ALVIUM MIPI CSI-2 CAMERAS

Adapter Board for NVIDIA Jetson TX2 and AGX Xavier

User Guide

V1.0.2

This document at a glance

Read this document carefully

Learn to use adapter boards in the most safe and efficient way and avoid damage to your embedded system.

Shipping contents

The delivery consists of the adapter board for NVIDIA Jetson TX2 and AGX Xavier Developer Kit with no other components.

Flexible printed circuit (FPC) cable is not included

The FPC cable to connect the adapter board to the camera is not included.

What else do you need?

Technical information and ordering of Allied Vision products

- For all information about Alvium CSI-2 cameras and accessories, see www.alliedvision.com/en/support/technical-documentation/alvium-csi-2-documentation.
- Please contact your Allied Vision Sales representative for ordering and for additional information on hardware options for Alvium cameras.

Technical information on NVIDIA Jetson embedded boards

For information on NVIDIA Jetson embedded boards, see www.nvidia.com/en-us/autonomous-machines/embedded-systems

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Contents

Document history and conventions

This chapter includes:

Document history

Version	Date	Remarks
V1.0.2	2020-Sep-02	Added information on I/O specifications in I/O connections on page 19 and on connecting I/Os in Connecting the I/Os on page 25.
V1.0.1	2020-Jun-02	• Added the diameter for the mounting holes of the adapter board. • Applied editorial changes.
V1.0.0	2019-Nov-21	Release version

Table 1: Document history

Conventions used in this user guide

To give this user guide an easily understood layout and to emphasize important information, the following typographical styles and symbols are used:

Typographical styles

Style	Function
Emphasis	Highlighting important things
Web links and references	Links to webpages and internal cross references

Table 2: Typographical styles

Symbols and notes

NOTICE

Material damage

Precautions are described.

Practical tip

Additional information helps to understand or ease handling the camera and components.

Additional information

Web link or reference to an external source with more information is shown.

Component naming

Components described in this user guide are not defined by common standards. Therefore, naming must be accurate to avoid misconceptions. Because naming is lengthy, reading is difficult. Simplified terms are used in this document.

Long version	Short version used in this document	Alvium CSI-2 Cameras Safety and Usage Instructions
Adapter Board for NVIDIA Jetson TX2 Developer Kit and for NVIDIA Jetson AGX Xavier Developer Kit	adapter for Jetson TX2 and Xavier	Not applicable
MIPI CSI-2[1] adapter board	adapter board	embedded board adapter
MIPI CSI-2 FPC (flexible printed circuit) cable	FPC cable	FPC cable
[1]MIPI CSI-2 Mobile Industry Processor Interface Camera Serial Interface 2		

Table 3: MIPI CSI-2 adapter board naming

Compliance, safety, and intended use

§

This chapter includes:

Compliance notifications

Intended use

Allied Vision's objective is the development, design, production, maintenance, servicing and distribution of digital cameras and components for image processing. We are offering standard products as well as customized solutions.

Intended use of Allied Vision product is the integration into Vision systems by professionals. All Allied Vision product is sold in a B2B setting.

Allied Vision isn't a legal manufacturer of medical product. Instead, Allied Vision cameras and accessories may be used as components for medical product after design-in by the medical device manufacturer and based on a quality assurance agreement (QAA) between Allied Vision (supplier) and medical device manufacturer (customer). Allied Vision's duties in that respect are defined by ISO 13485, clause 7.2 (customer-related processes, equivalent to ISO 9001, clause 8.2).

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Product safety

To prevent material damage, read the following to understand risks in using adapter boards.

Embedded systems

Setup and operation of Alvium CSI-2 cameras in embedded systems is different than for cameras in PC-based systems. Components can easily be damaged. If you are unfamiliar with embedded systems, be extremely careful. Follow the instructions in the Alvium CSI-2 Cameras User Guide.

Electrical connections

The MIPI CSI-2 standard does not specify electrical connections as extensively as the USB or GigE standard. Read specifications carefully.

Alvium CSI-2 cameras are not protected against damage caused by reverse polarity.

Electrostatic discharge (ESD)

Electrostatic discharge (ESD) is dangerous for electronic devices, especially when tools or hands get in contact with connectors. We recommend measures to avoid damage by ESD:

- Unpacking: Remove the adapter board from its anti-static packaging only when your body is grounded.
- Workplace: Use a static-safe workplace with static-dissipative mat and air ionization.
- Wrist strap: Wear a static-dissipative wrist strap to ground your body.
- Clothing: Wear ESD-protective clothing. Keep components away from your body and clothing. Even if you are wearing a wrist strap, your body is grounded but your clothes are not.
- Housing: use an ESD protective housing, including the camera, embedded board, adapter board, and FPC cable.

Camera power

Operating cameras beyond the specified range damages cameras. Cameras are powered using the FPC connector at a maximum input of 5.5 VDC, using a limited power source (LPS), according to IEC62368-1: 2014 (Second Edition) with maximum 1.5 A per camera. Cameras are not intended to be connected to DC distribution networks.

We recommend you to power cameras with USB 2.0 Micro B power supplies providing 4.5 to 5.5 VDC at 1.5 A for one camera and 3.0 A for two cameras.

If you want to power the camera via the embedded board, note:
Only Jetson TX2 boards enable to power cameras, Jetson Xavier boards do not.

