINI-SAS HD RIGHT ANGLE PUSH-IN, 2149966-1, 2x36pos
Signals	Data delivery
Mating cables	Ximea PN: CBL-SFF-X4G3-10M0, CBL-SFF-X4G3-30M0, CBL-SFF-X4G3-50M0

Table 7: PCIe iPass+ HD connector description

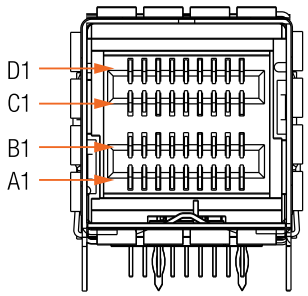


Figure 7: PCIe iPass+ HD SFF connector pinout

Pin	Name	Description	Pin	Name	Description
A1	CADDR	Control Address	C1	CMISCL	Clock line for Control Management Interface
A2	CINT	Control Interrupt	C2	CMISDA	Data line for Control Management Interface
A3	GND	Ground	C3	GND	Ground
A4	PCIe_PERP_0	PCIe RX differential signal (Lane 0)	C4	PCIe_PETP_0	PCIe TX differential signal (Lane 0)
A5	PCIe_PERN_0	PCIe RX differential signal (Lane 0)	C5	PCIe_PETN_0	PCIe TX differential signal (Lane 0)
A6	GND	Ground	C6	GND	Ground
A7	PCIe_PERP_3	PCIe RX differential signal (Lane 3)	C7	PCIe_PETP_3	PCIe TX differential signal (Lane 3)
A8	PCIe_PERN_3	PCIe RX differential signal (Lane 3)	C8	PCIe_PETN_3	PCIe TX differential signal (Lane 3)
A9	GND	Ground	C9	GND	Ground
B1	PWR	Power supply	D1	PWR	Power supply
B2	CBLPRSNT	Cable Present signal	D2	MGTPWR	Multi-Gigabit Transceiver Power
B3	GND	Ground	D3	GND	Ground
B4	PCIe_PERP_1	PCIe RX differential signal (Lane 1)	D4	PCIe_PETP_1	PCIe TX differential signal (Lane 1)
B5	PCIe_PERN_1	PCIe RX differential signal (Lane 1)	D5	PCIe_PETN_1	PCIe TX differential signal (Lane 1)
B6	GND	Ground	D6	GND	Ground
B7	PCIe_PERP_2	PCIe RX differential signal (Lane 2)	D7	PCIe_PETP_2	PCIe TX differential signal (Lane 2)
B8	PCIe_PERN_2	PCIe RX differential signal (Lane 2)	D8	PCIe_PETN_2	PCIe TX differential signal (Lane 2)
B9	GND	Ground	D9	GND	Ground

Table 8: PCIe iPass+ HD connector pin assignment

4.2.4 USB 3.1 Gen1 Type-A

Item	Value
Connector	USB 3.1
Signals	Standard USB 3.1 Gen1 Type-A Connector
Mating Connectors	Standard USB 3.1 Type-A Connector

Table 9: USB Type-A connector general description

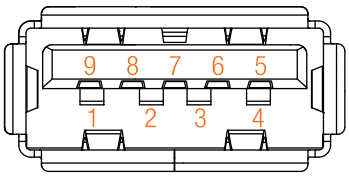


Figure 8: USB3 Type-A connector pinout

Pin	Signal	Description
1	VBUS	Power supply 5 V
2	D-	USB 2.0 differential data line neg.
3	D+	USB 2.0 differential data line pos.
4	GND	Ground return for power and signal
5	SSRX-	SuperSpeed receive differential pair neg.
6	SSRX+	SuperSpeed receive differential pair pos.
7	GND	Ground return for power and signal
8	SSTX-	SuperSpeed transmit differential pair neg.
9	SSTX+	SuperSpeed transmit differential pair pos.

