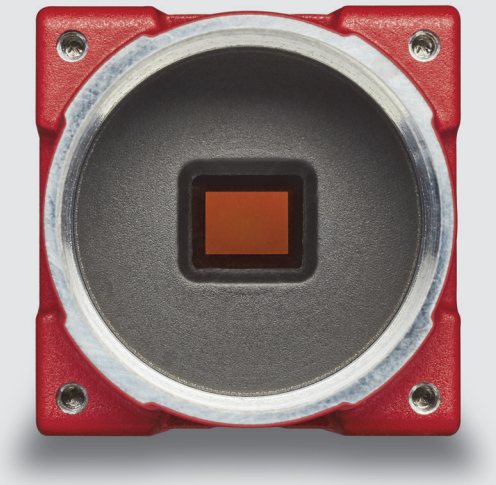
Allied Vision



USB Cameras

# Alvium USB Cameras

# User Guide

V1.1.0

Allied Vision Technologies GmbH // Taschenweg 2a, 07646 Stadtroda / Germany

2019-Jul-01

# Alvium USB cameras at a glance

**Read this document carefully**

Learn to avoid damage to your Alvium USB camera and use it in the most safe and efficient way.

## Shipping contents

- Alvium USB camera
- *Alvium USB Cameras Quickstart Guide* document

## What else do you need?

This is a selection of helpful document and software downloads:

| **Document** | **Link** |
|---|---|
| *Alvium USB Cameras Quickstart Guide* (multilingual) | https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html |
| *Alvium Cameras Accessory Guide* | |
| *Alvium Cameras Features Reference* | |
| *Optimum Heat Dissipation for Housed Alvium Cameras* application note | |
| *Electromagnetic Compatibility for Open Housing Alvium Cameras* application note | |
| *Avoiding Ground Loops in Vision Systems* application note | |
| **Software** | **Link** |
| **Vimba Suite** for Windows, Linux, and Linux/Arm, including **Vimba SDK**, **Vimba Viewer**, and **Vimba Driver Installer** for Windows | https://www.alliedvision.com/software |

# Contact us

## Connect with Allied Vision by function

https://www.alliedvision.com/en/meta-header/contact

## Find an Allied Vision office or distributor

https://www.alliedvision.com/en/about-us/where-we-are

## Email

info@alliedvision.com
support@alliedvision.com

## Sales offices

Europe, Middle East, and Africa: +49 36428-677-230
North, Central, and South America: +1 877 USA-1394
Asia-Pacific: +65 6634-9027
China: +86 21 64861133

## Headquarters

Allied Vision Technologies GmbH
Taschenweg 2a
07646 Stadtroda
Germany

Tel: +49 36428 677-0
Fax: +49 36428 677-28

CEO/Geschäftsführer: Andreas Gerk
Registration Office: AG Jena HRB 208962
Tax ID: DE 184383113

# Contents

# Document history and conventions

This chapter includes:

# Document history

| Version | Date | Remarks |
|---|---|---|
| V1.0.0 | 2019-Jun-13 | Release version |
| V1.1.0 | 2019-Jul-01 | • Added missing color pixel formats and removed separate bit depth in Specifications on page 24.<br>• Corrected ADC bit depth for Alvium U 1800-500 in Specifications on page 24 and in Image data flow on page 83. |

*Table 1: Document history*

# Conventions used in this manual

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

## Styles

| Style | Function |
|---|---|
| **Emphasis** | Programs, or highlighting important things |
| *Publication titles* | Publication titles |
| Web links and references | Links to webpages and internal cross references |

*Table 2: Styles*

## Symbols and notes

**CAUTION**

**Personal injuries**

Precautions are described.

***NOTICE***

**Material damage**

Precautions are described.

**Practical Tip**

Additional information helps to understand or ease handling the camera.

**Avoiding malfunctions**

Precautions are described.

**Additional information**

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

# Product naming

## Camera model naming

Alvium cameras are named to identify model properties.
For example, **Alvium 1800 U-500c** is composed of:

| | **Alvium** | **1800** | **U** | **500** | **c** |
|---|---|---|---|---|---|
| **Content** | Camera series | Camera series | Interface | Resolution | Color/ monochrome |
| **Examples** | Alvium | 1500: Video4Linux Access (CSI-2 cameras only)<br>1800: Vimba Access | C: MIPI CSI-2<br>U: USB | 500: 5.0 MP<br>050: 0.5 MP | c: color<br>m: monochrome |
| MP: Megapixel | | | | | |

*Table 3: Camera model naming*

**Hardware options**

Alvium USB cameras are available with various options for housing, lens mount, or USB connector position. For ordering, see hardware options and product codes in the *Alvium Cameras Hardware Options* document at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html for details.

# Terms and abbreviations

| Term | Description | Reference |
|---|---|---|
| ADC | Analog to Digital Converter | Specifications on page 24 |
| bare board | Camera consisting of electronics and sensor on a common printed circuit board (PCB), to be designed into a housing with heat sink and lens mount | USB 180° bare board on page 40 |
| CMOS | Complementary metal-oxide semiconductor | Specifications on page 24 |
| CRA | Chief ray angle | Specifications on page 24 |
| EMVA | European Machine Vision Association | https://www.emva.org/ |
| ERS | Electronic rolling shutter also known as “rolling shutter” | Triggering with rolling shutter cameras on page 81 |
| ESD | Electrostatic Discharge | Electrostatic discharge (ESD) on page 18 |
| FCC | Federal Communications Commission | For customers in the USA on page 13 |
| FOV | Field of view | Lenses: Focal length vs. field of view on page 55 |
| fps | Frames per second | Specifications on page 24 |
| GenICam | Generic Interface for Cameras, EMVA | https://www.emva.org/ |
| GND | Ground (power) | I/O connector pin assignment on page 73 |
| GPIOs | General purpose inputs and outputs (non-isolated) | GPIOs description on page 74 |
| H × V | Horizontal × Vertical (sensor resolution measurement) | Specifications on page 24 |
| KB | Kilobyte | Specifications on page 24 |
| open housing | Camera housing that is open at the back side to be designed into an encompassing housing with other components | USB 180° open housing C-Mount on page 49 |
| PCBA | Printed circuit board assembly | PCBAs on page 18 |
| QE | Quantum efficiency | Quantum efficiency (QE) on page 32 |
| RoHS | Restriction of Hazardous Substances Directive | For customers in Europe on page 13 |
| ROI | Region of interest | ROI frame rates on page 33 |
| SFNC | Standard Feature Naming Convention (GenICam) | https://www.emva.org/ |
| S-Mount | M12-Mount | Mounting and focusing S-Mount lenses on page 63 |

*Table 4: Terms and abbreviations*

# Compliance, safety, and intended use

This chapter includes:

# Compliance notifications

## For customers in Europe

Allied Vision has demonstrated the fulfillment of the requirements relating to the Alvium USB camera family:

- Directive 2011/65/EU, including amendment 2015/863/EU (RoHS)
- Directive 2012/19/EU (Waste of Electric and Electronic Equipment, WEEE)

**Closed housing cameras only**:

- Directive 2014/30/EU (Electromagnetic compatibility).

## For customers in the USA

**Closed housing cameras only: FCC Class B digital device**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

## United States of America: Supplier Declaration of Conformity

Alvium USB cameras comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

## Party issuing Supplier's Declaration of Conformity

Allied Vision Technologies GmbH
Taschenweg 2a
07646 Stadtroda
Germany
T// +49 (36428) 677-106
quality@alliedvision.com

## Responsible Party - U.S. Contact Information

Allied Vision Technologies, Inc.
102 Pickering Way – Suite 502
Exton, PA 19341
USA
T// +1 978 225 2030

**Note**: changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

# For customers in Canada

**Closed housing cameras only**

This apparatus complies with the Class B limits for radio noise emissions set out in the Radio Interference Regulations.

CAN ICES-003 (B) / NMB-1 (B)

# Pour utilisateurs au Canada

**Boîtier de caméra fermé seulement**

Cet appareil est conforme aux normes classe B pour bruits radioélectriques, spécifiées dans le Règlement sur le brouillage radioélectrique.

CAN ICES-003 (B) / NMB-1 (B)

# Bare board and open housing cameras

Bare board and open housing cameras are designed for integration and are delivered with open camera back on customer's request. Housing design is critical for electromagnetic compatibility (EMC) of the camera.

**Requirements for an EMC-protective housing**

See the Electromagnetic Compatibility for Open Housing Alvium Cameras application note at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

# Avoid electromagnetic interferences

Interface cables, power cables, and I/O cables are sensitive to electromagnetic interference.

- Use shielded cables only.
- We recommend using cables offered by Allied Vision.
- Avoid coiling.
- We recommend using GPIOs only in environments with low electromagnetic interference.

Moreover, avoid unnecessary bending to prevent damaging the cables.

# Camera applications and intended use

## General use

- For usage in product with specific safety requirements, a Quality Assurance Agreement with Allied Vision is required.
- The camera is intended for use in a commercial, industrial, or business environment. The test phase and programming should be carried out by advanced users.
- The user is responsible for operating the camera within the specifications defined in the user guide, and within appropriate environmental conditions and technical prerequisites, to ensure proper camera operation.
- The user is responsible to ensure that the application complies with the corresponding standards.
- The camera is compliant with current data communication standards; however, those standards do not allow for self-monitoring. Therefore, the camera cannot be used as a standalone device for security-related monitoring operations.
- The camera is a hardware product. Only when used with appropriate accompanying software, the camera will produce the desired results. The realization of intelligent solutions requires additional software that is suitable for the camera.
- The camera is a component, it is neither a finished product, nor is it a ready-made technical solution.
- The camera-supporting software can be obtained and installed separately from the camera. Usage of the software is solely the responsibility of the user.
- The camera must not be disassembled. For all repair tasks, contact Allied Vision or one of Allied Vision's authorized representatives.
- Observe the intended use. The camera must only be used for purposes that are in conformity with the stated intended use.
- Additionally, refer to the warranty information on alliedvision.com.

## Use in medical devices

The camera provides basic adequacy to be used in medical devices. However, it is not specially designated for operation in medical devices. When used as part of a medical device, a review of the specific application is necessary in cooperation with Allied Vision. Users who integrate the camera into an application must comply with the rules and regulations concerning medical devices.

## Copyright and trademarks

# Your safety

This section informs about issues related to your personal safety. Descriptions explain how to avoid hazards and operate Alvium USB cameras safely.

## Handling lens mounts

The lens mount thread has sharp edges. Be careful these edges do not cut your skin when mounting or unmounting lenses.

## Housed cameras: handling hot cameras

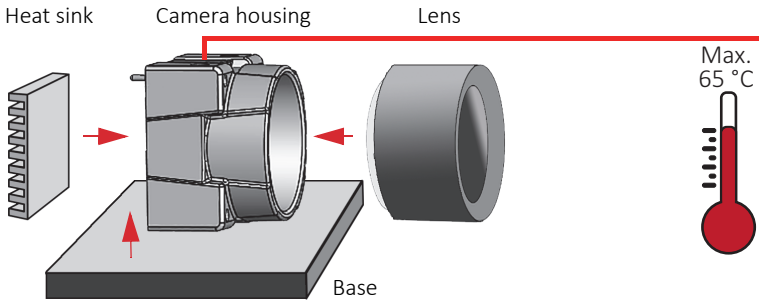
During operation, cameras can reach a housing temperature of +65 °C. If operating temperature exceeds +65 °C, the camera is powered off automatically. However, if you hold the camera in your hands during operation, your skin may get hurt. If you touch the camera when it is heated up, we recommend wearing protective gloves.

## Providing optimum heat dissipation

Design bare board and open housing cameras into a heat dissipative housing with a high thermal conductivity. For more information, see Mounting bare board cameras on page 61. Keep the housing temperature of open housing cameras between +5 °C and +65 °C for operation. This way, you enable best performance and protect the camera from damage.

For your safety and to improve camera performance, operate the camera:

- Mounted to a base with a high thermal conductivity
- With lens mounted
- With a heat sink mounted that has large surface areas. (Closed housing cameras include a heat sink.)
- With active cooling of camera, mounting base, and heat sink, such as by ventilation.




**More information**

For more information on heat dissipation, see the *Optimum Heat Dissipation for Housed Alvium Cameras* application note at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

# Product safety

To prevent material damage, read the following and understand how to safely handle and operate the camera. Get helpful details about electrical connections and learn how to optimize camera performance.

## Electrical connections

### Electrostatic discharge (ESD)

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

- Unpacking: Remove the camera 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.
- Bare board and open housing cameras: use a special ESD protective housing.

### Cable connections

Provide sufficient strain relief for all cable connections to avoid short circuits and malfunctions.

### PCBAs

Alvium USB cameras enable access to PCBAs (printed circuit board assemblies). Keep away from camera electronics to avoid damage.

### Camera power

Operating the camera beyond the specified range damages the camera. Cameras are powered over USB. Alternatively, cameras can be powered using the I/O 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. The camera is not intended to be connected to a DC distribution network.

- Make sure that USB 3.0 / 3.1 Gen 1 host controller cards, on-board host controllers, or hubs provide sufficient current supply for the connected cameras.
- We recommend using powered hubs, especially for multi-camera operation.
- For suitable USB accessories, see the *Alvium Cameras Accessory Guide*.

## GPIOs

To avoid damage to the camera, keep maximum input voltage below 5.5 VDC and maximum current below 12 mA per output. See Specifications on page 24 for details. The maximum length for I/O cables must not exceed 30 m.

### Reverse polarity

If Alvium USB cameras are externally powered with reverse polarity, the cameras can be damaged. See I/O connector pin assignment on page 73 for proper external power connections.

### JST-Cables

JST I/O cables without shielding are designed to be used with bare board or open housing Alvium cameras. The customer is responsible for an EMC compliant design. For applications without an additional EMC protective housing, please use shielded JST I/O cables with screw lock.

## Ground loops

Unsuitable connections can lead to different potentials between the camera system GND and the environmental shield/chassis GND caused by ground loops. This can damage the camera and the connected devices or cause malfunctions.

- Avoid potential differences between the camera housing and GND.
- All wiring must be done by authorized personnel, according to the corresponding technical standards.
- Read the *Avoiding Ground Loops in Vision Systems* application note.

**More information**

See the *Avoiding Ground Loops in Vision Systems* application note at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

## USB connections

### USB 3.0 / 3.1 Gen 1 host controllers and hubs

To avoid damage to USB 3.0 / 3.1 Gen 1 host controller cards or hubs, make sure these components provide sufficient current supply for the connected cameras. For suitable USB 3.0 accessories, see the *Alvium USB Cameras Accessory Guide* at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

If suddenly your camera is not recognized anymore, check for a crashed USB hub. Disconnect the USB and power supply cable from the hub. Reconnect both.

### USB cables

Proper cable handling enables reliable performance:

- Use only shielded cables to avoid electromagnetic interferences.
- Please use cables recommended by Allied Vision.
- Avoid unnecessary bending to prevent damaging the cables.
- Avoid coiling to prevent electromagnetic interference.

### Alvium USB cameras and USB 2.0

If Alvium USB cameras are connected to USB 2.0 ports, they are recognized. They can be operated with reduced performance only if `DeviceLinkThroughputLimit` is set to a value supported by USB 2.0. See Operating systems and bandwidth on page 91.

## Camera mounting

Housed cameras must be mounted using the mounting threads.

## Handling bare board cameras

Bare board cameras are an electronic assembly without a protective housing. Therefore, they can easily be damaged.

- Handle bare board cameras with extreme care.
- Avoid any mechanical stress to the sensor area.
- Avoid short circuits by keeping away from electronics components.

Please observe for mounting bare board cameras:

- Allow mechanical contact only at the mounting area. (This does not apply to the cooling area.)
- Enable proper cooling at the cooling area, see Mounting bare board cameras on page 61.
- Give 2 mm minimum clearance above board components.
- Tighten screws at 0.1 Nm maximum torque.
- Follow the instructions in Mounting bare board cameras on page 61.

# Optical components

Provide the following conditions to keep dirt and droplets out of the optical system of camera and lens:

- Dust-free environment
- Low relative humidity
- No condensation.

When camera or lens are stored:

- Cover the lens mount with a protection foil or cap.
- Cover front and back lens with caps.

**Damage to optical components by conductive media for heat sinks**

See Conductive media for heat sinks on page 23 for details.

## Sensor

Sensors are sensitive to excessive radiation: focused sunlight, lasers, and X-rays can damage the sensor. Dirt and scratches can damage the sensor, too.

Alvium USB cameras do not need additional cleaning. Cameras are cleaned before shipping. Incorrect cleaning can damage the sensor or the filter. Therefore, never clean the sensor or the filter.

Protect the camera filter and the sensor from dirt, because dirt becomes more visible the closer it gets to the sensor. In addition, keep the back lens clean. Hold the camera with the lens mount facing the ground to keep dirt out of the lens mount.

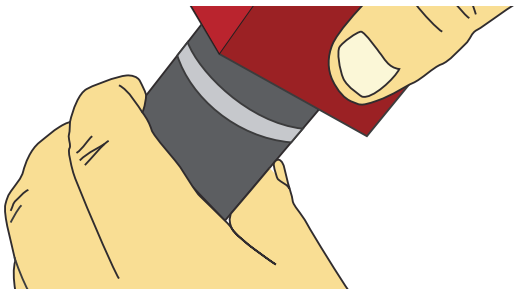


*Figure 1: Holding the camera with the lens mount facing the ground*

# Lenses

## Maximum protrusion

The sensor, filter, or lens can be damaged if a lens exceeding maximum protrusion is mounted to the camera. Use lenses with a maximum protrusion within camera specifications. Figure 2 shows maximum protrusion. For details, see Lens mounts, filters, and maximum protrusion on page 53.

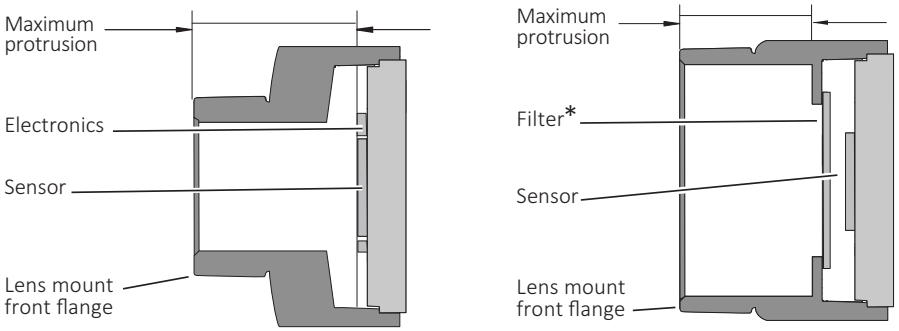



*Figure 2: Lens mount and maximum protrusion*
*S-Mount (left) | CS-Mount, C-Mount (right)*
**Only color models are equipped with an IR cut filter*

For S-Mount lenses, read Mounting and focusing S-Mount lenses on page 63 to avoid damage to the sensor, the electronics, and lens.

## Use of heavy lenses

For non-static applications, use lenses with a mass below 70 g and a length less than 38 mm, where the center of gravity is 20 mm, measured from the lens mount front flange. For heavier or longer lenses, use a lens support and apply additional tests. For more information, please contact support@alliedvision.com.

**Applied mechanical tests**

See Shock and vibration on page 25 for standards compliance.

# Heat sinks and conductive media

## Heat sinks

The camera can be damaged by overheating if heat sink or conductive media are not used properly.

- Adhere to the instructions and safety notes provided by the manufacturer of the heat sink.

## Conductive media for heat sinks

Some conductive media for heat sinks contain corrosive substances that can damage optical surfaces of the sensor, filter, and lenses.

- Cover the optical path of the camera when you apply heat sink compound or adhesive to prevent substances and fumes from damaging optical surfaces.
- Adhere to the instructions and safety notes provided by the manufacturer of the conductive media.
- Ensure that the conductive media is correctly positioned: covering only the components to be cooled.

**Cooling areas**

See Mounting the heat sink on page 59 for Alvium cameras cooling areas.

# BIOS drivers

Sometimes, USB component's firmware must be updated before operation, including devices, such as host adapters cards. To avoid damage and to benefit from possible updates to increase performance: Check for BIOS updates related to USB.

# Specifications

This chapter includes:

# Applied standards

## GenICam

GenICam is the programming interface for the USB3 Vision camera controls. GenICam is administered by the European Machine Vision Association (EMVA). GenICam establishes a common camera control interface allowing third-party software to communicate with cameras from various manufacturers without customization. Vimba Access enables operating Alvium USB cameras by software using GenICam features or custom features by Allied Vision for additional functions.

## USB 3.1 Gen 1

USB 3.1 Gen 1 is an update to the third version of an industry standard that defines cables, connectors, and communications protocols between computers and electronic devices. USB 3.1 Gen 1 adds “SuperSpeed” transfer mode that can transfer data at up to 5 Gbit/s and uses different connectors than USB 2.0.

## USB3 Vision

USB3 Vision standard for cameras and imaging products is based on USB 3.0 standard, using USB 3.0 ports. It provides control over compliant devices by GenICam Applications Programming Interface (API). USB3 Vision standard is administered by the Automated Imaging Association (AIA).

