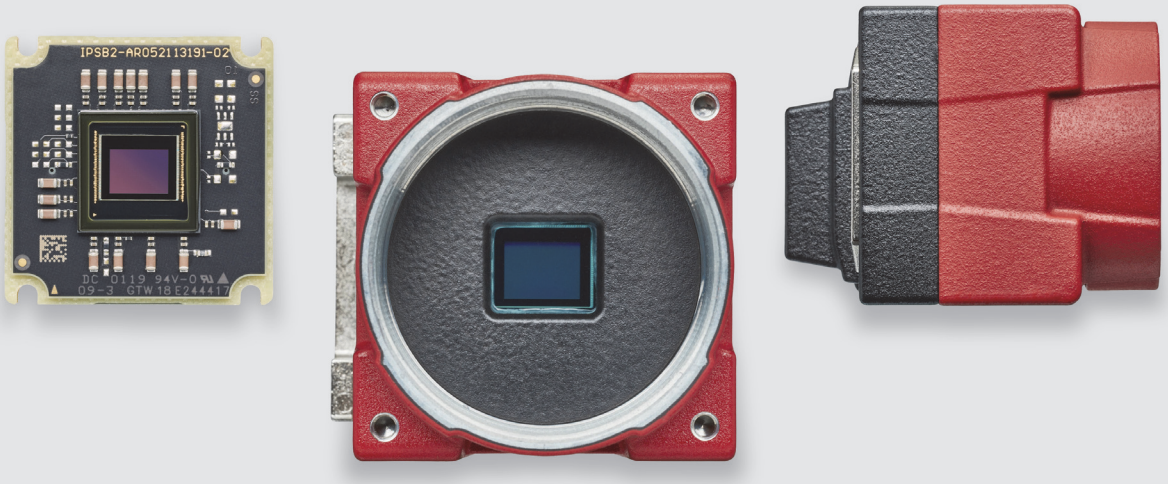
Allied Vision



USB3 Vision Cameras

Alvium USB Cameras

User Guide

V3.2.0

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

2020-Jul-22

Quick links

- Alvium USB cameras at a glance on page 14
- Contact us on page 17
- Contents on page 18

Read before use

EN - English

Safety

Before using the camera, read these safety instructions. Observe the warnings at all times. Use the camera only as stated in the Intended use on page 34.

CAUTION

Risk of burns

A camera in operation can reach temperature levels which could cause burns.

CAUTION

Injury by falling cameras or lenses

A falling camera or lens can cause injury.

CAUTION

Risk of cuts by sharp edges of lens mounts

The threads of the lens mount can have sharp edges.

Intended use

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

Cameras without closed housings

Cameras without housing or with incomplete housing must be shielded against EMC emission by professionals according to local EMC provisions.

DA - Dansk

Sikkerhed

Læs sikkerhedsanvisningerne, før kameraet bruges. Overhold alle advarsler. Brug kun kameraet som anført i Intended use på side 34.

FORSIGTIG

Forbrændingsfare

Når kameraet bruges, kan det blive meget varmt og forårsage forbrændinger.

FORSIGTIG

Kvæstelser, hvis kameraet eller linser falder ned

Falder kameraet eller linsen ned, kan dette forårsage kvæstelser.

FORSIGTIG

Fare for snitsår på linsemodulets skarpe kanter

Linsemodulets gevind kan have skarpe kanter.

Tilsigtet brug

Allied Vision produktets tilsigtede brug er en indbygning i et visionssystem, udført af fagfolk. Alle Allied Vision produkter sælges i B2B.

Kameraer uden lukket hus

Kameraer uden hus eller uden komplet hus skal beskyttes mod EMC emissioner iht. lokale EMC bestemmelser.

DE - Deutsch

Sicherheit

Bevor Sie die Kamera benutzen, lesen diese Sicherheitshinweise. Beachten Sie diese Hinweise immer. Verwenden Sie die Kamera nur wie beschrieben in Intended use auf Seite 34.

VORSICHT

Gefahr von Verbrennungen

Im Betrieb kann die Kamera Temperaturen erreichen, die zu Verbrennungen führen.

VORSICHT

Verletzung durch fallende Kameras oder Objektive

Eine fallende Kamera oder ein fallendes Objektiv kann Verletzungen verursachen.

VORSICHT

Schnitte durch scharfkantige Objektivgewinde

Objektivgewinde können scharfe Kanten haben.

Bestimmungsgemäßer Gebrauch

Allied Vision Produkte sind bestimmt für die Integration in Bildverarbeitungs-systeme durch Fachpersonal. Alle Allied Vision Produkte werden in einer B2B-Umgebung verkauft.

Kameras ohne geschlossenes Gehäuse

Für Kameras ohne Gehäuse oder mit unvollständigem Gehäuse muss die Abschirmung gegen EMV-Emissionen gemäß den örtlichen EMV-Bestimmungen durchgeführt werden.

ES - Español

Seguridad

Antes de utilizar la cámara lea estas instrucciones de seguridad. Observe las advertencias en todo momento. Utilice la cámara solo tal y como se estipula en el Intended use en la página 34.

ATENCIÓN

Riesgo de quemaduras

Una cámara en funcionamiento puede alcanzar temperaturas que podrían provocar quemaduras.

ATENCIÓN

Lesiones en caso de que las cámaras o las lentes se caigan

Si una cámara o una lente se cae puede provocar lesiones.

ATENCIÓN

Riesgo de cortes debido a los bordes afilados del objetivo

Las roscas de los objetivos pueden tener bordes afilados.

Uso previsto

El uso previsto del producto Allied Vision es la integración en el sistema de visión por parte de profesionales. Todos los productos Allied Vision se venden dentro de una relación B2B.

Cámaras sin carcasa cerrada

Las cámaras sin carcasa o con una carcasa incompleta deben protegerse contra las emisiones CEM por parte de profesionales de acuerdo con las disposiciones locales sobre la CEM.

FI - Suomi

Turvallisuus

Lue nämä turvallisuusohjeet ennen kameran käyttöä. Noudata varoituksia joka hetki. Käytä kameraa ainoastaan kohdassa Intended use sivulla 34 kuvatulla tavalla.

HUOMIO

Palovammojen vaara

Käytössä olevan kameran saavuttamat lämpötilatasot voivat aiheuttaa palovammoja.

HUOMIO

Putoavien kameroiden tai linssien aiheuttamat vammat

Putoava kamera tai linssi voi aiheuttaa vammoja.

HUOMIO

Linssien kiinnikkeiden terävien reunojen aiheuttamien viiltovammojen vaara

Linssin kiinnikkeiden kierteiden reunat voivat olla teräviä.

Käyttötarkoitus

Allied Vision-tuotteen käyttötarkoitus on integrointi kuvajärjestelmiin ammattilaisten toimesta. Kaikki Allied Vision-tuotteet myydään B2B-ympäristössä.

Kamerat, joissa ei ole suljettuja koteloita

Ammattilaisten on suojattava kamerat, joissa ei ole koteloa tai joiden kotelo on epätäydellinen, EMC-päästöiltä paikallisten EMC-määräysten mukaisesti.

FR - Français

Sécurité

Veuillez lire ces consignes de sécurité avant d'utiliser la caméra. Respectez continuellement les avertissements. Utilisez la caméra uniquement comme indiqué sous Intended use, page 34.

ATTENTION

Risque de brûlures

Une caméra en service peut atteindre des niveaux de température susceptibles d'entraîner des brûlures.

ATTENTION

Blessures en cas de chute de caméras ou d'objectifs

La chute d'une caméra ou d'un objectif peut entraîner des blessures.

ATTENTION

Risque de coupures sur les bords tranchants des montures d'objectif

Les filetages des montures d'objectif peuvent présenter des bords tranchants.

Utilisation prévue

L'utilisation prévue du produit Allied Vision est son intégration dans des systèmes de vision par le soin de professionnels. Tout produit Allied Vision est vendu dans un cadre B2B.

Caméras sans boîtier fermé

Les caméras sans boîtier fermé ou à boîtier incomplet doivent être blindées contre les émissions CEM par le soin de professionnels conformément aux dispositions CEM locales.

IT - Italiano

Sicurezza

Leggere queste istruzioni per la sicurezza prima di utilizzare la telecamera. Osservare sempre tutte le avvertenze. Utilizzare la telecamera come descritto alla sezione Intended use a pagina 34.

ATTENZIONE

Pericolo di ustioni

Durante il funzionamento una telecamera può raggiungere temperature elevate che possono essere causa di ustioni.

ATTENZIONE

Lesioni dovute alla caduta di telecamere o lenti

La caduta di una telecamera o di una lente può causare delle lesioni.

ATTENZIONE

Pericolo di tagliarsi sui bordi affilati degli attacchi della lente

I bordi della filettatura dell'attacco della lente possono essere affilati.

Uso previsto

Il prodotto Allied Vision è concepito per essere integrato in sistemi di monitoraggio in campo professionale. Tutti i prodotti Allied Vision sono venduti in uno scenario B2B.

Telecamere senza custodia chiusa

Le telecamere senza custodia o con una custodia incompleta devono essere protette dalle emissioni elettromagnetiche in ambienti professionali in conformità con le norme CEM nazionali.

JA – 日本語

安全性

本カメラを使用する前に、この安全の手引きをお読みください。常に、警告事項を守ってください。必ず、Intended use 34 ページの通りに、本カメラを使用してください。

注意

やけどの危険性

作動中のカメラは、やけどを引き起こす温度まで熱くなる恐れがあります。

注意

カメラまたはレンズの落下によるけが

カメラまたはレンズが落下すると、けがをする恐れがあります。

注意

レンズマウントの鋭利な端部で切り傷の危険性

レンズマウントのギザギザの部分が鋭利である可能性があります。

用途

Allied Vision製品は、専門家が視覚装置に統合することを意図したものです。すべてのAllied Vision製品は、企業間取り引き用に販売されています。

ハウジングで閉じられていないカメラ

ハウジングのないカメラまたはハウジングが不完全なカメラは、現地の電磁両立性（EMC）規定に従い、専門家によって、EMCエミッションから保護される必要があります。

NL - Nederlands

Veiligheid

Lees deze veiligheidsinstructies voordat u de camera gaat gebruiken. Neem deze waarschuwingen altijd in acht. Gebruik de camera uitsluitend, zoals aangegeven in het Intended use op pagina 34.

VOORZICHTIG

Risico van verbranding

Een camera die gebruikt wordt, kan temperatuurwaarden bereiken die brandwonden kunnen veroorzaken.

VOORZICHTIG

Letsel door vallende camera's of lenzen

Een vallende camera of lens kan letsel veroorzaken.

VOORZICHTIG

Risico van snijwonden door scherpe randen van lensbevestigingen

Het schroefdraad van de lensbevestiging kan scherpe randen hebben.

Beoogd gebruik

Het beoogde gebruik van het Allied Vision-product is de integratie in optische systemen door professionals. Alle Allied Vision-producten worden verkocht in de B2B-markt.

Camera's zonder gesloten behuizing

Camera's zonder behuizing of met een onvolledige behuizing moeten door professionals worden beschermd tegen EMC-straling door EMC-beschermingen ter plaatse.

NO - Norsk

Sikkerhet

Les disse sikkerhetsinstruksene før du bruker kameraet. Følg advarslene til en hver tid. Bruk kun kameraet i samsvar med Intended use på side 34.

FORSIKTIG

Risiko for brannskader

Et kamera i bruk kan nå temperaturnivåer som kan forårsake brannskader.

FORSIKTIG

Skade ved fallende kameraer eller linser

Et fallende kamera eller en fallende linse kan forårsake skade.

FORSIKTIG

Risiko for kutt fra skarpe kanter på linsefester

Sporene på linsefestet kan ha skarpe kanter.

Tiltenkt bruk

Den tiltenkte bruken av Allied Vision-produktet er integrering i visjonssystemer av profesjonelle. Alle Allied Vision-produkter selges i en forretning til forretning-situasjon.

Kameraer uten lukkede kamerahus

Kameraer uten kamerahus eller med ufullstendige kamerahus må beskyttes mot EMC-utslipp av fagfolk i henhold til lokale EMC-bestemmelser.

SV - Svenska

Säkerhet

Läs igenom säkerhetsinstruktionerna innan du använder kameran. Var hela tiden särskilt uppmärksam på varningarna. Använd enbart kameran på det sätt som anges i Intended use på sida 34.

VARNING

Risk för brännskada

En kamera i drift kan komma upp i temperaturer som kan orsaka brännskador.

VARNING

Risk för skador från fallande kameror eller objektiv

Fallande kameror eller objektiv kan förorsaka skador.

VARNING

Risk för skärsår från vassa kanter på objektivfattningar

Objektivets gängor kan ha vassa kanter.

Avsedd användning

Den avsedda användningen av Allied Vision-produkter är integrering i visionssystem av fackmän. Samtliga Allied Vision-produkter säljs i en B2B-miljö.

Kameror utan slutna kamerahus

Kameror utan eller med ofullständiga kamerahus måste skyddas mot elektromagnetiska emissioner av fackmän enligt lokala bestämmelser för elektromagnetiska emissioner.

ZH - 英文简体中文版

安全需知

使用本相机前，请阅读本安全说明书。请务必遵守相关警告 和 Intended use 于第 34 页 .

注意事项

烫伤风险

相机操作过程中温度可能上升并导致烫伤风险。

注意事项

相机或者镜头跌落造成伤害

相机或者镜头可能会跌落并造成伤害。

注意事项

镜头接口的锐利边缘划伤风险

镜头接口螺纹边缘可能较为锐利。

预期用途

Allied Vision 产品的预期用途是由专业人士整合到视觉系统中。所有 Allied Vision 的产品均通过 B2B 渠道销售。

无封闭式外壳相机

使用不带外壳或外壳不完整的相机时，必须由专业人员根据当地的 EMC 规定，对其进行 EMC 屏蔽。

Alvium USB cameras at a glance

Get an overview of Alvium USB camera documentation.

Read this document carefully

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

Bandwidth, exposure time values, delays, and ROI frame rates

- The **default bandwidth** for Alvium USB cameras is 200 MBps. For some models, you can achieve higher frame rates by increasing values for `MaxTransferSize` and `DeviceLinkThroughputLimit`. See Operating systems and bandwidth on page 176.
- Available values and increments for **exposure time** depend on other controls, such as `DeviceLinkThroughputLimit`. See Value changes by feature interdependencies on page 171.
- **Minimum and maximum exposure time values** in Specifications on page 43 are preliminary. The next version of this document will provide final values.
- For **delays**, see Triggering with rolling shutter cameras on page 161.
- Calculation of maximum **frame rates for different ROIs** for Alvium USB cameras does not allow to give a formula. Typical operation on page 49 defines the conditions for measuring ROI frame rates.

Default user set

If you want to use the `UserSetDefault` feature to reset to default values, be aware that some features may not be reset.

Individual properties of Alvium USB cameras

Please consider individual properties of Alvium USB cameras to design applications successfully. See Performance and troubleshooting on page 168 for details.

Bare board cameras

If you intend to design an application using bare board cameras, please consider:

- Aligning the sensor to the lens is extremely difficult and expensive. Therefore, we recommend you to do evaluation with housed cameras first.
- Bare board cameras are specialized components. We cannot give all data needed for any application in advance.
- Please let us partner with you for bare board camera applications to ensure a successful design.

Shipping contents

- Alvium USB camera
- Alvium USB Cameras Quickstart Guide

What else do you need?

This is a selection of helpful downloads:

Document	**Link**
Alvium USB Cameras Quickstart Guide (multilingual)	www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation
Alvium Cameras Features Reference	
Alvium Cameras Hardware Options	www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents
Alvium Cameras Accessory Guide	
Optimum Heat Dissipation for Housed Alvium Cameras application note	
Electromagnetic Compatibility for Open Housing Alvium Cameras application note	
Defect Pixel Correction on 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	www.alliedvision.com/software

Table 1: Downloads for Alvium USB cameras

Contact us

Website

General
www.alliedvision.com/en/contact

Distribution partners
www.alliedvision.com/en/about-us/where-we-are

Email

General
info@alliedvision.com

Support
support@alliedvision.com

Sales offices

Europe, Middle East, and Africa	T// +49 36428 677-230
North and South America	Toll-free: +1 877 USA 1394 T// +1 978 225 2030 California: +1 408 721 1965
Asia-Pacific	T// +65 6634 9027
China	T// +86 21 64861133

Headquarters

Allied Vision Technologies GmbH
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Contents

Document history and conventions

This chapter includes:

Document history

Version	Date	Remarks
V3.2.0	2020-Jul-22	• Added Alvium 1800 U-240m/c, 1800 U-508m/c, and 1800 U-1240m/c models. • Updated ROI frame rates and pixel formats in Alvium 1800 U model specifications on page 51. • Added QE and spectral response to Alvium 1800 U-2050m/c on page 104. • Extended information in Shock and vibration on page 44. • Updated spectral response graphic in IR cut filter on page 128. • Added Sensor position accuracy on page 129. • Added Read before use on page 2. • Corrected minor errors.
V3.1.3	2020-Mar-12	• Corrected maximum exposure times. • Added *`ExposureActive`* signal to the description of sensor shutter modes. • DPC: Removed specifications into an application note. • FPNC: Updated note in Image data flow on page 163.
V3.1.2	2020-Mar-04	Applied minor changes.
V3.1.1	2020-Feb-28	• Updated frame rates and exposure time values. • Added information about frame rates with different triggering modes.
V3.1.0	2020-Feb-20	• Added Alvium 1800 U-319m/c, 1800 U-507m/c, 1800 U-1236m/c, and 1800 U-2050m/c models. • Added specifications for DPC. • Updated description for sensor shutter modes.
V3.0.0	2020-Jan-06	• Added Alvium 1800 U-040m/c, 1800 U-158m/c, and 1800 U-501m NIR models.

Table 2: Document history (sheet 1 of 2)

Version	Date	Remarks
V2.0.0	2019-Oct-18	• Added Alvium 1800 U-050m/c and 1800 U-120m/c models. • Updated contents about bandwidth. • Updated screenshots for camera driver installation. • Added Dark current compensation on page 172. • Updated technical drawings and dimensions for bare board in Technical drawings on page 111. • Restructured contents in Performance and troubleshooting on page 168. • Applied editorial changes.
V1.1.0	2019-Jul-01	• Added missing color pixel formats and removed separate bit depth in Specifications on page 43. • Corrected ADC bit depth in specifications for Alvium 1800 U-500m/c on page 76 and in Image data flow on page 163.
V1.0.0	2019-Jun-13	Release version

Table 2: Document history (sheet 2 of 2)

Conventions used in this user guide

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

Typographic styles

Style	Function
Emphasis	Programs, or highlighting important things
`Feature names`	Names for GenICam features
`Feature options`	Options for GenICam features
`Input commands`	Text or command to type in by the user, selected menu options, or other selectable options
UIElements	Text that is displayed or output by the system, like parts of the GUI, dialog boxes, buttons, menus, important information, or windows titles
Web addresses and references	Links to webpages and internal cross references

Table 3: Typographic styles

Symbols and notes

CAUTION

Risk of burns

Precautions are described

CAUTION

Injury by falling cameras or lenses

Precautions are described

CAUTION

Risk of cuts by sharp edges of lens mounts

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

Naming and terms

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 details	Interface	Resolution	Color/ monochrome
Examples	Alvium	1500: Basic feature set 1800: Advanced feature set or high-performance sensors	C: MIPI CSI-2 U: USB	500: 5.0 MP 050: 0.5 MP	c: color m: monochrome

Table 4: 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 www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

Terms and acronyms

Term or acronym	Description	Reference
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	Bare Board on page 112
CRA	Chief ray angle	Alvium 1800 U-500m/c on page 76
EMVA	European Machine Vision Association	www.emva.org
ERS	Electronic rolling shutter, see RS	Shutter types affecting image readout on page 175
ESD	Electrostatic discharge	ESD on page 37
FCC	Federal Communications Commission	For customers in the USA on page 31
FPNC	Pixed pattern noise correction	Image data flow on page 163
fps	Frames per second	Alvium 1800 U-500m/c on page 76

Table 5: Terms and acronyms (sheet 1 of 2)

Term or acronym	Description	Reference
GenICam	Generic Interface for Cameras, EMVA	www.emva.org
GND	Ground (power)	I/O connector pin assignment on page 154
GPIOs	General purpose inputs and outputs (non-isolated)	GPIOs description on page 156
GRRS	Global reset release shutter, see GRS	Shutter types affecting image readout on page 175
GRS	Global reset shutter, see GRRS	Shutter types affecting image readout on page 175
GS	Global shutter	Shutter types affecting image readout on page 175
H × V	Horizontal × Vertical (sensor resolution)	Alvium 1800 U-500m/c on page 76
KB	Kilobyte	Alvium 1800 U-500m/c on page 76
MBps	Megabytes per second	Alvium 1800 U-500m/c on page 76
open housing	Camera housing that is open at the back side to be designed into an encompassing housing with other components	Open Housing S-Mount on page 115
PCBA	Printed circuit board assembly	PCBAs on page 37
QE	Quantum efficiency	Absolute QE on page 78
ROI	Region of interest	ROI frame rates on page 79
RS	Rolling shutter, see ERS	Shutter types affecting image readout on page 175
SFNC	Standard Features Naming Convention (GenICam)	www.emva.org
shutter mode	Value of the `ShutterMode` feature to select between rolling shutter (RS) and global release shutter (GRS)	Triggering on page 49
shutter type	Sensor specific readout, such as rolling shutter (RS) or global shutter (GS)	Shutter types affecting image readout on page 175
S-Mount	M12-Mount	Mounting and focusing S-Mount lenses on page 145

Table 5: Terms and acronyms (sheet 2 of 2)

Compliance, safety, and intended use

This chapter includes:

Compliance notifications

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-3 (B) / NMB-3 (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-3 (B) / NMB-3 (B)

Bare board and open housing cameras

Bare board and open housing cameras are designed for integration and are delivered with open camera back or without housing on customer's request. Housing design is critical for electromagnetic compatibility (EMC) of the camera.