Table 10: USB Type-A pin assignment

4.2.5 Power connector

Item	Value
Connector	CONN Header Block 3-POS, 3.5MM, Right Angle, 250V/8A, THT, 1843800
Signals	Power, GND
Mating connector	Phoenix Contact 1847068 (CBL-10-01096)[1]

[1]Power cable is part of the ACC-XSWITCH-PCIE kit

Table 11: Power connector description

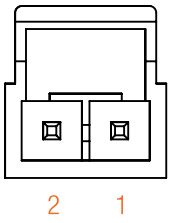


Figure 9: Power connector pinout

Pin	Name	Description
1	Vin 12 to 24 V	Power 12 to 24 V
2	SHLD	Shielding
3	GND	Power supply Ground

Table 12: Power connector pin assigment

4.2.6 GPI / GPO connectors

Item	Value
Connector	CONN-9P-0530470910, Through-hole pin header, 9 positions, 1.25 mm pitch
Signals	GPI / GPO
Mating connector	P1.25 mm pitch wire-to-board receptacle housing with matching crimp terminals

Table 13: GPI / GPO connectors general description

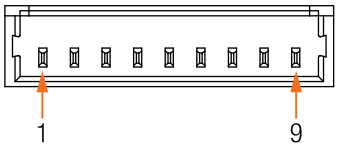


Figure 10: GPI / GPO connectors pinout

GPI connector		GPO connector	
Pin	Name	Pin	Name
1	ISO_GPI 1	1	ISO_GPO 1
2	ISO_GPI 2	2	ISO_GPO 2
3	ISO_GPI 3	3	ISO_GPO 3
4	ISO_GPI 4	4	ISO_GPO 4
5	ISO_GND	5	ISO_GND
6	ISO_GPI 5	6	ISO_GPO 5
7	ISO_GPI 6	7	ISO_GPO 6
8	ISO_GPI 7	8	ISO_GPO 7
9	ISO_GPI 8	9	ISO_GPO 8

Table 14: GPI / GPO connectors pin assigment

5 IO-subsystem

The IO subsystem is designed to enable synchronized operation of connected XIMEA cameras. Synchronization can be achieved either through an external trigger signal or by using a master-slave configuration. An external trigger signal is connected to the input pin ISO_GPI. In the master-slave mode, one of the cameras connected to the switch is designated as the master, while the remaining cameras are synchronized using the output signal from the master camera.

5.1 Internal power supply

To enable synchronization of all connected cameras via either an external trigger or the master camera's output, the switches include an internal 5 V power supply (an isolated 2 W DC/DC converter) that powers the IO subsystem.

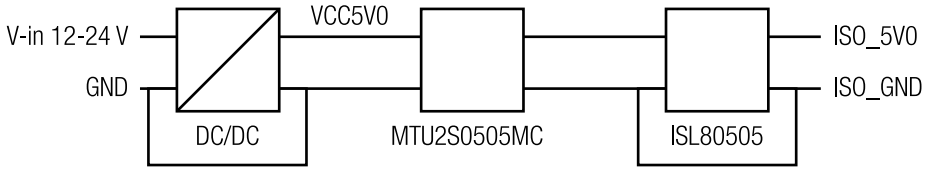


Figure 11: Power supply of IO-subsystem

5.2 Circuitry requirement

All components of the IO subsystem are powered by the two voltage levels: ISO_5V0 and ISO_GND.
ISO_5V0 is generated by the internal power supply.

5.3 Synchronization mode selection

Two synchronization modes are available:

- External trigger
- Master-slave mode

The selection between both modes is made via the dip-switch GPI-Select:

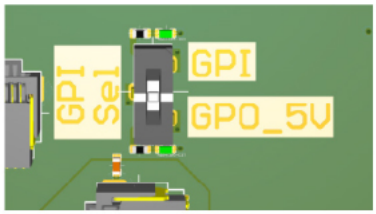


Figure 12: Synchronization mode selector

Position GPI-Sel	Synchronization mode
GPI	External trigger (pin ISO_GPI signal)
GPO_5V0	Master-Slave-Mode (pin ISO_GPO_5V signal)

Table 15: DIP switch mode description

5.4 IO configuration

The xSWITCH is designed to support different synchronization modes of the connected XIMEA cameras.