## IP class

The following statement applies to closed housing cameras only. Equipped with a lens as intended, the Alvium USB closed housing camera complies with IP30 class according to IEC 60529.

## Shock and vibration

Open housing cameras were tested successfully according to the following standards:

- IEC 60068-2-6, sinusoidal vibration testing
- IEC 60068-2-27, non-repetitive shock testing
- IEC 60068-2-27, repetitive shock testing
- IEC 60068-2-64, random vibration testing.

# Notes on specifications

## Sensor

### Absolute quantum efficiency (QE) plots

Measurements for color cameras were done with IR cut filter, measurements for monochrome and S-Mount cameras were done without optical filters. With optical filters, QE decreases by approximately 10%. The uncertainty in measurement of the QE values is ±10.25%. This is mainly due to uncertainties in the measuring apparatus itself (such as Ulbricht sphere and optometer).

Manufacturing tolerance of the sensor increases overall uncertainty.

#### ON Semiconductor sensors

The curve in the absolute QE plots shown in this chapter is from the sensor manufacturer data sheet. The information was correct at the time of publishing.

#### Wavelength

The wavelength range in the absolute QE plots reflects the information available in the sensor manufacturer data sheet at the time of publishing. For additional wavelength information, contact the sensor manufacturer.

## Exposure time and frame rate

### Exposure time values

Interdependencies between controls affect each other, see Value changes by features interdependencies on page 82.

### Fixed frame rate control

The maximum frame rate which can be selected depends on various values, such as available bandwidth, pixel format, exposure time, and region of interest (ROI).

### Maximum frame rates

Data was calculated for minimum exposure time and full resolution, using Mono8 pixel format, for camera operation in free run mode. If cameras are triggered, frame rates are lower. To increase frame rates, reduce region of interest and exposure time.

**Bandwidth adjustments**

Consider the bandwidth available for camera payload depends on your individual hardware, the operating system, software, and drivers, and your application. We recommend you to adjust `DeviceLinkThroughputLimit` and `MaxTransferSize` to your requirements. See Operating systems and bandwidth on page 91.

## Frame rate jitter

Generally, some parameters can be changed during exposure without affecting the timing. When the camera is operated in freerun mode without triggering, changing parameters during exposure leads to a frame rate jitter.

When parameters are entered, the next frame starts only after readout and sensor reconfiguration delay are finished. When the camera is run in `AutoExposure` mode, the actual frame rate is less than the calculated value for the corresponding exposure time. Please, consider frame rate jitter for your application.

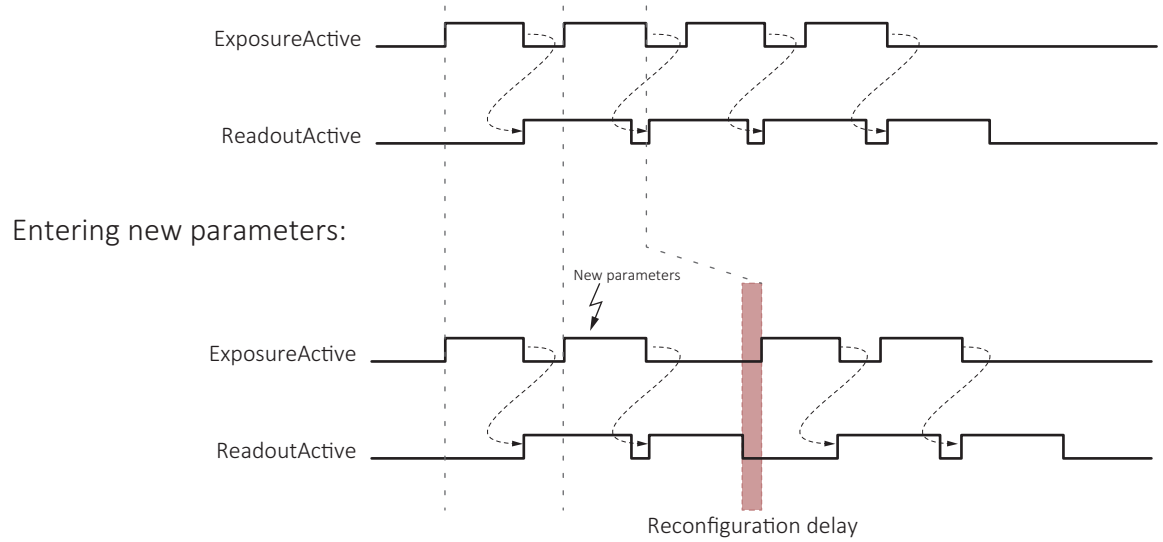



*Figure 3: Delayed exposure due to parameters change*

## ROI frame rates

Calculation of maximum frame rates for different regions of interest (ROIs) for Alvium USB cameras does not allow to give a formula. Data was generated at minimum exposure time and full resolution, using Mono8 pixel format. The bandwidth of your system can limit the available maximum frame rate.

# Triggering and sensor shutter types

Triggering behavior differs between cameras with global shutter (GS) and electronic rolling shutter (ERS). See Triggering and timings on page 77 for details.

# Power consumption

Values are given for maximum performance of the camera. To reduce the power consumption, reduce the frame rate or activated features.

# Dimensions

In manufacturing, camera board and sensor are moved against each other to adjust flange focal distance. The value range for camera length with open housing cameras reflects in the technical drawings.

# Specifications for 1800 U-500m/c

| Feature | Specification | |
|---|---|---|
| | Monochrome models | Color models |
| Sensor model | ON Semiconductor AR0521 | ON Semiconductor AR0521 |
| Resolution | 2592 (H) × 1944 (V) \| 5.1 megapixels | |
| Sensor type | Progressive scan CMOS | |
| Shutter type | Rolling shutter | |
| Sensor size | Type 1/2.5 \| 5.7 mm × 4.3 mm \| 7.13 mm diagonal | |
| Pixel size | 2.2 µm × 2.2 µm | |
| Chief ray angle (CRA) | 9° | |
| ADC | 10-bit | |
| Monochrome pixel formats | Mono8 (default), Mono10, Mono10p | Mono8 (default), Mono10, Mono10p |
| YUV color pixel formats | - | YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr |
| RGB color pixel formats | - | BayerGR8, BayerGR10, BayerGR10p, BGR8, RGB8 |
| Maximum image bit depth | 10-bit | |
| Maximum frame rate | 67 fps at 350 MByte/s, Mono8, full resolution | |
| Exposure time | 7 µs to 0.5 s | |
| Image buffer (RAM) | 256 KB | |
| Non-volatile memory (Flash) | 1024 KB | |
| Gain | 0 dB to 24 dB; 0.1 dB increments | |
| GPIOs | 4 programmable GPIOs<br>As direct inputs (push-pull): 0 to 5.5 VDC<br>As direct outputs (push-pull): 0 to 3.3 VDC @ 12 mA | |
| ExposureModes | Timed | |
| Power requirements | Power over USB \| External power | |
| Power consumption | USB power (5 VDC): 2.2 W (typical), 2.3 W (max.) \|<br>Ext. power (5 VDC): 2.5 W (typical), 2.6 W (max.) \| (values at 20 °C) | |
| Storage temperature | -10 °C to +70 °C ambient temperature | |
| Operating temperature | Housing: +5 °C to +65 °C with heat sink<br>Protect the camera from excessive heat, operate only with lens and heat sink mounted. Ambient temperature: <30 °C.<br>See Housed cameras: handling hot cameras on page 17. | |
| Relative humidity | 0% to 80% (non-condensing) | |

*Table 5: Specifications for 1800 U-500m/c (Sheet 1 of 2)*

| Feature | Specification | |
|---|---|---|
| | Monochrome models | Color models |
| Digital interface | Micro-B USB 3.1 Gen 1 interface | |
| Camera controls | GenICam V2.0 (GenICam Access) | |

*Table 5: Specifications for 1800 U-500m/c (Sheet 2 of 2)*

# Dimensions, mass, and filter

## Bare board cameras

| Feature | USB 90° | USB 180° |
|---|---|---|
| Dimensions (L × W × H [mm]) | 13 × 30 × 26 | 13 × 26 × 26 |
| Mass [g] | 15 g | 15 g |

*Table 6: Bare board dimensions and mass for 1800 U-500m/c*

## USB 90° cameras

| USB 90° open housing | S-Mount | CS-Mount | C-Mount |
|---|---|---|---|
| Flange focal distance, optical [mm] | 12.63 (in air) | 12.526 (in air) | 17.526 (in air) |
| Thread [mm] | M12 × 0.5 | 1x32TPI-UNS-2B | 1x32TPI-UNS-2B |
| Max. protrusion[1] [mm] | 11.0 | 8.6 | 13.6 |
| Body dimensions (L × W × H [mm]) | 25 × 32 × 29 | 25 × 32 × 29 | 30 × 32 × 29 |
| Mass [g] | 45 g | 45 g | 50 g |
| Optical filter | No filter | **Color sensor**: IR cut filter<br>**Monochrome sensor**: no filter | **Color sensor**: IR cut filter<br>**Monochrome sensor**: no filter |
| [1]For details, see Lens mounts, filters, and maximum protrusion. | | | |

| USB 90° closed housing | S-Mount | CS-Mount | C-Mount |
|---|---|---|---|
| Flange focal distance, optical [mm] | 12.63 (in air) | 12.526 (in air) | 17.526 (in air) |
| Thread [mm] | M12 × 0.5 | 1x32TPI-UNS-2B | 1x32TPI-UNS-2B |
| Max. protrusion[1] [mm] | 11.0 | 8.6 | 13.6 |
| Body dimensions (L × W × H [mm]) | 33 × 32 × 29 | 33 × 32 × 29 | 38 × 32 × 29 |
| Mass [g] | 65 g | 60 g | 65 g |
| Optical filter | No filter | **Color sensor**: IR cut filter<br>**Monochrome sensor**: no filter | **Color sensor**: IR cut filter<br>**Monochrome sensor**: no filter |
| [1]For details, see Lens mounts, filters, and maximum protrusion. | | | |

## USB 180° cameras

| USB 180° open housing | S-Mount | CS-Mount | C-Mount |
|---|---|---|---|
| Flange focal distance, optical [mm] | 12.63 (in air) | 12.526 (in air) | 17.526 (in air) |
| Thread [mm] | M12 × 0.5 | 1x32TPI-UNS-2B | 1x32TPI-UNS-2B |
| Max. protrusion[1] [mm] | 11.0 | 8.6 | 13.6 |
| Body dimensions (L × W × H [mm]) | 25 × 29 × 29 | 25 × 29 × 29 | 30 × 29 × 29 |
| Mass [g] | 45 | 40 | 45 |
| Optical filter | No filter | **Color sensor**: IR cut filter<br>**Monochrome sensor**: no filter | **Color sensor**: IR cut filter<br>**Monochrome sensor**: no filter |
| [1]For details, see Lens mounts, filters, and maximum protrusion. | | | |

| USB 180° closed housing | S-Mount | CS-Mount | C-Mount |
|---|---|---|---|
| Flange focal distance, optical [mm] | 12.63 (in air) | 12.526 (in air) | 17.526 (in air) |
| Thread [mm] | M12 × 0.5 | 1x32TPI-UNS-2B | 1x32TPI-UNS-2B |
| Max. protrusion[1] [mm] | 11.0 | 8.6 | 13.6 |
| Body dimensions (L × W × H [mm]) | 33 × 29 × 29 | 33 × 29 × 29 | 38 × 29 × 29 |
| Mass [g] | 60 | 60 | 60 |
| Optical filter | No filter | **Color sensor**: IR cut filter<br>**Monochrome sensor**: no filter | **Color sensor**: IR cut filter<br>**Monochrome sensor**: no filter |
| [1]For details, see Lens mounts, filters, and maximum protrusion. | | | |

*Table 7: Housing dimensions and mass for 1800 U-500m/c*

# Quantum efficiency (QE)

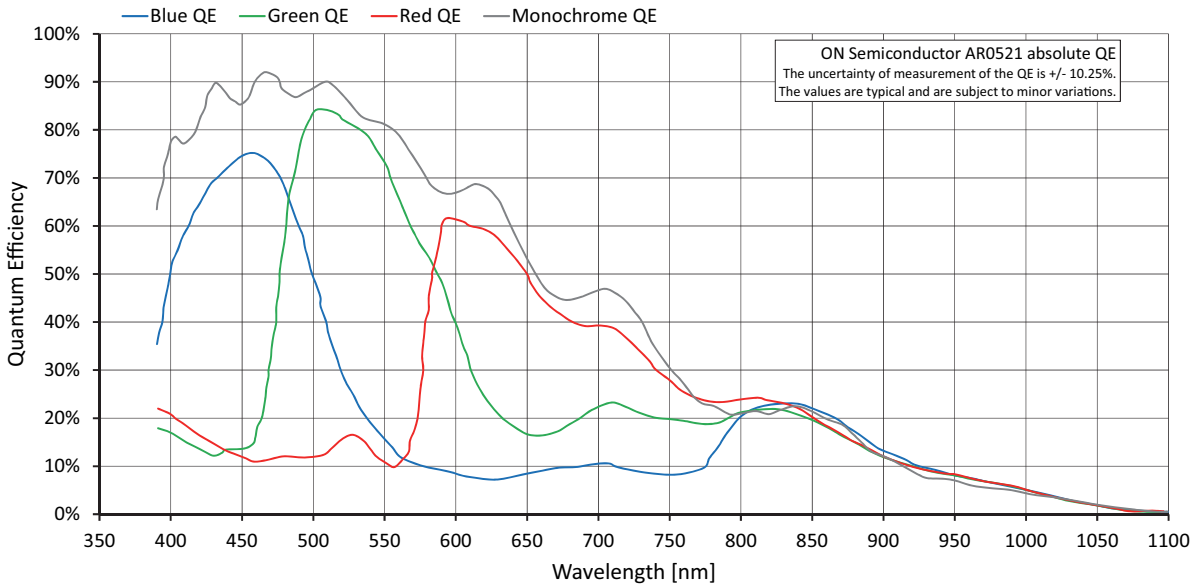



*Figure 4: Absolute QE for 1800 U-500m/c (ON Semiconductor AR0521)*

# ROI frame rates

This section lists the resulting frame rates for changing image heights and widths when the camera is operated with Mono8 pixel format, for camera operation in free run mode. If cameras are triggered, frame rates are lower. Values are calculated and depend on the performance of your host system.

**Bandwidth adjustments**

Consider the bandwidth available for camera payload depends on your individual hardware, the operating system, software, and drivers, and your application. We recommend you to adjust `DeviceLinkThroughputLimit` and `MaxTransferSize` to your requirements. See Operating systems and bandwidth on page 91.

## ROI frame rates at 250 to 350 MByte/s

| Image format | Width [pixel] | Height [pixel] | ROI area [pixel] | Frame rate [fps] | | | |
|---|---|---|---|---|---|---|---|
| | | | | 200MB/s* | 250 MB/s | 300 MB/s | 330 MB/s |
| Max. × max. | 2592 | 1944 | 5.038.848 | 38 | 48 | 57 | 63 |
| Max. × min. | 2592 | 8 | 20.736 | 1169 | 1358 | 1543 | 1631 |
| Min. × max. | 8 | 1944 | 15.552 | 68 | 68 | 68 | 68 |
| Min. × min. | 8 | 8 | 64 | 2617 | 2617 | 2617 | 2617 |
| Full resolution | 2592 | 1944 | 5.038.848 | 38 | 48 | 57 | 63 |
| $^1/_2$ resolution | 1296 | 972 | 1.259.712 | 132 | 132 | 132 | 132 |
| $^1/_4$ resolution | 648 | 484 | 313.632 | 254 | 254 | 254 | 254 |
| $^1/_8$ resolution | 324 | 240 | 77.760 | 472 | 472 | 472 | 472 |
| NTSC | 852 | 480 | 408.960 | 255 | 255 | 255 | 255 |
| PALplus | 1024 | 576 | 589.824 | 215 | 215 | 215 | 215 |
| HD | 1280 | 720 | 921.600 | 175 | 175 | 175 | 175 |
| Full HD | 1920 | 1080 | 2.073.600 | 91 | 113 | 118 | 118 |
| QQVGA | 160 | 120 | 19.200 | 820 | 820 | 820 | 820 |
| HQVGA | 240 | 160 | 38.400 | 657 | 657 | 657 | 657 |
| QVGA | 320 | 240 | 76.800 | 472 | 472 | 472 | 472 |
| WQVGA | 360 | 240 | 86.400 | 472 | 472 | 472 | 472 |
| WQVGA | 384 | 240 | 92.160 | 472 | 472 | 472 | 472 |
| WQVGA | 400 | 240 | 96.000 | 471 | 471 | 471 | 471 |
| HVGA | 480 | 320 | 153.600 | 369 | 369 | 369 | 369 |

* For Alvium 1800 U cameras, the default value for `DeviceLinkThroughputLimit` is 200 MB/s.

*Table 8: ROI frame rates |1800 U-500m/c | at 200 to 330 MByte/s (Sheet 1 of 2)*

| Image format | Width [pixel] | Height [pixel] | ROI area [pixel] | Frame rate [fps] | | | |
|---|---|---|---|---|---|---|---|
| | | | | 200MB/s* | 250 MB/s | 300 MB/s | 330 MB/s |
| VGA | 640 | 480 | 307.200 | 256 | 256 | 256 | 256 |
| WVGA | 720 | 480 | 345.600 | 255 | 255 | 255 | 255 |
| WVGA | 768 | 480 | 368.640 | 255 | 255 | 255 | 255 |
| WVGA | 800 | 480 | 384.000 | 255 | 255 | 255 | 255 |
| FWVGA | 852 | 480 | 408.960 | 255 | 255 | 255 | 255 |
| SVGA | 800 | 600 | 480.000 | 208 | 208 | 208 | 208 |
| WSVGA | 1024 | 576 | 589.824 | 215 | 215 | 215 | 215 |
| DVGA | 960 | 640 | 614.400 | 195 | 195 | 195 | 195 |
| WSVGA | 1024 | 600 | 614.400 | 207 | 207 | 207 | 207 |
| XGA | 1024 | 768 | 786.432 | 165 | 165 | 165 | 165 |
| WXGA | 1152 | 768 | 884.736 | 165 | 165 | 165 | 165 |
| WXGA | 1280 | 768 | 983.040 | 164 | 164 | 164 | 164 |
| XGA+ | 1152 | 864 | 995.328 | 147 | 147 | 147 | 147 |
| WXGA | 1280 | 800 | 1.024.000 | 158 | 158 | 158 | 158 |
| WXGA | 1360 | 768 | 1.044.480 | 164 | 164 | 164 | 164 |
| FWXGA | 1364 | 768 | 1.047.552 | 164 | 164 | 164 | 164 |
| WXGA+ | 1440 | 900 | 1.296.000 | 141 | 141 | 141 | 141 |
| WSXGA | 1440 | 960 | 1.382.400 | 133 | 133 | 133 | 133 |
| SXGA | 1280 | 1024 | 1.310.720 | 125 | 125 | 125 | 125 |
| SXGA+ | 1400 | 1048 | 1.467.200 | 123 | 123 | 123 | 123 |
| WSXGA+ | 1680 | 1048 | 1.760.640 | 107 | 122 | 122 | 122 |
| UXGA | 1600 | 1200 | 1.920.000 | 99 | 107 | 107 | 107 |
| WUXGA | 1920 | 1200 | 2.304.000 | 82 | 102 | 107 | 107 |
| QWXGA | 2048 | 1152 | 2.359.296 | 80 | 100 | 111 | 111 |
| UW-UXGA | 2560 | 1080 | 2.764.800 | 68 | 85 | 102 | 112 |
| QXGA | 2048 | 1536 | 3.145.728 | 61 | 76 | 85 | 85 |
| WQHD | 2560 | 1440 | 3.686.400 | 52 | 64 | 77 | 85 |
| WQXGA | 2560 | 1600 | 4.096.000 | 47 | 58 | 70 | 77 |

* For Alvium 1800 U cameras, the default value for `DeviceLinkThroughputLimit` is 200 MB/s.