FPC connectors

Hirose FH55-22S-0.5SH FPC connectors enable compact camera design. The small-sized connectors are sensitive to mechanical stress and are specified for maximum 20 mating and unmating cycles. Especially if you are inexperienced with this connector, be very cautious. If the FPC connector is broken, the complete device must be replaced. Follow the instructions in Using the adapter board on page 20 carefully.

- Avoid stress to FPC connectors.
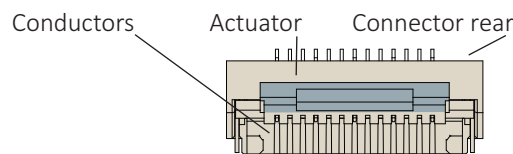- Allow only the FPC cable to touch conductors.

Conductors   Actuator   Connector rear

Figure 1: Hirose FH55-22S-0.5SH FPC connector

Additional information

For technical data and more instructions on the Hirose FH55-22S-0.5SH connector, see the manufacturer data sheet at www.hirose.com.

Handling the actuator

- Move the actuator only between 0° (locked position) to 105° (open position).
- Carefully flip the actuator at the middle with your finger nail, see Connecting FPC cables to Hirose FPC connectors on page 21.

MIPI CSI-2 FPC cables

Manufacturing FPC cables or embedded boards

If you want to design your own components to connect Alvium CSI-2 cameras to embedded boards, contact your Allied Vision Sales representative or Allied Vision Support at support@alliedvision.com.

FPC cable position

Short circuits of the FPC cable can damage the camera or connected hardware.

- Insert the FPC cable into the connector with cable guiding tabs matching the connector's side guides. See Connecting FPC cables to Hirose FPC connectors on page 21.
- Connect the camera and the embedded board (adapter) only as shown by the arrow printed on the FPC cable, see Connecting FPC cables to Hirose FPC connectors on page 21.

FPC cables and stress

Over-stressed FPC cables can damage the camera and connected hardware. When camera and embedded board are twisted against each other or pulled apart from each other with too much force, the FPC cable is over-stressed. Spring contacts of FPC connectors are worn out, causing short circuits and unreliable electrical connections.

- Insert the FPC cable into the FPC connector at 12° to the PCB board surface. See Connecting FPC cables to Hirose FPC connectors on page 21.
- Allow only slight bending of the FPC cable (minimum bending radius: 10 mm).
- For strain relief, we recommend you to mount the embedded board, adapter board, and camera to a common base.

No hot-plugging for MIPI CSI-2

Alvium CSI-2 cameras do not support hot-plugging. Hot-plugging can destroy the camera and connected hardware by high inrush current.

- Disconnect power supplies before connecting FPC cables.

FPC cable signal quality

Noise and electromagnetic interference can disable camera functions.

- Avoid contact to metal surfaces, causing electromagnetic interference.
- Please use cables recommended by Allied Vision.

I/O connections

Through the adapter board, the camera connects to the embedded board. To reduce signal latencies, I/O cables can be connected directly to the adapter board. This includes soldering.

- Do soldering only if you have sufficient working knowledge.
- Follow the instructions in Connecting the I/Os on page 25.

Specifications

This chapter includes:

Specifications

Feature	Specification
Product code	14909
Dimensions (Length × width × height [mm])	75.6 × 25 × 15.3
Mass (adapter board only)	10 g
Storage temperature	-10 °C to +70 °C ambient temperature
Temperature range	+5 °C to +65 °C
Relative humidity	0% to 80% (non-condensing)
Supported embedded boards	• NVIDIA Jetson TX2 Developer Kit • NVIDIA Jetson AGX Xavier Developer Kit
Supported cameras	Alvium CSI-2 cameras
Supported FPC cables for camera connections	Allied Vision 12316, 12317, 12318