Requirements for EMC housings

See the Electromagnetic Compatibility for Open Housing Alvium Cameras application note at www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

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 damage to the cables.

Intended use

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

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

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

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

If the mainboard temperature exceeds the specified maximum for more than two seconds, the camera is powered off automatically. The current value for mainboard temperature is output by `DeviceTemperature`. You can use this value to control cooling by software, for example, to control a fan.

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 142. Keep the operating temperature in the specified range to enable best image quality and to protect the camera from damage. Temperature values apply to a relative humidity of 0 to 80 percent that is non-condensing.

Hardware option	Housing	Components in the cooling areas[1]	Mainboard[2]
Bare board[3]	Not applicable	+5 °C to +85 °C	See model Specifications on page 43.
Open housing[4]	+5 °C to +65 °C		
Closed housing		Not applicable	

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

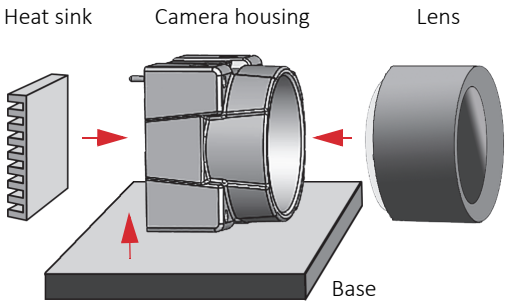
[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 6: Operating temperature ranges for Alvium USB cameras

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

- Mounted to a base with a high thermal conductivity
- With lens or other optical components mounted
- With a heat sink mounted that has large surface areas (closed housing cameras include a heat sink)
- Using conductive media for camera and heat sink mounting
- 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 www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

Camera mounting

Housed cameras must be mounted using the mounting threads. If vibration is higher than specified, cameras can disconnect from the mounting. Falling cameras can hurt you. To avoid personal injury:

- Mount the camera according to the instructions in Mounting housed cameras on page 143.
- Ensure, shock and vibration do not exceed the specified range, see Shock and vibration on page 44.
- Use a lens support if you want to use Heavy lenses.

Heavy lenses

For non-static applications, use lenses with a mass less than 70 grams 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.

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

ESD

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 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 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. 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 or 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 43 for details. The maximum length for I/O cables must not exceed 30 meters.

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 154 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 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 www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

USB connections

USB 3.0 and 3.1 Gen 1 host controllers and hubs

To avoid damage to USB 3.0 or 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 Cameras Accessory Guide at www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

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 damage to 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 176. Some pixel formats may not be supported.

Handling bare board cameras

Bare board cameras are an electronic assembly without a protective housing. To avoid damage:

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

Observe for mounting bare board cameras:

- Allow mechanical contact only at the mounting area. (This does not apply to the cooling areas.)
- Enable proper cooling at the cooling areas, see Mounting bare board cameras on page 142.
- 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 142.

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 42 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 as well.

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.

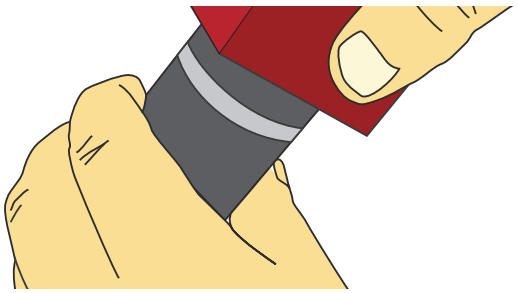
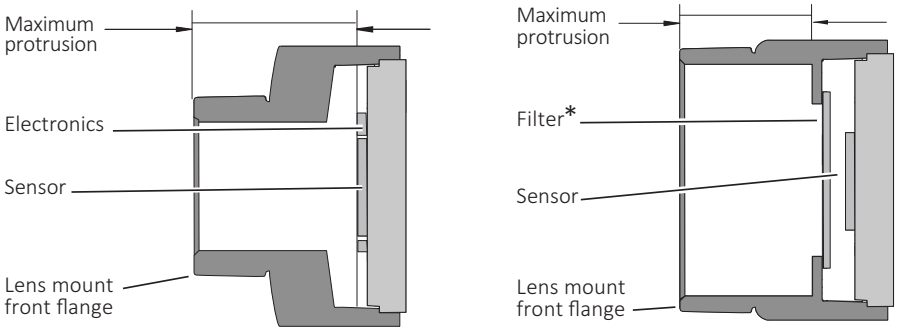


Figure 1: Holding the camera with the lens mount facing the ground

Lenses

Maximum protrusion

The sensor, filter, lens, or camera electronics 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 and maximum protrusion on page 127.



*Only color models are equipped with an IR cut filter

Figure 2: Maximum protrusion S-Mount (left); CS-Mount and C-Mount (right)

For S-Mount lenses, read Mounting and focusing S-Mount lenses on page 145 to avoid damage to the sensor, the electronics, and lens.

Heat sinks and conductive media

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

Heat sinks

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 lens.

- 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 140 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 provides a generic access for cameras and devices that is independent of the interface. This enables to operate cameras with USB3 Vision, GigE Vision, or CoaXPress interfaces and Alvium USB cameras with a common software.

GenICam consists of multiple modules for different tasks. Allied Vision cameras and software use these modules, like the SFNC that standardizes feature names and types via an XML file or the transport layer interface (GenTL) used to grab images.

Alvium 1800 U cameras comply to:

- GenICam GenAPI V3.1
- GenICam Standard Features Naming Convention V2.2 (SFNC)
- GenICam Pixel Format Naming Convention V2.0 (PFNC).

USB3 Vision 1.0.1

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

Alvium closed and open housing cameras were tested according to the following standards:

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

Cameras were inspected before and after the tests. All tests were passed successfully:

Condition	Passed
Image streaming	Images are streamed without errors.
Mechanics	• The camera housings showed no deformations. • The connections between camera components had not come loose. • The sensor position was within the specified tolerances of a new camera.
Image quality	Image quality was not affected.
Camera behavior	Camera functionalities were not affected, no deviations occurred.

Table 7: Conditions for passed tests

The conditions for cameras and lenses were the same for all tests. Solid aluminum tubes were used to represent real lenses:

Parameter	Value
Lens dummy length	38 mm
Lens dummy mass	70 g
Center of gravity (CoG)[1]	20 mm
[1]For camera and lens dummy assemblies, measured from the lens mount front flange	

Table 8: Conditions for lenses

IEC 60068-2-6: Sinusoidal vibration

Frequency	Acceleration	Displacement
10 Hz to 58.1 Hz	Not applicable	1.5 mm
58.1 Hz to 500 Hz	20 *g*	Not applicable

Table 9: Frequency, acceleration, and displacement for IEC 60068-6 tests

Parameter	Value
Axis	x, y, z
Sweep rate	1 oct/min
Duration per axis [hh:mm:ss]	00:11:17
Number of sweeps	20

Table 10: Other parameters for IEC 60068-6 tests

IEC 60068-2-27: Shock

Parameter	Value
Axis	x, y, z
Acceleration	20 *g*
Number of shocks per axis	10
Duration per axis	11 ms
Waveform	Half sine

Table 11: Parameters for IEC 60068-2-27 tests

IEC 60068-2-64: Random vibration

Frequency	Acceleration
15 Hz to 500 Hz	0.05 $g^2/_{Hz}$

Table 12: Frequency and acceleration for IEC 60068-2-64 tests

Parameter	Value
Axis	x, y, z
Acceleration RMS (Sigma)	4.9 *g*
Acceleration peak (Sigma)	14.8 *g*
Duration per axis [hh:mm:ss]	00:30:00

Table 13: Other parameters for IEC 60068-64 tests

Notes on specifications

This section defines the conditions for specifications stated in this chapter.

Sensor

Absolute 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 percent. The uncertainty in measurement of the QE values is ±10 percent. 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.

Sony sensors

Sony provides relative response curves in their sensor data sheets. To create the absolute QE plots shown in this chapter, the relative response was converted to a normalized QE response and then adjusted as per three measured QE values (at 448 nm, 529 nm, 632 nm) for color sensors and one measured QE value (at 529 nm) for monochrome sensors.

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.

Spectral response plots

The curves in the spectral response plots shown in this chapter were calculated from measured quantum efficiencies at 448 nm, 529 nm, and 632 nm. The shape of the curve is taken from the sensor data sheet but the values have been adjusted based on these measured values. The uncertainty in measurement of the spectral response values is ±10 percent.

Exposure time and frame rate

Stated values were measured for a maximum bandwidth of 375 MBps for Typical operation, using the following test setup:

Component	Property
Desktop workstation	Dell Precision T5500 Precision (EHW400)
Chipset	Intel X5520
CPU	Intel Xeon X5670 (6 cores)
CPU frequency	2.93 GHz
RAM	12 GB
Graphics controller	NVIDIA Quadro FX 580
USB controller	Delock U3 PCIe 1XG205-1S Rev. 1.1 (2-port USB 3.0 to PCI Express x1 Gen 2 with Renesas chipset)
Operating system	Windows 7 Ultimate 64-bit SP1
Measured by	Oscilloscope
Measured signal	*ExposureActive*

Table 14: Test setup components

Bandwidth, exposure time values, delays, and ROI frame rates

- The **default bandwidth** for Alvium USB cameras is 200 MBps. For some models, you can achieve higher frame rates by increasing values for `MaxTransferSize` and `DeviceLinkThroughputLimit`. See Operating systems and bandwidth on page 176.
- Available values and increments for **exposure time** depend on other controls, such as `DeviceLinkThroughputLimit`. See Value changes by feature interdependencies on page 171.
- **Minimum and maximum exposure time values** in Specifications on page 43 are preliminary. The next version of this document will provide final values.
- For **delays**, see Exposure start delay = exposure area – exposure time. on page 161.
- Calculation of maximum **frame rates for different ROIs** for Alvium USB cameras does not allow to give a formula. Typical operation on page 49 defines the conditions for measuring ROI frame rates.

Typical operation

All timing values are based on following parameters:

- Factory settings (camera after startup)
- Minimum exposure time
- Full resolution
- Mono8 pixel format (also for color models)
- Camera operation in freerun mode
- Sensor readout using ADC bit depth
- Without bandwidth limitations.

Bandwidth: Data is measured for six steps in a range of 200 MBps to 375 MBps. The default value for `DeviceLinkThroughputLimit` is 200 MBps for Alvium 1800 U cameras measured as average sensor readout.

Bit depth: Values are measured for Mono8. If you are using color formats or 10-bit or 12-bit pixel formats, frame rates fall below values for Mono8. increasing the `DeviceLinkThroughputLimit` value may increase maximum frame rates.

Triggering

The following table shows how the shutter mode impacts available frame rates. Reducing the area for ROI reduces readout time. The relations in Table 15 apply only if exposure time is shorter than readout time.

Sensor type	Shutter mode	Trigger mode	Available frame rates	ROI frame rates
Global shutter (GS)	Global shutter (GS)	Freerun	Maximum values	Increased values
	Global shutter (GS)	External trigger	Maximum values	Increased values
Rolling shutter (RS)	Rolling shutter (RS)	Freerun	Maximum values	Increased values
	Rolling shutter (RS)	External trigger	**Reduced values**	Increased values
	Global reset shutter (GRS)	Freerun	Maximum values	**No increase**
	Global reset shutter (GRS)	External trigger	Maximum values	**No increase**

Table 15: Frame rates depending on shutter modes and trigger modes

Achieved frame rates may not match specified values

- Some sensors have an exposure start jitter that may reduce maximum frame rates.
- Your individual setup may cause delays in data transmission.

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 176.

Interdependencies between ROI and ExposureTime values

Changing parameters for ROI can affect values for `ExposureTime`, such as minimum, maximum, and increments, but `ExposureTime` itself as well. We recommend you to set:

- ROI values
- `DeviceLinkThroughputLimit`

before you set values for `ExposureTime`.

See Value changes by feature interdependencies on page 171 for details.

`MaxTransferSize` can have an impact as well.

Sensor shutter types and triggering

Differences between sensors with global shutter (GS), rolling shutter (RS), and global reset shutter (GRS) are explained in Shutter types affecting image readout on page 175. Triggering behavior differs between cameras with global shutter (GS) and rolling shutter (RS). See Triggering on page 159 for details.

Power consumption

The power consumption values in this chapter are for **typical operation**:

- Factory settings (camera after startup)
- Minimum exposure time
- Maximum frame rate
- Full resolution
- Mono8 pixel format (also for color models)
- Camera operation in freerun mode
- Sensor readout using ADC bit depth
- Without bandwidth limitations.

Dimensions

For your model's dimensions, see Dimensions and mass on page 109.

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. See Technical drawings on page 111.

Alvium 1800 U model specifications

Alvium 1800 U-040m/c

Feature	Specification	
	1800 U-040m (monochrome)	**1800 U-040c (color)**
Sensor model	Sony IMX287	
Resolution	728 (H) × 544 (V); 0.4 MP	
Sensor type	CMOS	
Shutter type	Global shutter (GS)	
Sensor size	Type 1/2.9; 5 mm × 3.8 mm; 6.3 mm diagonal	
Pixel size	6.9 µm × 6.9 µm	
CRA	0 deg	
ADC	12-bit	
Monochrome pixel formats	Mono8 (default), Mono10, Mono12, Mono12p	Mono8, Mono10, Mono12, Mono12p
YUV color pixel formats	Not applicable	YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr
RGB color pixel formats	Not applicable	BayerGR8, BayerGR10, BayerGR10p, BayerRG12, BayerRG12p, BGR8, RGB8 (default)
Maximum image bit depth	12-bit	
Maximum frame rate	281 fps (at ≥200 MBps)	
Exposure time	177 µs to 10 s (at 200 MBps)	
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 As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA	
ExposureModes	Timed, TriggerControlled, TriggerWidth	
Power requirements	Power over USB; External power	
Power consumption (typical, at 5 VDC)	USB power: 1.9 W External power: 2.1 W	

Table 16: Alvium 1800 U-040m/c specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-040m/c			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +85 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 16: Alvium 1800 U-040m/c specifications (sheet 2 of 2)

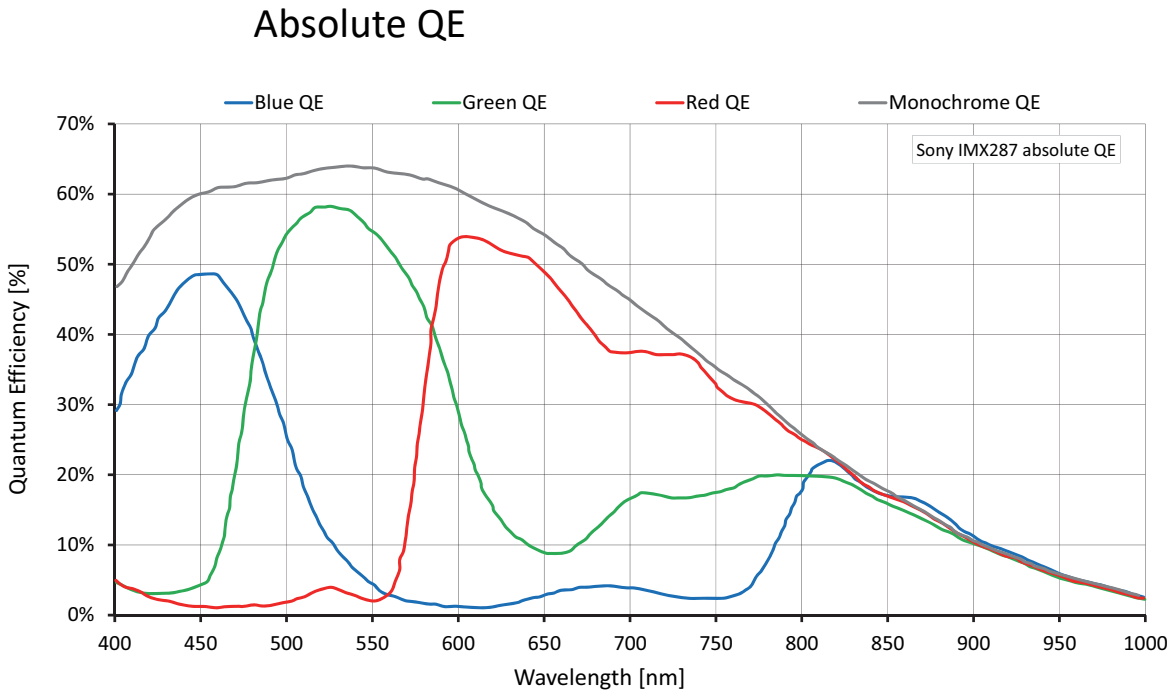


Figure 3: Alvium 1800 U-040m/c (Sony IMX287) absolute QE

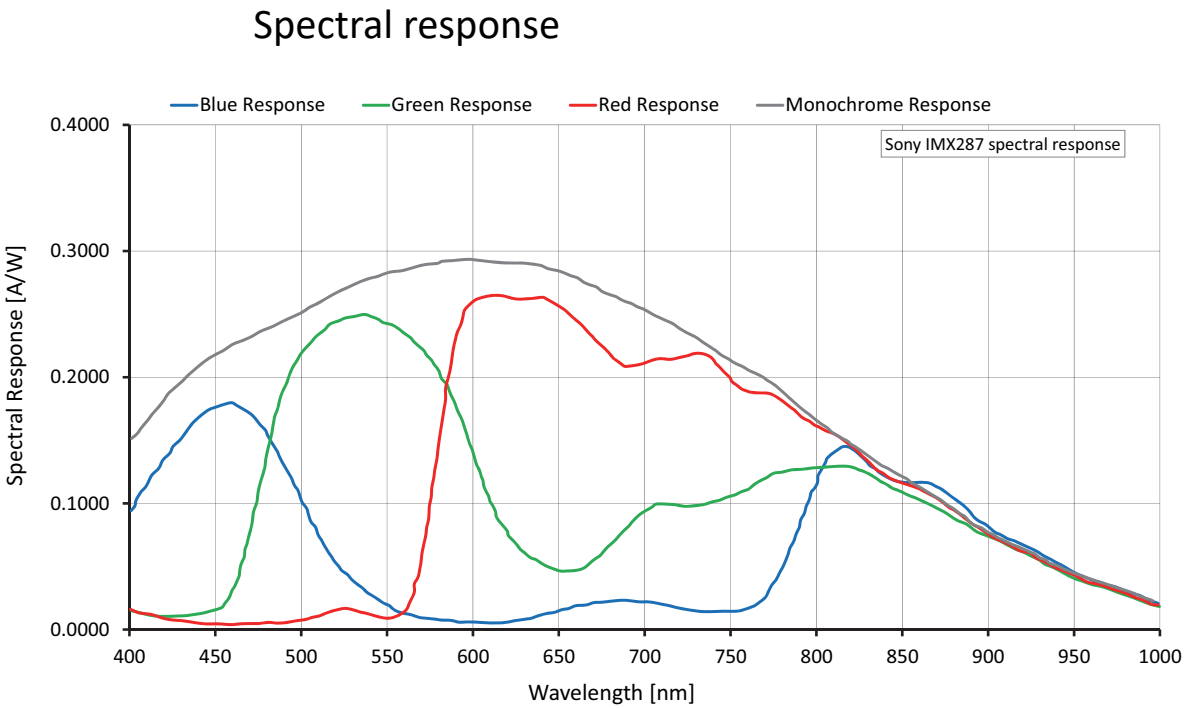


Figure 4: Alvium 1800 U-040m/c (Sony IMX287) spectral response

ROI frame rates

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 200 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps] at 200 MBps
Full resolution	728	544	396,032	281
VGA	640	480	307,200	312
HVGA	480	320	153,600	436
QVGA	320	240	76,800	543
Maximum × half	728	272	198,016	481
Maximum × minimum	728	8	5,824	1,546
Minimum × maximum	8[1]	544	4,352	287
Minimum × minimum	8[1]	8	64	1,753
[1]Constant for values ≤260 pixels				