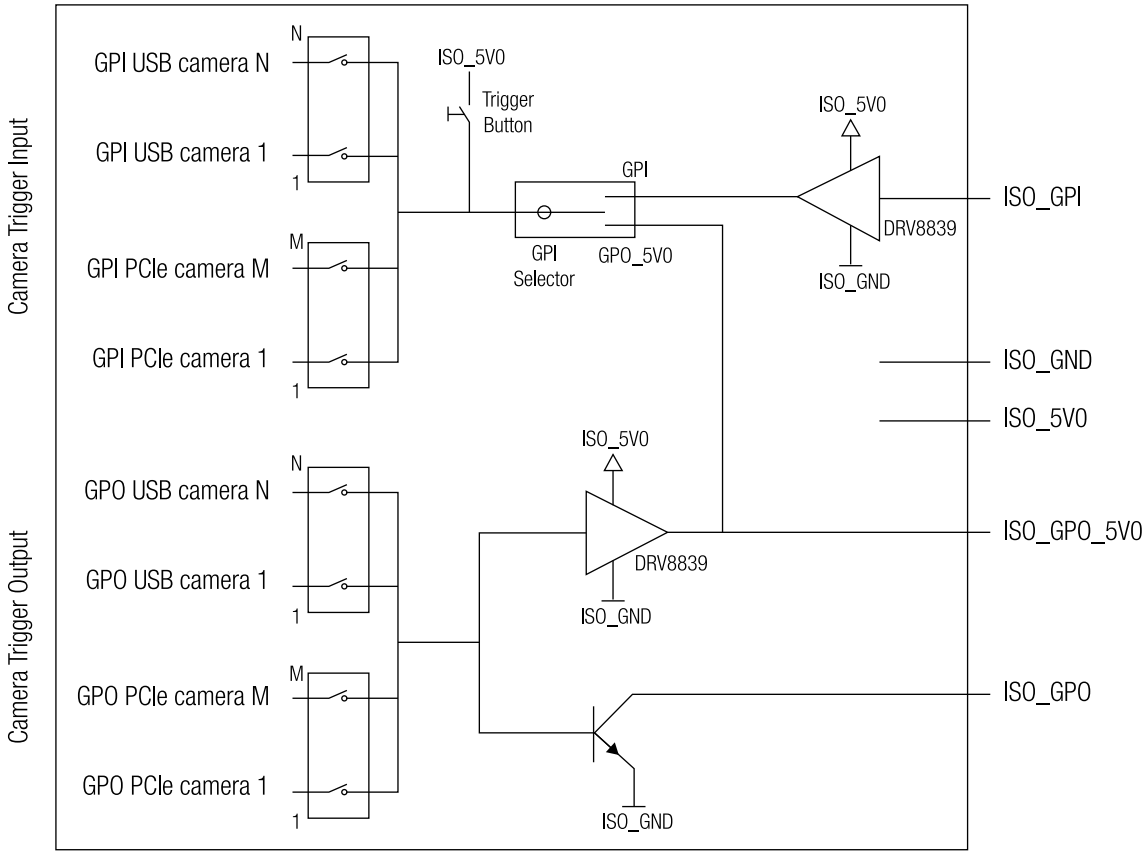


Figure 13: Functional diagram of the IO-system

The interconnected IO ports of the cameras are the optically isolated input and output lines.

5.4.1 Trigger input configuration

To synchronize the cameras, either the IO connector pin ISO_GPI (for external trigger mode) or the internal signal ISO_GPO_5V0 (for master-slave mode) is connected to the GPI pins of the cameras that require synchronization. The specific cameras to be synchronized are defined by configuring their individual DIP switches (GPI USB Camera n or GPI PCIe Camera n). These DIP switches connect the input signal to the corresponding camera's input line.