Table 4: Adapter for Jetson TX2 and Xavier specifications

Dimensions and PCB layout
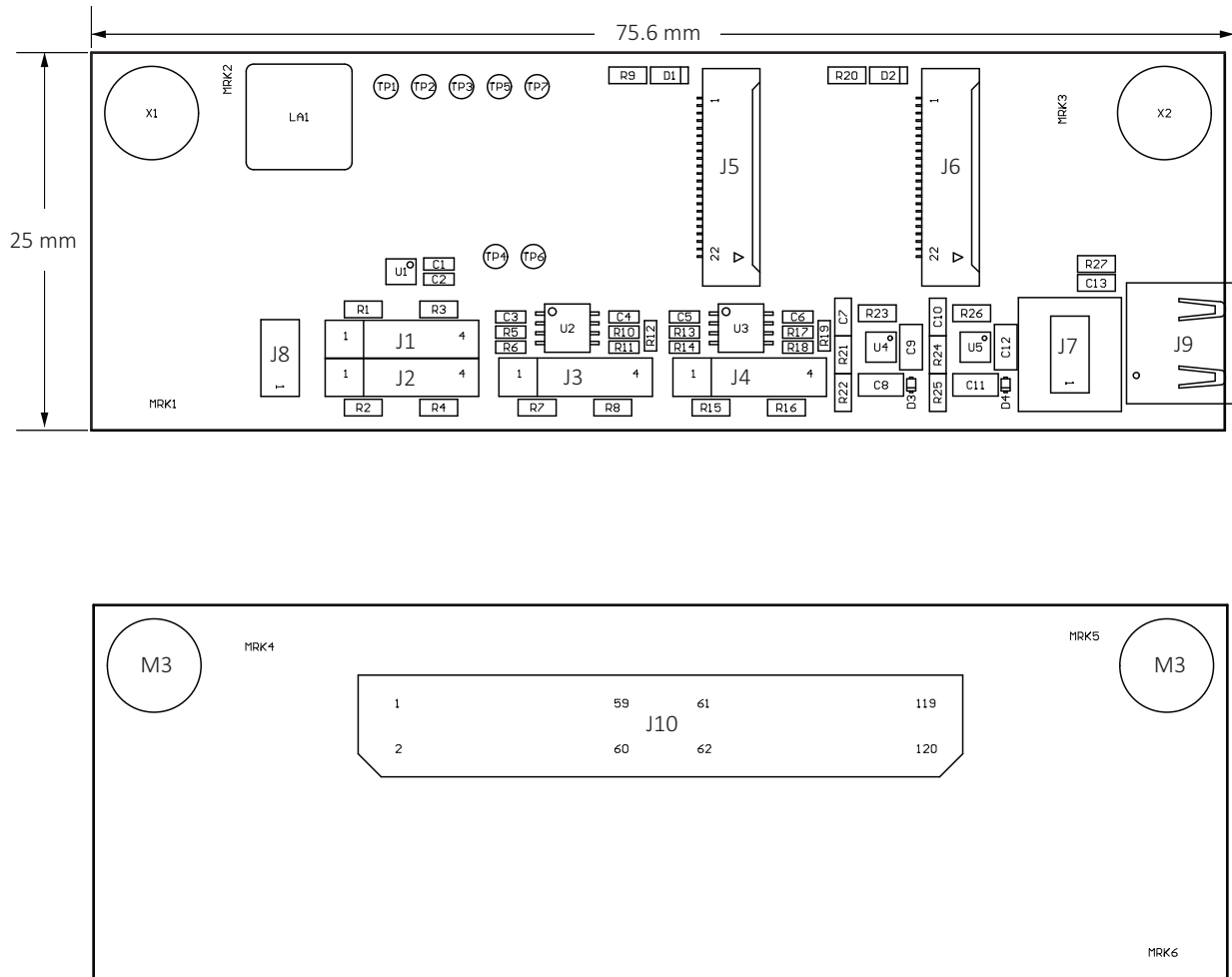
Figure 2: Adapter for Jetson TX2 and Xavier dimensions and PCB layout
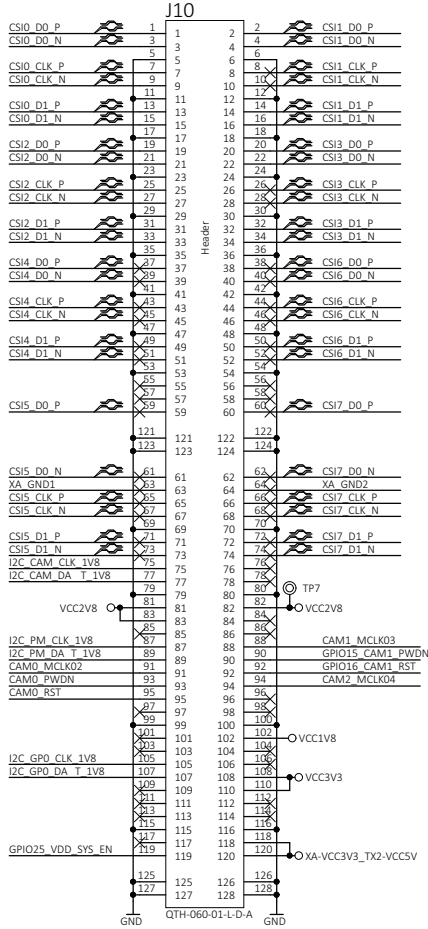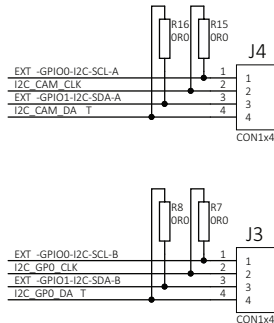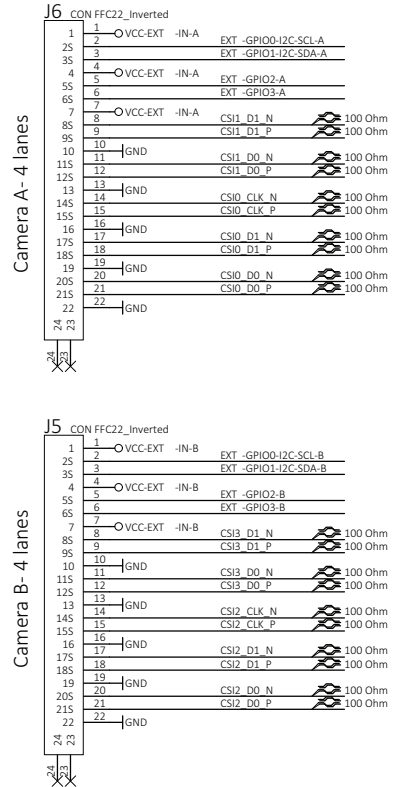
Electronic schematics
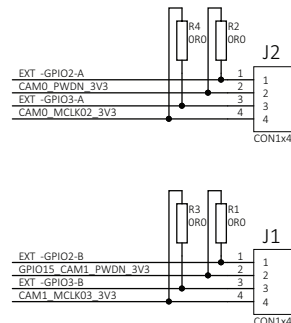
Figure 3: Adapter for Jetson TX2 and Xavier electronic schematics, part 1
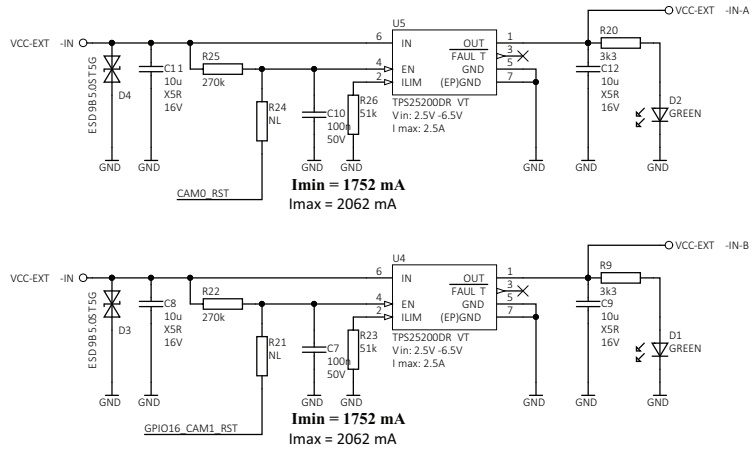
VCC-EXT-IN: DCIN 4V5..5V5, max. 2 × 1.5 A