Table 17: Alvium 1800 U-040m/c ROI frame rates at 200 MBps

Alvium 1800 U-050m/c

Feature	Specification	
	1800 U-050m (monochrome)	**1800 U-050c (color)**
Sensor model	ON Semiconductor PYTHON 480	
Resolution	808 (H) × 608 (V); 0.5 MP	
Sensor type	CMOS	
Shutter type	Global shutter (GS)	
Sensor size	Type 1/3.6; 3.9 mm × 2.9 mm; 4.9 mm diagonal	
Pixel size	4.8 µm × 4.8 µm	
CRA	1.65 deg	
ADC	10-bit	
Monochrome pixel formats	Mono8 (default), Mono10	Mono8, Mono10
YUV color pixel formats	Not applicable	YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr
RGB color pixel formats	Not applicable	BayerGR8, BayerGR10, BayerGR10p, BGR8, RGB8 (default)
Maximum image bit depth	10-bit	
Maximum frame rate	115 fps (at ≥200 MBps)	
Exposure time	64 µs to 10 s (at 200 MBps)	
Image buffer (RAM)	256 KB	
Non-volatile memory (Flash)	1024 KB	
Gain	0 dB to 11.3 dB; 0.1 dB increments	
GPIOs	4 programmable GPIOs As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA	
ExposureModes	Timed, TriggerControlled, TriggerWidth	
Power requirements	Power over USB; External power	
Power consumption (typical, at 5 VDC)	USB power: 1.5 W External power: 1.7 W	

Table 18: Alvium 1800 U-050m/c specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-050m/c			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +85 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 18: Alvium 1800 U-050m/c specifications (sheet 2 of 2)

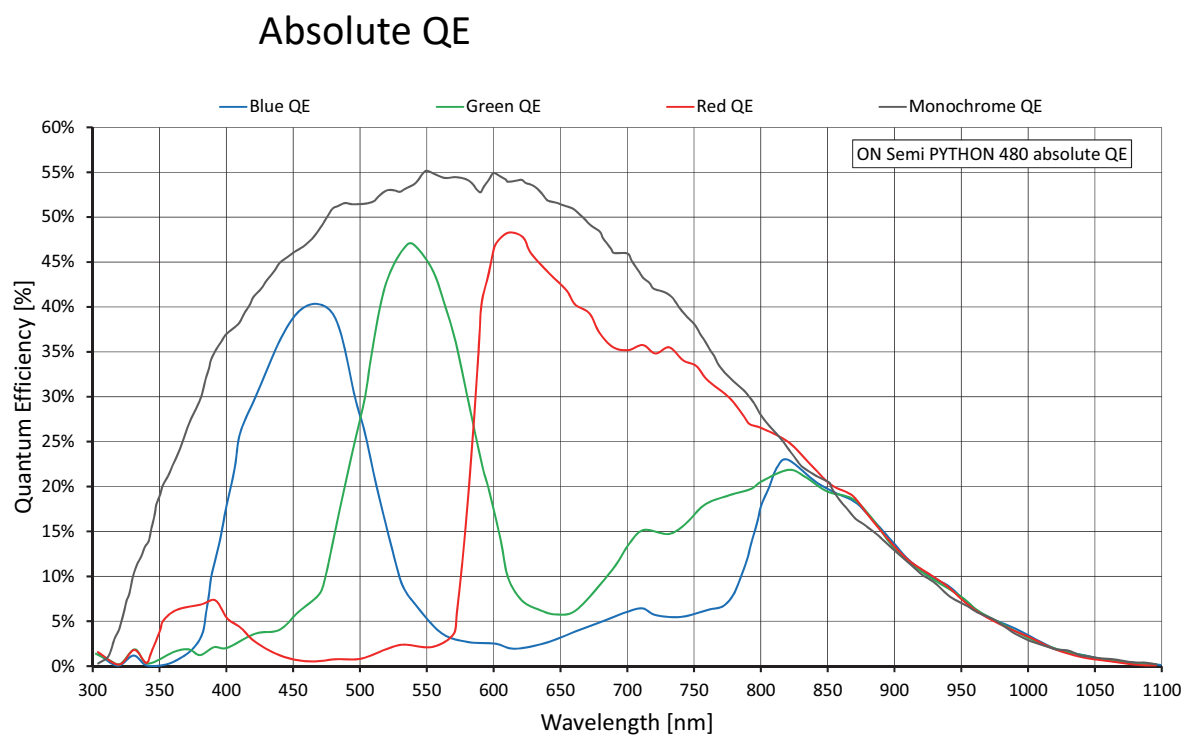


Figure 5: Alvium 1800 U-050m/c (ON Semi PYTHON 480) absolute QE

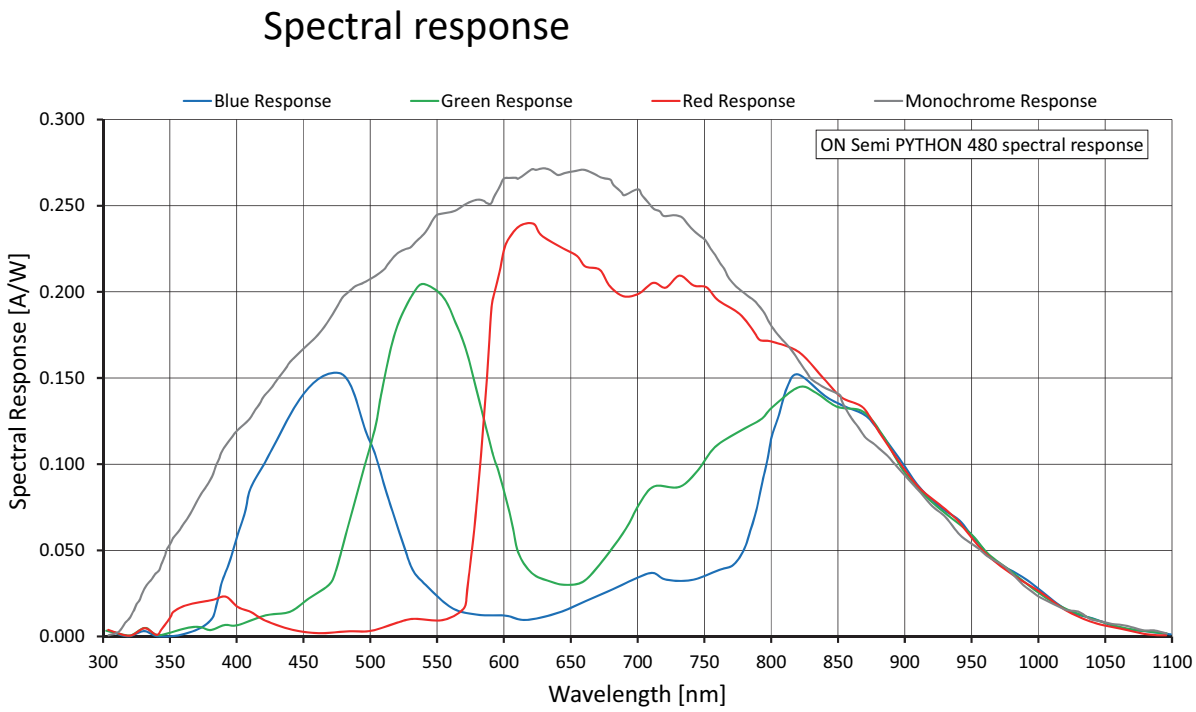


Figure 6: Alvium 1800 U-050m/c (ON Semi PYTHON 480) spectral response

ROI frame rates

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 200 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps] at 200 MBps
Full resolution	808	608	491,264	115
VGA	640	480	307,200	174
HVGA	480	320	153,600	309
QVGA	320	240	76,800	502
HQVGA	240	160	38,400	758
QQVGA	160	120	19,200	1,030
Maximum × half	808	304	245,632	216
Maximum × minimum	808	8	6,464	1,332
Minimum × maximum	8[1]	608	4,864	712
Minimum × minimum	8[1]	8	64	1,880
[1]Constant for values ≤16 pixels				

Table 19: Alvium 1800 U-050m/c ROI frame rates at 200 MBps

Alvium 1800 U-120m/c

Feature	Specification	
	1800 U-120m (monochrome)	**1800 U-120c (color)**
Sensor model	ON Semiconductor AR0135CS	
Resolution	1280 (H) × 960 (V); 1.2 MP	
Sensor type	CMOS	
Shutter type	Global shutter (GS)	
Sensor size	Type 1/3; 4.8 mm × 3.6 mm; 6.0 mm diagonal	
Pixel size	3.75 µm × 3.75 µm	
CRA	0 deg	
ADC	12-bit	
Monochrome pixel formats	Mono8 (default), Mono10, Mono12, Mono12p	Mono8, Mono10, Mono12, Mono12p
YUV color pixel formats	Not applicable	YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr
RGB color pixel formats	Not applicable	BayerGR8, BayerGR10, BayerGR10p, BayerRG12, BayerRG12p, BGR8, RGB8 (default)
Maximum image bit depth	12-bit	
Maximum frame rate	52 fps (at ≥200 MBps)	
Exposure time	57 µs to 10 s (at 200 MBps)	
Image buffer (RAM)	256 KB	
Non-volatile memory (Flash)	1024 KB	
Gain	0 dB to 17.7 dB; 0.1 dB increments	
GPIOs	4 programmable GPIOs As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA	
ExposureModes	Timed	
Power requirements	Power over USB; External power	
Power consumption (typical, at 5 VDC)	USB power: 1.3 W External power: 1.5 W	

Table 20: Alvium 1800 U-120m/c specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-120m/c			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +85 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 20: Alvium 1800 U-120m/c specifications (sheet 2 of 2)

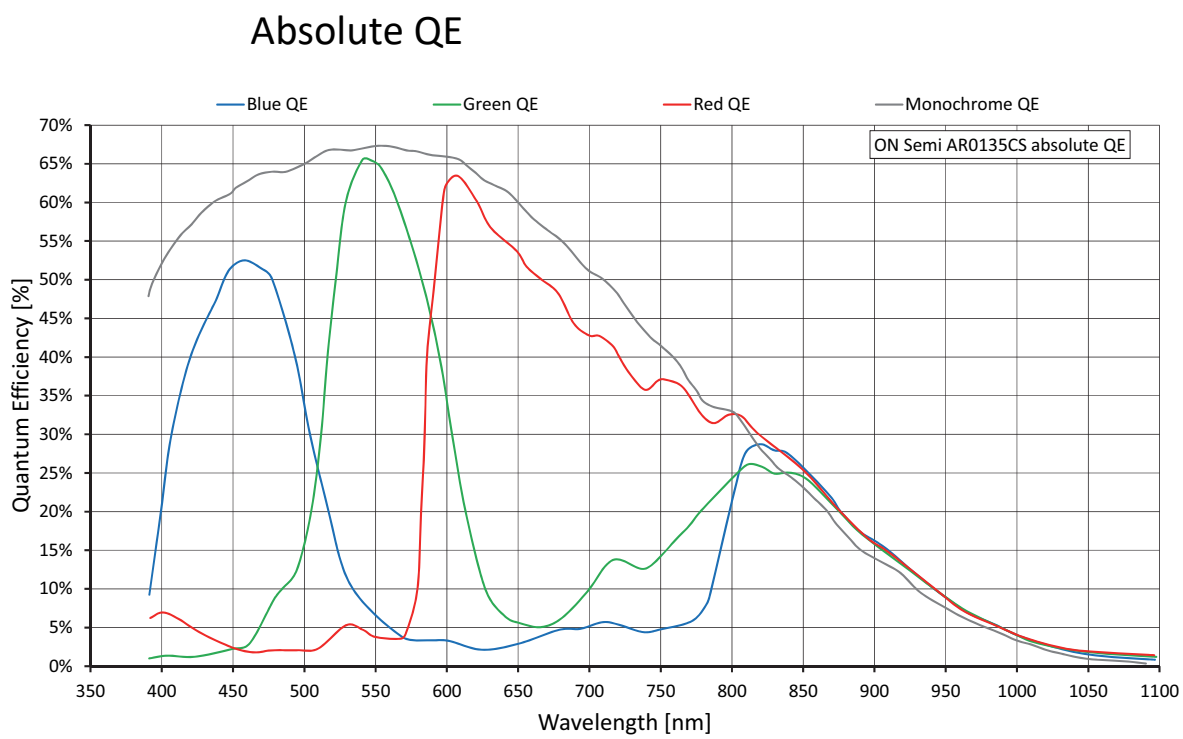


Figure 7: Alvium 1800 U-120m/c (ON Semi AR0135CS) absolute QE

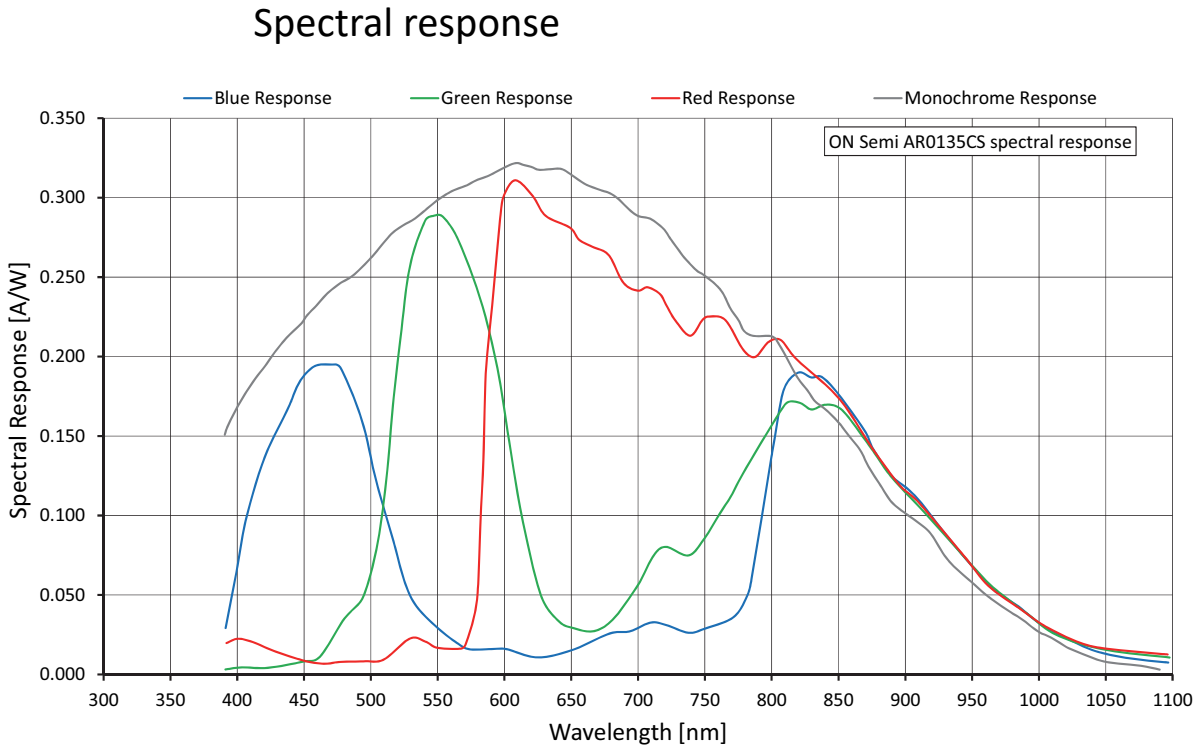


Figure 8: Alvium 1800 U-120m/c (ON Semi AR0135CS) spectral response

ROI frame rates

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 200 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps] at 200 MBps
Full resolution	1,280	960	1,228,800	52
HD 720	1,280	720	921,600	68
XGA	1,024	768	786,432	64
SVGA	800	600	480,000	81
VGA	640	480	307,200	99
QVGA	320	240	76,800	181
Maximum × half	1,280	480	614,400	99
Maximum × minimum	1,280	8	10,240	872
Minimum × maximum	8[1]	960	7,680	52
Minimum × minimum	8[1]	8	64	882

[1]Constant for values ≤280 pixels

Table 21: Alvium 1800 U-120m/c ROI frame rates at 200 MBps

Alvium 1800 U-158m/c

Feature	Specification	
	1800 U-158m (monochrome)	**1800 U-158c (color)**
Sensor model	Sony IMX273	
Resolution	1456 (H) × 1088 (V); 1.6 MP	
Sensor type	CMOS	
Shutter type	Global shutter (GS)	
Sensor size	Type 1/2.9; 5 mm × 3.8 mm; 6.3 mm diagonal	
Pixel size	3.45 µm × 3.45 µm	
CRA	0 deg	
ADC	12-bit	
Monochrome pixel formats	Mono8 (default), Mono10, Mono12, Mono12p	Mono8, Mono10, Mono12, Mono12p
YUV color pixel formats	Not applicable	YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr
RGB color pixel formats	Not applicable	BayerGR8, BayerGR10, BayerGR10p, BayerRG12, BayerRG12p, BGR8, RGB8 (default)
Maximum image bit depth	12-bit	
Maximum frame rate	150 fps (at ≥300 MBps)	
Exposure time	177 µs to 10 s (at 300 MBps)	
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 As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA	
ExposureModes	Timed, TriggerControlled, TriggerWidth	
Power requirements	Power over USB; External power	
Power consumption (typical, at 5 VDC)	USB power: 2.5 W External power: 2.6 W	

Table 22: Alvium 1800 U-158m/c specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-158m/c			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +85 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 22: Alvium 1800 U-158m/c specifications (sheet 2 of 2)