*Table 8: ROI frame rates |1800 U-500m/c | at 200 to 330 MByte/s (Sheet 2 of 2)*

## ROI frame rates at 375 to 450 MByte/s

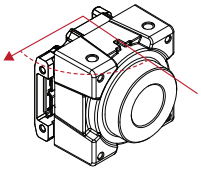
| Image format | Width [pixel] | Height [pixel] | ROI area [pixel] | Frame rate [fps] | | | |
|---|---|---|---|---|---|---|---|
| | | | | 350 MB/s | 375 MB/s | 400 MB/s | 450 MB/s |
| Max. × max. | 2592 | 1944 | 5.038.848 | 67 | 67 | 67 | 67 |
| Max. × min. | 2592 | 8 | 20.736 | 1688 | 1701 | 1701 | 1701 |
| Min. × max. | 8 | 1944 | 15.552 | 68 | 68 | 68 | 68 |
| Min. × min. | 8 | 8 | 64 | 2617 | 2617 | 2617 | 2617 |
| Full resolution | 2592 | 1944 | 5.038.848 | 67 | 67 | 67 | 67 |
| $^1/_2$ resolution | 1296 | 972 | 1.259.712 | 132 | 132 | 132 | 132 |
| $^1/_4$ resolution | 648 | 484 | 313.632 | 254 | 254 | 254 | 254 |
| $^1/_8$ resolution | 324 | 240 | 77.760 | 472 | 472 | 472 | 472 |
| NTSC | 852 | 480 | 408.960 | 255 | 255 | 255 | 255 |
| PALplus | 1024 | 576 | 589.824 | 215 | 215 | 215 | 215 |
| HD | 1280 | 720 | 921.600 | 175 | 175 | 175 | 175 |
| Full HD | 1920 | 1080 | 2.073.600 | 118 | 118 | 118 | 118 |
| QQVGA | 160 | 120 | 19.200 | 820 | 820 | 820 | 820 |
| HQVGA | 240 | 160 | 38.400 | 657 | 657 | 657 | 657 |
| QVGA | 320 | 240 | 76.800 | 472 | 472 | 472 | 472 |
| WQVGA | 360 | 240 | 86.400 | 472 | 472 | 472 | 472 |
| WQVGA | 384 | 240 | 92.160 | 472 | 472 | 472 | 472 |
| WQVGA | 400 | 240 | 96.000 | 471 | 471 | 471 | 471 |
| HVGA | 480 | 320 | 153.600 | 369 | 369 | 369 | 369 |
| VGA | 640 | 480 | 307.200 | 256 | 256 | 256 | 256 |
| WVGA | 720 | 480 | 345.600 | 255 | 255 | 255 | 255 |
| WVGA | 768 | 480 | 368.640 | 255 | 255 | 255 | 255 |
| WVGA | 800 | 480 | 384.000 | 255 | 255 | 255 | 255 |
| FWVGA | 852 | 480 | 408.960 | 255 | 255 | 255 | 255 |
| SVGA | 800 | 600 | 480.000 | 208 | 208 | 208 | 208 |
| WSVGA | 1024 | 576 | 589.824 | 215 | 215 | 215 | 215 |
| DVGA | 960 | 640 | 614.400 | 195 | 195 | 195 | 195 |
| WSVGA | 1024 | 600 | 614.400 | 207 | 207 | 207 | 207 |
| XGA | 1024 | 768 | 786.432 | 165 | 165 | 165 | 165 |
| WXGA | 1152 | 768 | 884.736 | 165 | 165 | 165 | 165 |
| WXGA | 1280 | 768 | 983.040 | 164 | 164 | 164 | 164 |

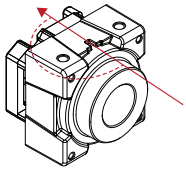
*Table 9: ROI frame rates |1800 U-500m/c | at 350 to 450 MByte/s (Sheet 1 of 2)*

| Image format | Width [pixel] | Height [pixel] | ROI area [pixel] | Frame rate [fps] | | | |
|---|---|---|---|---|---|---|---|
| | | | | 350 MB/s | 375 MB/s | 400 MB/s | 450 MB/s |
| XGA+ | 1152 | 864 | 995.328 | 147 | 147 | 147 | 147 |
| WXGA | 1280 | 800 | 1.024.000 | 158 | 158 | 158 | 158 |
| WXGA | 1360 | 768 | 1.044.480 | 164 | 164 | 164 | 164 |
| FWXGA | 1364 | 768 | 1.047.552 | 164 | 164 | 164 | 164 |
| WXGA+ | 1440 | 900 | 1.296.000 | 141 | 141 | 141 | 141 |
| WSXGA | 1440 | 960 | 1.382.400 | 133 | 133 | 133 | 133 |
| SXGA | 1280 | 1024 | 1.310.720 | 125 | 125 | 125 | 125 |
| SXGA+ | 1400 | 1048 | 1.467.200 | 123 | 123 | 123 | 123 |
| WSXGA+ | 1680 | 1048 | 1.760.640 | 122 | 122 | 122 | 122 |
| UXGA | 1600 | 1200 | 1.920.000 | 107 | 107 | 107 | 107 |
| WUXGA | 1920 | 1200 | 2.304.000 | 107 | 107 | 107 | 107 |
| QWXGA | 2048 | 1152 | 2.359.296 | 111 | 111 | 111 | 111 |
| UW-UXGA | 2560 | 1080 | 2.764.800 | 118 | 118 | 118 | 118 |
| QXGA | 2048 | 1536 | 3.145.728 | 85 | 85 | 85 | 85 |
| WQHD | 2560 | 1440 | 3.686.400 | 90 | 90 | 90 | 90 |
| WQXGA | 2560 | 1600 | 4.096.000 | 81 | 81 | 81 | 81 |

*Table 9: ROI frame rates |1800 U-500m/c | at 350 to 450 MByte/s (Sheet 2 of 2)*

# Camera dimensions


90°


180°

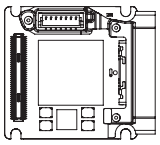
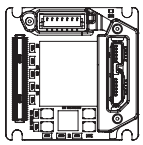
**USB connector position**

- 90°: the connector is angled to the optical axis of the camera.
- 180°: the connector is parallel to the optical axis of the camera.

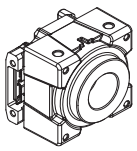
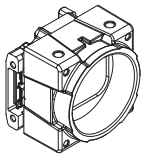
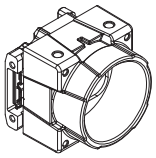
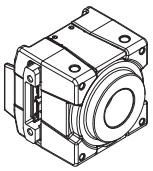
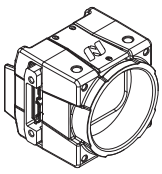
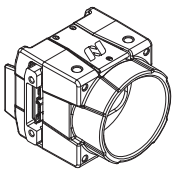
## Housing options overview

Alvium USB cameras are available as shown below:

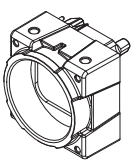
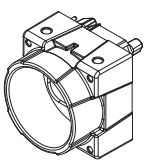
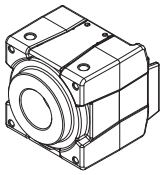
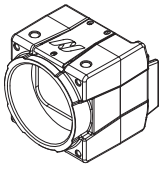
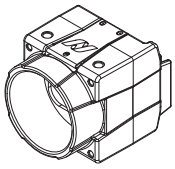
**Bare board**

| USB 90° | USB 180° |
|---|---|
|  |  |
| page 39 | page 40 |

**USB 90°**

| Open housing | | | Closed housing | | |
|---|---|---|---|---|---|
| S-Mount | CS-Mount | C-Mount | S-Mount | CS-Mount | C-Mount |
|  |  |  |  |  |  |
| page 41 | page 42 | page 43 | page 44 | page 45 | page 46 |

**USB 180°**

| Open housing | | | Closed housing | | |
|---|---|---|---|---|---|
| S-Mount | CS-Mount | C-Mount | S-Mount | CS-Mount | C-Mount |
|  |  |  |  |  |  |
| page 47 | page 48 | page 49 | page 50 | page 51 | page 52 |

**Mounting the camera**

To mount the camera properly, see Mounting housed cameras on page 62.

**Tripod adapter**

For more information, see the *Alvium Cameras Accessory Guide* at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

# USB 90° bare board

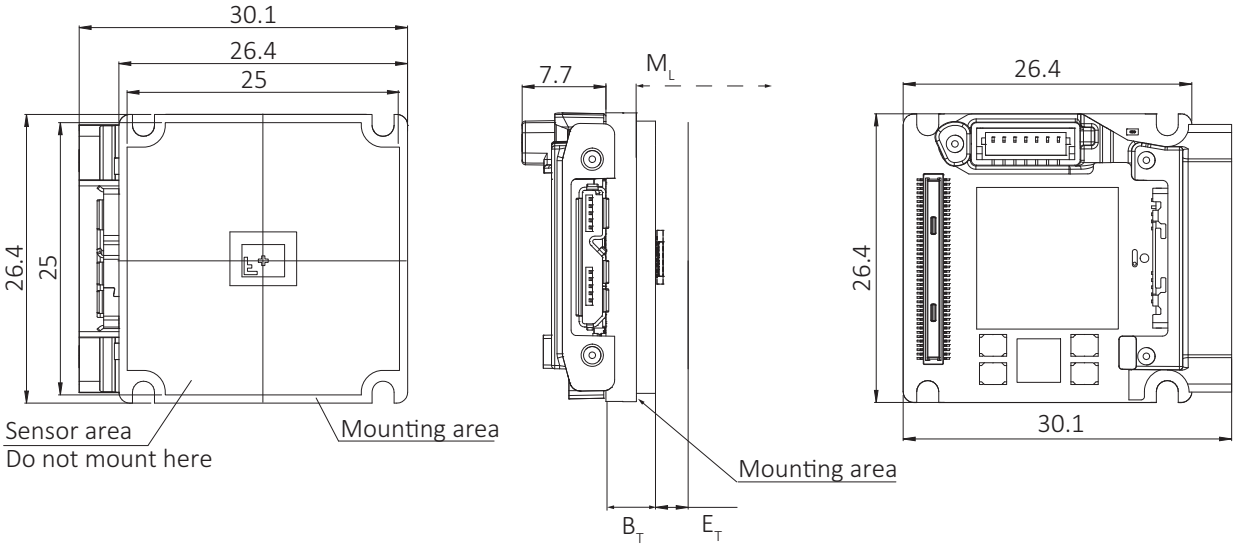



*Figure 5: Dimensions for USB 90° bare board*

Dimensions that are common between different models are displayed in Figure 5, model specific dimensions are listed in Table 10. **Mechanical length** ($M_L$) defines the mechanical distance from the mounting area to the lens mount front flange. **Electronics thickness** ($E_T$) relates to the electronic components with maximum thickness, in some cases the sensor.

| Camera model | $M_L$ Mechanical length for C-Mount | $B_T$ Board thickness | $E_T$ Electronics thickness |
|---|---|---|---|
| Alvium 1800 U-500 | 19.6 mm | 3.95 mm ± 0.505 mm | 1.6 mm |

*Table 10: USB 90° bare board | dimension details by camera model*

**Mechanical length for S-Mount and CS-Mount**

Mechanical length for other mounts is:

- [CS-Mount value] = [C-Mount value] – 5 mm
- S-Mount: depending on your design.

# USB 180° bare board

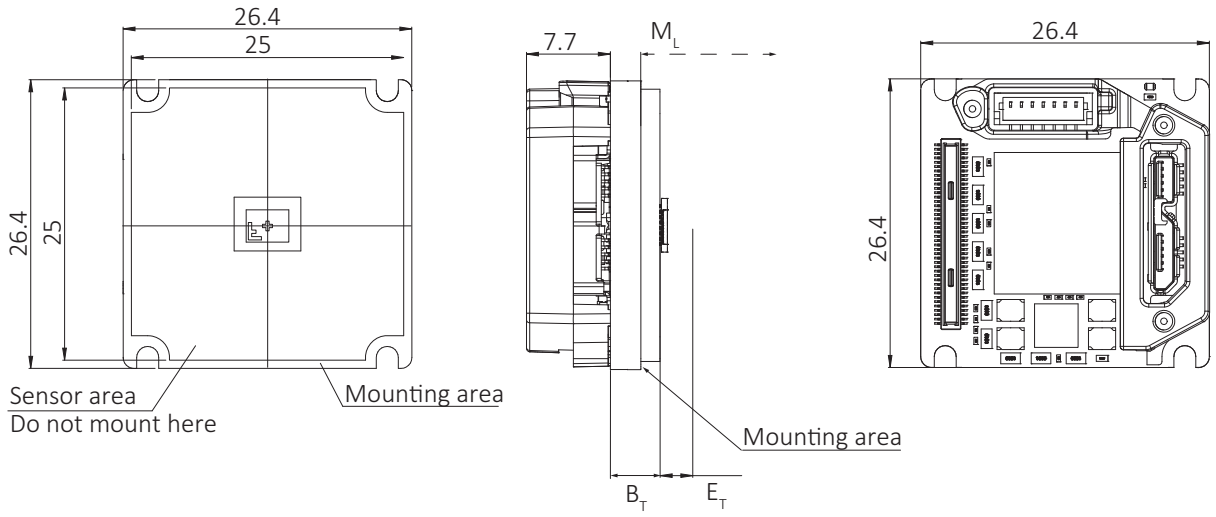



*Figure 6: Dimensions for USB 180° bare board*

Dimensions that are common between different models are displayed in Figure 6, model specific dimensions are listed in Table 11. **Mechanical length** ($M_L$) defines the mechanical distance from the mounting area to the lens mount front flange. **Electronics thickness** ($E_T$) relates to the electronic components with maximum thickness, in some cases the sensor.

| Camera model | $M_L$ Mechanical length for C-Mount | $B_T$ Board thickness | $E_T$ Electronics thickness |
|---|---|---|---|
| Alvium 1800 U-500 | 19.6 mm | 3.95 mm ± 0.505 mm | 1.6 mm |

*Table 11: USB 180° bare board | dimension details by camera model*

**Mechanical length for S-Mount and CS-Mount**

Mechanical length for other mounts is:

- C-Mount value minus 5 mm
- S-Mount: depending on your design.