Note:
J7 is not equipped.
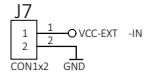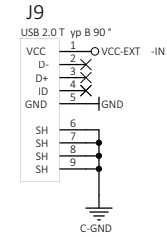
Note:
Recommended to be used

External power
J7

External USB power
J9

NOTICE

Damage to the embedded board

- We recommend you to power Alvium cameras using the USB connector J9.
- If you want to use J8 to power Alvium cameras via Jetson TX2, ensure the embedded board's power supply provides sufficient current for the Jetson TX2 board **and** the connected camera(s).
- **Do not use J8 for camera power with other embedded boards.**

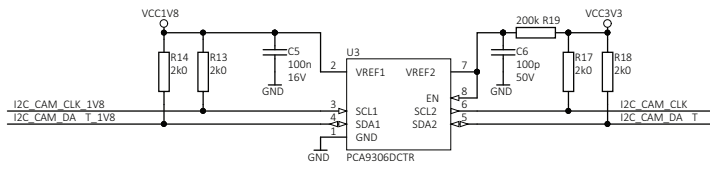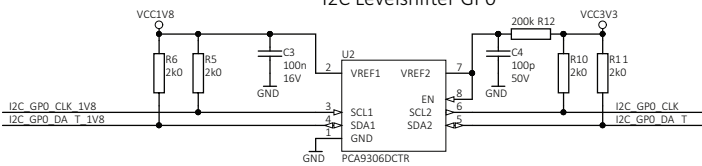Place a jumper on J8 to power Alvium cameras via Jetson TX2 boards.
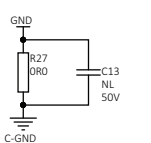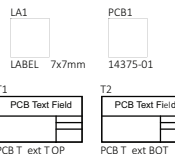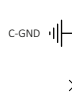
TX2 power
J8
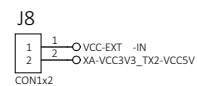
GPIO Levelshifter 1V8 <-> 3V3
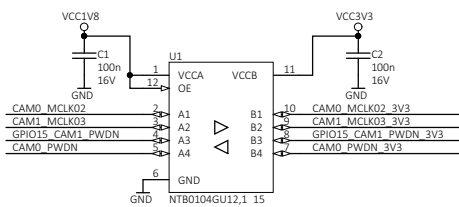
I2C Levelshifter CAM

I2C Levelshifter GP0

GND <-> Chassis-GND

Unused GPIO 1V8

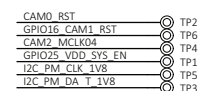Holes on NVIDIA carrier boards are connected to GND.

Figure 4: Adapter for Jetson TX2 and Xavier electronic schematics, part 2

Camera power

NOTICE

Damage to power supplies

If power supplies do not provide sufficient current, they may be damaged.

Ensure USB power supplies provide 1.5 A for one camera and 3.0 A for two cameras.

Power Alvium cameras using the USB 2.0 Micro B receptacle (J9). See the description in Figure 4, Adapter for Jetson TX2 and Xavier electronic schematics, part 2 on page 18.

I/O connections

You can use the I/O lines to trigger the camera or to output a signal from the camera to trigger a device, such as a strobe light to control illumination. Through the adapter board, the camera connects to the embedded board:

Camera	Camera line	Embedded board line
Camera A	EXT-GPIO2-A	CAM0_PWDN
Camera A	EXT-GPIO3-A	CAM0_MCLK02
Camera B	EXT-GPIO2-B	GPIO15_CAM1_PWDN
Camera B	EXT-GPIO3-B	CAM1_MCLK03

Table 5: I/O connections from the camera to the embedded board

If you want to reduce signal latencies, such as for triggering the camera by a light barrier, you can connect I/O cables directly to the adapter board. Please see the instructions in Connecting the I/Os on page 25.

Using the adapter board

This chapter includes:

Embedded system accessories

FPC cables

For more information, see the Alvium Cameras Accessory Guide at www.alliedvision.com/en/support/technical-documentation/alvium-csi-2-documentation.