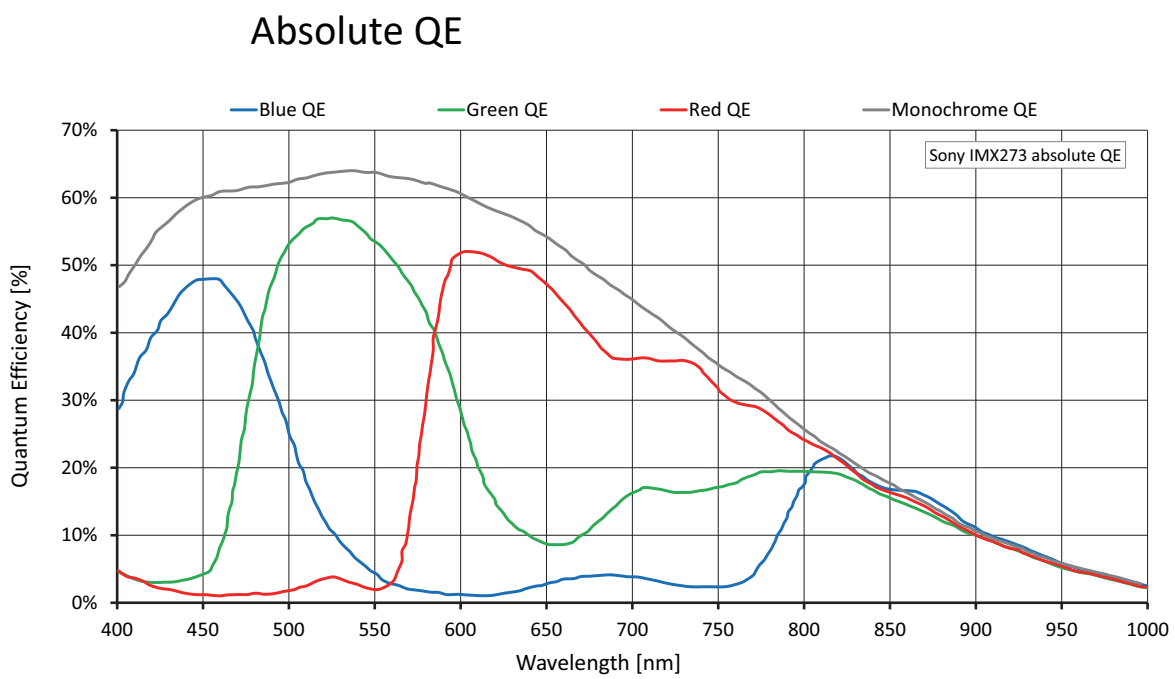


Figure 9: Alvium 1800 U-158m/c (Sony IMX273) absolute QE

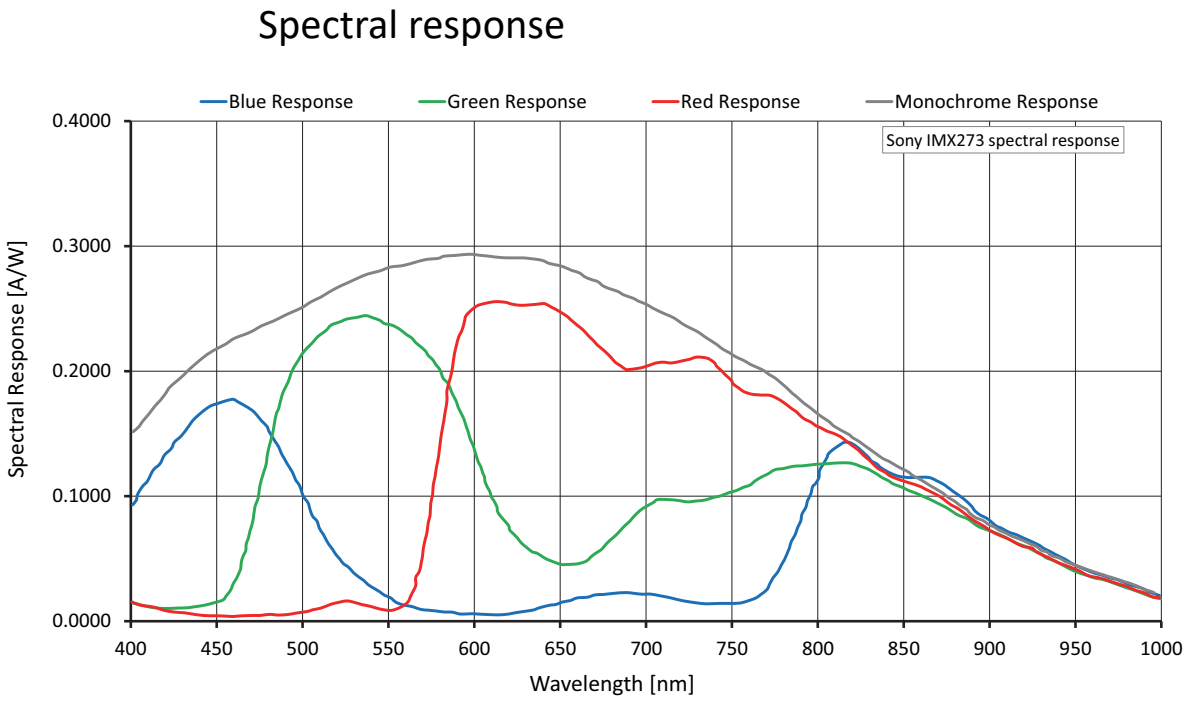


Figure 10: Alvium 1800 U-158m/c (Sony IMX273) spectral response

ROI frame rates

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 300 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps]		
				200 MBps	250 MBps	300 MBps
Full resolution	1,456	1,088	1,584,128	112	138	150
WXGA+	1,440	900	1,296,000	134	166	177
SXGA	1,280	1,024	1,310,720	134	158	
HD 720	1,280	720	921.600	183	215	
XGA	1,024	768	786,432	205		
SVGA	800	600	480,000	256		
VGA	640	480	307,200	313		
QVGA	320	240	76,800	525		
Maximum × half	1,456	544	792,064	203	250	270
Maximum × minimum	1,456	8	11,648	1,043	1,207	1,278
Minimum × maximum	8[1]	1,088	8,704	155		
Minimum × minimum	8[1]	8	64	1,771		

[1]Constant for values ≤260 pixels

Table 23: Alvium 1800 U-158m/c ROI frame rates at 200 to 300 MBps

Alvium 1800 U-240m/c

Feature	Specification	
	1800 U-240m (monochrome)	**1800 U-240c (color)**
Sensor model	Sony IMX392	
Resolution	1936 (H) × 1216 (V); 2.4 MP	
Sensor type	CMOS	
Shutter type	Global shutter (GS)	
Sensor size	Type 1/2.3; 6.7 mm × 4.2 mm; 7.9 mm diagonal	
Pixel size	3.45 µm × 3.45 µm	
CRA	0 deg	
ADC	12-bit	
Monochrome pixel formats	Mono8 (default), Mono10, Mono12, Mono12p	Mono8, Mono10, Mono12, Mono12p
YUV color pixel formats	Not applicable	YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr
RGB color pixel formats	Not applicable	BayerGR8, BayerGR10, BayerGR10p, BayerRG12, BayerRG12p, BGR8, RGB8 (default)
Maximum image bit depth	12-bit	
Maximum frame rate	126 fps (at ≥330 MBps)	
Exposure time	175 µs to 96 s (at 330 MBps)	
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 As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA	
ExposureModes	Timed, TriggerControlled, TriggerWidth	
Power requirements	Power over USB; External power	
Power consumption (typical, at 5 VDC)	USB power: 2.8 W External power: 3.0 W	

Table 24: Alvium 1800 U-240m/c specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-240m/c			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +85 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 24: Alvium 1800 U-240m/c specifications (sheet 2 of 2)

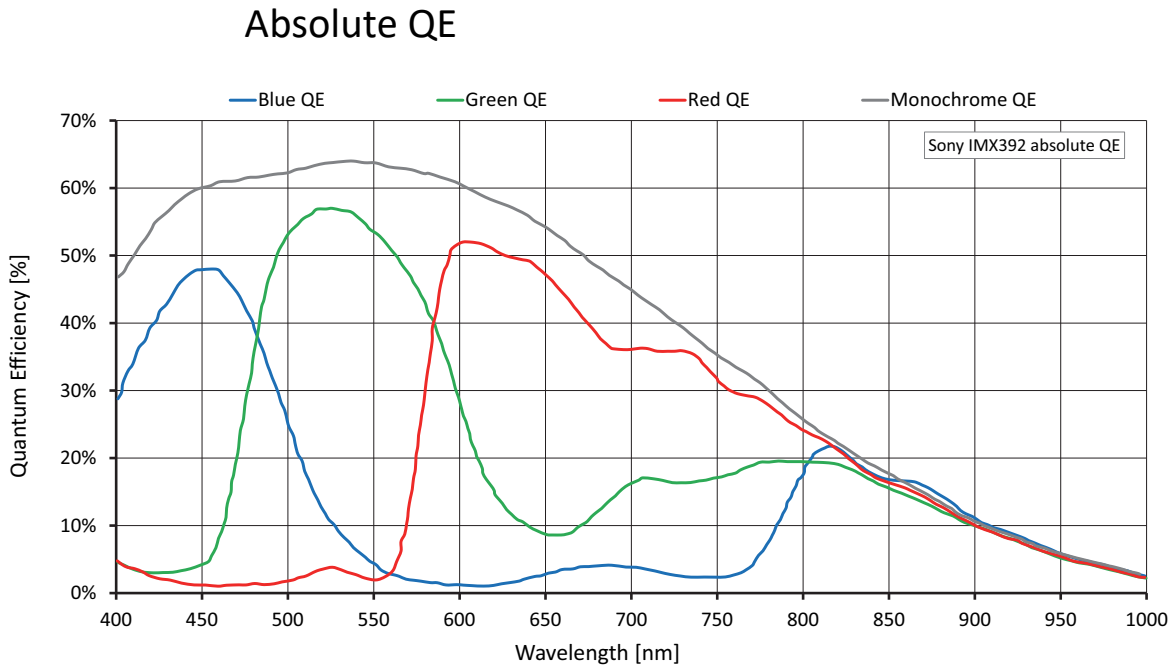


Figure 11: Alvium 1800 U-240m/c (Sony IMX392) absolute QE

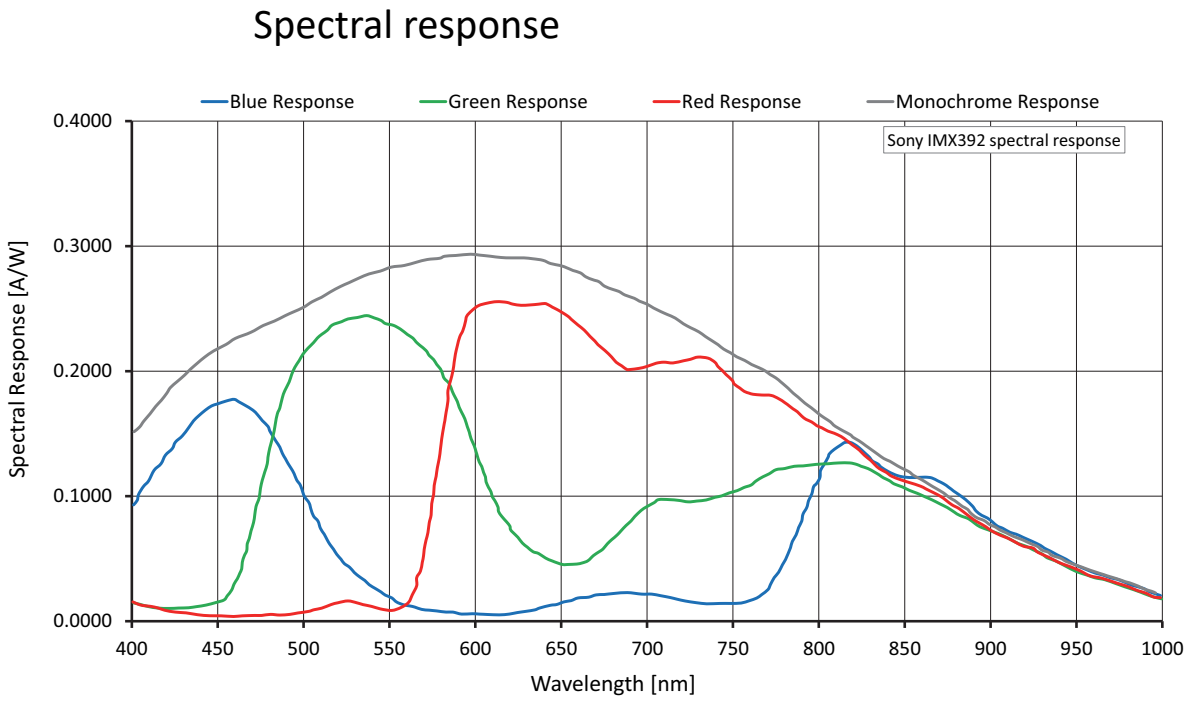


Figure 12: Alvium 1800 U-240m/c (Sony IMX392) spectral response

ROI frame rates

200 to 300 Mbps

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 330 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps]		
				200 MBps	250 MBps	300 MBps
Full resolution	1,936	1,216	2,354,176	79	98	117
Full HD	1,920	1,080	2,073,600	89	109	130
UXGA	1,600	1,200	1,920,000	97	119	128
WXGA+	1,440	900	1,296,000	139	167	
SXGA	1,280	1,024	1,310,720	138	149	
HD 720	1,280	720	921,600	190	205	
XGA	1,024	768	786,432	194		
SVGA	800	600	480,000	244		
VGA	640	480	307,200	297		
QVGA	320	240	76,800	530		
Maximum × half	1,936	608	1,177,088	149	183	217
Maximum × minimum	1,936	8	15,488	1,133	1,277	1,394
Minimum × maximum	8[1]	1,216	9,728	129		
Minimum × minimum	8[1]	8	64	2,039		

[1]Constant for values ≤260 pixels

Table 25: Alvium 1800 U-240m/c ROI frame rates at 200 to 300 MBps

Frame rate values

Frame rates increase when bandwidth is increased, see 330 to 375 Mbps on page 71.

330 to 375 Mbps

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 330 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps]		
				330 MBps	350 MBps	375 MBps
Full resolution	1,936	1,216	2,354,176	126		
Full HD	1,920	1,080	2,073,600	140		
UXGA	1,600	1,200	1,920,000	128		
WXGA+	1,440	900	1,296,000	167		
SXGA	1,280	1,024	1,310,720	149		
HD 720	1,280	720	921,600	205		
XGA	1,024	768	786,432	194		
SVGA	800	600	480,000	244		
VGA	640	480	307,200	297		
QVGA	320	240	76,800	530		
Maximum × half	1,936	608	1,177,088	233		
Maximum × minimum	1,936	8	15,488	1,442		
Minimum × maximum	8[1]	1,216	9,728	129		
Minimum × minimum	8[1]	8	64	2,039		
[1]Constant for values ≤260 pixels						

Table 26: Alvium 1800 U-240m/c ROI frame rates at 330 to 375 MBps

Alvium 1800 U-319m/c

Feature	Specification	
	1800 U-319m (monochrome)	**1800 U-319c (color)**
Sensor model	Sony IMX265	
Resolution	2064 (H) × 1544 (V); 3.2 MP	
Sensor type	CMOS	
Shutter type	Global shutter (GS)	
Sensor size	Type 1/1.8; 7.1 mm × 5.3 mm; 8.9 mm diagonal	
Pixel size	3.45 µm × 3.45 µm	
CRA	0 deg	
ADC	12-bit	
Monochrome pixel formats	Mono8 (default), Mono10, Mono12, Mono12p	Mono8, Mono10, Mono12, Mono12p
YUV color pixel formats	Not applicable	YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr
RGB color pixel formats	Not applicable	BayerGR8, BayerGR10, BayerGR10p, BayerRG12, BayerRG12p, BGR8, RGB8 (default)
Maximum image bit depth	12-bit	
Maximum frame rate	53 fps (at ≥200 MBps)	
Exposure time	175 µs to 10 s (at 200 MBps)	
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 As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA	
ExposureModes	Timed, TriggerControlled, TriggerWidth	
Power requirements	Power over USB; External power	
Power consumption (typical, at 5 VDC)	USB power:2.2 W External power: 2.4 W	

Table 27: Alvium 1800 U-319m/c specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-319m/c			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +85 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 27: Alvium 1800 U-319m/c specifications (sheet 2 of 2)

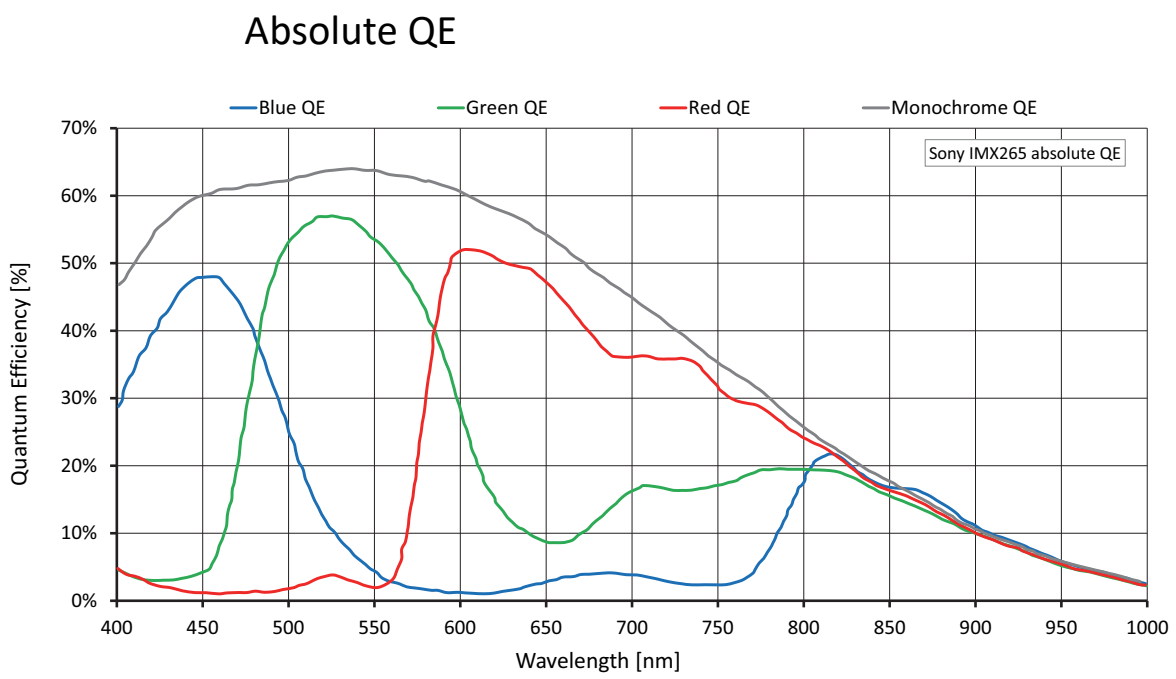


Figure 13: Alvium 1800 U-319m/c (Sony IMX265) absolute QE

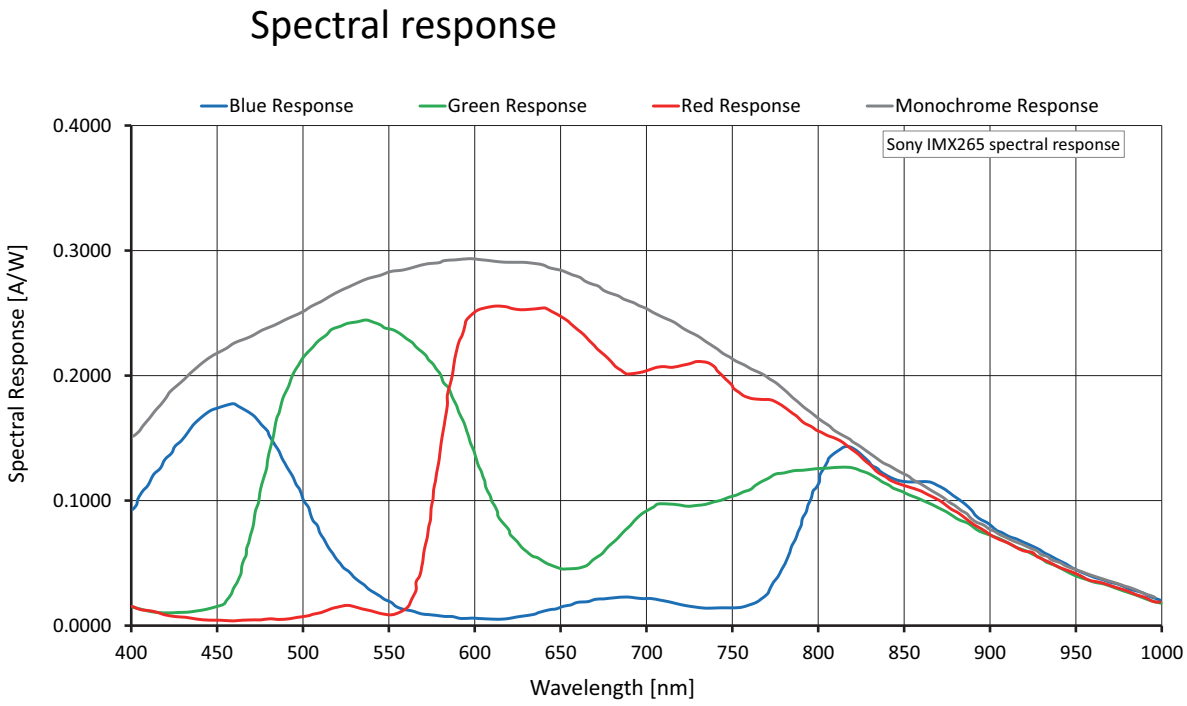


Figure 14: Alvium 1800 U-319m/c (Sony IMX265) spectral response

ROI frame rates

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 200 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps] at 200 MBps
Full resolution	2,064	1,544	3,186,816	53
Full HD	1,920	1,080	2,073,600	74
UXGA	1,600	1,200	1,920,000	67
WXGA+	1,440	900	1,296,000	88
SXGA	1,280	1,024	1,310,720	78
HD 720	1,280	720	921,600	108
XGA	1,024	768	786,432	102
SVGA	800	600	480,000	128
VGA	640	480	307,200	156
QVGA	320	240	76,800	280
QQVGA	160	120	19,200	459
Maximum × half	2,064	772	1,593,408	100
Maximum × minimum	2,064	8	16,512	851
Minimum × maximum	8[1]	1,544	12,352	53
Minimum × minimum	8[1]	8	64	1,127

[1]Constant for values ≤260 pixels

Table 28: Alvium 1800 U-319m/c ROI frame rates at 200 MBps

Alvium 1800 U-500m/c

Feature	Specification	
	1800 U-500m (monochrome)	**1800 U-500c (color)**
Sensor model	ON Semiconductor AR0521SR	
Resolution	2592 (H) × 1944 (V); 5.0 MP	
Sensor type	CMOS	
Shutter type	Rolling shutter (RS)	
Sensor size	Type 1/2.5; 5.7 mm × 4.3 mm; 7.1 mm diagonal	
Pixel size	2.2 µm × 2.2 µm	
CRA	9 deg	
ADC	10-bit	
Monochrome pixel formats	Mono8 (default), Mono10	Mono8, Mono10
YUV color pixel formats	Not applicable	YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr
RGB color pixel formats	Not applicable	BayerGR8, BayerGR10, BayerGR10p, BGR8, RGB8 (default)
Maximum image bit depth	10-bit	
Maximum frame rate	67 fps (at ≥350 MBps)	
Exposure time	7.4 µs to 2 s (at 350 MBps)	
Image buffer (RAM)	256 KB	
Non-volatile memory (Flash)	1024 KB	
Gain	0 dB to 24.1 dB; 0.1 dB increments	
GPIOs	4 programmable GPIOs As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA	
ExposureModes	Timed	
Power requirements	Power over USB; External power	
Power consumption (typical at 5 VDC)	USB power: 2.2 W External power: 2.4 W	