# USB 90° open housing S-Mount

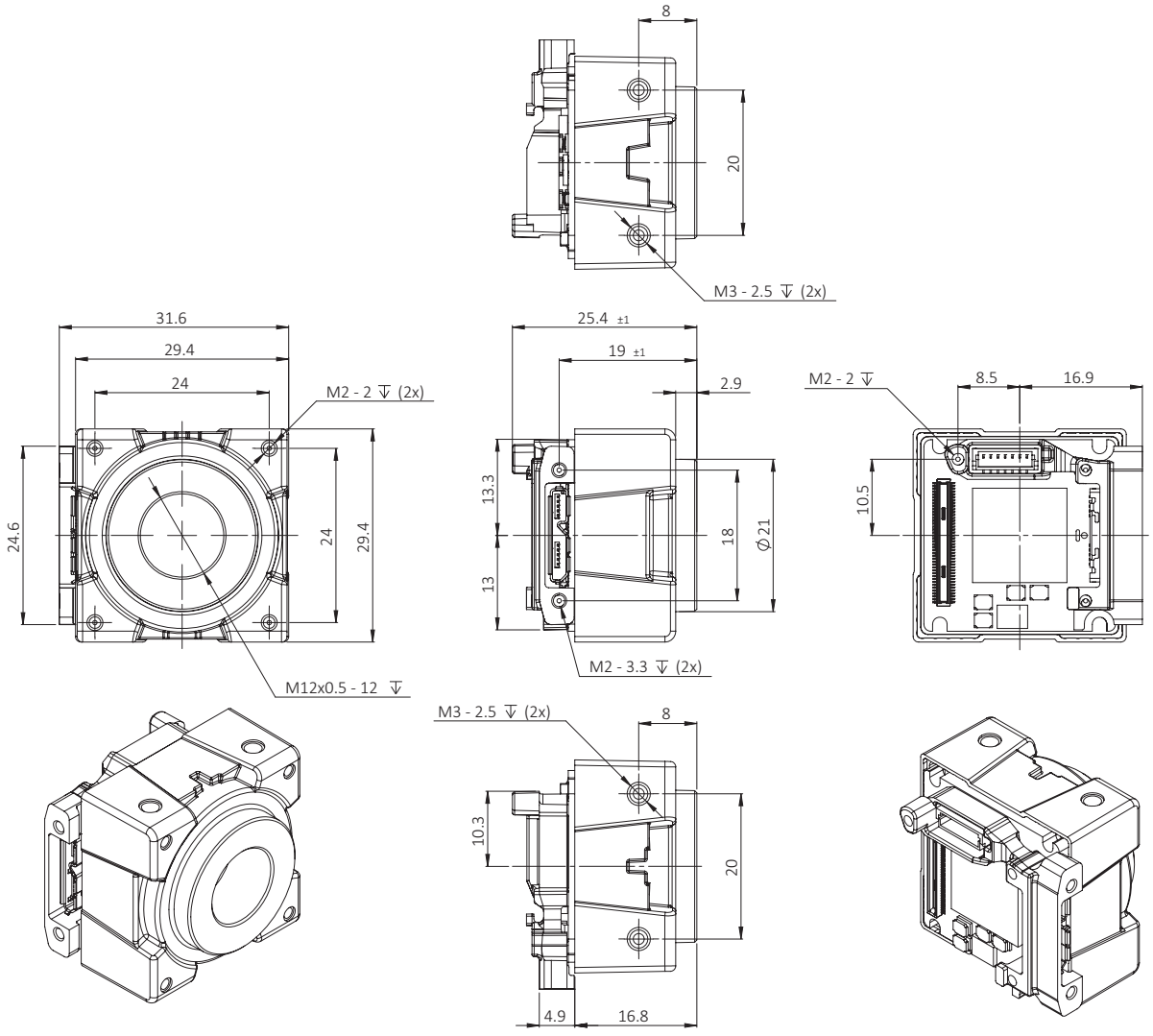



*Figure 7: Dimensions for USB 90° open housing S-Mount*

# USB 90° open housing CS-Mount

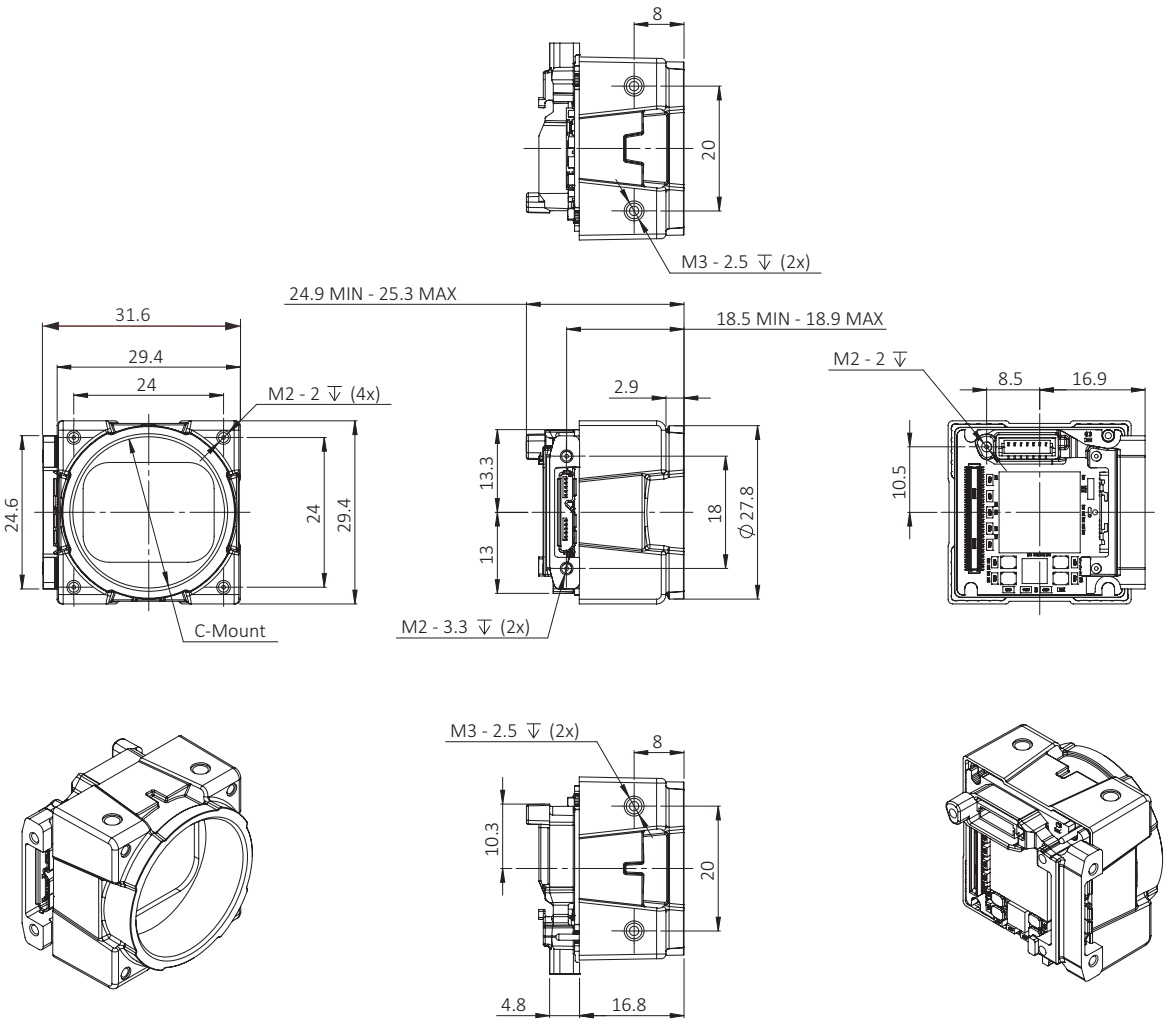



*Figure 8: Dimensions for USB 90° |open housing, |CS-Mount*

# USB 90° open housing C-Mount

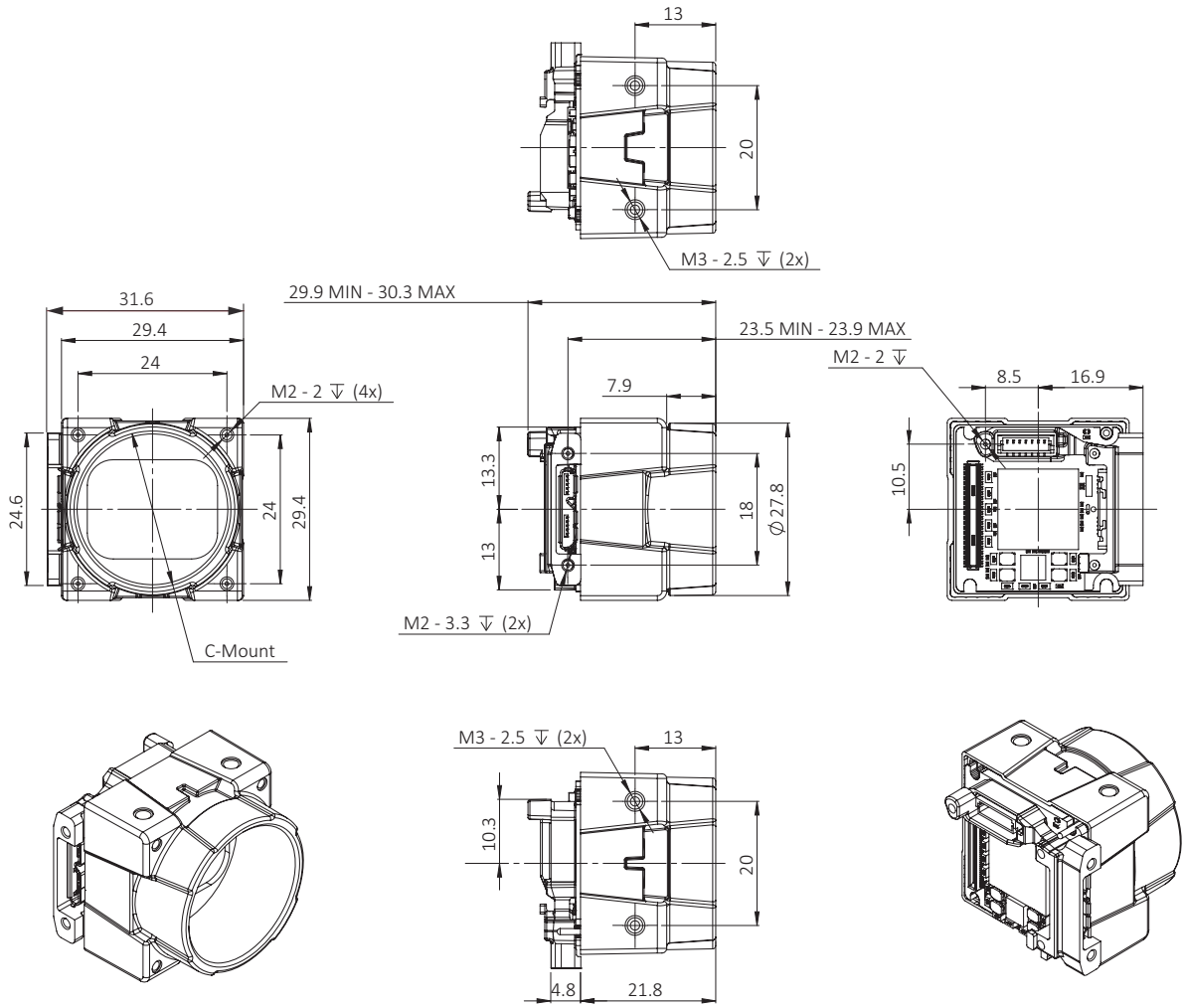



*Figure 9: Dimensions for USB 90° open housing C-Mount*

# USB 90° closed housing S-Mount

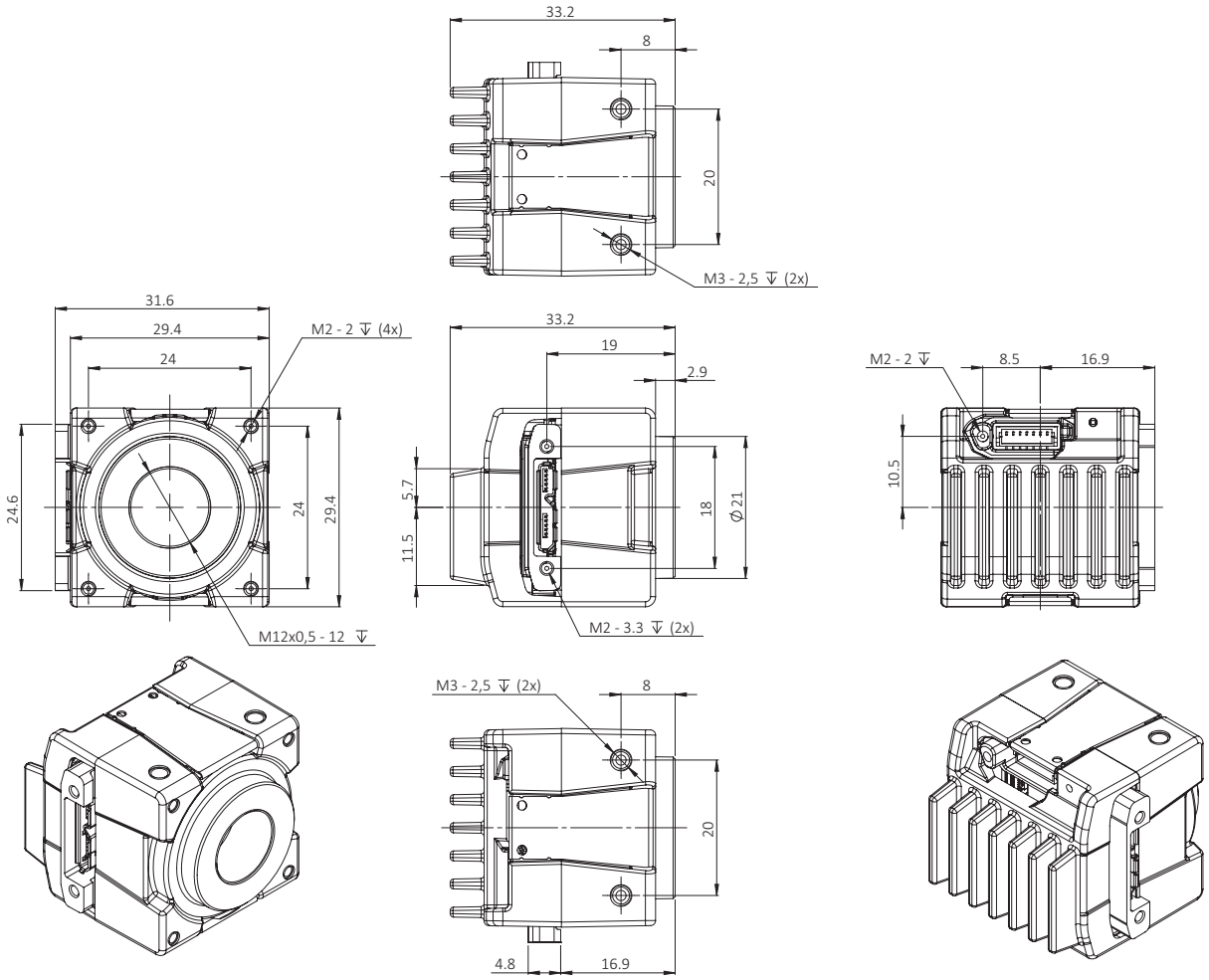



*Figure 10: Dimensions for USB 90° closed housing S-Mount*

# USB 90° closed housing CS-Mount

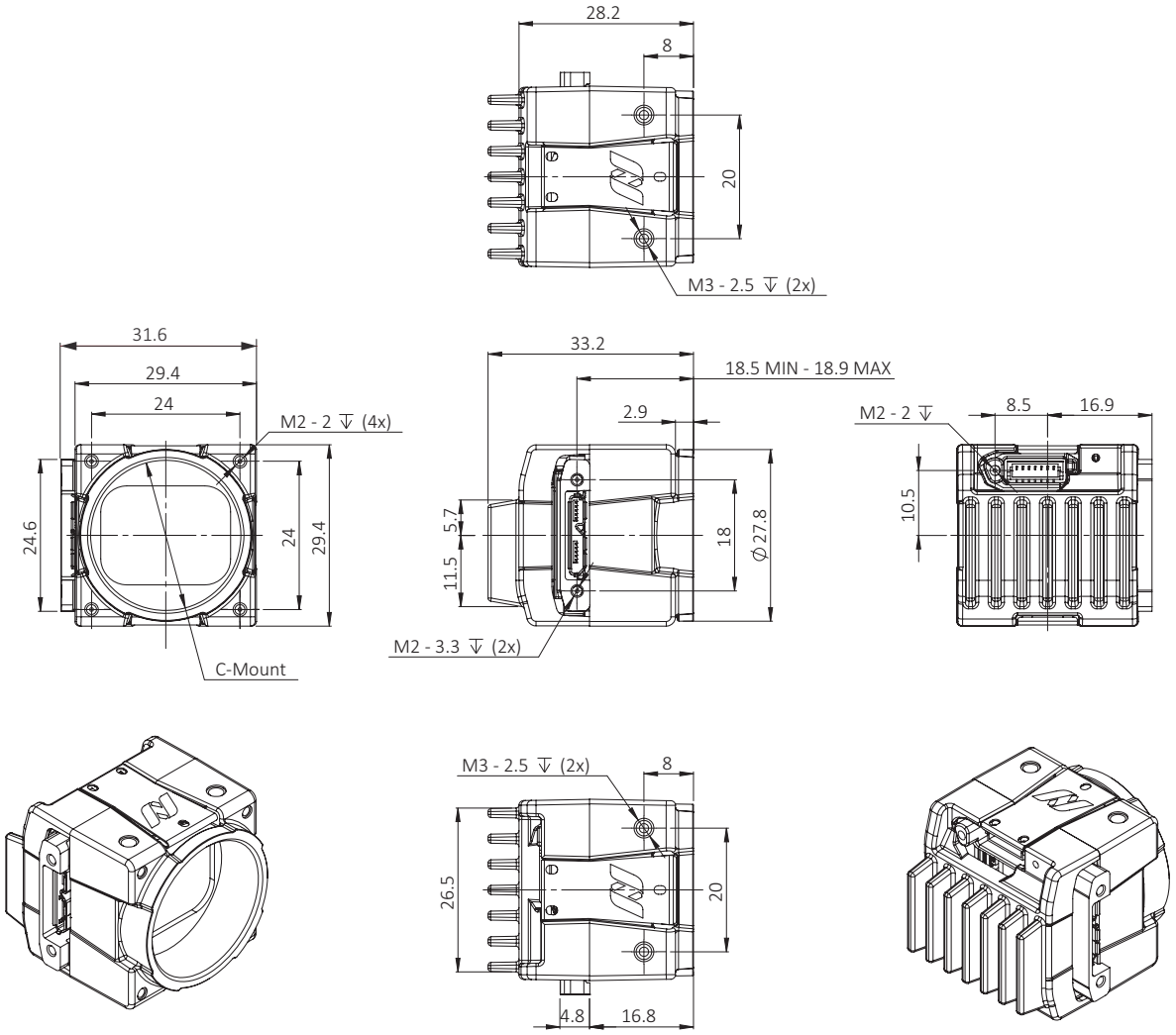



*Figure 11: Dimensions for USB 90° closed housing CS-Mount*

# USB 90° closed housing C-Mount

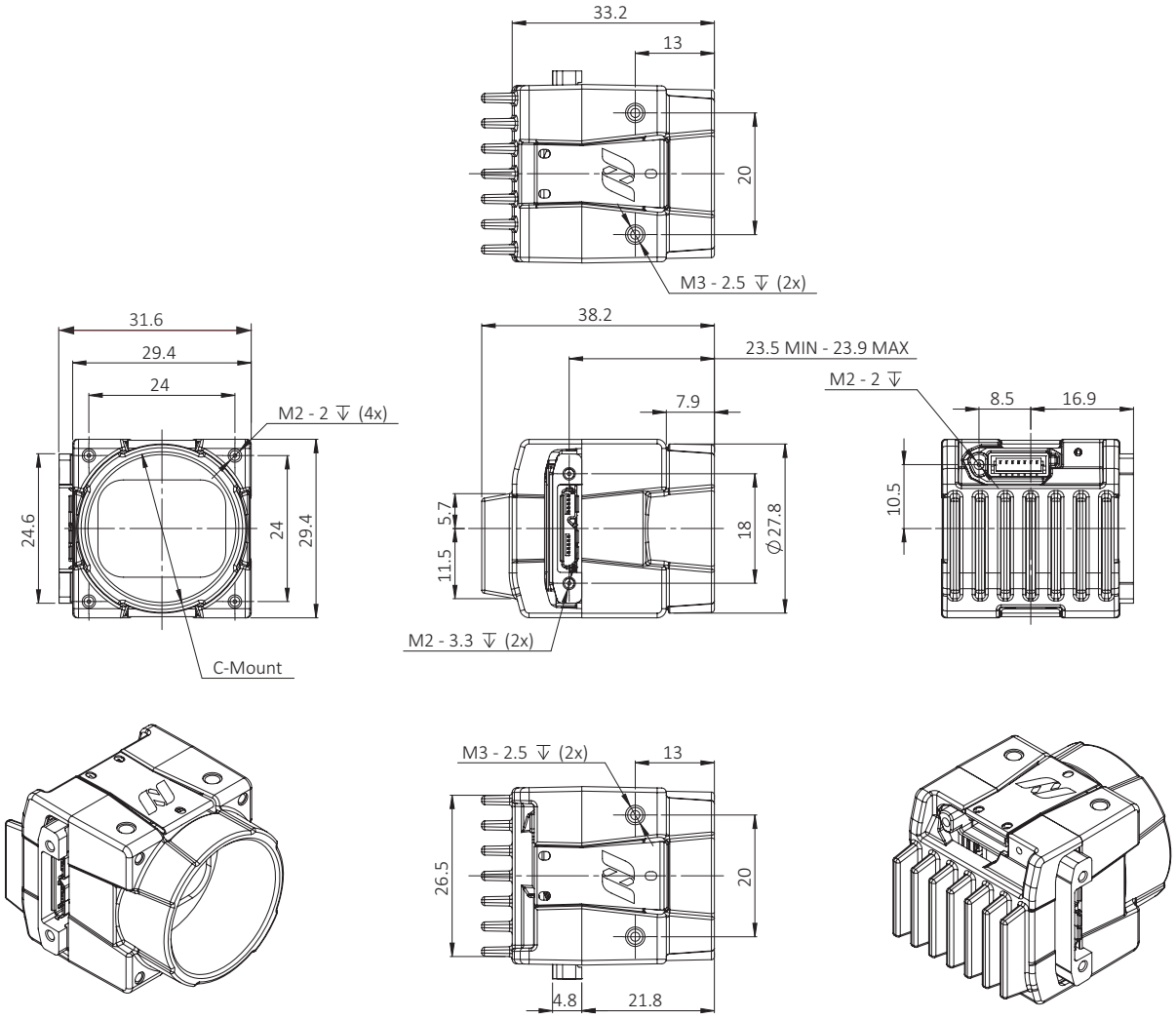



*Figure 12: Dimensions for USB 90° closed housing C-Mount*

# USB 180° open housing S-Mount

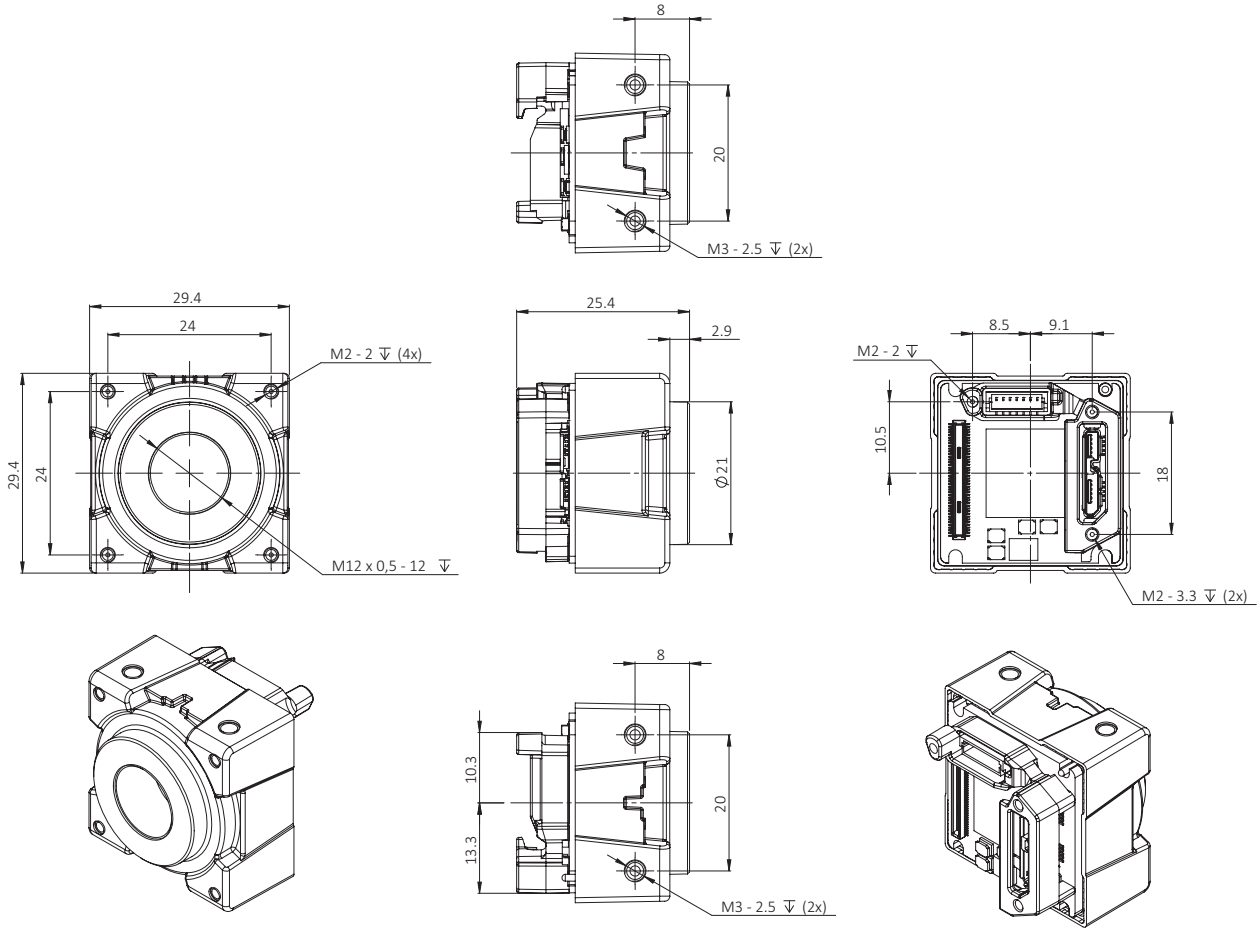



*Figure 13: Dimensions for USB 180° open housing S-Mount*

# USB 180° open housing CS-Mount

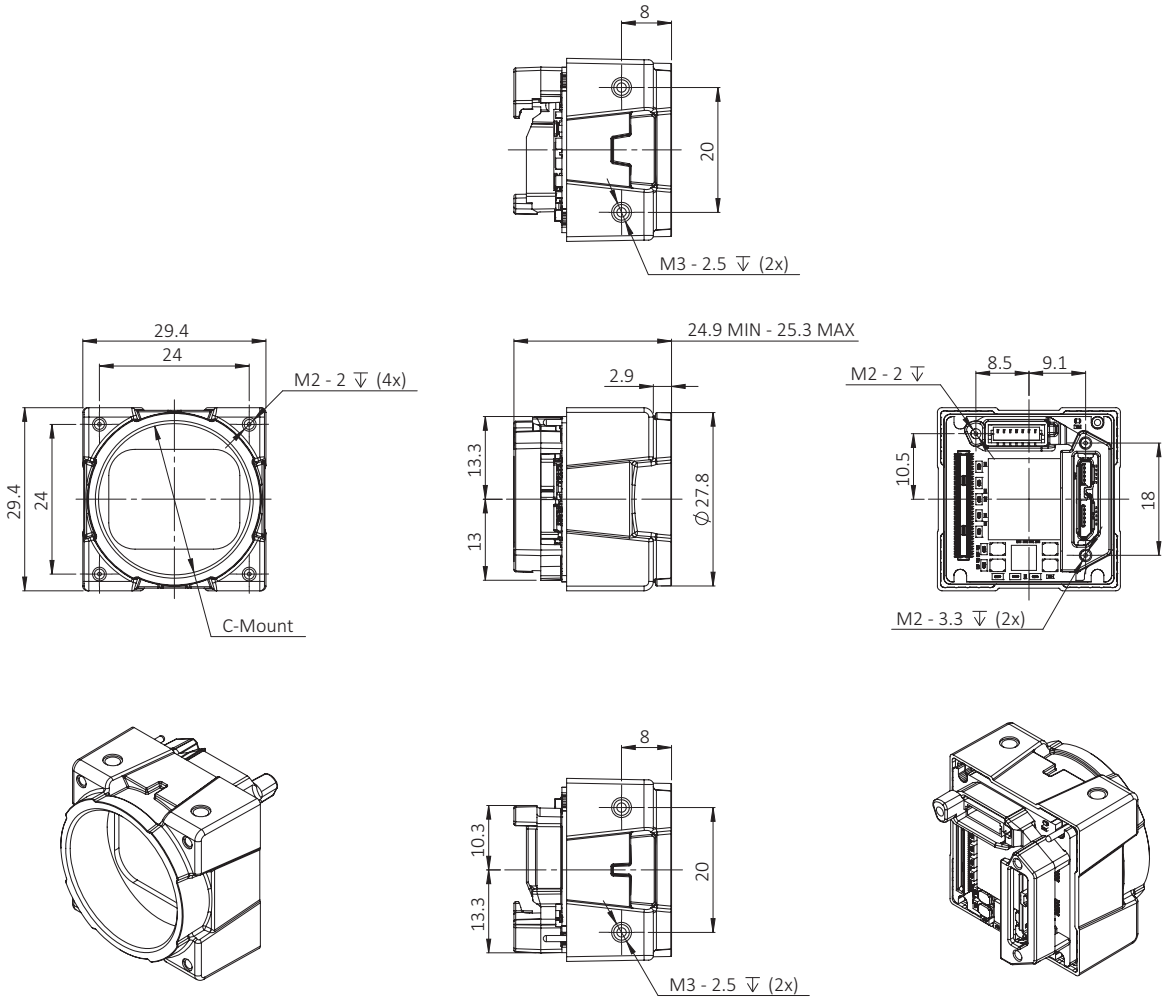



*Figure 14: Dimensions for USB 180° open housing CS-Mount*

# USB 180° open housing C-Mount

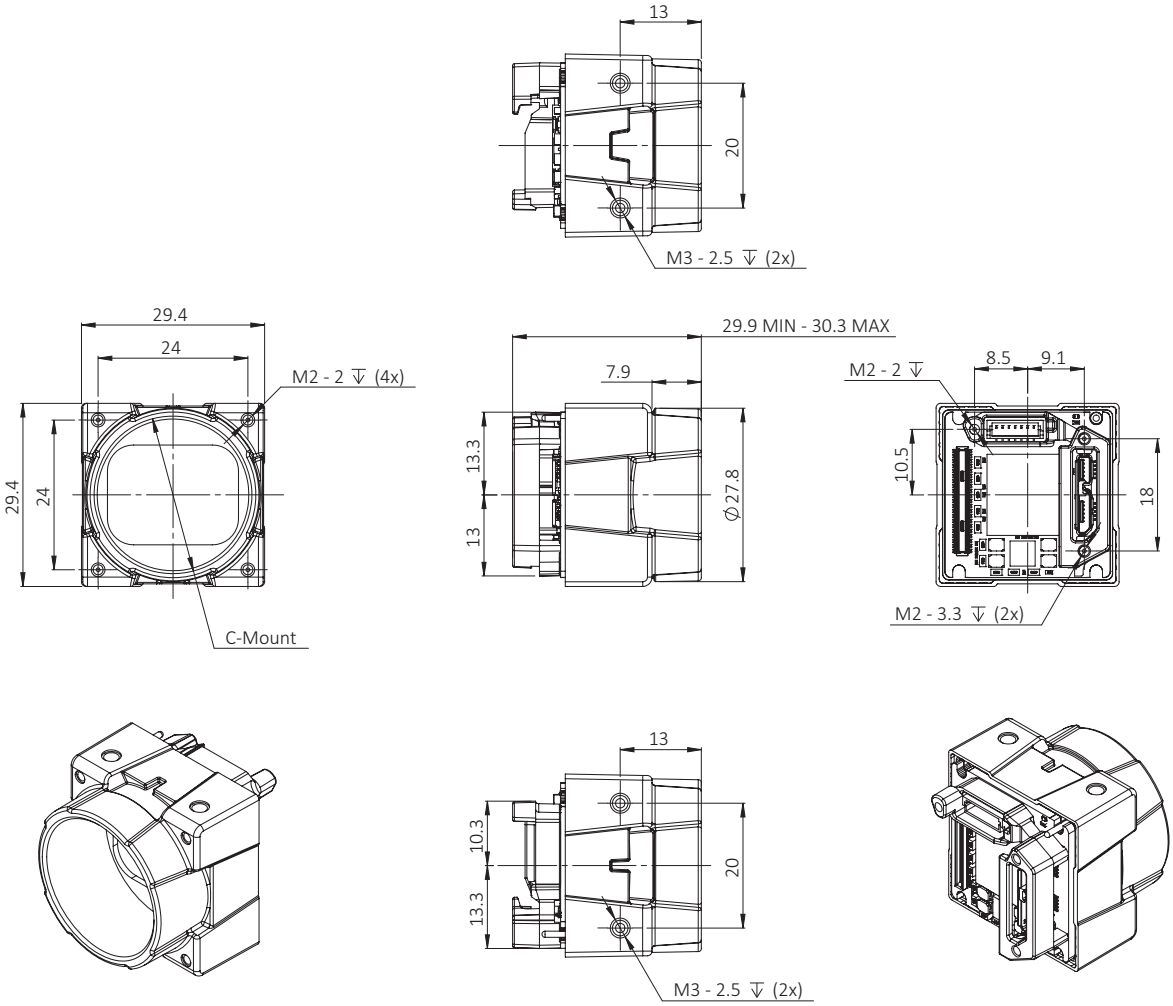



*Figure 15: Dimensions for USB 180° open housing C-Mount*

# USB 180° closed housing S-Mount

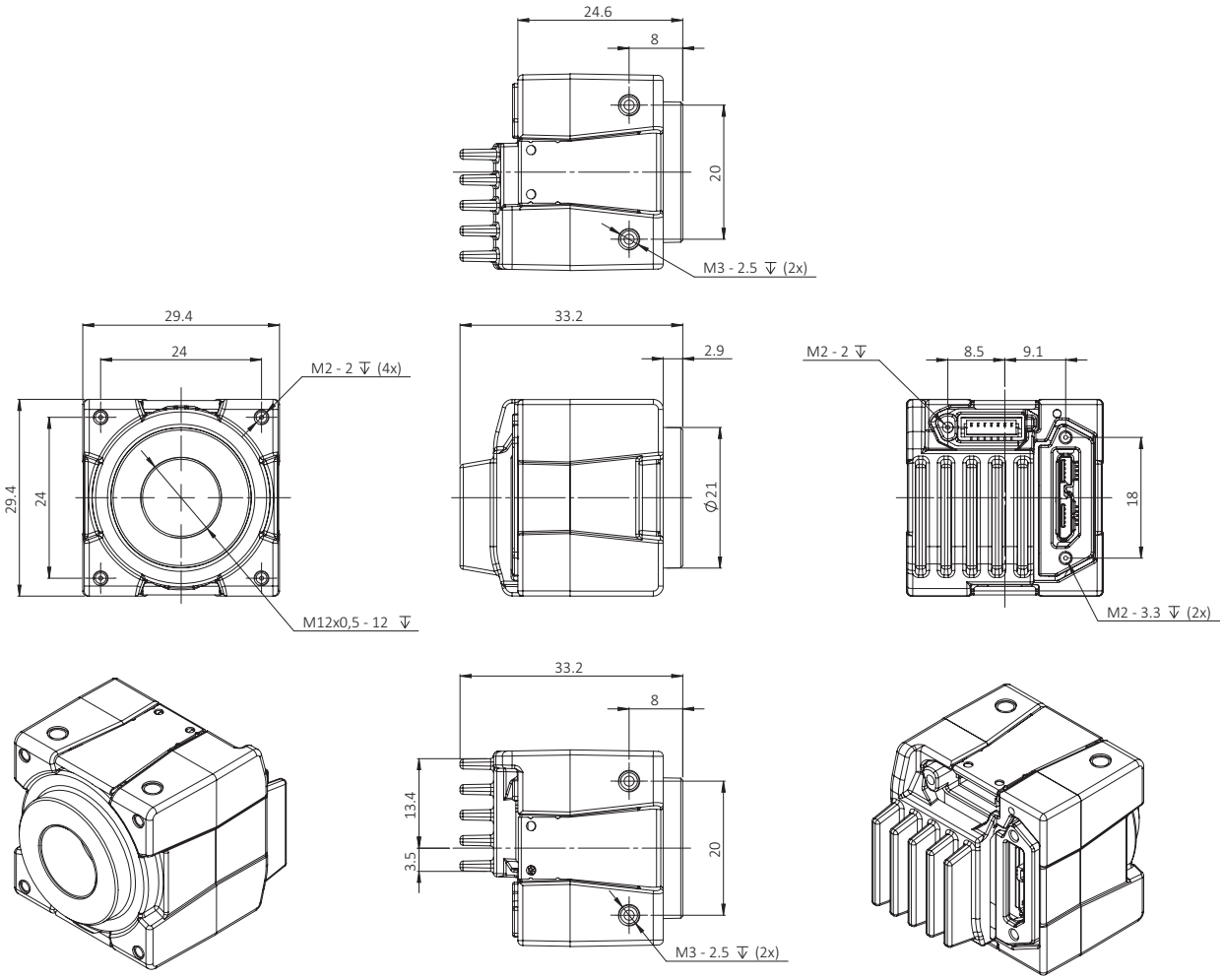



*Figure 16: Dimensions for USB 180° closed housing S-Mount*

# USB 180° closed housing CS-Mount

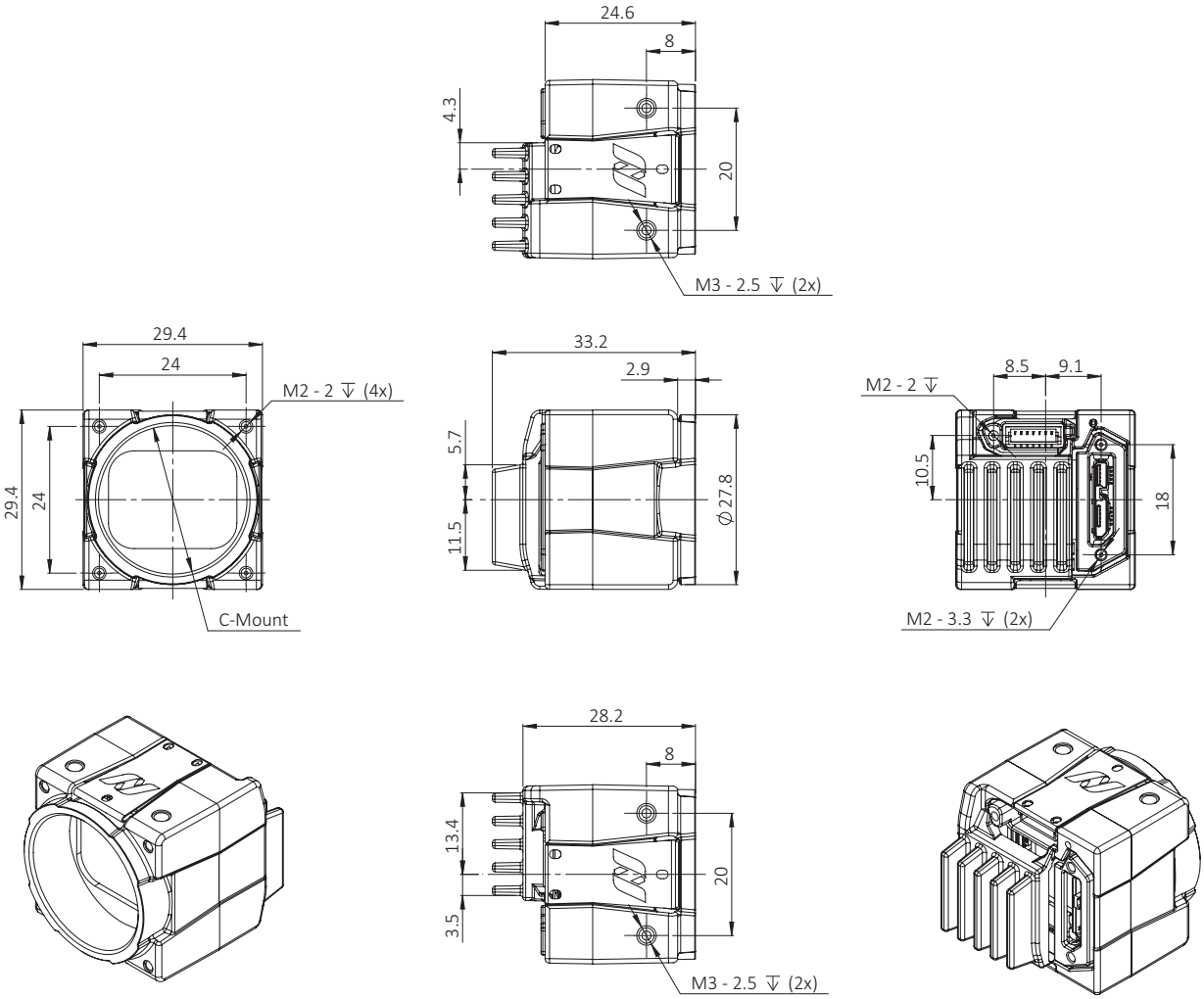



*Figure 17: Dimensions for USB 180° closed housing CS-Mount*

# USB 180° closed housing C-Mount

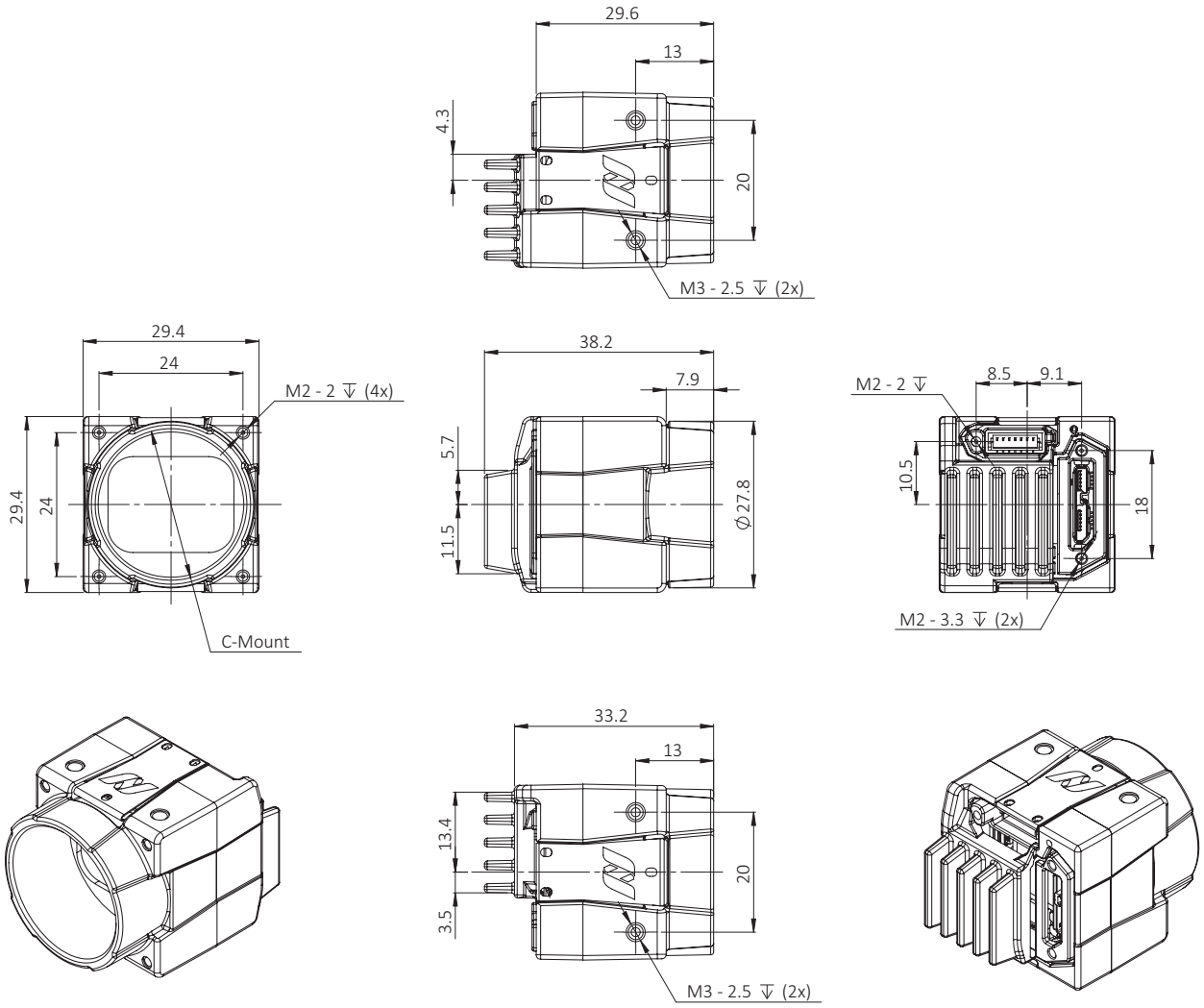



*Figure 18: Dimensions for USB 180° closed housing C-Mount*

# Lens mounts, filters, and maximum protrusion

**No need to readjust lens mounts**

Alvium USB camera mounts are adjusted with high precision during manufacturing. Construction ensures permanent accuracy without need to readjust.