5.4.2 Trigger output configuration

One camera can be selected — and only one should be selected — to generate the output signal by configuring its specific DIP switch (GPO USB Camera n or GPO PCIe Camera n). This output signal can be used to:

- Trigger all cameras connected to the same switch
- Trigger external devices (e.g., another xSWITCH)

The selected output signal will be connected to the internal and external signal ISO_GPO / ISO_GPO_5V0.

5.5 Signal level

5.5.1 ISO_GPI signal level

The signal level of the GPI is described in the following table:

V-in-min [V]	V-in-max [V]	State
0	<0.4	Off (0)
0.4	2.5	Transient
>2.5	24	On (1)

Table 16: Digital trigger input ISO_GPI, signal levels

Note: The Input level **V-in** represents the amplitude of the input signal. Voltage levels referenced to common ground ISO_GND

5.5.2 ISO_GPO signal level

The digital output ISO_GPO type is Open Collector NPN, the maximum usable open circuit voltage level is 24 V.

5.5.3 ISO_GPO_5V0 signal level

The signal level of the ISO_GPO_5V0 is described in the following table:

Logic status	V-out [V]
Off (0)	0.0
On (1)	5.0

Table 17: Digital output ISO_GPO_5V0, signal levels

Note: The Output level **V-out** represents the amplitude of the input signal. The voltage levels refer to ISO_GND

6 Usages

6.1 Buttons

Two buttons are soldered onto the switch. The trigger button is located on the left side of the switch, while the second button, the PCIe reset button, is located on the bottom-right side.

6.1.1 Trigger button

This button can be used to generate a trigger pulse on the GPI-Selector output position to test the GPI configuration.
A rising edge trigger pulse (0V -> 5V) will be generated.

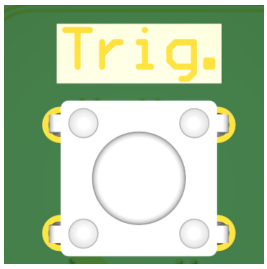


Figure 14: Trigger button

6.1.2 PCIe reset button

Pressing this button will result in reset of the xSWITCH PCIe bus and all connected cameras.

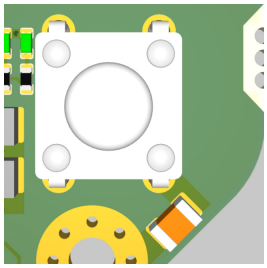


Figure 15: PCIe reset button

Note: This PCIe reset button is for debugging purposes only.

7 Additional information

7.1 Cables

7.1.1 CBL-SFF-X4G3-10M0

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



Figure 16: CBL-SFF-X4G3-10M0

7.1.2 CBL-SFF-X4G3-COP-5M0

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



Figure 17: CBL-SFF-X4G3-COP-5M0

7.1.3 CBL-MQ-FL-0M1

Cable FPC MQ Flex-Line cable, 0.1 m, 0.25 m, polarized flexible flat ribbon custom cable with power transfer. Minimal advised bending radius is 2 mm. Cable thickness 0.16 mm.



Figure 18: CBL-MQ-FL-0M1

Note: Cable have marked ends. It is important to connect the end marked “CAM” to the camera and end marked “BOB” to host or adapter. Swapped orientation leads to nonoperational state. Connecting camera to powered host can cause destruction of camera. For detaching

cable, the connector needs to be unlocked, otherwise connector soldering may be damaged.

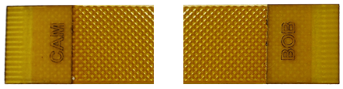


Figure 19: CBL-MQ-FL-0M1 cable zoom

7.1.4 CBL-USB3FLEX-0M10

The newer generation of FFC cable with available lengths 0.1 m, 0.25 m, 5 m, non-polarized flexible flat ribbon cable with power transfer. Minimal advised bending radius is 5 mm. Cable thickness 0.38 mm. This cable is NOT polarized and either end can be used for the camera or the host.



Figure 20: CBL-USB3FLEX-0M10

7.1.5 CBL-MX-X2G2-0M07

7 cm / 10 cm / 25 cm / 50 cm flex ribbon cable.