Table 29: Alvium 1800 U-500m/c specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-500m/c			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +85 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 29: Alvium 1800 U-500m/c specifications (sheet 2 of 2)

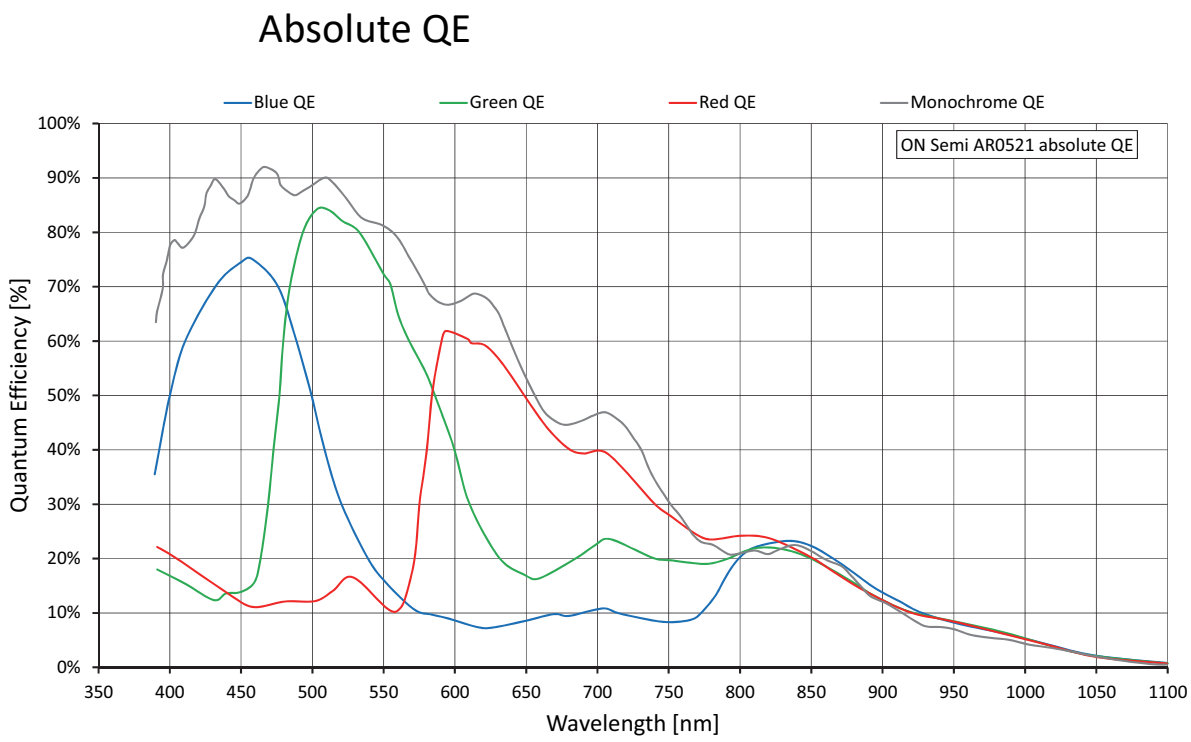


Figure 15: Alvium 1800 U-500m/c (ON Semi AR0521SR) absolute QE

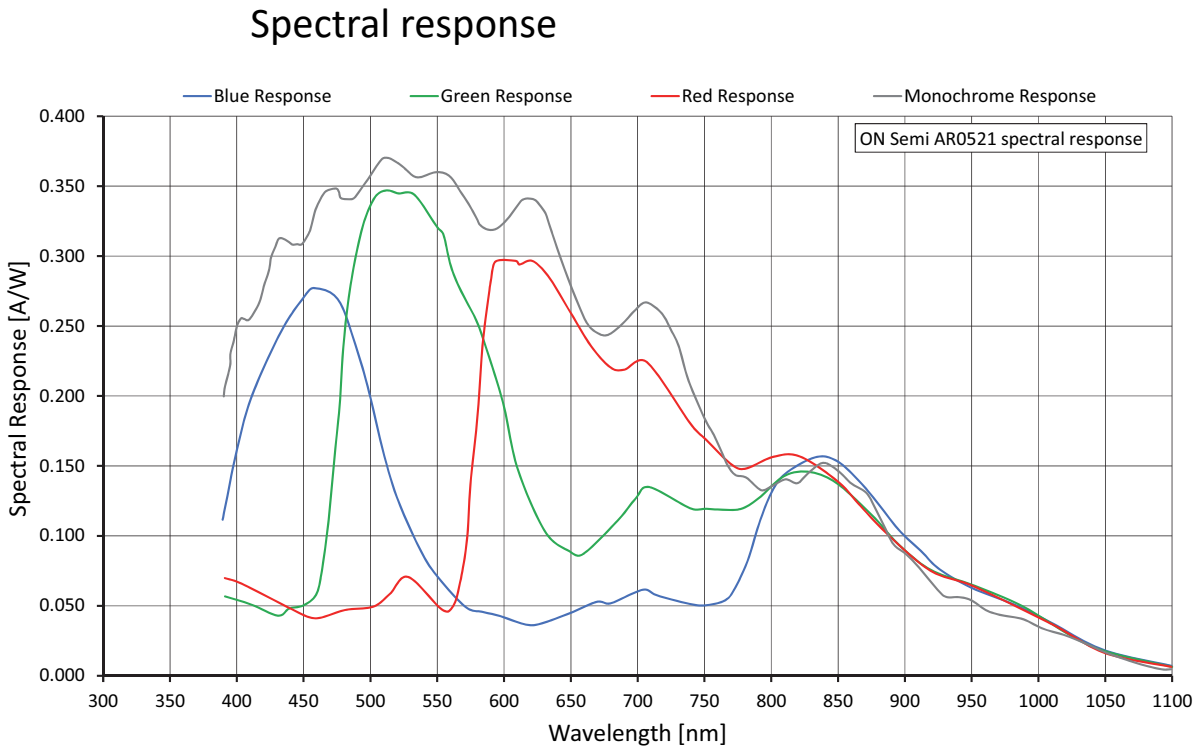


Figure 16: Alvium 1800 U-500m/c (ON Semi AR0521SR) spectral response

ROI frame rates

200 to 300 MBps

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 350 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps]		
				200 MBps	250 MBps	300 MBps
Full resolution	2,592	1,944	5,038,848	38	48	57
QXGA	2,048	1,536	3,145,728	61	76	85
Full HD	1,920	1,080	2,073,600	91	113	118
UXGA	1,600	1,200	1,920,000	99	108	
WXGA+	1,440	900	1,296,000	141		
SXGA	1,280	1,024	1,310,720	125		
HD 720	1,280	720	921,600	175		
XGA	1,024	768	786,432	165		
SVGA	800	600	480,000	208		
VGA	640	480	307,200	256		
QVGA	320	240	76,800	472		
QQVGA	160	120	19,200	817		
Maximum × half	2,592	972	2,519,424	74	93	111
Maximum × minimum	2,592	8	20,736	1,168	1,357	1,542
Minimum × maximum	8	1,944	15,552	68		
Minimum × minimum	8	8	64	2,613		

Table 30: Alvium 1800 U-500m/c ROI frame rates at 200 to 300 MBps

Frame rates for higher bandwidths

Frame rates increase when bandwidth is increased, see 330 to 375 MBps on page 80.

330 to 375 MBps

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 350 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps]		
				330 MBps	350 MBps	375 MBps
Full resolution	2,592	1,944	5,038,848	63	67	
QXGA	2,048	1,536	3,145,728	85		
Full HD	1,920	1,080	2,073,600	118		
UXGA	1,600	1,200	1,920,000	107		
WXGA+	1,440	900	1,296,000	141		
SXGA	1,280	1,024	1,310,720	125		
HD 720	1,280	720	921,600	175		
XGA	1,024	768	786,432	165		
SVGA	800	600	480,000	208		
VGA	640	480	307,200	256		
QVGA	320	240	76,800	472		
QQVGA	160	120	19,200	817		
Maximum × half	2,592	972	2,519,424	122	129	130
Maximum × minimum	2,592	8	20,736	1,639	1,690	
Minimum × maximum	8	1,944	15,552	68		
Minimum × minimum	8	8	64	2,600		

Table 31: Alvium 1800 U-500m/c ROI frame rates at 330 to 375 MBps

Alvium 1800 U-501m NIR

Feature	Specification
	1800 U-501m NIR (monochrome)
Sensor model	ON Semiconductor AR0522
Resolution	2592 (H) × 1944 (V); 5.0 MP
Sensor type	CMOS
Shutter type	Rolling shutter (RS)
Sensor size	Type 1/2.5; 5.7 mm × 4.3 mm; 7.1 mm diagonal
Pixel size	2.2 µm × 2.2 µm
CRA	9 deg
ADC	10-bit
Monochrome pixel formats	Mono8 (default), Mono10
YUV color pixel formats	Not applicable
RGB color pixel formats	Not applicable
Maximum image bit depth	10-bit
Maximum frame rate	67 fps (at ≥350 MBps)
Exposure time	7.4 µs to 2 s (at 350 MBps)
Image buffer (RAM)	256 KB
Non-volatile memory (Flash)	1024 KB
Gain	0 dB to 24.1 dB; 0.1 dB increments
GPIOs	4 programmable GPIOs As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA
ExposureModes	Timed
Power requirements	Power over USB; External power
Power consumption (typical at 5 VDC)	USB power: 2.2 W External power: 2.4 W

Table 32: Alvium 1800 U-501m NIR specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-501m NIR (monochrome)			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +85 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 32: Alvium 1800 U-501m NIR specifications (sheet 2 of 2)

Absolute QE

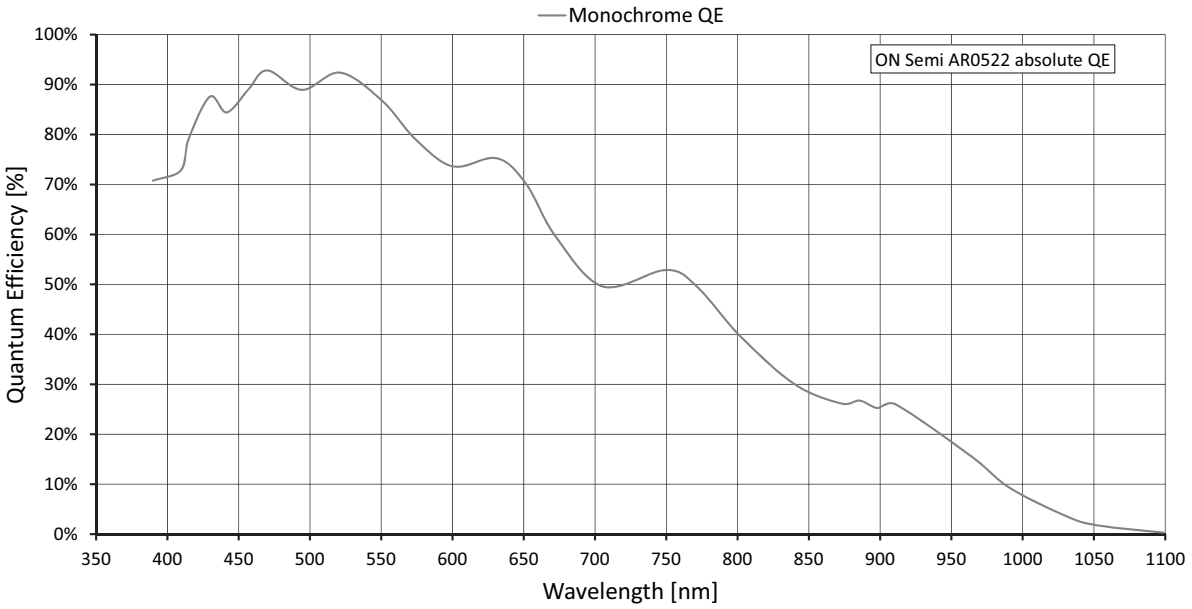


Figure 17: Alvium 1800 U-501m NIR (ON Semi AR0522) absolute QE

Spectral response

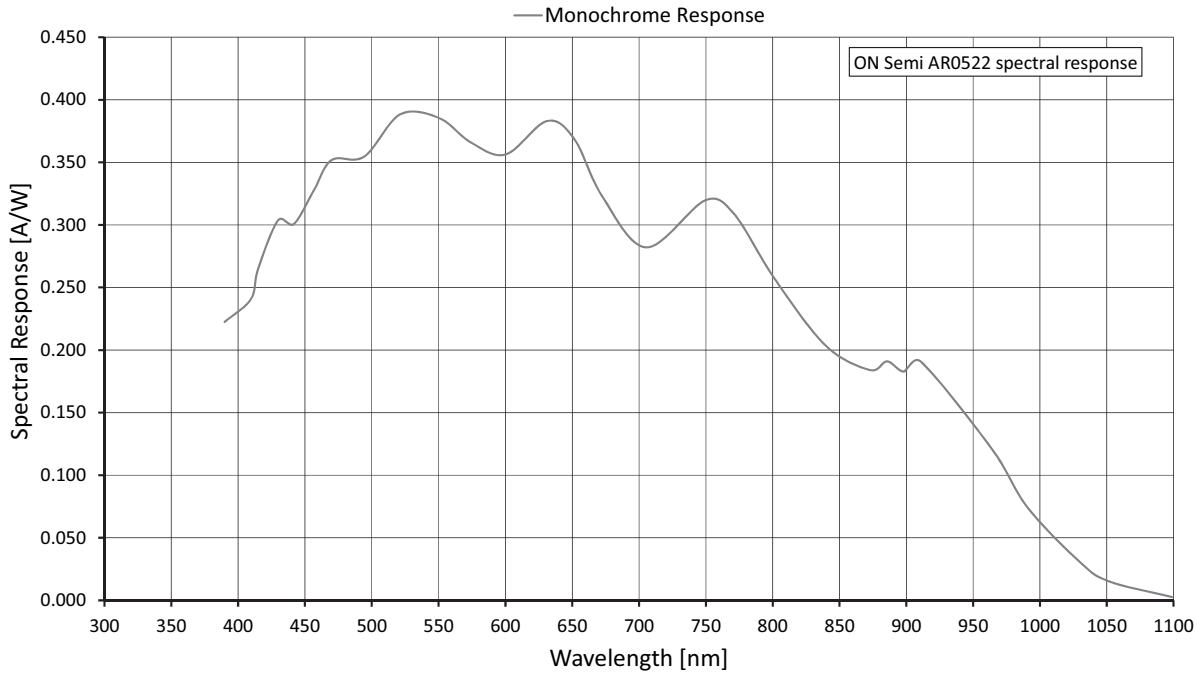


Figure 18: Alvium 1800 U-501m NIR (ON Semi AR0522) spectral response

ROI frame rates

200 to 300 MBps

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 350 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps]		
				200 MBps	250 MBps	300 MBps
Full resolution	2,592	1,944	5,038,848	38	48	57
QXGA	2,048	1,536	3,145,728	61	76	85
Full HD	1,920	1,080	2,073,600	91	113	118
UXGA	1,600	1,200	1,920,000	99	108	
WXGA+	1,440	900	1,296,000	141		
SXGA	1,280	1,024	1,310,720	125		
HD 720	1,280	720	921,600	175		
XGA	1,024	768	786,432	165		
SVGA	800	600	480,000	208		
VGA	640	480	307,200	256		
QVGA	320	240	76,800	472		
QQVGA	160	120	19,200	817		
Maximum × half	2,592	972	2,519,424	74	93	111
Maximum × minimum	2,592	8	20,736	1,168	1,357	1,542
Minimum × maximum	8	1,944	15,552	68		
Minimum × minimum	8	8	64	2,613		

Table 33: Alvium 1800 U-501m NIR ROI frame rates at 200 to 300 MBps

Frame rates for higher bandwidths

Frame rates increase when bandwidth is increased, see 330 to 375 MBps on page 85.

330 to 375 MBps

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 350 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps]		
				330 MBps	350 MBps	375 MBps
Full resolution	2,592	1,944	5,038,848	63	67	
QXGA	2,048	1,536	3,145,728	85		
Full HD	1,920	1,080	2,073,600	118		
UXGA	1,600	1,200	1,920,000	107		
WXGA+	1,440	900	1,296,000	141		
SXGA	1,280	1,024	1,310,720	125		
HD 720	1,280	720	921,600	175		
XGA	1,024	768	786,432	165		
SVGA	800	600	480,000	208		
VGA	640	480	307,200	256		
QVGA	320	240	76,800	472		
QQVGA	160	120	19,200	817		
Maximum × half	2,592	972	2,519,424	122	129	130
Maximum × minimum	2,592	8	20,736	1,639	1,690	
Minimum × maximum	8	1,944	15,552	68		
Minimum × minimum	8	8	64	2,600		

Table 34: Alvium 1800 U-501m NIR ROI frame rates at 330 to 375 MBps

Alvium 1800 U-507m/c

Feature	Specification	
	1800 U-507m (monochrome)	**1800 U-507c (color)**
Sensor model	Sony IMX264	
Resolution	2464 (H) × 2056 (V); 5.1 MP	
Sensor type	CMOS	
Shutter type	Global shutter (GS)	
Sensor size	Type 2/3; 8.5 mm × 7.1 mm; 11.1 mm diagonal	
Pixel size	3.45 µm × 3.45 µm	
CRA	0 deg	
ADC	12-bit	
Monochrome pixel formats	Mono8 (default), Mono10, Mono12, Mono12p	Mono8, Mono10, Mono12, Mono12p
YUV color pixel formats	Not applicable	YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr
RGB color pixel formats	Not applicable	BayerGR8, BayerGR10, BayerGR10p, BayerRG12, BayerRG12p, BGR8, RGB8 (default)
Maximum image bit depth	12-bit	
Maximum frame rate	34 fps (at ≥200 MBps)	
Exposure time	176 µs to 10 s (at 200 MBps)	
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 As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA	
ExposureModes	Timed, TriggerControlled, TriggerWidth	
Power requirements	Power over USB; External power	
Power consumption (typical, at 5 VDC)	USB power: 2 W External power:2.2 W	

Table 35: Alvium 1800 U-507m/c specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-507m/c			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +85 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 35: Alvium 1800 U-507m/c specifications (sheet 2 of 2)