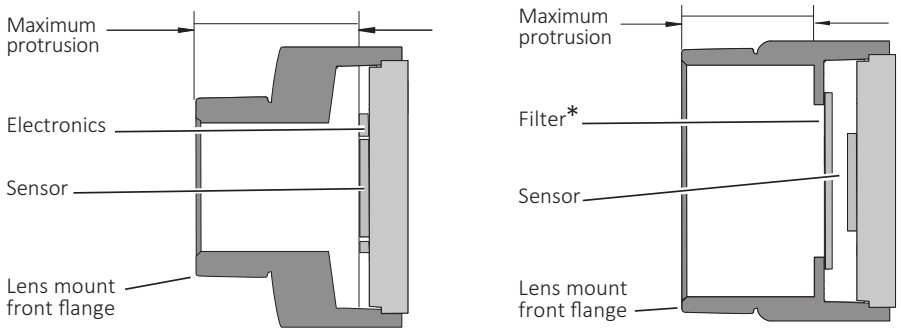



*Figure 19: Lens mount and maximum protrusion*
*S-Mount (left) | CS-Mount, C-Mount (right)*
**Only color models are equipped with an IR cut filter*

Figure 19 shows schematics for maximum protrusion of lenses, Table 12 on page 53 shows values for maximum protrusion.

**Filters in Alvium USB color cameras**

C-Mount and CS-Mount models of Alvium USB color models are delivered with IR cut filter. The filter is permanently installed and cannot be removed.
Monochrome and S-Mount models are delivered without filter. This extends the sensitivity for low-light imaging. Moreover, spectral sensitivity is increased. As a side effect, color, contrast, and sharpness can be affected by near-IR wavelengths.

***NOTICE***

**Damage to sensor or optics by unsuitable lenses**

The sensor, filter, or lens can be damaged if a lens exceeding maximum protrusion is mounted to the camera.

- Use lenses with less than the allowed maximum protrusion, see Table 12.
- See Mounting the lens on page 63.
- For S-Mount lenses, see Mounting and focusing S-Mount lenses on page 63.

| Mount | Maximum protrusion |
|---|---|
| S-Mount | 11.0 mm |
| CS-Mount | 8.6 mm |
| C-Mount | 13.6 mm |

*Table 12: Maximum protrusion for Alvium USB cameras*

# IR cut filter

By default, C-Mount and CS-Mount models of Alvium USB color models are delivered with an IR cut filter. The filter is employed to prevent infrared light from passing to the sensor. Without an IR cut filter, color reproduction quality can be affected and images may be blurred, depending on scene illumination. See Figure 20 for the filter transmission response.

**Spectral transmission values**

Values may vary slightly by filter lot.

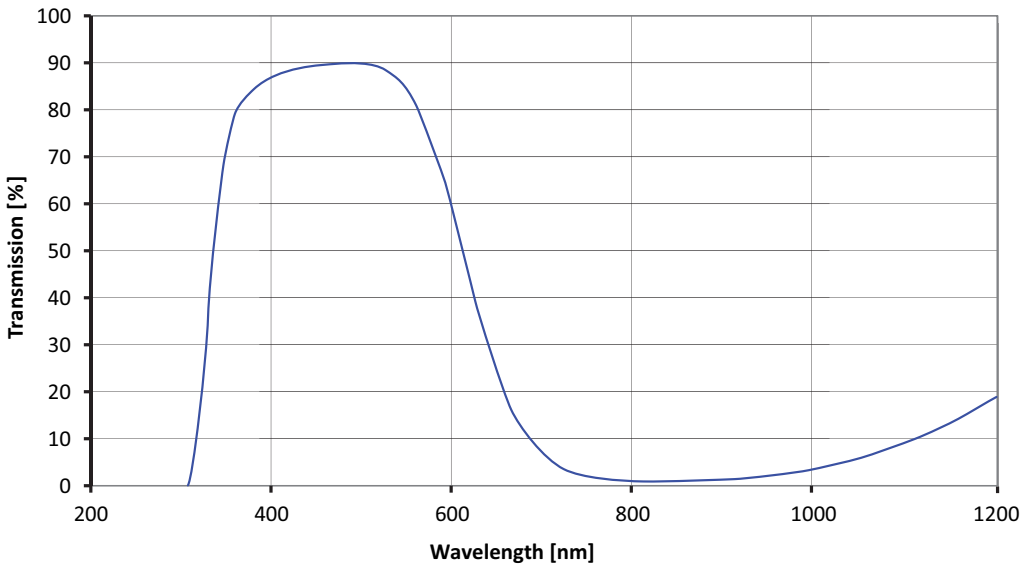



*Figure 20: Spectral transmission for IR cut filter*

Monochrome and S-Mount camera models are delivered without filter.