Plarized Flexible Flat ribbon cable - FFC. Cable have marked ends. It is important to connect the end marked “CAM” to the camera and end marked “BOB” to host or adapter. Swapped orientation can cause damage to camera.

It is important that the power is turned off when inserting/detaching the cable. Connecting camera to a powered host can cause destruction of the camera. When detaching cables, the connector needs to be unlocked, otherwise the connector soldering may be damaged.



Figure 21: CBL-MX-X2G2-0M10

7.1.6 Cable connection

Flex connectors are equipped with a locking mechanism. When locked, pulling the cable may lead to damage to the connector or the camera. When manipulating the cable, the power supply for the camera must be turned off.

Cables CBL-MQ-FL-xxx and CBL-MX-X2G2-xxxx have marked ends. It is important to connect the end marked “CAM” to the camera and the end marked “BOB” to the host or adapter (In this case to the xiSwitch XS-12P-X2G2-X8G3-SFF). Swapped orientation can cause damage to the camera.

Note: Flex cables PN: CBL-USB3FLEX-xxx or CBL-PCIEFLEX-X2G2-xxx are not polarized therefore the orientation of the cable between camera and host is not important.

Inserting Flex cable

Step 1. Open the lock on the connecto.r

Step 2. Insert the flex cable (e.g., CBL-MQ-FL-0M1) into the camera or xiSwitch.

Step 3. Close the connector lock.

Detaching Flex cable

Step 1. Open the lock on the connector.

Step 2. Gently pull the cable in the marked direction.

Step 3. Close the connector lock.

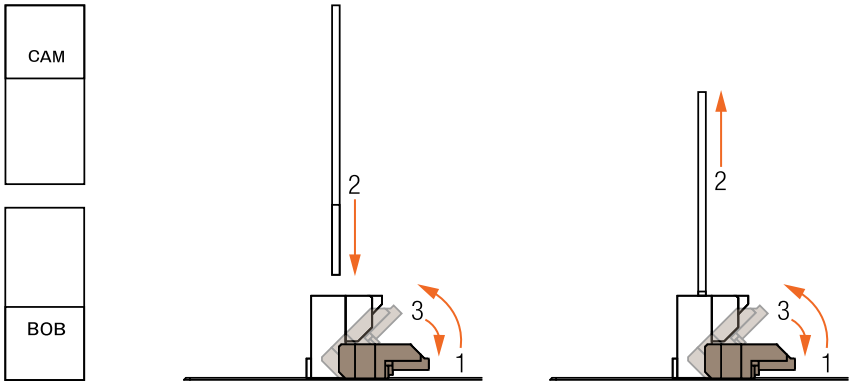


Figure 22: Flex cable inserting (left) / detaching (right)

7.2 Handling precautions

7.2.1 ESD precautions

Semiconductor components are particularly sensitive to electrostatic discharge (ESD). Therefore, take the following precautions:

1. Maintain relative humidity in the working environment between 40% and 70%. The use of an apparatus for ion generation may be needed to remove electricity.

2. Ensure that all conveyors, solder vessels, soldering irons, and peripheral equipment are electrically grounded.

3. Use rings or bracelets connected to ground through high resistance (on the level of 1 MΩ). Wearing ESD clothing and footwear, using conductive floor mats, and implementing other measures to minimize electrostatic discharge is recommended.

4. Avoid using Styrofoam or other highly static-prone materials for storing completed board assemblies.

7.2.2 Heat dissipation

All xSWITCH models are very compact, high-performance devices. Although the xSWITCH models are designed to be power efficient, the high component packing density can lead to elevated temperatures. In particular, the PCIe switch component located on the bottom side of the main PCB generates a significant amount of heat during operation. As a result, the entire unit may heat up.

Adequate heat dissipation must therefore be ensured, for example by providing sufficient thermal contact to a heat sink or by adding active or passive cooling, if required.