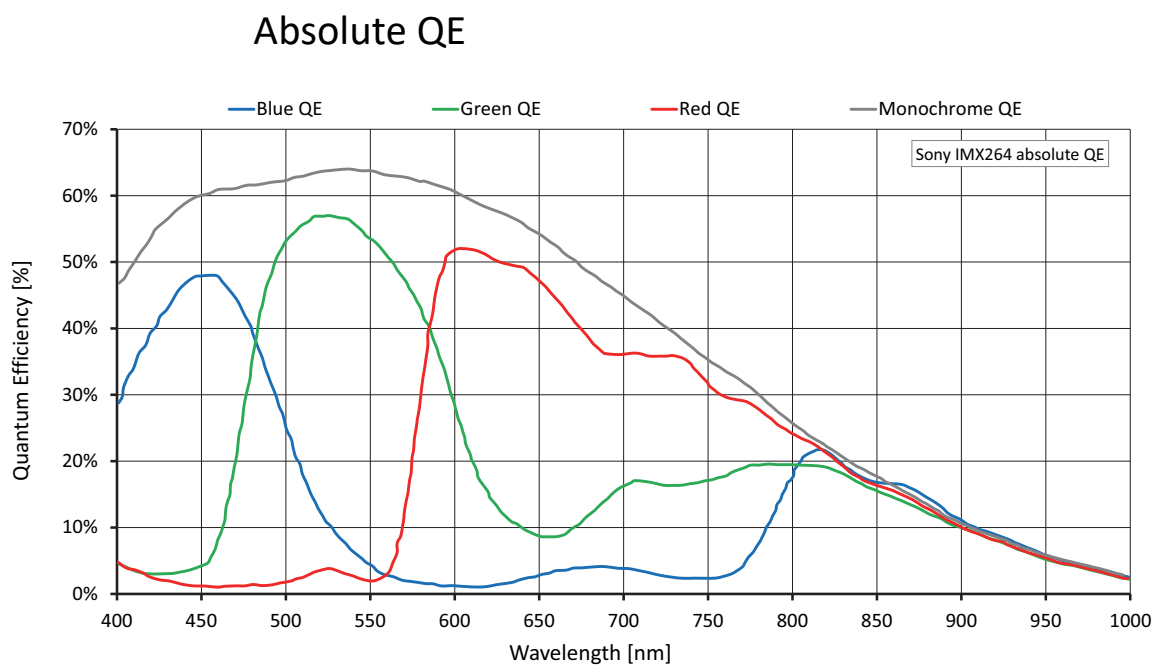


Figure 19: Alvium 1800 U-507m/c (Sony IMX264) absolute QE

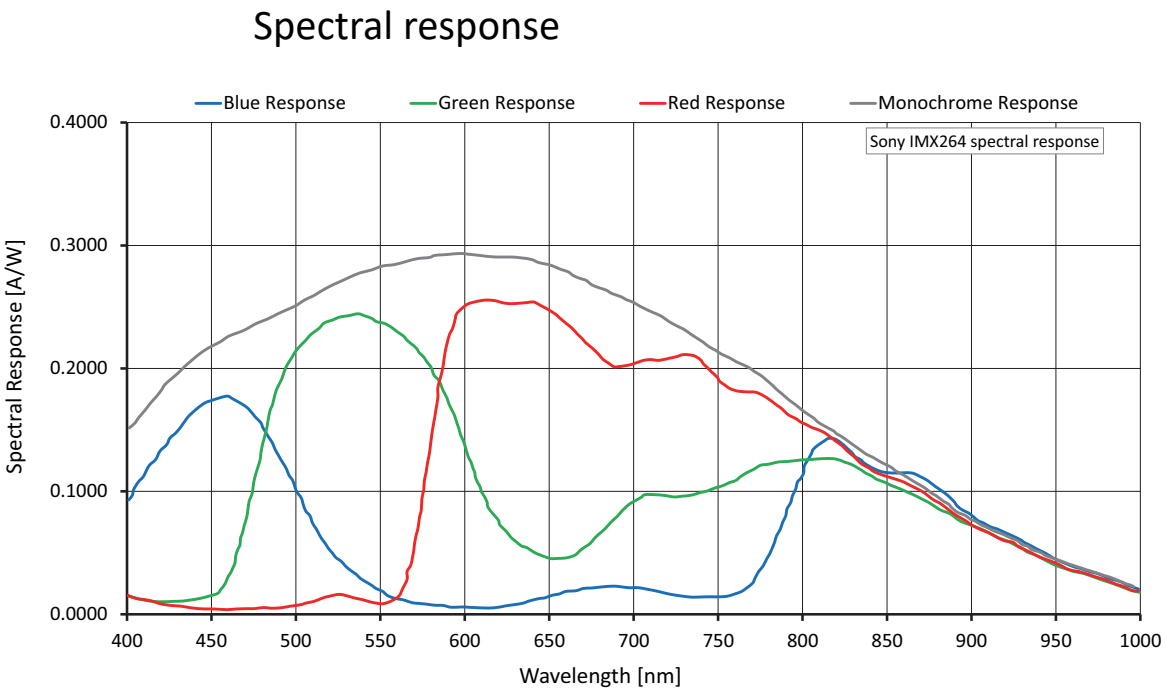


Figure 20: Alvium 1800 U-507m/c (Sony IMX264) spectral response

ROI frame rates

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 200 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps] at 200 MBps
Full resolution	2,464	2,056	5,065,984	34
QXGA	2,048	1,536	3,145,728	45
Full HD	1,920	1,080	2,073,600	63
UXGA	1,600	1,200	1,920,000	57
WXGA+	1,440	900	1,296,000	75
SXGA	1,280	1,024	1,310,720	66
HD 720	1,280	720	921,600	92
XGA	1,024	768	786,432	87
SVGA	800	600	480,000	109
VGA	640	480	307,200	133
QVGA	320	240	76,800	239
QQVGA	160	120	19,200	392
Maximum × half	2,464	1,028	2,532,992	65
Maximum × minimum	2,464	8	19,712	723
Minimum × maximum	8[1]	2,056	16,448	34
Minimum × minimum	8[1]	8	64	971

[1]Constant for values ≤260 pixels

Table 36: Alvium 1800 U-507m/c ROI frame rates at 200 MBps

Alvium 1800 U-508m/c

Feature	Specification	
	1800 U-508m (monochrome)	**1800 U-508c (color)**
Sensor model	Sony IMX250LLR	Sony IMX250LQR
Resolution	2464 (H) x 2056 (V); 5.1 MP	
Sensor type	CMOS	
Shutter type	Global shutter (GS)	
Sensor size	Type 2/3; 8.5 mm × 7.1 mm; 11.1 mm diagonal	
Pixel size	3.45 µm × 3.45 µm	
CRA	0 deg	
ADC	12-bit	
Monochrome pixel formats	Mono8 (default), Mono10, Mono12, Mono12p	Mono8, Mono10, Mono12, Mono12p
YUV color pixel formats	Not applicable	YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr
RGB color pixel formats	Not applicable	BayerGR8, BayerGR10, BayerGR10p, BayerRG12, BayerRG12p, BGR8, RGB8 (default)
Maximum image bit depth	12-bit	
Maximum frame rate	65 fps (at **≥375** MBps)	
Exposure time	175 µs to 96 s (at 375 MBps)	
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 As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA	
ExposureModes	Timed, TriggerControlled, TriggerWidth	
Power requirements	Power over USB; External power	
Power consumption (typical, at 5 VDC)	USB power: 2.9 W External power: 3.1 W	

Table 37: Alvium 1800 U-508m/c specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-508m/c			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +85 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 37: Alvium 1800 U-508m/c specifications (sheet 2 of 2)

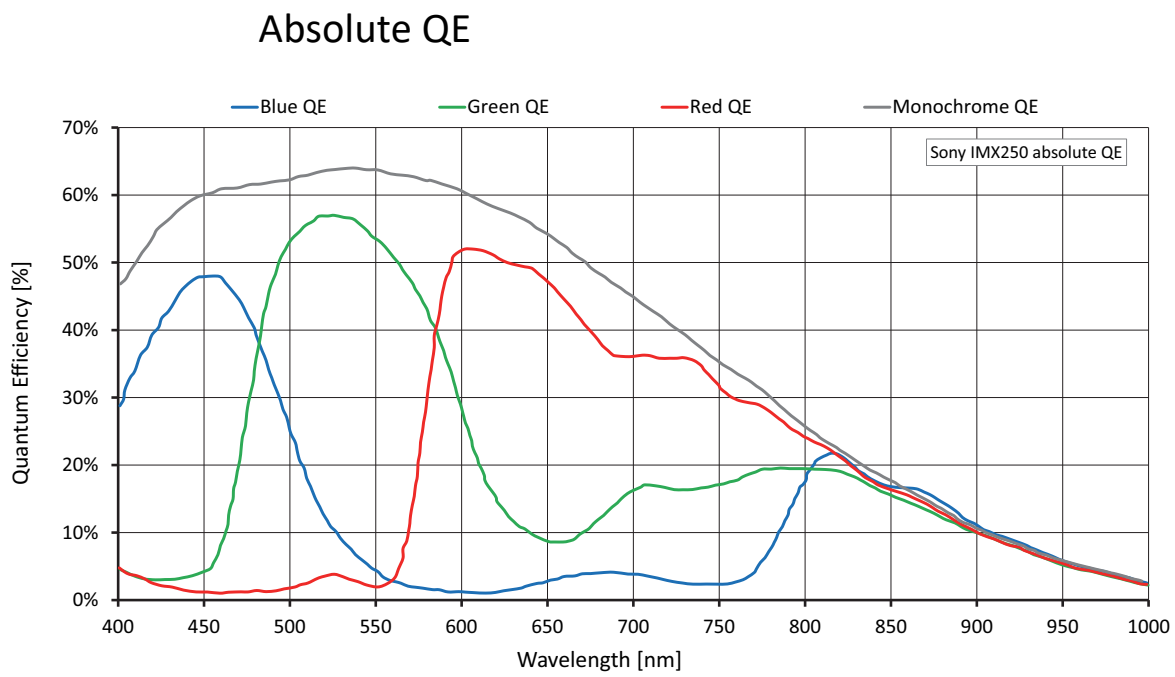


Figure 21: Alvium 1800 U-508m/c (Sony IMX250) absolute QE

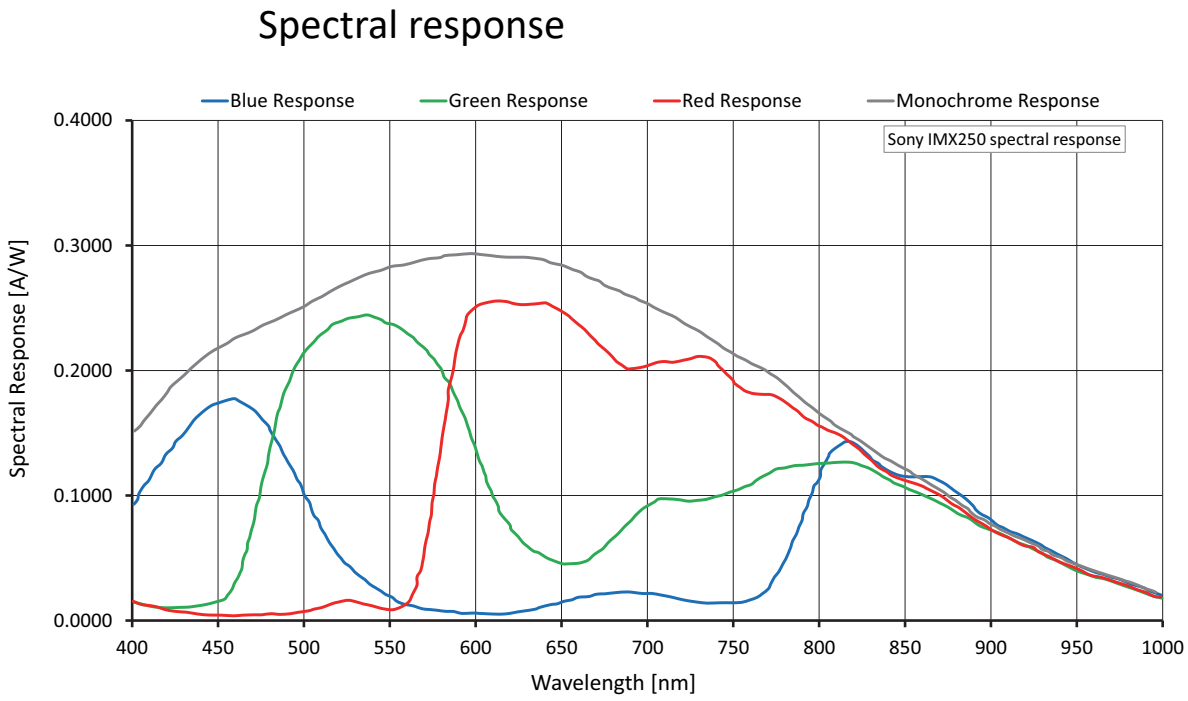


Figure 22: Alvium 1800 U-508m/c (Sony IMX250) spectral response

ROI frame rates

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 375 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps]		
				200 MBps	250 MBps	300 MBps
Full resolution	2,464	2,056	5,065,984	37	47	56
QXGA	2,048	1,536	3,145,728	60	74	86
Full HD	1,920	1,080	2,073,600	89	109	120
UXGA	1,600	1,200	1,920,000	96	109	
WXGA+	1,440	900	1,296,000	138	143	
SXGA	1,280	1024	1,310,720	127		
HD 720	1,280	720	921,600	175		
XGA	1,024	768	786,432	166		
SVGA	800	600	480,000	208		
VGA	640	480	307,200	254		
Maximum × half	2,464	1,028	2,532,992	72	90	107
Maximum × minimum	2,464	8	19,712	888	1,014	1,102
Minimum × maximum	8[1]	2,056	16,448	66		
Minimum × minimum	8[1]	8	64	1,673		

[1]Constant for values ≤516 pixels

Table 38: Alvium 1800 U-508m/c ROI frame rates at 200 to 300 MBps

Frame rate values

Frame rates increase when bandwidth is increased, see 330 to 375 Mbps on page 94.

330 to 375 Mbps

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 375 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps]		
				330 MBps	350 MBps	375 MBps
Full resolution	2,464	2,056	5,065,984	61	64	65
QXGA	2,048	1,536	3,145,728	86		
Full HD	1,920	1,080	2,073,600	120		
UXGA	1,600	1,200	1,920,000	109		
WXGA+	1,440	900	1,296,000	143		
SXGA	1,280	1024	1,310,720	127		
HD 720	1,280	720	921,600	175		
XGA	1,024	768	786,432	166		
SVGA	800	600	480,000	208		
VGA	640	480	307,200	254		
Maximum × half	2,464	1,028	2,532,992	117	123	124
Maximum × minimum	2,464	8	19,712	1,146	1,179	1,185
Minimum × maximum	8[1]	2,056	16,448	66		
Minimum × minimum	8[1]	8	64	1,673		

[1]Constant for values ≤516 pixels

Table 39: Alvium 1800 U-508m/c ROI frame rates at 330 to 375 MBps

Alvium 1800 U-1236m/c

Feature	Specification	
	1800 U-1236m (monochrome)	**1800 U-1236c (color)**
Sensor model	Sony IMX304	
Resolution	4112 (H) × 3008 (V); 12.4 MP	
Sensor type	CMOS	
Shutter type	Global shutter (GS)	
Sensor size	Type 1.1; 14.2 mm × 10.4 mm; 17.6 mm diagonal	
Pixel size	3.45 µm × 3.45 µm	
CRA	0 deg	
ADC	12-bit	
Monochrome pixel formats	Mono8 (default), Mono10, Mono12, Mono12p	Mono8, Mono10, Mono12, Mono12p
YUV color pixel formats	Not applicable	YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr
RGB color pixel formats	Not applicable	BayerGR8, BayerGR10, BayerGR10p, BayerRG12, BayerRG12p, BGR8, RGB8 (default)
Maximum image bit depth	12-bit	
Maximum frame rate	22 fps (at ≥300 MBps)	
Exposure time	169 µs to 10 s (at 300 MBps)	
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 As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA	
ExposureModes	Timed, TriggerControlled, TriggerWidth	
Power requirements	Power over USB; External power	
Power consumption (typical, at 5 VDC)	USB power: 2.9 W External power: 3.1 W	

Table 40: Alvium 1800 U-1236m/c specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-1236m/c			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +88 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 40: Alvium 1800 U-1236m/c specifications (sheet 2 of 2)

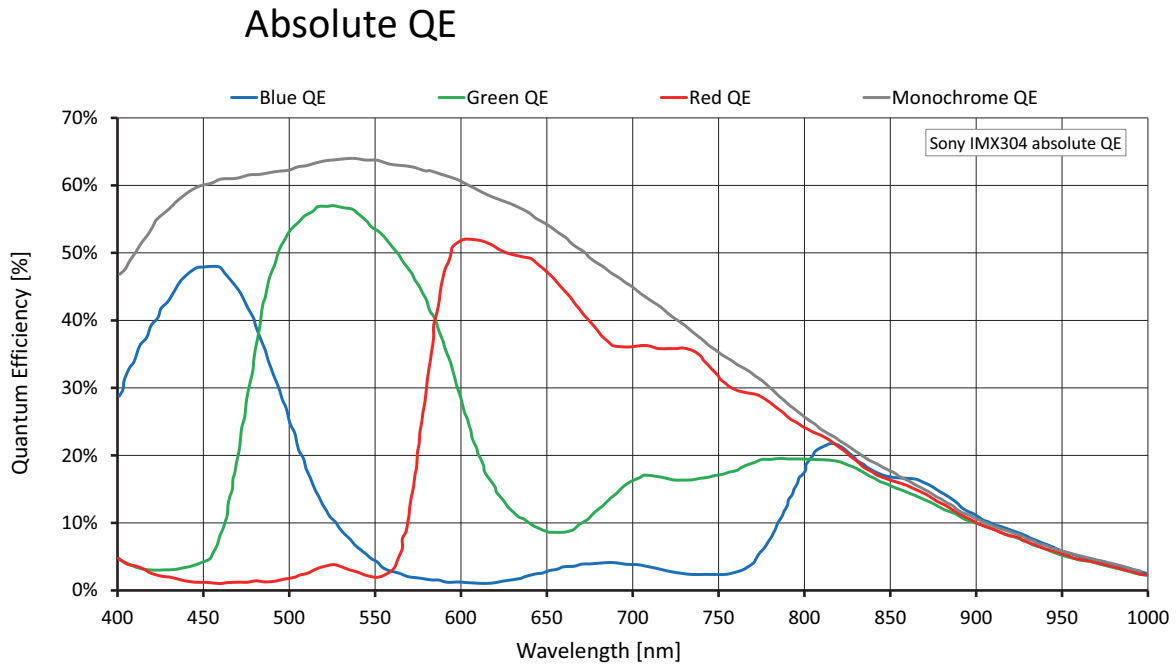


Figure 23: Alvium 1800 U-1236m/c (Sony IMX304) absolute QE

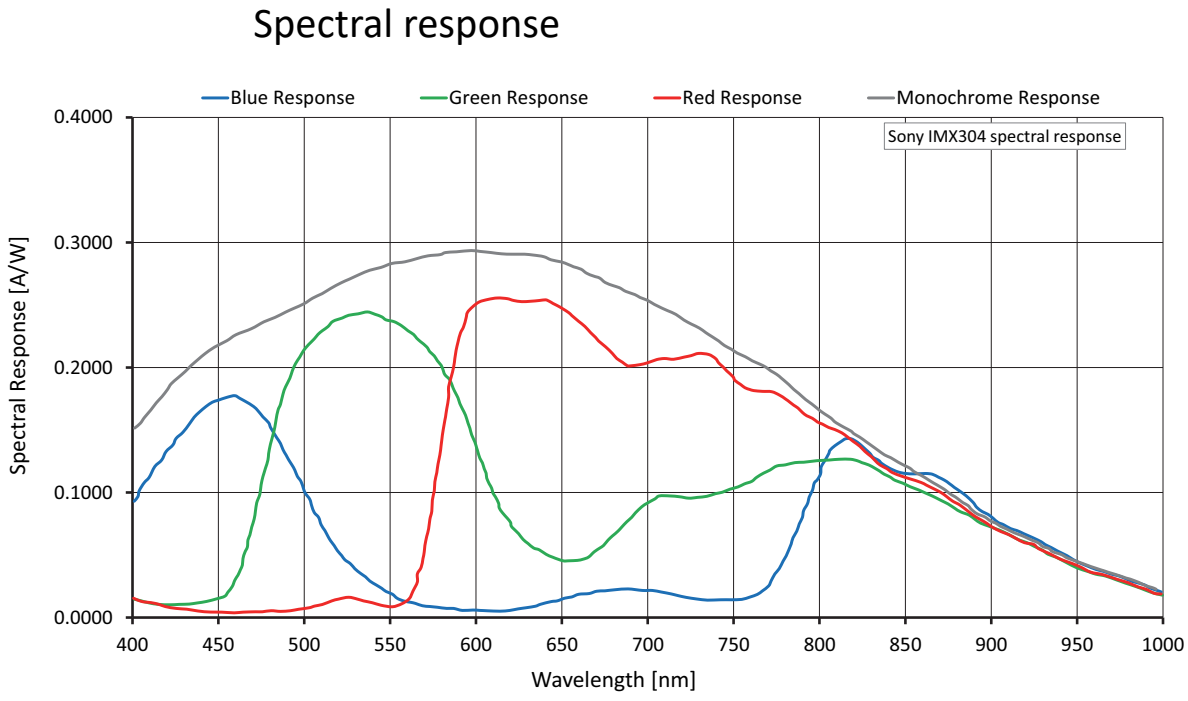


Figure 24: Alvium 1800 U-1236m/c (Sony IMX304) spectral response

ROI frame rates

Values were measured for **typical operation**, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 300 MBps. Increasing the `DeviceLinkThroughputLimit` value does not increase frame rates.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps]		
				200 MBps	250 MBps	300 MBps
Full resolution	4,112	3,008	12,368,896	15	19	22
QSXGA	2,560	2,048	5,242,880	32		
WQHD	2,560	1,440	3,686,400	45		
QXGA	2,048	1,536	3,145,728	43		
Full HD	1,920	1,080	2,073,600	60		
UXGA	1,600	1,200	1,920,000	54		
WXGA+	1,440	900	1,296,000	71		
SXGA	1,280	1,024	1,310,720	63		
HD 720	1,280	720	921,600	88		
XGA	1,024	768	786,432	83		
SVGA	800	600	480,000	104		
VGA	640	480	307,200	127		
QVGA	320	240	76,800	227		
QQVGA	160	120	19,200	370		
Maximum × half	4,112	1,504	6,184,448	30	37	43
Maximum × minimum	4,112	8	32,896	431	499	548
Minimum × maximum	8^2	3,008	24,064	22		
Minimum × minimum	8^2	8	64	897		