**S-Mount lenses with IR cut design**

For improved image quality, we recommend using S-Mount lenses that are IR- optimized or that have IR cut coating. See the *S-Mount Lenses User Guide* at https://www.alliedvision.com/en/products/accessories.

# Lenses: Focal length vs. field of view

This chapter includes:

# About this chapter

This section presents tables that list selected fields of view (FOV) depending on sensor size, distance, and focal length of the lens.

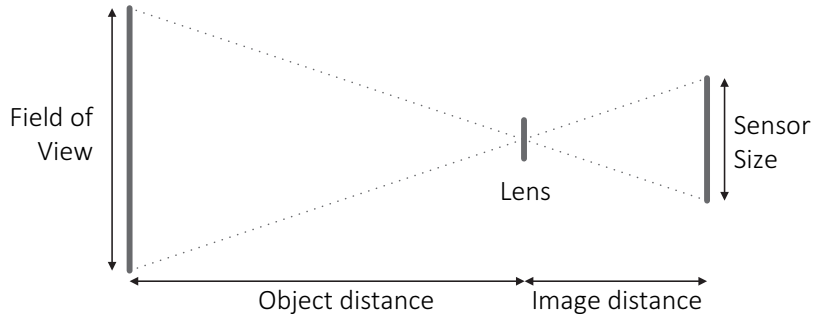



*Figure 21: Parameters used in tables for focal length vs. FOV*

**Allied Vision S-Mount lenses**

For technical data of Allied Vision S-Mount lenses with dedicated operating instructions, see the *S-Mount Lenses User Guide* at

https://www.alliedvision.com/en/products/accessories.

## Parameters in tables

The distance to the object is measured from the first principal the plane of the lens to the object. For some lenses, manufacturers to not define the principal plane position. Production spread causes tolerances for all values, including actual focal lengths. Calculations apply for image reproduction without distortion. Please ask your Allied Vision Sales representative in case you need more information.

# Optical vignetting with certain lenses

Lenses with short focal lengths may show optical vignetting at the edges of the image. Microlenses on the sensor pixels can increase the effect.

For demanding applications, we suggest testing camera and lens to find a suitable setup. If you have questions, please contact your Allied Vision Sales representative.

# About S-Mount lenses

Alvium USB color models with S-Mount have no filter. We recommend S-Mount lenses with an integrated IR-cut filter for a better image quality.

Read Mounting and focusing S-Mount lenses on page 63 to avoid damage when using S-Mount lenses.

# Focal length vs. field of view tables

## 1800 U-500, type 1/2.5

| Focal length [mm] | Field of view (H × V in mm) | |
|---|---|---|
| | Object distance = 500 mm | Object distance = 1000 mm |
| 2,8 | 1013 × 759 | 2031 × 1523 |
| 3,6 | 786 × 590 | 1578 × 1184 |
| 4,8 | 588 × 441 | 1182 × 887 |
| 6 | 469 × 352 | 945 × 709 |
| 8 | 351 × 263 | 707 × 530 |
| 12 | 232 × 174 | 469 × 352 |
| 16 | 172 × 129 | 351 × 263 |
| 25 | 108 × 81 | 222 × 167 |

*Table 13: Focal length vs. field of view (1800 U-500 cameras)*

# Installing the camera

This chapter includes:

# Mounting the heat sink

Alvium USB cameras must be cooled according to the specification. Bare board cameras and open housing cameras should be equipped with a heat sink to guarantee best heat dissipation.

**Optimizing heat dissipations**

For estimating requirements for your application and for designing heat dissipative housings, see the *Optimum Heat Dissipation for Housed Alvium Cameras* application note at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

***NOTICE***

**Damage to the camera by heat sinks mounted improperly**

- Allow mechanical contact only at the cooling areas.
- Avoid any mechanical stress to the sensor and electronics area.
- Avoid short circuits of the electronics components.

***NOTICE***

**Damage to the sensor, filter, and lens by corrosive substances**

Some conductive media for heat sinks contain corrosive substances that can damage optical surfaces of the sensor, filter, and lenses.

- Cover the optical path of the camera when you apply heat sink compound or adhesive to prevent substances and fumes from damaging optical surfaces.
- Adhere to the instructions and safety notes provided by the manufacturer of the conductive media.

***NOTICE***

**Damage to camera electronics**

Heat sinks can cause short circuits if they are not electrically isolated.

- Avoid electrical contact between electronic components by unsuitable heat sinks and thermal conductive media.

1. Connect components (blue areas in Figure 22) to a heat sink, following the instructions of the manufacturer of the heat sink and the thermal conductive media. (Cooling areas for Alvium USB 90° cameras are the same.)

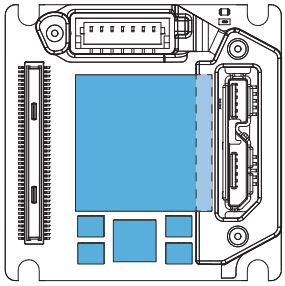


*Figure 22:* Components to be cooled for Alvium USB bare board cameras

# Mounting the camera

## Mounting bare board cameras

**Heat dissipation and housings for bare board cameras**

For heat dissipation, see the *Optimum Heat Dissipation for Housed Alvium Cameras* application note.

For designing suitable camera housings, see the *FPC Cables and Embedded Boards for Alvium USB Cameras* requirement specification.

For electromagnetic compatibility, see the *Electromagnetic Compatibility for Open Housing Alvium Cameras* application note.

You can find all documents at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

***NOTICE***

**Damage to the camera by improper mounting**

- Allow mechanical contact only at the mounting area.
- Avoid any mechanical stress to the sensor and the electronics area.
- Avoid short circuits of the electronics components.
- Give 2 mm minimum clearance above board components.
- Tighten screws at 0.1 Nm maximum torque.

Schematic drawings in Figure 23 show Alvium USB bare board cameras. Only the mounting area (gray) can be used for mounting. The sensor/electronics area (red) must not be touched nor put at mechanical stress.

a = Screw hole
b = Screw hole and chassis ground

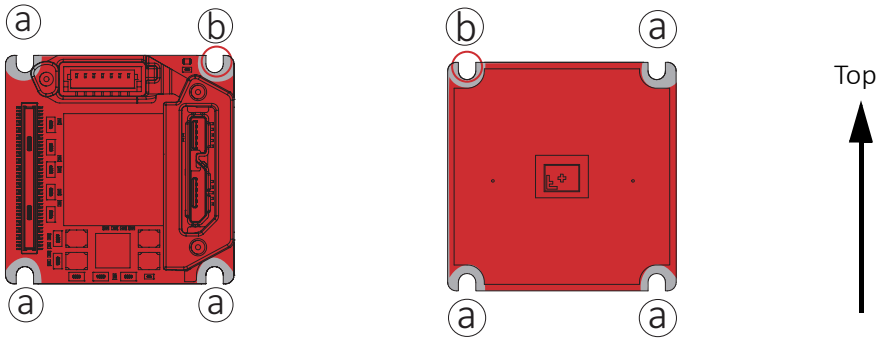



*Figure 23: Mounting area of Alvium USB bare board cameras connector side (left) | sensor side (right)*

1. Mount the bare board with four M2 screws at 0.1 Nm maximum torque. Mounting areas for Alvium USB 90° cameras are the same.

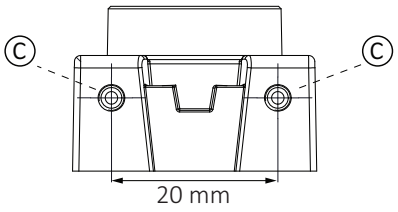
# Mounting housed cameras

**Tripod adapter**

For more information, see the *Alvium Cameras Accessory Guide* at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

## Bottom or top mounting

Camera top and bottom mounting is done the same way.

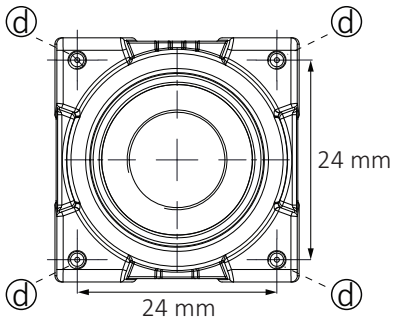



ⓒ = Mounting thread M3 -2↓

*Figure 24: Alvium USB camera, top and bottom with mounting threads*

1. Mount the camera to the base using suitable M3 screws at 0.6 Nm maximum torque for a thread engagement of 2.5 mm between screws and mounting threads, see Figure 24. For technical drawings, see Camera dimensions on page 37.
2. Continue with Mounting the lens on page 63.

## Front mounting




ⓓ = Mounting thread M2-2↓

*Figure 25: Alvium USB camera, lens mount with mounting threads*

1. Mount the camera to the base using suitable M2 screws at 0.18 Nm maximum torque for a thread engagement of 2 mm between screws and mounting threads, see Figure 25. For technical drawings, see Camera dimensions on page 37.
   We recommend to additionally use bottom and top mounting threads for a more solid connection.
2. Continue with Mounting the lens on page 63.

# Mounting the lens

Observe the notes below before you mount a lens to the Alvium camera.

**CAUTION**

**Cuts to the skin by sharp edges of lens mounts**

The threads of the lens mount and the lens itself have sharp edges.

- Be careful when mounting or unmounting lenses.

***NOTICE***

**Damage to sensor or optics by unsuitable lenses**

The sensor, filter, or lens can be damaged if a lens exceeding maximum protrusion is mounted to the camera.

- Use lenses only up to the specified the maximum protrusion, see Lens mounts, filters, and maximum protrusion on page 53.
- S-Mount lenses must be screwed into the camera less than maximum protrusion (11.0 mm), see Mounting and focusing S-Mount lenses on page 63.
- Avoid short S-Mount lenses falling into the camera.

## Mounting and focusing S-Mount lenses

**Allied Vision S-Mount lenses**

For technical data of Allied Vision S-Mount lenses with dedicated operating instructions, see the *S-Mount Lenses User Guide* at

https://www.alliedvision.com/en/products/accessories.

This section instructs how to use S-Mount lenses with your camera safely.

S-Mount lenses are screwed into the mount to adjust focus. Vibration moves lenses out of position. Several techniques can be used to fasten S-Mount lenses in focus. We recommend using fixing nuts. See instructions in this section.

**S-Mount fixing nuts in instructions drawings**

Several manufacturers offer various types of S-Mount fixing nuts. The type shown in the instructions drawings display an example.

Figure 26 shows how fixing nuts lock S-Mount lenses.

Follow the instructions to lock the lens in focus position.

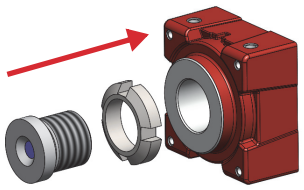


Figure 26: Fixing nut locking an S-Mount lens

**NOTICE**

**Damage to sensor or optics by improper handling**

If an S-Mount lens is screwed against the sensor, sensor and lens can be damaged.

- Screw in the lens at 11.0 mm maximum protrusion.
- Follow the instructions carefully.

**Determining the allowed range for the position of the lens**

1. Measure the length of the lens.
2. Calculate: **a = c – b**
   a: length of the lens, measured from lens mount front flange
   b: maximum protrusion (11.0 mm)
   c: length of the lens

   See Lens mounts, filters, and maximum protrusion on page 53.
3. Set a gauge to the length of (a).

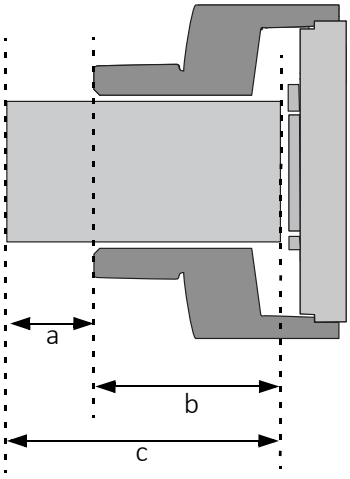



Figure 27: S-Mount lens and maximum protrusion

**Mounting the fixing nut to the lens**

4. Screw the fixing nut clockwise onto the lens until you can hold the front part (d) of the lens with your finger tips.

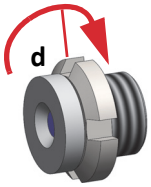



Figure 28: Lens and fixing Nut

**Focusing the lens**

5. **Checking (a) with a gauge**, slowly screw the lens clockwise into the lens mount until the image is roughly in focus.
6. Slowly screw the lens in and out until you have found most accurate focus.

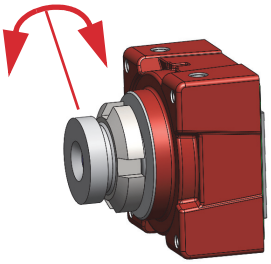


Figure 29: Adjusting focus

**NOTICE**

**Damage to lens threads and fixing nut by excessive force**

If the fixing nut is screwed with too much force, threads are worn out and the lens cannot be locked anymore.

- Screw fixing nuts only with little force to keep the lens in a fix position.

**Locking focus**

Pinch nose pliers are used to screw the fixing nut:

7. Holding the lens in position with one hand, screw the fixing nut clockwise against the lens mount until you feel the lens is locked.

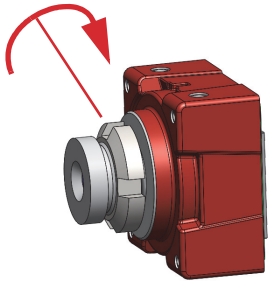


Figure 30: Tightening the fixing nut

**Checking focus is set and locked properly**

8. Check No.1: Try to rotate the lens with little strength in both directions to ensure the lens is safely locked in position.

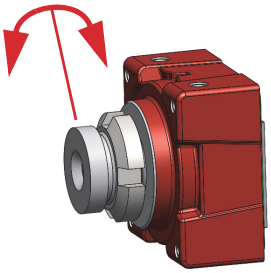


Figure 31: Checking lens is safely locked

9. Check No. 2: S-Mount thread allows a slightly tilted lens position. In this case, focus for a common object plane varies over the image plane.
   **If focus is constant** over the image plane, you are done.
   **If focus varies** over the image plane, the lens is tilted. Continue with 10.

10. Loosen the fixing nut.

11. Continue with 6.

    The lens is locked in focus and ready for operation.

# Software and driver installation on the host PC

## Prerequisites

**Easy camera access with Vimba**

This section lists general requirements to operate Alvium USB cameras on your system.

To download **Vimba Suite** for Windows, Linux, and Linux/Arm, including **Vimba SDK**, **Vimba Viewer**, and **Vimba Driver Installer** for Windows, see https://www.alliedvision.com/software.

For more details see **ReleaseNotes_Linux.txt** or **ReleaseNotes_Windows.txt** in the directory of your **Vimba** installation, or see https://www.alliedvision.com/software.

## Required components

**Driver installation and OS support**

**Windows**: Please use **Vimba** to install the camera driver. For **Vimba** system requirements and supported Windows versions, see https://www.alliedvision.com/software.

**Linux**: Allied Vision does not provide a special driver. For **Vimba** system requirements and supported operating systems, see https://www.alliedvision.com/software.

You need the following accessories:

- USB 3.0 / 3.1 Gen 1 external host controller card or on-board host controller
- USB 3.0 / 3.1 Type-A to Micro-B cable.

**Compatible USB 3.0 / 3.1 Gen 1 accessories**

See the *Alvium Cameras Accessory Guide* at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

## Installing the camera driver using Vimba on a Windows system

Instructions in this chapter describe installation of the camera driver using **Vimba** on a Windows system. On Linux systems, the generic driver for USB3 Vision devices is used.

**Unexpected events**

Should installation or operation not work properly, see Troubleshooting and performance on page 85.

## Using the camera with third-party drivers

Alvium USB cameras may not support third-party drivers. We recommend using the **Vimba** camera driver.

# Installing drivers for camera and host adapter

## Installing host adapter and Vimba

1. Install the USB 3.0 / 3.1 Gen 1 host controller card and driver according to the manufacturer's instructions.
2. Download and install **Vimba**:
   https://www.alliedvision.com/software.
3. Next step: Installing the camera driver on page 67.

## Installing the camera driver

**Connecting the camera to a USB 2.0 port**

If the Alvium USB camera is connected to a USB 2.0 port, the **Vimba** driver can be installed and the camera can be configured and operated. But for full performance, the camera must be connected to a USB 3.0 / 3.1 Gen 1 port.

- For performance, connect the camera to a USB 3.0 / 3.1 Gen 1 port.

**Command line driver installer**

**Vimba** also provides a command line driver installer. For more information about the **Vimba Driver Installer**, see the *Vimba Manual*.

During the **Vimba** installation, select at least **Camera Demonstration** and **Vimba Applications** to operate Alvium USB cameras. If the camera is not recognized or to subsequently change an assigned driver., follow the instructions below.

1. Connect your Alvium USB camera to the PC using a USB 3.0 / 3.1 Type-A to Micro-B cable.
2. Start **Vimba Driver Installer** and open the **USB3 Vision Cameras** tab.
   The **Driver Source** is not installed, yet.
   If other USB3 Vision devices are installed, another USB3 Vision driver may be assigned to your camera.
3. Click the Alvium USB camera entry.
   The current **Vimba** driver is offered as a popup (Vimba 2.1.1 in the example).

4. Click the **Vimba** driver popup.

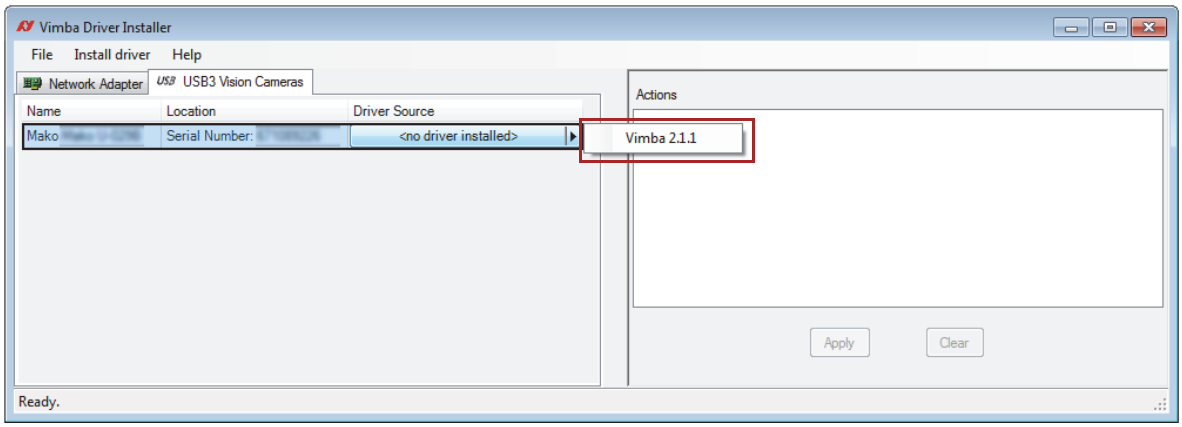



*Figure 32: Vimba Driver Installer, camera driver not installed*

5. Click *Apply* to install the **Vimba** driver for the camera.

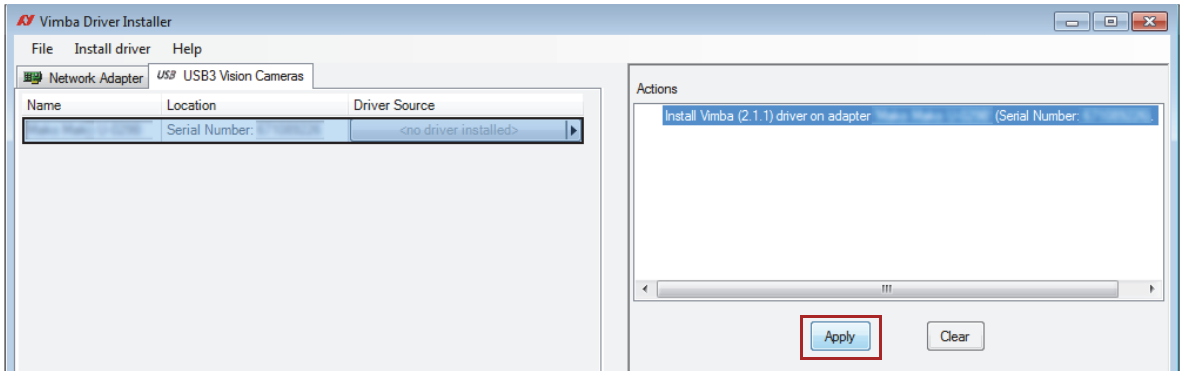



*Figure 33: Vimba Driver Installer, driver installation started*

The driver has been installed successfully.