7.3 Scope of delivery

- The switch XS-12P-X2G2-X8G3-SFF
- A Power cable (CBL-10-01096), one DC power input socket female (OD5.5/ID2.1, Center +) with 3-pin Power-mating-connector Phoenix Contact 1847068
- A 5-pin IO-mating-connector Phoenix Contact 1847084
- A screwdriver (MECH-SCRDRW-2.5MM-50MM)

8 Quickstart guide

8.1 Hardware setup

8.1.1 Essential components

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

- XS-12P-X2G2-FF-X8G3-SFF multi camera platform
- Power cable CBL-10-01096
- Camera cables: e.g USB Flex cable (CBL-USB3FLEX-0M10), PCIe Flex cable (CBL-MX-X2G2-0M25)
- XIMEA camera with PCIe Flex or USB Flex interface
- Host cable: SFF-8644 cable (CBL-SFF-X4G3-10M0, CBL-SFF-X4G3-COP-1M0)
- Host PC (with SFF host adapter card)

Note: Two X4G3 SFF cables are required for X8G3 devices for proper use and data transfer.

8.1.2 Connecting the components

Step 1. Ensure the power supply and the computer are turned off before connecting any cables.
The order of cable connections is not strictly specified.

Step 2. After all other cables are connected, connect the XS-12P-X2G2-FF-X8G3-SFF to the power supply.

Step 3. Power on the computer.

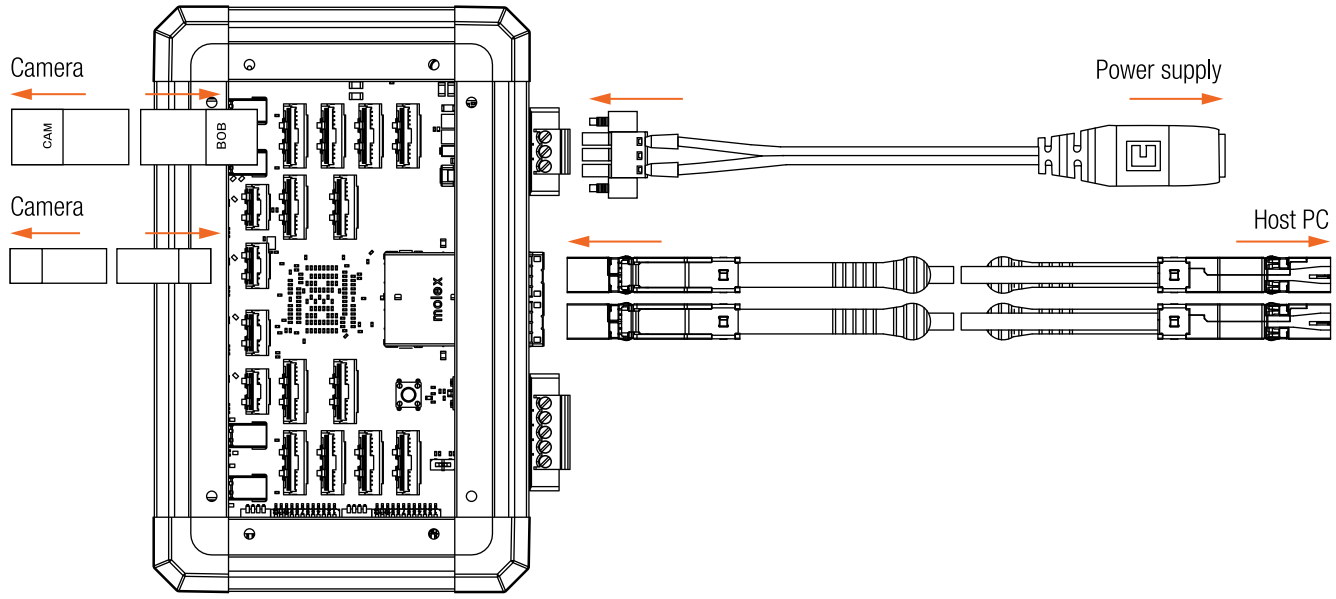


Figure 23: XS-12P-X2G2-X8G3-SFF cable connection

For more information about XS-12P-X2G2-X8G3-SFF please contact: sales@ximea.com.

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