Designing your own embedded components

If you want to design your own components to connect Alvium CSI-2 cameras to embedded boards, contact your Allied Vision Sales representative or Allied Vision Support at support@alliedvision.com.

Proper usage of the Hirose FH55-22S-0.5SH FPC connector is vital for connecting Alvium CSI-2 cameras to embedded boards. Therefore, instructions start with usage of the FPC connector. Afterwards, setting up the adapter boards is described.

Connecting FPC cables to Hirose FPC connectors

Figure 5 shows how the FPC cable connects to the FPC connector.

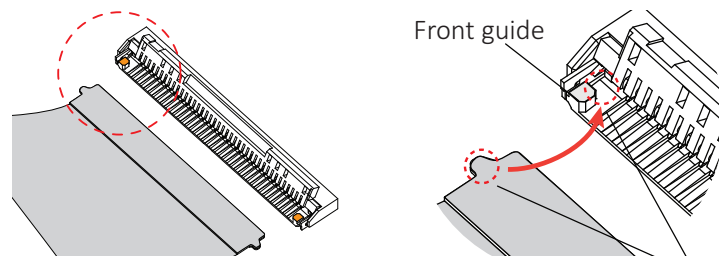Follow the instructions to connect the FPC cable to the camera and to the embedded board.

Figure 5: FPC cable and FPC connector (open position)

1. Opening the FPC connector: With your fingernail*, flip the actuator to open position at 105° to the PCB surface, see Figure 6.

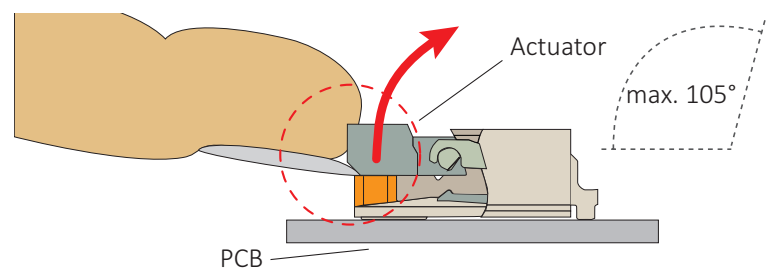   *Or use a plastic tool, as metal tools can damage the actuator.

Figure 6: Opening the FPC connector

NOTICE

Damage to the camera by reverse polarity

If Alvium CSI-2 cameras are powered with reverse polarity, camera electronics is damaged.

- Before connecting camera power and I/O power, carefully read the Alvium Cameras User Guide for the FPC connector pin assignment.
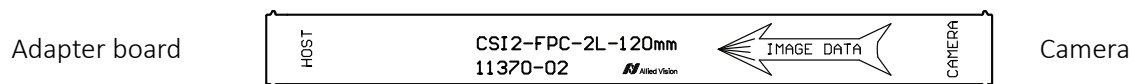- Connect the cable as shown in this section.

Figure 7: FPC cable image data direction

2. **Ensuring proper cable direction between host and camera**, take the FPC cable with conductors facing the FPC connector conductors (see Figure 8).

3. Inserting the FPC cable:
   At a horizontal angle of 90° to the connector's rear (see Figure 8) and at a vertical angle of 12° to the PCB (see Figure 9), slowly insert the FPC cable into the actuator...
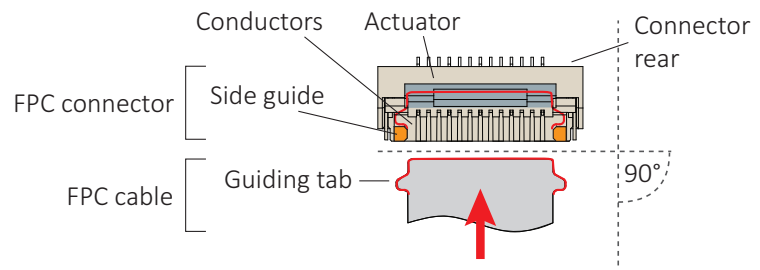

Figure 8: FPC cable and FPC connector

4. ...until cable guiding tabs are caught between connector rear and side guides (see Figure 8). Pull the cable slightly to ensure guiding tabs are properly engaged.

5. Holding the FPC cable in position, flap down the actuator to closed position (see Figure 9).
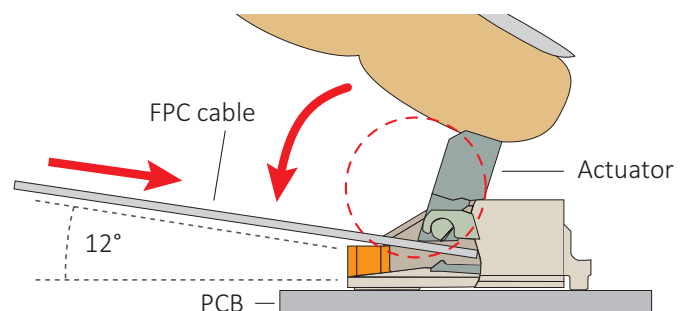

Figure 9: Engaging the FPC cable in the FPC connector

Installing adapter boards

NOTICE

Damage to electronics

- Disconnect all power supplies before installing the adapter board to your embedded board.
- Reconnect power only after installation is complete.
- Mount the embedded board, adapter board, and camera on a common base for strain relief.