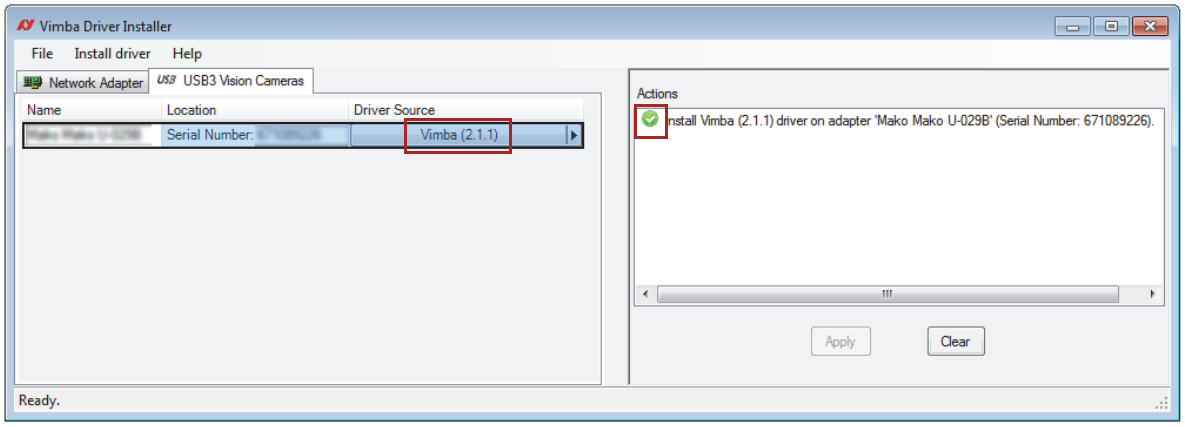



*Figure 34: Vimba Driver Installer, driver installed successfully*

**Manual Vimba Driver installation**

Windows: For manual **Vimba** driver installation, see instructions below.

## Installing the camera driver with Windows tools

As alternative practice, you can install the **Vimba** driver manually. Check for connected USB devices on your Windows system.

**Screenshots are examples**

The following screenshots were taken on a test system. The view may be different, depending on the configuration of your system.

Under Windows, the **Device Manager** provides an overview of USB resources and connected devices. As long as the **Vimba** USB device driver is not installed, the camera is not recognized.

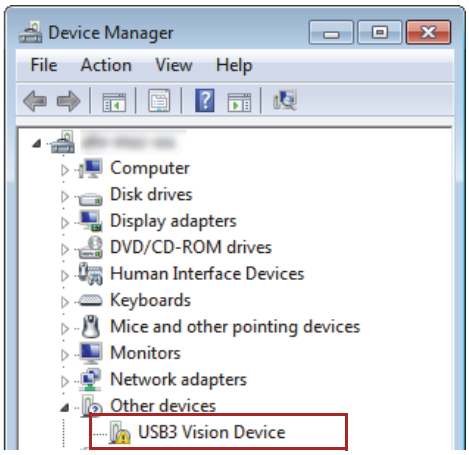



*Figure 35: Windows Device Manager, unrecognized USB3 Vision camera*

If no **USB3 Vision Device** is displayed under the section **Other devices**, continue with action step 1. Otherwise, continue with action step 3.

1. Look at the section **Universal Serial Bus controllers**.
2. Disable the new found **USB Composite Device** and enable it again.
   This creates the entry under the section **Other Devices** as shown in Figure 35.

3. Right-click the unrecognized **USB3 Vision Device**.

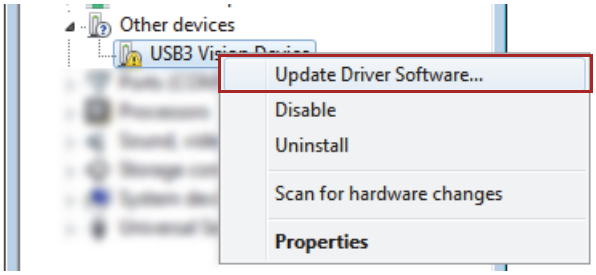



*Figure 36: Windows Device Manager, Windows Driver Installer*

4. Click: “Browse my computer for driver software”.
5. Select [Your local Vimba directory]\Allied Vision\Vimba_V.x.x\VimbaUSBTL\Driver.
6. Follow the instructions.
   The camera driver is installed successfully.

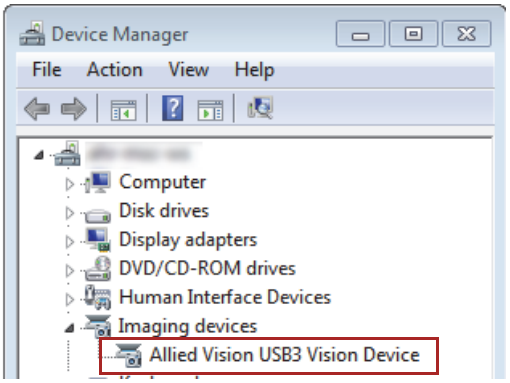
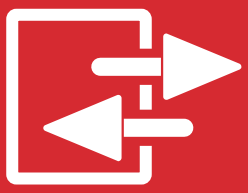



*Figure 37: Windows Device Manager, USB3 Vision camera installed successfully*

# Camera interfaces



This chapter includes:

# Recommended accessories

**Compatible electronics accessories**

See the *Alvium Cameras Accessory Guide* at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

# Back panel

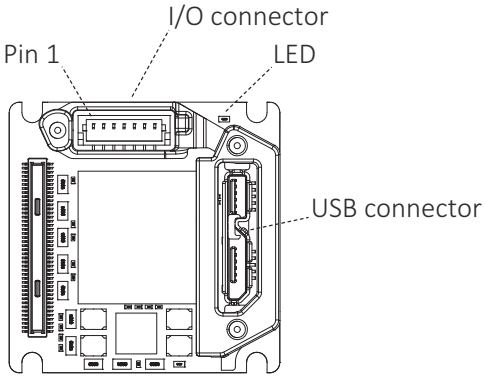



*Figure 38: Alvium USB bare board camera with 180° USB connector*

### Interface descriptions

| Interface | Section in this manual |
|---|---|
| I/O connector | Non-isolated, programmable GPIOs on page 74 |
| Status LED | Status LED on page 76 |

*Table 14: Interface descriptions overview*

# I/O connector pin assignment

**I/O connector details**

JST BM07B-SRSS-TBT connector set consists of:
Camera connector: JST BM07B-SRSS-TBT
Cable housing: JST SHR-07V-S
Cable, crimp contacts: JST SSH-003T-P0.2-H

See https://www.jst.de. for details.

**I/O cables and electromagnetic interference (EMI)**

Please consider for I/O cables by Allied Vision:

- 12319 JST I/O cables without screw lock have no shielding and are designed to be used with bare board or open housing Alvium cameras.
- For applications without an additional EMC protective housing, please use shielded cables, such as 12322 JST I/O cables **with screw lock**.

***NOTICE***

**Damage by reverse polarity**

If Alvium USB cameras are externally powered with reverse polarity, the cameras can be damaged.

- Power Alvium USB cameras according to the specifications described in this section.

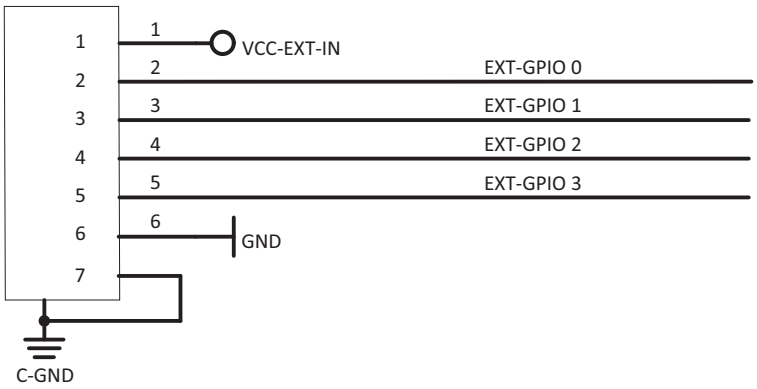



*Figure 39: Pin assignment of JST BM07B-SRSS-TBT type I/O connector*

| Pin | Signal | Direction | Level | Description |
|---|---|---|---|---|
| 1 | VCC-EXT-IN | PWR IN | 4.5 to 5.5 VDC | Power supply voltage<br>See Camera power on page 18. |
| 2 | EXT-GPIO 0 | IN/OUT | $U_{in}$ (low) = -0.3 to 0.8 VDC<br>$U_{in}$ (high) = 2.0 to 5.5 VDC<br>$U_{out}$ (low) = 0 to 0.4 VDC<br>$U_{out}$ (high) = 2.4 to 3.3 VDC @ max. 12 mA | General purpose input / output<br>Internal pull-up resistor: 33 kΩ to 63 kΩ |
| 3 | EXT-GPIO 1 | IN/OUT | See Pin 2, EXT-GPIO 0 | |
| 4 | EXT-GPIO 2 | IN/OUT | See Pin 2, EXT-GPIO 0 | |
| 5 | EXT-GPIO 3 | IN/OUT | See Pin 2, EXT-GPIO 0 | |
| 6 | GND | PWR | 0 VDC | Power supply ground |
| 7 | C-GND | PWR | 0 VDC | Chassis ground and shielding |

*Table 15: Pin assignment of the JST BM07B-SRSS-TBT type I/O connector*

# Non-isolated, programmable GPIOs

**I/O cables maximum length**

The maximum length for I/O cables must not exceed 30 m.

## GPIOs description

The camera has four non-isolated GPIOs that can be configured by software to act as inputs or outputs.

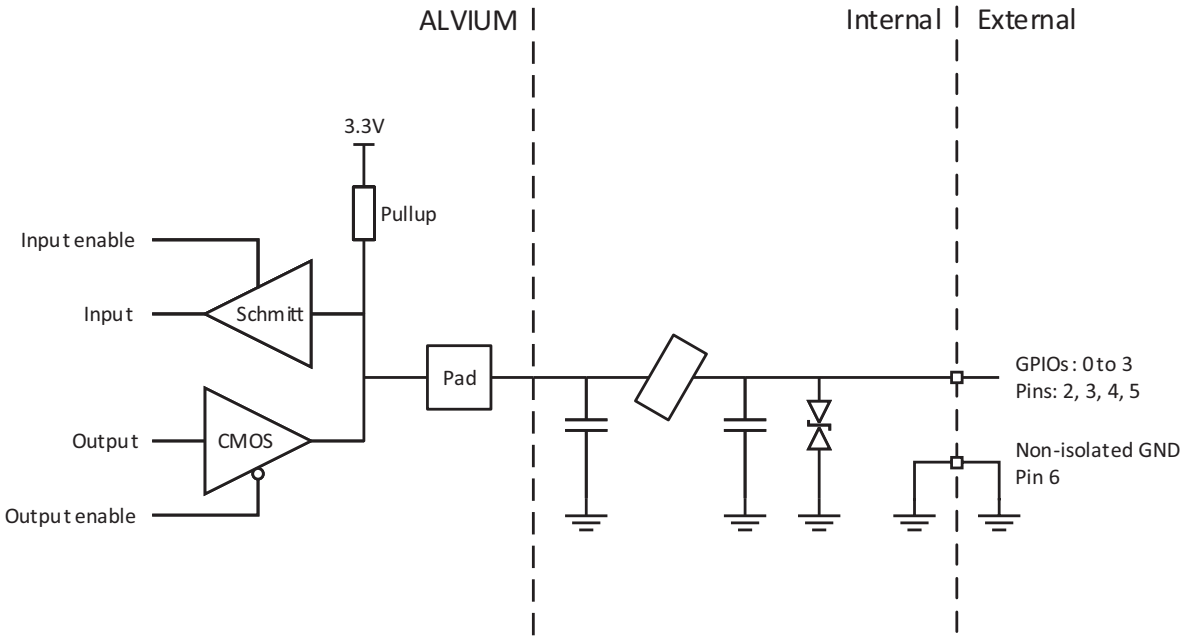



*Figure 40: GPIOs, block diagram*

# Input levels

The GPIOs can be connected directly to the system controlling the camera for voltages up to 5.5 VDC. An external resistor is not necessary.

**NOTICE**

**Damage to the camera by high input voltage**

Exceeding maximum input voltage can damage the camera.

- Keep maximum input voltage below 5.5 VDC.

| Parameter | Value |
|---|---|
| $U_{in}$ (low) | -0.3 to 0.8 VDC |
| $U_{in}$ (high) | 2.0 to 5.5 VDC |
| Undefined levels | 0.8 to 2.0 VDC |

*Table 16: GPIOs as input, voltage levels*

# Output levels

**NOTICE**

**Damage to the camera by high output current or voltage**

The camera can be damaged when connected to a device that exceeds the specified maximum current or voltage. Consider maximum values:

- Max. current = 12 mA per output
- Max. Out VCC = 3.3 VDC

| Parameter | Value |
|---|---|
| External output voltage $U_{out}$ (low, Off state) | 0 to 0.4 VDC |
| External output voltage $U_{out}$ (high, On state) | 2.4 to 3.3 VDC |
| Undefined levels | 0.4 to 2.4 VDC |
| Maximum external output voltage | 3.3 VDC |
| Maximum output current | 12 mA |

*Table 17: GPIOs as output, current and voltage levels*

**Output voltage in the On state**

The voltage level in the On state depends on the load current. Higher currents yield lower voltage.

# Status LED

Alvium USB cameras have a green status LED. The following tables describe the flashing pattern indicating different events. Inverse flashing: If an LED is already on, it is switched off for a short time.

**LED settings**

LED settings can be changed only if the camera is operated using GenICam features:

- You can define LED settings with the `DeviceIndicatorLuminance` feature. A value of *10* enables LED signaling at the highest luminance level.
- Values below *10* reduce the luminance level.
- *0* disables LED signaling.

## Normal operation

| LED codes | Behavior | Status |
|---|---|---|
|  | Continuously active | Power on/idle state |
|  | Irregular flashing | Command or image traffic, such as for camera startup |
|  | 4 short flashes | Error state |

*Table 18: LED codes for normal operation*

**LED codes during firmware update**

For LED codes signaling a firmware update, see To update the firmware, follow the instructions of the *Vimba Manual*. on page 84.

## Error conditions

4 short flashes followed by another sequence indicates errors. In this case, try the following to get the camera back to normal operation:

- Restart the camera.
- Should this fail, recover the firmware. See Firmware update on page 84.
- Should this fail, please contact support@alliedvision.com

# Triggering and timings

This chapter includes:

# Compensation for the rolling shutter effect

This section is about sensor shutter types affecting moving images.

Some cameras have **global shutter** sensors, see Figure 41 shows the global shutter effect: All sensor lines (left) are integrated simultaneously, the image (right) of a rotating fan appears natural.


*Figure 41: Global shutter - unavailable with Alvium U 1800-500 cameras*

1800 U-500 cameras have a **rolling shutter** sensor. Figure 42 shows the rolling shutter effect: Sensor lines (left) are integrated sequentially, the image (right) of a rotating fan appears distorted.

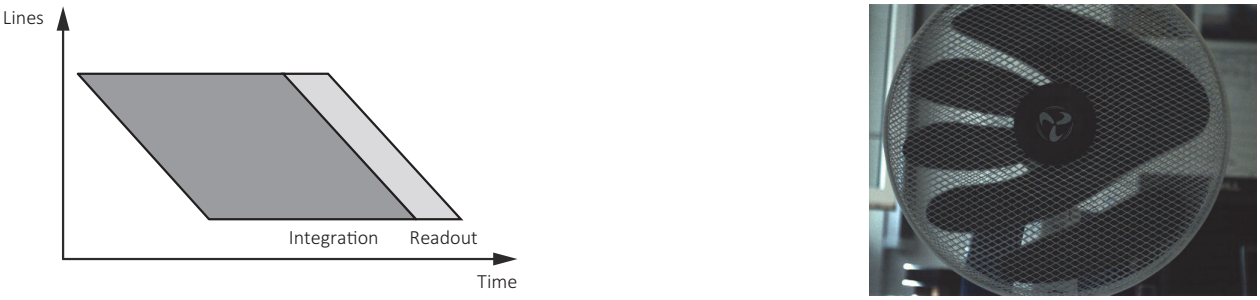



*Figure 42: Rolling shutter effect with 1800 U-500*

**Avoiding the rolling shutter effect** with the 1800 U-500 camera: Figure 43 shows how the rolling shutter effect can be avoided. With a strobe light fired while all sensor lines (left) are integrating, the image (right) of a rotating fan appears natural.

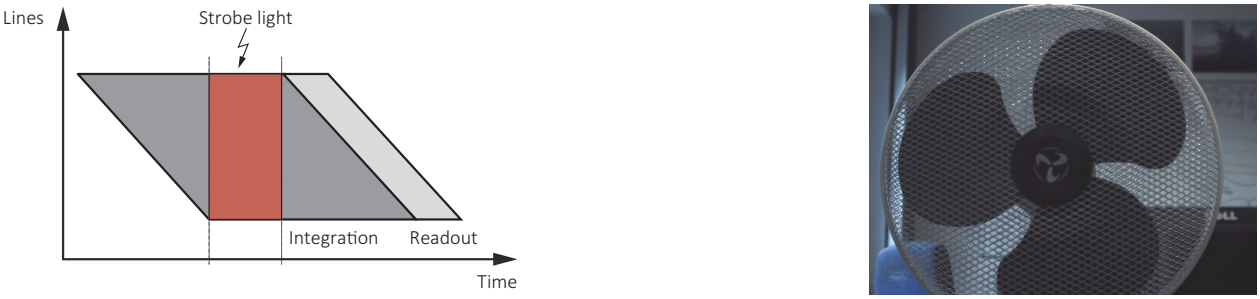



*Figure 43: Avoiding the rolling shutter effect with 1800 U-500*

# Trigger signal flow

Figure 44 shows a general diagram for the trigger signal flow. The external signal can be a physical source, such as light barrier as hardware trigger or a software trigger. This external signal starts the exposure of a frame. The end of exposure starts the readout. High levels show the active state of a signal.

**Features availability**

States displayed below apply to Alvium USB cameras. The corresponding features may not be supported. See the Alvium Cameras Features Reference at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html for details.

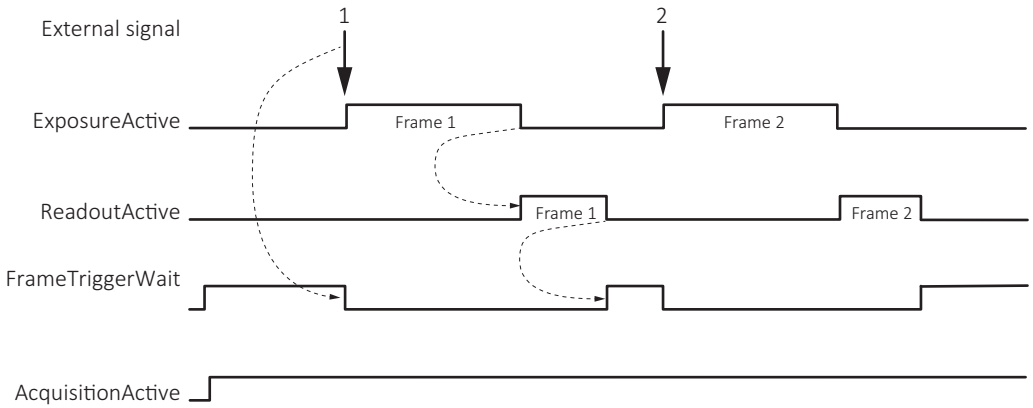



*Figure 44: Schematic trigger signal flow*

| Term | Description |
|---|---|
| External signal | Electrical trigger signal starting the signal flow |
| *ExposureActive* | Exposing a frame |
| *ReadoutActive* | Reading out a frame |
| *FrameTriggerWait* | Waiting for a trigger |
| *AcquisitionActive* | Enables frame acquisition: Expose, read out data, or wait for triggers. |

*Table 19: Trigger signal flow, legend*

# Trigger latency

In theory, a trigger creates a camera response at speed of light, depending on the cable length. In practice, the host PC may add a delay that is mostly unpredictable, especially on Windows systems. In addition, camera electronics and sensors have a delay.

Electronic rolling shutter (ERS) cameras in this document also have exposure delay, depending on camera settings, see Triggering with rolling shutter cameras on page 81. Electronic rolling shutter is commonly called rolling shutter.