[1] Constant for values ≤260 pixels

Table 41: Alvium 1800 U-1236m/c ROI frame rates at 200 to 300 MBps

Alvium 1800 U-1240m/c

Feature	Specification	
	1800 U-1240m (monochrome)	**1800 U-1240c (color)**
Sensor model	Sony IMX226	
Resolution	4024 (H) x 3036 (V); 12.2 MP	
Sensor type	CMOS	
Shutter type	Rolling shutter (RS) or Global reset shutter (GRS)	
Sensor size	Type 1/1.7; 7.4 mm × 5.6 mm; 9.33 mm diagonal	
Pixel size	1.85 µm × 1.85 µm	
CRA	0 deg	
ADC	10-bit	
Monochrome pixel formats	Mono8 (default), Mono10	Mono8, Mono10
YUV color pixel formats	Not applicable	YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr
RGB color pixel formats	Not applicable	BayerGR8, BayerGR10, BayerGR10p, BGR8, RGB8 (default)
Maximum image bit depth	10-bit	
Maximum frame rate	29 fps (at **≥375** MBps)	
Exposure time	9 µs to 66 s (at 375 MBps)	
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 As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA	
ExposureModes	Timed, TriggerControlled, TriggerWidth	
Power requirements	Power over USB; External power	
Power consumption (typical, at 5 VDC)	USB power: 3.1 W External power: 3.3 W	

Table 42: Alvium 1800 U-1240m/c specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-1240m/c			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +88 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 42: Alvium 1800 U-1240m/c specifications (sheet 2 of 2)

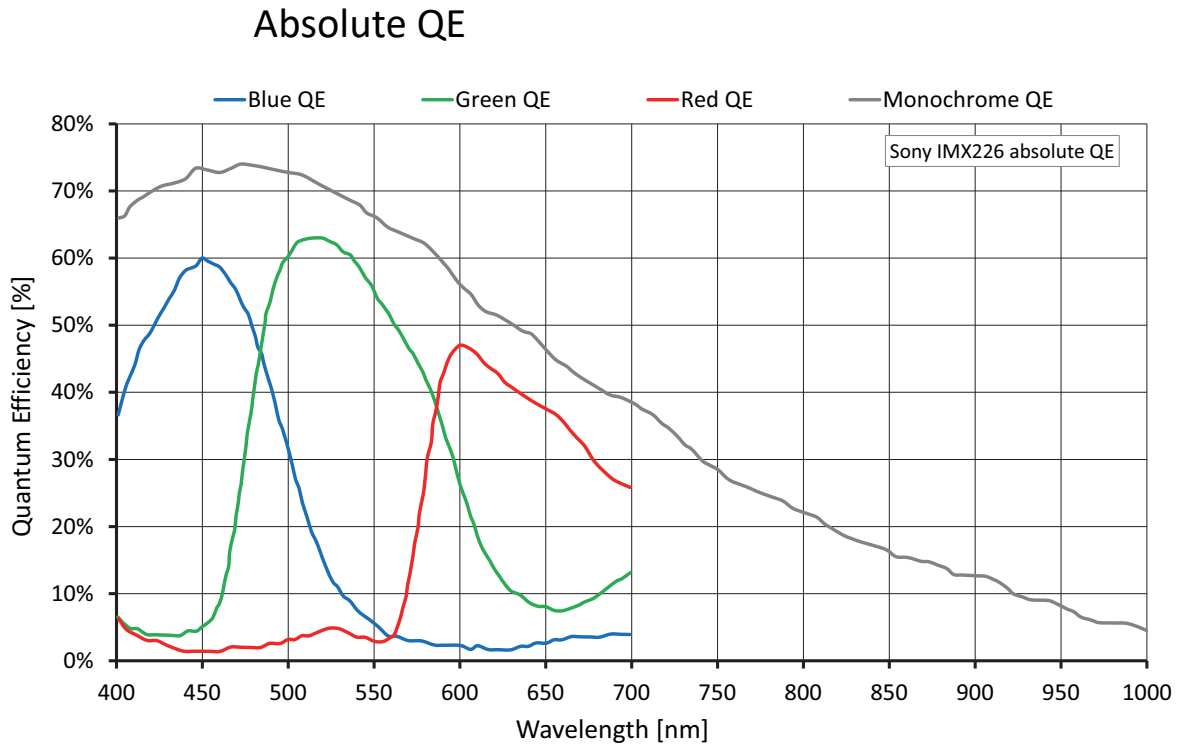


Figure 25: Alvium 1800 U-1240m/c (Sony IMX226) absolute QE

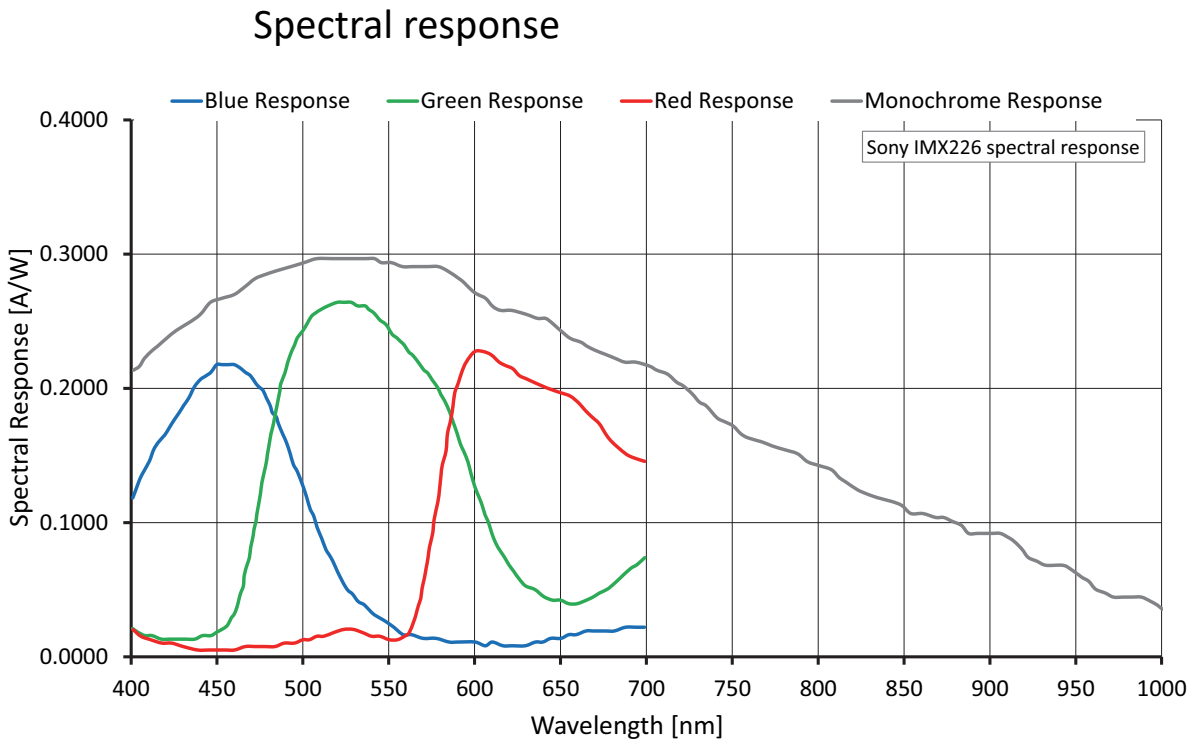


Figure 26: Alvium 1800 U-1240m/c (Sony IMX226) spectral response

ROI frame rates

200 to 300 MBps

Values were measured for **typical operation** in rolling shutter (RS) mode, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 375 MBps. Increasing the `DeviceLinkThroughputLimit` value may even increase frame rates if supported by the hardware used.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps], in RS mode		
				200 MBps	250 MBps	300 MBps
Full resolution	4,024	3,036	12,216,664	15	19	23
UHD 4K	3,840	2,160	8,294,400			
QSXGA	2,560	2,048	5,242,880			
WQHD	2,560	1,440	3,686,400			
QXGA	2,048	1,536	3,145,728			
Full HD	1,920	1,080	2,073,600			
UXGA	1,600	1,200	1,920,000			
WXGA+	1,440	900	1,296,000			
SXGA	1,280	1,024	1,310,720			
HD 720	1,280	720	921,600			
XGA	1,024	768	786,432			
SVGA	800	600	480,000			
VGA	640	480	307,200			
QVGA	320	240	76,800			
QQVGA	160	240	19,200			
Maximum × half	4,024	1,518	6,108,432			
Maximum × minimum	4,024	8	32,192			
Minimum × maximum	8	3,036	24,288			
Minimum × minimum	8	8	64			

Table 43: Alvium 1800 U-1240m/c ROI frame rates at 200 to 300 MBps

Frame rate values

- Frame rates increase when bandwidth is increased, see 330 to 375 MBps on page 103.
- Frame rates for Alvium 1800 U-1240m/c models have been calculated. Measurements will follow in a future version of this document.

330 to 375 MBps

Values were measured for **typical operation** in rolling shutter (RS) mode, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 375 MBps. Increasing the `DeviceLinkThroughputLimit` value may even increase frame rates if supported by the hardware used.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps], in RS mode		
				330 MBps	350 MBps	375 MBps
Full resolution	4,024	3,036	12,216,664	27	27	29
UHD 4K	3,840	2,160	8,294,400			
QSXGA	2,560	2,048	5,242,880			
WQHD	2,560	1,440	3,686,400			
QXGA	2,048	1,536	3,145,728			
Full HD	1,920	1,080	2,073,600			
UXGA	1,600	1,200	1,920,000			
WXGA+	1,440	900	1,296,000			
SXGA	1,280	1,024	1,310,720			
HD 720	1,280	720	921,600			
XGA	1,024	768	786,432			
SVGA	800	600	480,000			
VGA	640	480	307,200			
QVGA	320	240	76,800			
QQVGA	160	240	19,200			
Maximum × half	4,024	1,518	6,108,432			
Maximum × minimum	4,024	8	32,192			
Minimum × maximum	8	3,036	24,288			
Minimum × minimum	8	8	64			

Table 44: Alvium 1800 U-1240m/c ROI frame rates at 330 to 375 MBps

Frame rate values

Frame rates for Alvium 1800 U-1240m/c models have been calculated. Measurements will follow in a future version of this document.

Alvium 1800 U-2050m/c

Feature	Specification	
	1800 U-2050m (monochrome)	**1800 U-2050c (color)**
Sensor model	Sony IMX183	
Resolution	5496 (H) × 3672 (V); 20.2 MP	
Sensor type	CMOS	
Shutter type	Rolling shutter (RS) or Global reset shutter (GRS)	
Sensor size	Type 1; 13.1 mm × 8.8 mm; 15.86 mm diagonal	
Pixel size	2.4 µm × 2.4 µm	
CRA	3 deg	
ADC	10-bit	
Monochrome pixel formats	Mono8 (default), Mono10	Mono8, Mono10
YUV color pixel formats	Not applicable	YCbCr411_8_CbYYCrYY, YCbCr422_8_CbYCrY, YCbCr8_CbYCr
RGB color pixel formats	Not applicable	BayerGR8, BayerGR10, BayerGR10p, BGR8, RGB8 (default)
Maximum image bit depth	10-bit	
Maximum frame rate	17 fps (at ≥375 MBps)	
Exposure time	17 µs to 10 s (at 375 MBps)	
Image buffer (RAM)	256 KB	
Non-volatile memory (Flash)	1024 KB	
Gain	0 dB to 27 dB; 0.1 dB increments	
GPIOs	4 programmable GPIOs As direct inputs (push-pull): 0 to 5.5 VDC As direct outputs (push-pull): 0 to 3.3 VDC at 12 mA	
ExposureModes	Timed	
Power requirements	Power over USB; External power	
Power consumption (typical, at 5 VDC)	USB power: 3.2 W External power: 3.4 W	

Table 45: Alvium 1800 U-2050m/c specifications (sheet 1 of 2)

Feature	Specification			
	1800 U-2050m/c			
Storage temperature	-10 °C to +70 °C ambient temperature			
Operating temperature	**Hardware option**	**Housing**	**Cooling areas[1]**	**Mainboard[2]**
	Bare board[3]	Not applicable	+5 °C to +85 °C	+5 °C to +88 °C
	Open housing[4]	+5 °C to +65 °C		
	Closed housing	+5 °C to +65 °C	Not applicable	
Relative humidity	0% to 80% (non-condensing)			
Digital interface	Micro-B USB 3.1 Gen 1 interface			
Camera controls	GenICam V2.0 (GenICam Access)			

[1] See Mounting the heat sink on page 140.

[2] Output by `DeviceTemperature`

[3] Ensure that the sensor is operated in the temperature range specified by the manufacturer. For any questions, please contact support@alliedvision.com.

[4] Temperature values must be observed for the housing **and** for the cooling areas.

Table 45: Alvium 1800 U-2050m/c specifications (sheet 2 of 2)

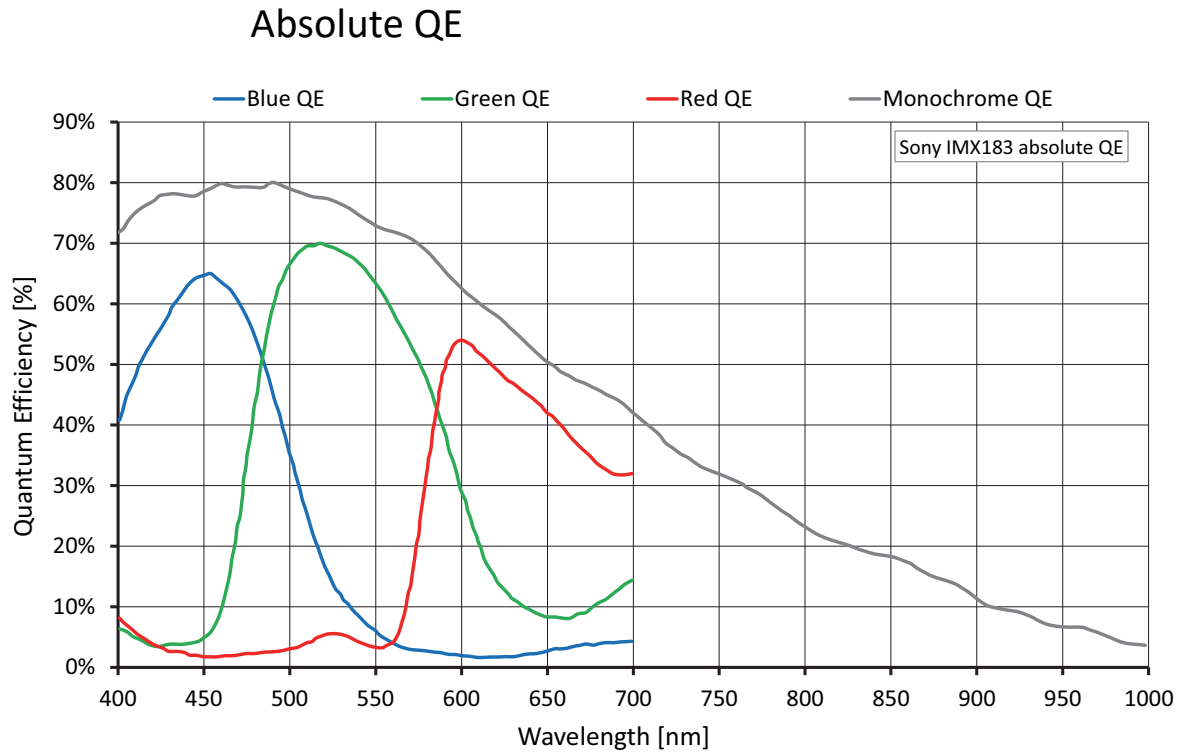


Figure 27: Alvium 1800 U-2050m/c (Sony IMX183) absolute QE

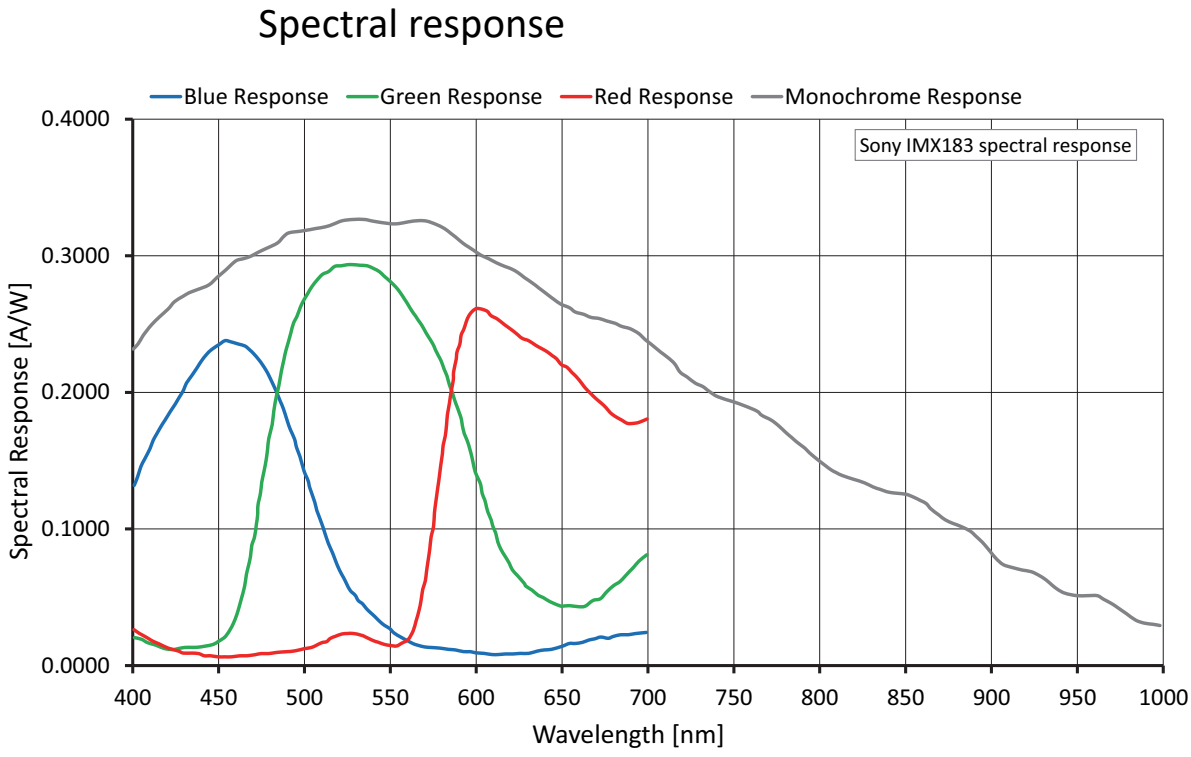


Figure 28: Alvium 1800 U-2050m/c (Sony IMX183) spectral response

ROI frame rates

200 to 300 MBps

Values were measured for **typical operation** in rolling shutter (RS) mode, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 375 MBps. Increasing the `DeviceLinkThroughputLimit` value may even increase frame rates if supported by the hardware used.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps], in RS mode		
				200 MBps	250 MBps	300 MBps
Full resolution	5,496	3,672	20,181,312	9[1]	12[1]	14[1]
HXGA	4,096	3,072	12,582,912	11	14	17
QSXGA	2,560	2,048	5,242,880	16	21	25
WQHD	2,560	1,440	3,686,400	18	23	27
QXGA	2,048	1,536	3,145,728			
Full HD	1,920	1,080	2,073,600			
UXGA	1,600	1,200	1,920,000			
WXGA+	1,440	900	1,296,000			
SXGA	1,280	1,024	1,310,720			
HD 720	1,280	720	921,600			
XGA	1,024	768	786,432			
SVGA	800	600	480,000			
VGA	640	480	307,200			
QVGA	320	240	76,800			
QQVGA	160	240	38,400			
Maximum × half	5,496	1,836	10,090,656			
Maximum × minimum	5,496	8	43,968			
Minimum × maximum	8	3,672	29,376	9	12	14
Minimum × minimum	8	8	64	18	23	27

[1] In GRS mode, this value applies to all ROIs.

Table 46: Alvium 1800 U-2050m/c ROI frame rates at 200 to 300 MBps

Frame rates for higher bandwidths

Frame rates increase when bandwidth is increased, see 330 to 375 MBps on page 108.