Connecting the embedded board

NVIDIA Jetson Manuals

For details on NVIDIA Jetson Nano boards, including FFC connectors, see the manufacturer's manual at
www.nvidia.com/en-us/autonomous-machines/embedded-systems.

1. Connect the embedded board connector (a) of the adapter board to the camera connector of the embedded board.
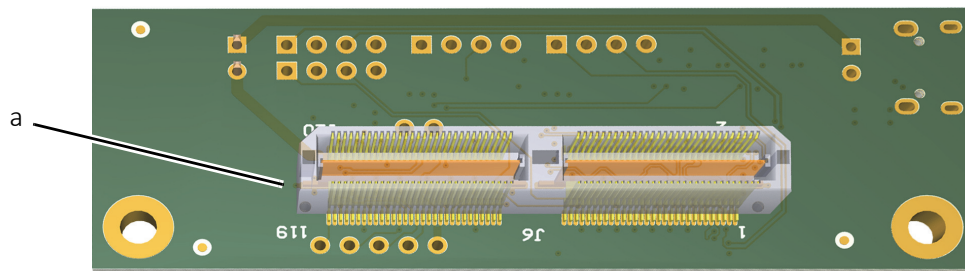

Figure 10: Embedded board connector of the adapter board (bottom view)

Connecting the camera

FPC camera connector priority

The FPC camera connectors J5 and J6 have the same priority.

1. Following the instructions in Connecting FPC cables to Hirose FPC connectors on page 21, connect the FPC cable to one of the FPC camera connectors (b).
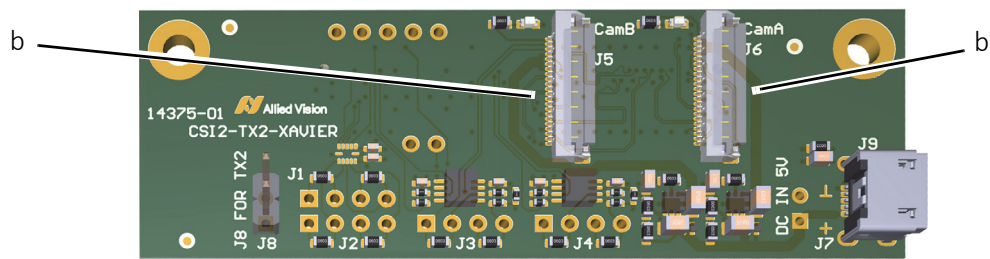2. Connect the other end of the FPC cable to the camera.

Figure 11: FPC camera connectors of the adapter board (top view)

Your Alvium CSI-2 camera is connected to the embedded board.

Connecting USB power

We recommend you to power the camera(s) using USB power.

NOTICE

Damage to power supplies

If power supplies do not provide sufficient current, they may be damaged.

Ensure USB power supplies provide 1.5 A for one camera and 3.0 A for two cameras.

1. Ensure the USB power supply is disconnected from the mains power.
2. Connect the power supply's output connector to the USB 2.0 Micro B receptacle (c).
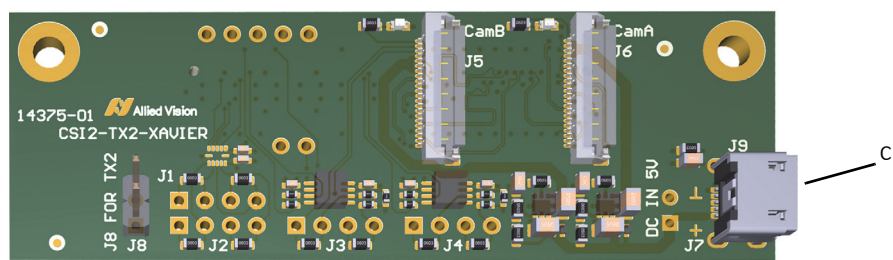

Figure 12: FPC camera connectors of the adapter board

3. Connect the power supply to the mains power.
4. Power and boot the embedded board.

Your Alvium CSI-2 cameras can be operated via the embedded board.

Connecting the I/Os

If you want to use the I/O lines of the **embedded board**, see I/O connections on page 19. This way, you can use the I/Os immediately.

If you want to use the I/O lines of the **adapter board**, see the following instruction. This way, you reduce signal latencies, such as for triggering the camera by a light barrier

About this instruction

This is a best-practice solution.

Please contact support@alliedvision.com if you have any questions.

NOTICE

Damage to the adapter board

Improper soldering can cause copper pads to come loose from the PCB. To ensure soldering does not damage the adapter board:

- Keep soldering temperature low.
- Allow only short contact time between the soldering tip and the PCB.
- Use only minimal force to desolder the resistors.

Camera A

Camera A is connected to the embedded board by FPC connector J6 (f).