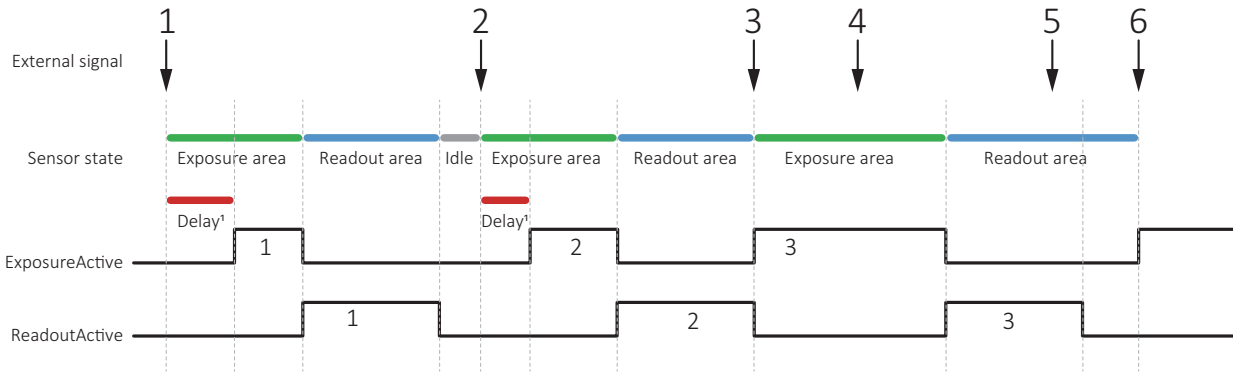
# Triggering with rolling shutter cameras

This section describes triggering behavior for 1800 U-500 cameras with rolling shutter sensor.

Figure 45 shows how an external signal triggers exposure and readout for cameras with rolling shutter sensors. As for global shutter sensors, readout has a constant duration, acquisition must be active to enable exposure, the end of exposure starts readout.

ERS sensors run in cycles where readout area equals exposure area. Overlapping triggering is not supported. If exposure time is shorter than readout time, exposure starts with a delay:

Exposure start delay = exposure area – exposure time




**Legend** ¹Exposure start delay

*Figure 45: Triggering rolling shutter cameras*

1. Exposure time is shorter than readout time.
   Trigger 1 starts exposure 1 with a delay
2. Exposure time is shorter than readout time, but **longer** than for exposure 1.
   Trigger 2 starts exposure 2 with a delay **shorter** than for exposure 1.
3. Exposure time is longer than readout time.
   Trigger 3 starts exposure time without a delay. Because the exposure area is longer, also the readout area is longer than for triggers 1 and 2.
4. Exposure area is ongoing.
   Trigger 4 is ignored.
5. Readout area is ongoing.
   Trigger 5 is ignored.
6. Readout area is finished. Exposure time is longer than readout time.
   Trigger 6 starts exposure 6 without a delay.

**Available values for TriggerSelector**

Cameras with rolling shutter **can** be triggered using ***AcquistionStart***, ***AcquisitionEnd***, or ***FrameStart*** for `TriggerSelector`.

Cameras with rolling shutter **cannot** be triggered using ***ExposureStart*** or ***ExposureEnd*** for `TriggerSelector`.

# Value changes by features interdependencies

The conversion between time and clock cycles affects control values. Features for pixel format, bandwidth, region of interest, exposure time, and triggering are related to each other. Changing values for one feature can change values for another feature. For example, frame rates can be reduced when the pixel format is changed subsequently. Figure 46 shows the interdependencies.

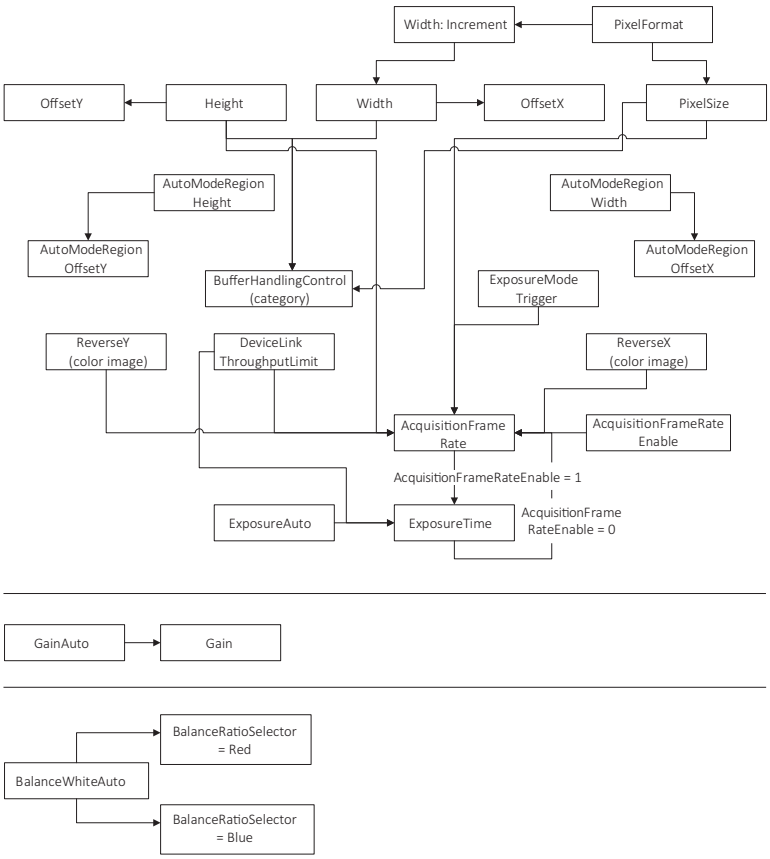



*Figure 46: Interdependencies between features*

# Effects for the related features

Changing one feature's value affects other feature's values, such as:

- Height value is changed.
- A changed Height value may affect other values, such as for Frame Rate and ExposureTime.

We recommend you to consider:

- The more features you adjust, the more current values deviate from previously set values.
- The same effects that apply to ExposureTime, apply to AutoExposure, too.
- To avoid readjustments, follow the order displayed in Figure 46.

# Image data flow

## Alvium USB cameras

The following flow chart shows image data processing for Alvium USB cameras in general. The legend below informs about image processing details.

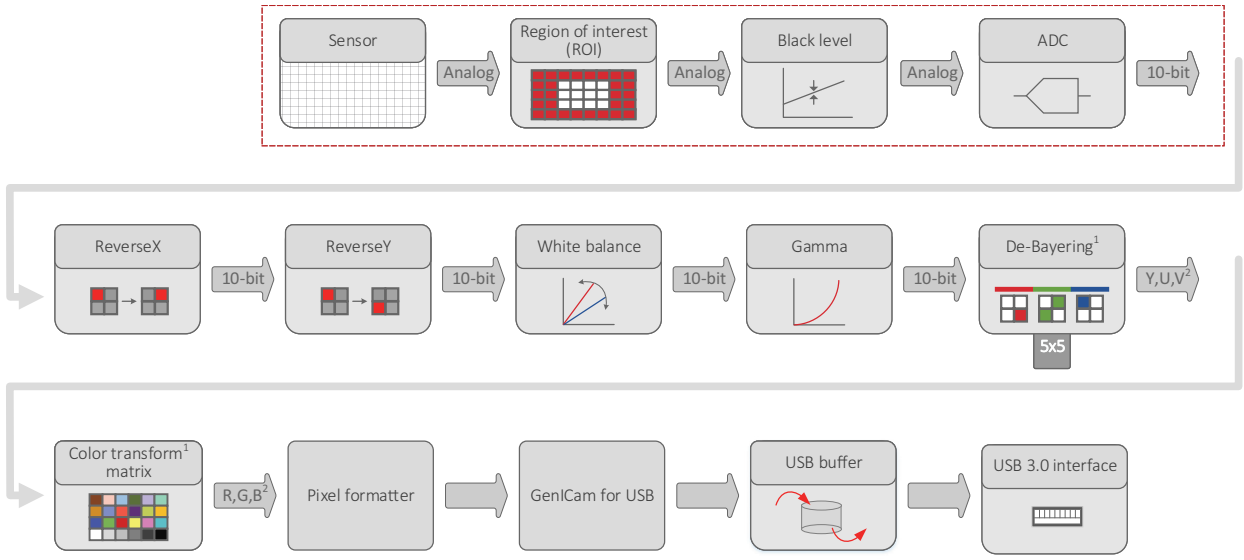



*Figure 47: Image data flow of Alvium USB cameras*

**Legend**

[1]Color models only
[2]For monochrome models: Y

# Firmware update

You should update firmware only to change camera functions or fix bugs.

**Consider**: Any firmware update may not only add new features to a camera or fix bugs. It may also replace previous features or change camera characteristics.

**Keep the camera connected**

- Keep the camera and the computer running while you are executing a firmware update.
- If the camera is powered down during firmware update, the camera firmware may get into a non-functional state.

# Firmware update with Vimba

We recommend to install **Vimba** completely.

**Vimba Driver Installer**

Windows: By default, **Vimba Driver Installer** is installed as well.

1. Download and install **Vimba**.
   The download includes the **Vimba Firmware Updater** and the *Vimba Manual*.
2. To update the the firmware, follow the instructions of the *Vimba Manual*.

**Downloads**

- For Vimba, see https://www.alliedvision.com/software.
- For firmware updates, see https://www.alliedvision.com/en/support/firmware.html.

**Recovering firmware without Vimba**

We recommend to use the **Vimba Firmware Updater** for easy handling.
If you want to recover the firmware without installing **Vimba**, please contact support@alliedvision.com.

**Fallback mode**

If firmware update fails,

- The camera is displayed as “Fallback” on the USB bus.
- The camera is not recognized by **Vimba Viewer**.
- You can repeat firmware update.

**Firmware update errors**

Should the firmware recovery not succeed, please contact support@alliedvision.com.

# Troubleshooting and performance

This chapter includes:

# Questions and answers

This section is about unexpected events with the operation of Alvium USB cameras. The events are ordered from general to detail:

- Camera recognition
- Unexpected events
- Performance
- Radio signal interference

Each entry consists of:

- Observed unwanted event, numbered for easier handling
- Short description of the solution
- Step-by-step instructions to resolve the issue.

**Hardware installation**

For background information, see Installing the camera on page 58.

## Camera recognition

**How can I make the PC/Vimba Viewer recognize the camera?**

**1.** Check if the **hardware** supports your USB camera.

See the *Alvium Cameras Accessory Guide* at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

**Windows**

**2.** Check if your PC has an appropriate **USB 3.0 / 3.1 Gen 1 host controller driver** installed.

**Windows 8 and later OS** provide a USB 3.0 / 3.1 Gen 1 host controller driver. On a properly installed OS, no problems should occur.

**Windows 7 and earlier OS** do not provide a USB 3.0 / 3.1 Gen 1 host controller driver.
To install the host controller card:

1. Download the manufacturer USB 3.0 / 3.1 Gen 1 host controller driver. Install the driver on your PC.

Result: The installed driver enables the host controller.

**Windows**

**3.** Check if the **USB3 Vision device driver** is properly installed and assigned to the camera.

Follow the instructions in Installing host adapter and Vimba on page 67.

4. The camera, **connected to a USB 3.0 / 3.1 Gen 1 hub**, is not recognized anymore. Check if the USB 3.0 / 3.1 Gen 1 hub has crashed.

   1. Disconnect the USB and power supply cable from the hub.
   2. Reconnect both.

   Result: The camera is recognized again.

5. The camera, **connected directly to the PC**, is not recognized anymore. Check if a hub included in the **USB host controller** has crashed.

   1. In the **Device Manager**, deactivate the host controller.
      For **Windows**, see Installing the camera driver with Windows tools on page 69.
   2. Reactivate the host controller.

   Result: The camera is recognized again.

# Unexpected events

**How do I get the camera back to normal operation?**

1. Check if an error is displayed by the **camera** Status LED.

   If: The status LED signals 4 short flashes followed by another sequence.
   Then: Restart the camera.
   If: If the camera still does not respond.
   Then: Recover the firmware, see Firmware update on page 84.
   Then: If the camera still does not respond.
   Then: Please contact support@alliedvision.com.

2. Check if **power cables**, such as cables with a high current in the environmental setup, **harmfully interfere with camera cables**.

   If: Any camera cable crosses or goes parallel with a power cable.
   Then: Separate camera cables from power cables.

3. Make sure the **camera is intact**.
   For this, exclude issues of the cable or the connected PC:

   1. Connect the camera with a **different cable** to a **different PC**.
   If: The camera works properly.
   Then: The camera is intact, but your previous PC or cable has a defect. Continue with 2.
   If: The camera does not work properly.
   Then: Most likely, the camera has a defect. Please contact Allied Vision support.
   2. Connect the camera with the **previous cable** to the **different PC**.
   If: The camera works properly.
   Then: Replace the cable.
   3. Connect the camera with the **replaced cable** to the **previous PC**.
   If: The camera does not work properly.
   Then: Check the PC to fix the issue.

4. **Why does the camera not transfer images after restart?**
   This happens if the camera is started with a user set including trigger settings, but the camera does not receive a trigger.

   Check if a user set is active that is requiring a trigger for camera acquisition or exposure.

   If: User settings require a trigger.
   Then: Send the camera the corresponding trigger.
   Or: Change user settings and deactivate trigger settings to control the camera without triggering.

# Performance

**How can I improve camera performance?**

1. Check if the **hardware** sufficiently supports your USB camera.

   See the Alvium USB *Cameras Accessory Guide* at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

2. Check if the **camera shares the bus with other devices** reducing the available bandwidth.

   Connect the camera to an individual bus, not shared by other devices.
   For more information, see Dividing bandwidth between devices on a common USB 3.0 / 3.1 Gen 1 bus on page 94.

3. Check if the **camera is connected to cascading hubs**, reducing the available bandwidth.

   Attach devices directly to a separate USB 3.0 / 3.1 Gen 1 bus. If you want cameras to share a common bus, use only a single hub to attach devices. For more information, see Dividing bandwidth between devices on a common USB 3.0 / 3.1 Gen 1 bus on page 94.

4. Check if all your USB **accessories support USB 3.0 / 3.1 Gen 1**.

   For recommended USB accessories, see the *Alvium USB Cameras Accessory Guide* at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

# Radio signal interference

**How can I avoid radio signal interference from wireless devices?**

1. Ensure camera installation complies with **Electromagnetic Compatibility**.

   Wireless devices and USB 3.0 / 3.1 Gen 1 commonly use 2.4 GHz frequency (WLAN uses 2.4, 3.6, and 4.9 GHz).

   Even USB 3.0 / 3.1 Gen 1 cables can interfere harmfully with other electromagnetic devices. For example, despite shielding, a USB 3.0 / 3.1 Gen 1 cable can interfere with a wireless mouse. Tests have shown an increase of the noise floor up to 20 dB for the affected devices.

   - To enable maximum bandwidth, 2.4 GHz radio frequencies must be avoided; therefore, use **maximum shielded cables only**.
   - Keep **maximum distance** between your Alvium USB camera setup and interfering devices.
   - Use **high-gain antennas** to reduce power of the radio signals.

   For tested USB accessories, see the *Alvium USB Cameras Accessory Guide* at https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.

# Optimizing performance

## Operating systems and bandwidth

Even if your hardware supports high bandwidths, you may encounter corrupted frames. This is some best practice advice.

### Windows and Linux

For smooth data transfer of USB3 Vision cameras, the host computer must be equipped with a high-performance USB controller.

**Suitable USB 3.0 accessories**

See https://www.alliedvision.com/en/products/accessories for suitable USB 3.0 host controller cards and cables or contact your Allied Vision Sales representative.

During free run, Alvium cameras do not automatically adapt the frame rate to the USB controller's limits. If the data rate is too high for your USB controller, it receives corrupted frames. The image transfer status in **Vimba Viewer** is signaled as **Running**. However, the corrupted frames are not displayed.

To avoid corrupted frames, adjust the `DeviceLinkThroughputLimit` value. Consider that **Vimba Viewer** does not gray out values that exceed the supported bandwidth. Avoid selecting values that result in corrupted frames.

#### Calculating DeviceLinkTroughputLimit

**Numbers in this section**

For readability, numbers are shown as ***1,000*** instead of ***1000***. In program code and in **Vimba Viewer**, values must be entered as ***1000***.

Values required for `DeviceLinkThroughputLimit` (D) for different fame rates:

RGB8: D = H × V × 3 x frame rate [Byte/s]
Mono8: D = H × V × 1 x frame rate [Byte/s]

Example calculation for RGB8:

D = 1944 pixels × 2592 pixels × 3 × 28 fps = 423,263,232 Byte/s

Adding 5% (estimation) for the overhead of the USB3 Vision protocol:

423,263,232 Byte/s × 1.05 = 444,426,393.6 Byte/s

## Linux only

### Adapting the Vimba USB Transport Layer settings

To ensure compatibility with older Linux versions, the default value of `MaxTransferSize` in the **Vimba USBTL** (USB Transport Layer) is not very high.

To optimize the performance, adjust the value of the VimbaUSBTL.xml file:

1. In the Vimba program folder, open VimbaUSBTL.
2. Depending on your system, the XML file is located in, for example, Bin/x86_64bit/VimbaUSBTL.xml.
3. Open the XML file and find `MaxTransferSize`.
4. Per default, the value is commented out. Delete the XML comments to activate the value.
5. Replace the **Vimba** default value (32,768) by the **Windows** default value (262,144).

# Performance on reference systems

Cameras were operated in `AquisitionMode` = *`Continuous`*, frame rates were measured using **Vimba Viewer**.

| Camera | Specification |
|---|---|
| Model | Alvium 1800 U-500c |
| Firmware | 1.0.25857 |

| System component | Linux desktop system | Linux ARM system |
|---|---|---|
| Mainboard | Dell Precision T5600 | Nvidia Jetson TX2 |
| CPU | Intel Xeon E5-2609 0 (4 cores) | ARMv8 (2x rev 0, 4x rev 3, 6 cores) |
| CPU frequency | 2.40 GHz | 2.0 GHz |
| RAM | 8 GB | 8 GB |
| Graphics | NVIDIA Quadro NVS 295 | On-board |
| USB-Controller | ExSys EX-11092-2 (upper PCIe port) | On-board |
| Extension cards | 2 (see above) | None |
| Operating system | Ubuntu 18.04 64bit, Kernel 4.15 | Ubuntu 16.04 64bit, Kernel 4.4 |

| Feature | Linux desktop system | Linux ARM system |
|---|---|---|
| DeviceLinkThroughputLimit[1] | 400000000 (400 MB/s) | 450000000 (450 MB/s) |
| MaxTransferSize[2] | 262144 | |
| MaxTransferCount[2] | 31 (default) | |
| [1]Camera feature | [2]VimbaUSBTL.xml | |

# Frame rates and CPU payload

| Property | Linux desktop system | Linux ARM system |
|---|---|---|
| Pixel format | RGB8 | |
| Image size | 2592 × 1944 | |
| Frame rate | 25.7 fps | 28.6 fps |
| CPU payload | 30% (4 cores) | 50% (4 cores) |

| Property | Linux desktop system | Linux ARM system |
|---|---|---|
| Pixel format | Mono8 | |
| Image size | 2592 × 1944 | |
| Frame rate | 67.5 fps | 67.5 fps |
| CPU payload | 35% (4 kernels) | 55% (4 kernels) |

# Dividing bandwidth between devices on a common USB 3.0 / 3.1 Gen 1 bus

## Ideal setup for two cameras

### Preconditions

- Control traffic is ignored.
- The possibility of the host being busy with other tasks is ignored.
- Cameras share 100% bus bandwidth.
- Cameras need 100% bus bandwidth in total.
- Cameras stream in the same way because they are the same model and have identical settings.
- No other device is connected.

### Result

- Bandwidth is divided by two, cameras get assigned 50% bandwidth each. For three cameras, the bandwidth is 33.3% each.
- If one camera sends no data, the other camera will be assigned 100% bandwidth. To always assign 50% to both cameras, they have to be controlled to use no more than 50% bandwidth each.
- If the PC cannot process the images received from a camera, images are corrupted.

# Best practice for bandwidth management

- To assign maximum bandwidth to a camera, make sure your camera is the only device on the bus.
- Avoid that devices, such as a monitor or a mouse, share bandwidth with the USB3 Vision camera connected to the same bus.
- For maximum bandwidth, use a current version host controller card. See https://www.alliedvision.com/en/support/technical-documentation/alvium-documentation.html.
- USB3 Vision devices use bulk transfer. Avoid using other transfer modes.
- Control bandwidth by assigning the desired amount to the separate cameras.

# Cascading hubs divide bandwidth

The following example applies to standard behavior without individual settings. The graphics show bandwidth distribution on a common bus. Three cameras try to use full bandwidth at the same time. If one camera is inactive, the host will provide its share to the others until this camera sends data again.

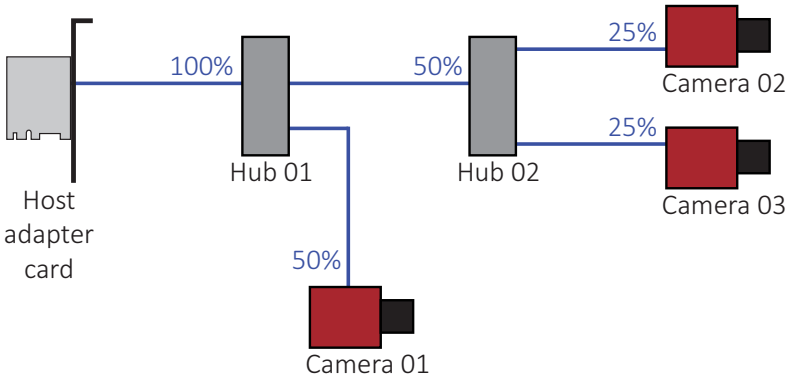



*Figure 48: Bandwidth assignment for cascading hubs*

# Index