1. Desolder the resistors R2 (g) and R4 (h).
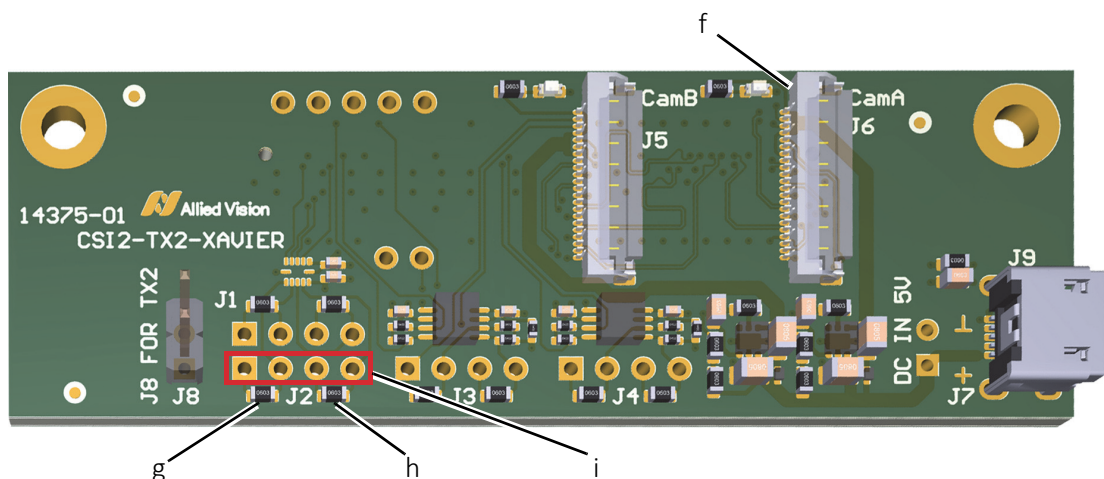2. Solder a pin header (i) to J2.

Figure 13: Desoldering resistors and soldering a pin header for Camera A

3. On the pin header (i) on connector J2, use the I/O pins defined in I/O signal levels and description on page 28.
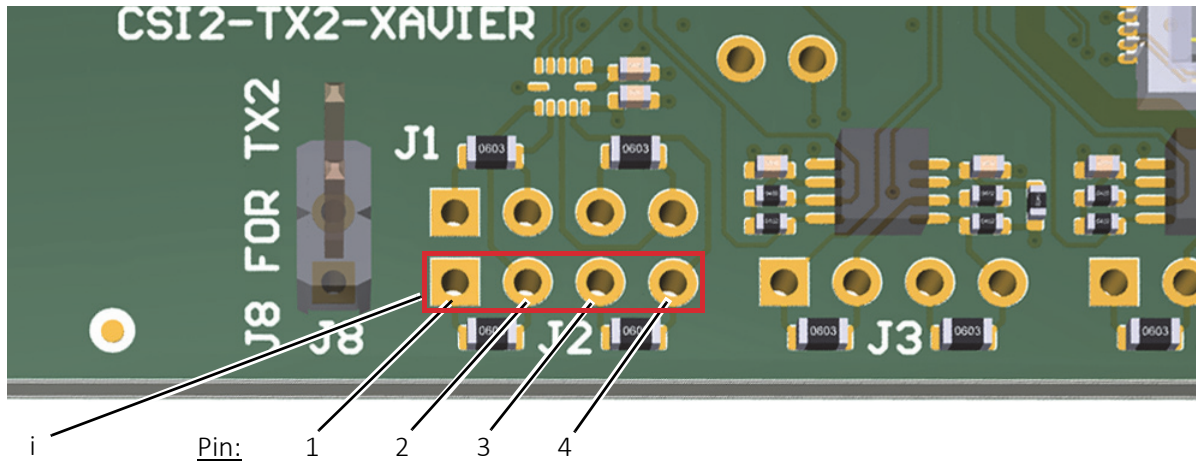

Figure 14: Connecting the I/Os for Camera A

4. For connecting ground, continue with Connecting ground on page 27.

Camera B

Camera B is connected to the embedded board by FPC connector J5 (n).

1. Desolder the resistors R1 (k) and R3 (l).
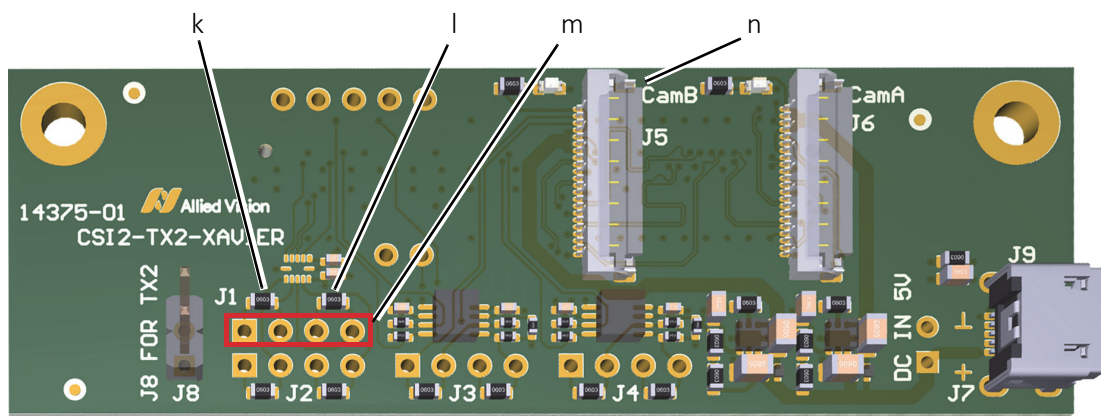2. Solder a pin header (m) to J1.

Figure 15: Desoldering resistors and soldering a pin header for Camera B

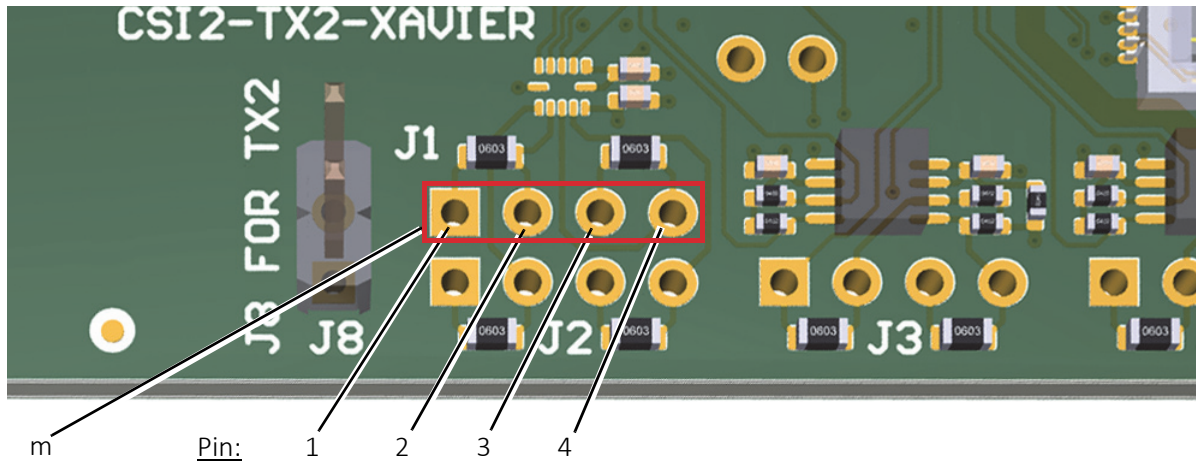3. On the pin header (m) on connector J1, use the I/O pins defined in I/O signal levels and description on page 28.

Figure 16: Connecting the I/Os for Camera B

Connecting ground

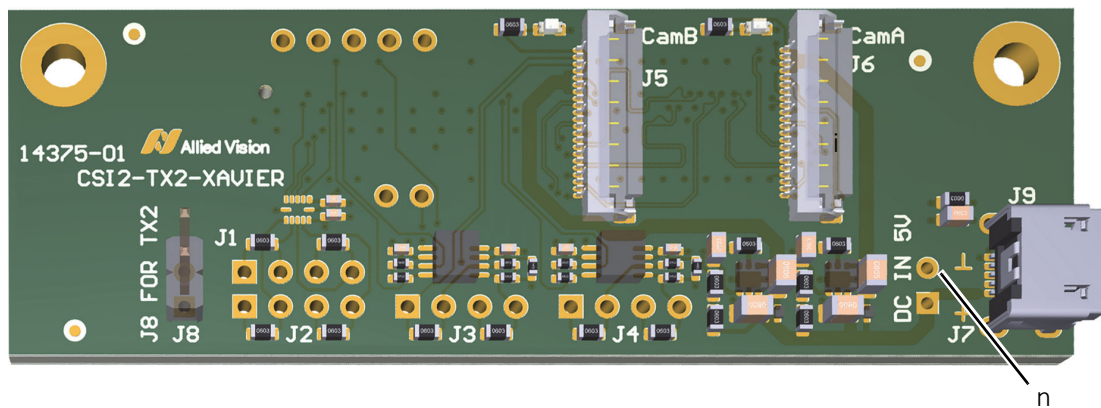4. Connect GND to pin 2 (o) of connector J7.

Figure 17: Connecting GND

I/O signal levels and description

Table 6 displays the signals for the GPIOs on connector J2, for GND on connector J4, and for VCC-EXT-IN on the USB connector J5.

Connector	Pin	Signal	< - >	Level	Description
J1	1	EXT-GPIO2-B	IN/OUT	U_{in} (low) = -0.3 to 0.8 VDC U_{in} (high) = 2.0 to 5.5 VDC U_{out} (low) = 0 to 0.4 VDC U_{out} (high) = 2.4 to 3.3 VDC at max. 12 mA	GPIO Internal pull-up resistor: 33 kΩ to 63 kΩ
J1	2	GPIO15_CAM1_PWDN	IN/OUT	U_{in} (low) = 0 to 1.2[1] VDC U_{in} (high) = 2.2[1] to 5.5 VDC U_{out} (low) = 0 to 0.4 VDC U_{out} (high) = 2.9[1] to 3.3[1] VDC at max. 50 mA	GPIO Keep external pull-up or pull-down resistor above 50 kΩ
J1	3	EXT-GPIO3-B		See EXT-GPIO2-B	
J1	4	CAM1_MCLK03		See GPIO15_Cam1_PWDN	
J2	1	EXT-GPIO2-A		See EXT-GPIO2-B on connector J1	
J2	2	CAM0_PWDN		See GPIO15_CAM1_PWDN on connector J1	
J2	3	EXT-GPIO3-A		See EXT-GPIO2-B on connector J1	
J2	4	CAM0_MCLK02		See CAM1_MCLK03 on connector J1	
J7	1	VCC-EXT-IN	PWR IN	4.5 to 5.5 VDC	Connects to J5, pin 1
J7	2	GND	PWR	0 VDC	Power supply ground
J9	1	VCC-EXT-IN	PWR IN	4.5 to 5.5 VDC	USB power supply Maximum input current: 1.5 A

[1]Depends on the 3.3 VDC output voltage of the embedded board

Table 6: I/O connections from the adapter board to the camera