330 to 375 MBps

Values were measured for **typical operation** in rolling shutter (RS) mode, using the test setup defined in Exposure time and frame rate on page 48.

To reach the maximum frame rate available for typical operation, the bandwidth for image traffic is 375 MBps. Increasing the `DeviceLinkThroughputLimit` value may even increase frame rates if supported by the hardware used.

Image format	Width [pixels]	Height [pixels]	ROI area [pixels]	Frame rate [fps], in RS mode		
				330 MBps	350 MBps	375 MBps
Full resolution	5,496	3,672	20,181,312	15[1]	16[1]	17[1]
HXGA	4,096	3,072	12,582,912	18	19	21
QSXGA	2,560	2,048	5,242,880	27	29	31
WQHD	2,560	1,440	3,686,400	30	32	34
QXGA	2,048	1,536	3,145,728			
Full HD	1,920	1,080	2,073,600			
UXGA	1,600	1,200	1,920,000			
WXGA+	1,440	900	1,296,000			
SXGA	1,280	1,024	1,310,720			
HD 720	1,280	720	921,600			
XGA	1,024	768	786,432			
SVGA	800	600	480,000			
VGA	640	480	307,200			
QVGA	320	240	76,800			
QQVGA	160	240	38,400			
Maximum × half	5,496	1,836	10,090,656			
Maximum × minimum	5,496	8	43,968			
Minimum × maximum	8	3,672	29,376	15	16	17
Minimum × minimum	8	8	64	30	32	34

[1] In GRS mode, this value applies to all ROIs.

Table 47: Alvium 1800 U-2050m/c ROI frame rates at 330 to 375 MBps

Dimensions and mass

Bare board

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

Table 48: Bare board dimensions and mass

Open housing

Open housing	S-Mount	CS-Mount	C-Mount
Flange focal distance, optical [mm]	12.63	12.526	17.526
Thread [mm]	M12 × 0.5	1x32TPI-UNS-2B	1x32TPI-UNS-2B
Maximum 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	45 g	40 g	45 g
[1]For details, see Lens mounts and maximum protrusion.			

Table 49: Open housing dimensions and mass

Open housing 90°

USB 90° open housing	S-Mount	CS-Mount	C-Mount
Flange focal distance, optical [mm]	12.63	12.526	17.526
Thread [mm]	M12 × 0.5	1x32TPI-UNS-2B	1x32TPI-UNS-2B
Maximum 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	45 g	45 g	50 g
[1]For details, see Lens mounts and maximum protrusion.			

Table 50: Open housing 90° dimensions and mass

Closed housing

Closed housing	S-Mount	CS-Mount	C-Mount
Flange focal distance, optical [mm]	12.63	12.526	17.526
Thread [mm]	M12 × 0.5	1x32TPI-UNS-2B	1x32TPI-UNS-2B
Maximum 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	60 g	60 g	60 g
[1]For details, see Lens mounts and maximum protrusion.			

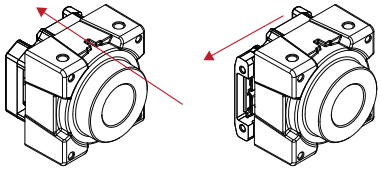
Table 51: Closed housing dimensions and mass

Closed housing 90°

USB 90° closed housing	S-Mount	CS-Mount	C-Mount
Flange focal distance, optical [mm]	12.63	12.526	17.526
Thread [mm]	M12 × 0.5	1x32TPI-UNS-2B	1x32TPI-UNS-2B
Maximum 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	65 g	60 g	65 g
[1]For details, see Lens mounts and maximum protrusion.			

Table 52: Closed housing 90° dimensions and mass

Technical drawings

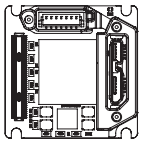
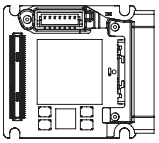


Standard 90°

USB connector position

- **Standard**: The connector is at the camera backside. This option is not mentioned in the naming for camera hardware options.
- **90°**: The connector is at the camera left side, as seen from the lens mount. This option is named **90°**.

Alvium USB cameras are available as shown in the following table:

Bare Board	
Standard	**90°**
	
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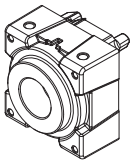
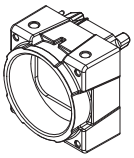
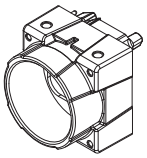
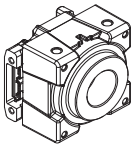
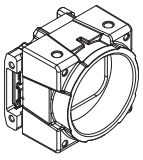
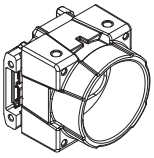
Open Housing					
Standard			**90°**		
S-Mount	CS-Mount	C-Mount	S-Mount	CS-Mount	C-Mount
					
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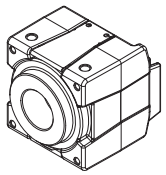
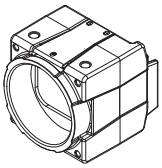
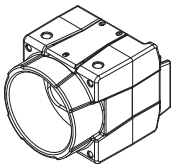
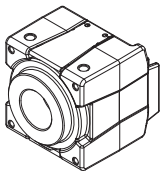
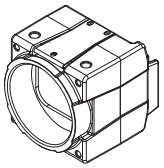
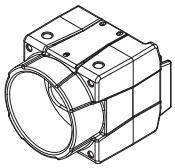
Closed Housing					
Standard			**90°**		
S-Mount	CS-Mount	C-Mount	S-Mount	CS-Mount	C-Mount
					
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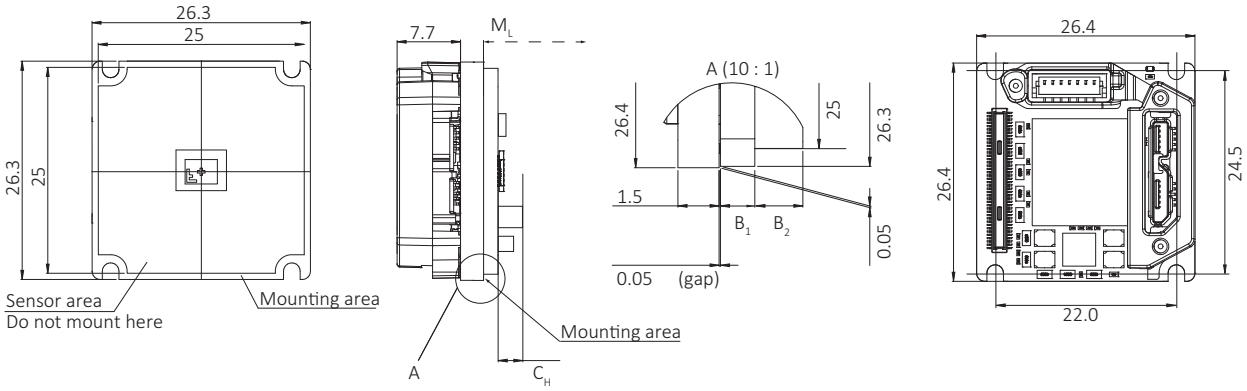
Bare Board



Sensor and electronic components are schematics and vary between models.

Figure 29: Bare Board dimensions

Dimensions that are common between different models are shown in Figure 29, model specific dimensions are listed in Table 53. **Mechanical length** (M_L) defines the mechanical distance from the mounting area to the lens mount front flange. **Components height** (C_H) relates to the electronic components with maximum thickness, in some cases the sensor.

Mechanical length for S-Mount and CS-Mount

Mechanical length for other mounts is:

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

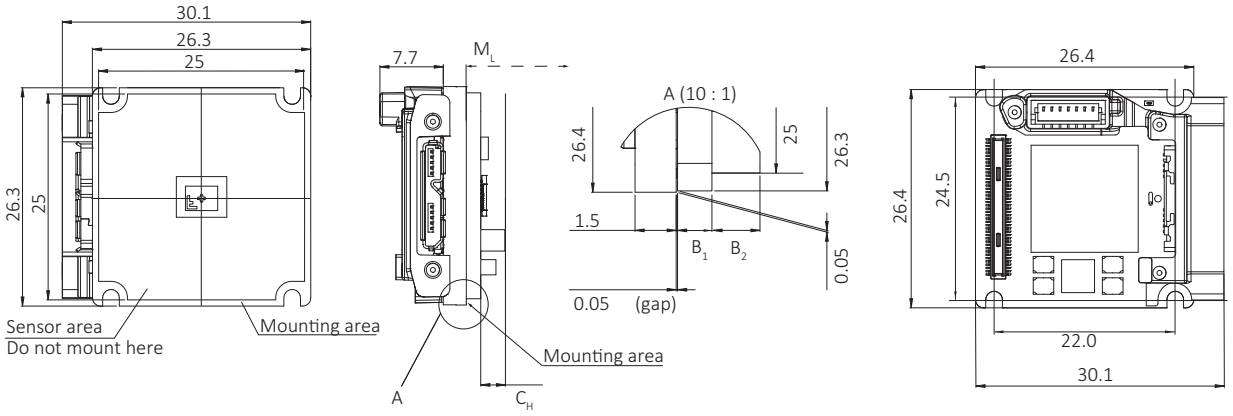
Camera model	M_L Mechanical length for C-Mount	C_H Components height, incl. the sensor	B_1 Board thickness	B_2 Board thickness
Alvium 1800 U-040m/c	~19.8 mm	2.2 mm	1.0 mm	1.3 mm
Alvium 1800 U-050m/c	~19.5 mm	1.4 mm	1.25 mm	1.75 mm
Alvium 1800 U-120m/c	~19.6 mm	1.3 mm	1.15 mm	1.15 mm
Alvium 1800 U-158m/c	~19.8 mm	2.2 mm	1.0 mm	1.3 mm
Alvium 1800 U-240m/c	~ 19.9 mm	2.2 mm	0.95 mm	1.25 mm
Alvium 1800 U-319m/c	~19.9 mm	2.2 mm	1.0 mm	1.3 mm
Alvium 1800 U-500m/c	~19.8 mm	1.6 mm	1.2 mm	1.2 mm
Alvium 1800 U-501m NIR	~19.8 mm	1.6 mm	1.2 mm	1.2 mm
Alvium 1800 U-507m/c	~19.8 mm	2.2 mm	1.0 mm	1.3 mm
Alvium 1800 U-508m/c	~ 19.9 mm	2.2 mm	0.95 mm	1.25 mm

Table 53: Bare Board model specific dimensions and nominal values (sheet 1 of 2)

Camera model	M_L Mechanical length for C-Mount	C_H Components height, incl. the sensor	B_1 Board thickness	B_2 Board thickness
Alvium 1800 U-1236m/c	~19.7 mm	2.2 mm	1.0 mm	1.3 mm
Alvium 1800 U-1240m/c	~ 19.8 mm	2.15 mm	1.05 mm	1.15 mm
Alvium 1800 U-2050m/c	~18.6 mm	2.8 mm	1.15 mm	1.05 mm

Table 53: Bare Board model specific dimensions and nominal values (sheet 2 of 2)

Bare Board 90°



Sensor and electronic components are schematics and vary between models.

Figure 30: Bare Board 90° dimensions

Dimensions that are common between different models are shown in Figure 30, model specific dimensions are listed in Table 54. **Mechanical length** (M_L) defines the mechanical distance from the mounting area to the lens mount front flange. **Components height** (C_H) relates to the electronic components with maximum thickness, in some cases the sensor.

Mechanical length for S-Mount and CS-Mount

Mechanical length for other mounts is:

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

Camera model	M_L Mechanical length for C-Mount	C_H Components height, incl. the sensor	B_1 Board thickness	B_2 Board thickness
Alvium 1800 U-040m/c	~19.8 mm	2.2 mm	1.0 mm	1.3 mm
Alvium 1800 U-050m/c	~19.5 mm	1.4 mm	1.25 mm	1.75 mm
Alvium 1800 U-120m/c	~19.6 mm	1.3 mm	1.15 mm	1.15 mm
Alvium 1800 U-158m/c	~19.8 mm	2.2 mm	1.0 mm	1.3 mm
Alvium 1800 U-240m/c	~ 19.9 mm	2.2 mm	0.95 mm	1.25 mm
Alvium 1800 U-319m/c	~19.9 mm	2.2 mm	1.0 mm	1.3 mm
Alvium 1800 U-500m/c	~19.8 mm	1.6 mm	1.2 mm	1.2 mm
Alvium 1800 U-501m NIR	~19.8 mm	1.6 mm	1.2 mm	1.2 mm
Alvium 1800 U-507m/c	~19.8 mm	2.2 mm	1.0 mm	1.3 mm
Alvium 1800 U-508m/c	~ 19.9 mm	2.2 mm	0.95 mm	1.25 mm
Alvium 1800 U-1236m/c	~19.7 mm	2.2 mm	1.0 mm	1.3 mm
Alvium 1800 U-1240m/c	~ 19.8 mm	2.15 mm	1.05 mm	1.15 mm
Alvium 1800 U-2050m/c	~18.6 mm	2.8 mm	1.15 mm	1.05 mm

Table 54: Bare Board 90° model specific dimensions and nominal values

Open Housing S-Mount

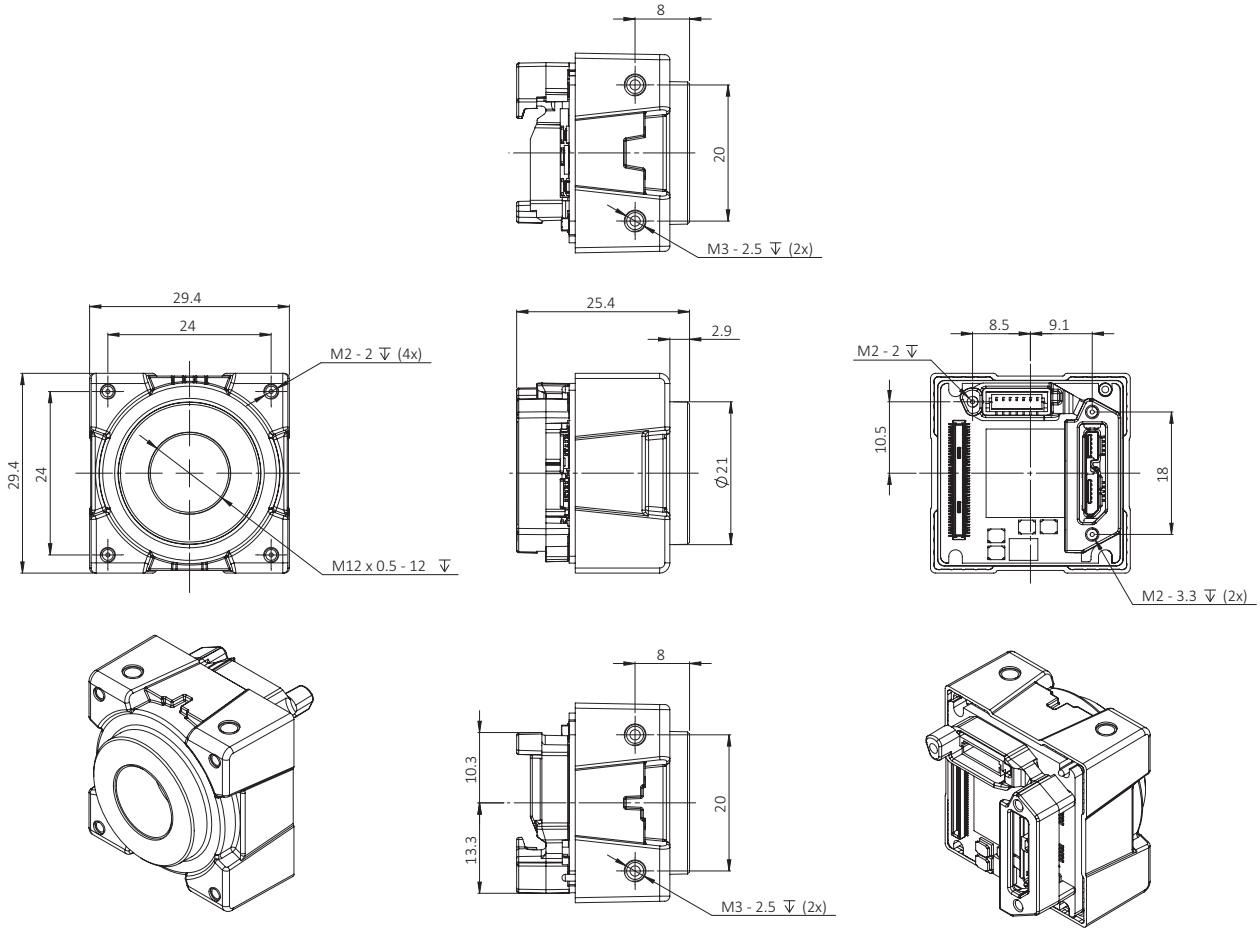


Figure 31: Open Housing S-Mount dimensions

Open Housing CS-Mount

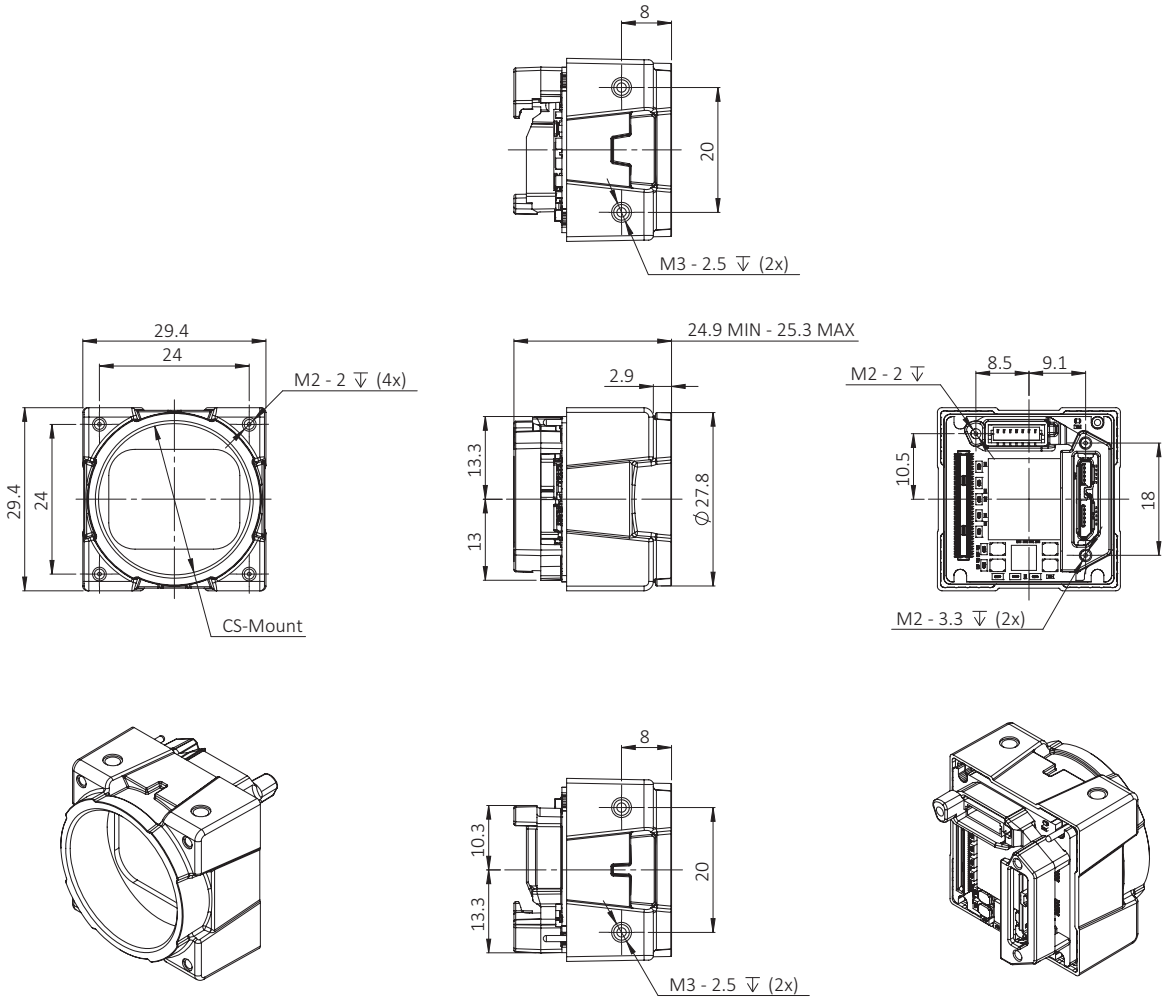


Figure 32: Open Housing CS-Mount dimensions

Open Housing C-Mount

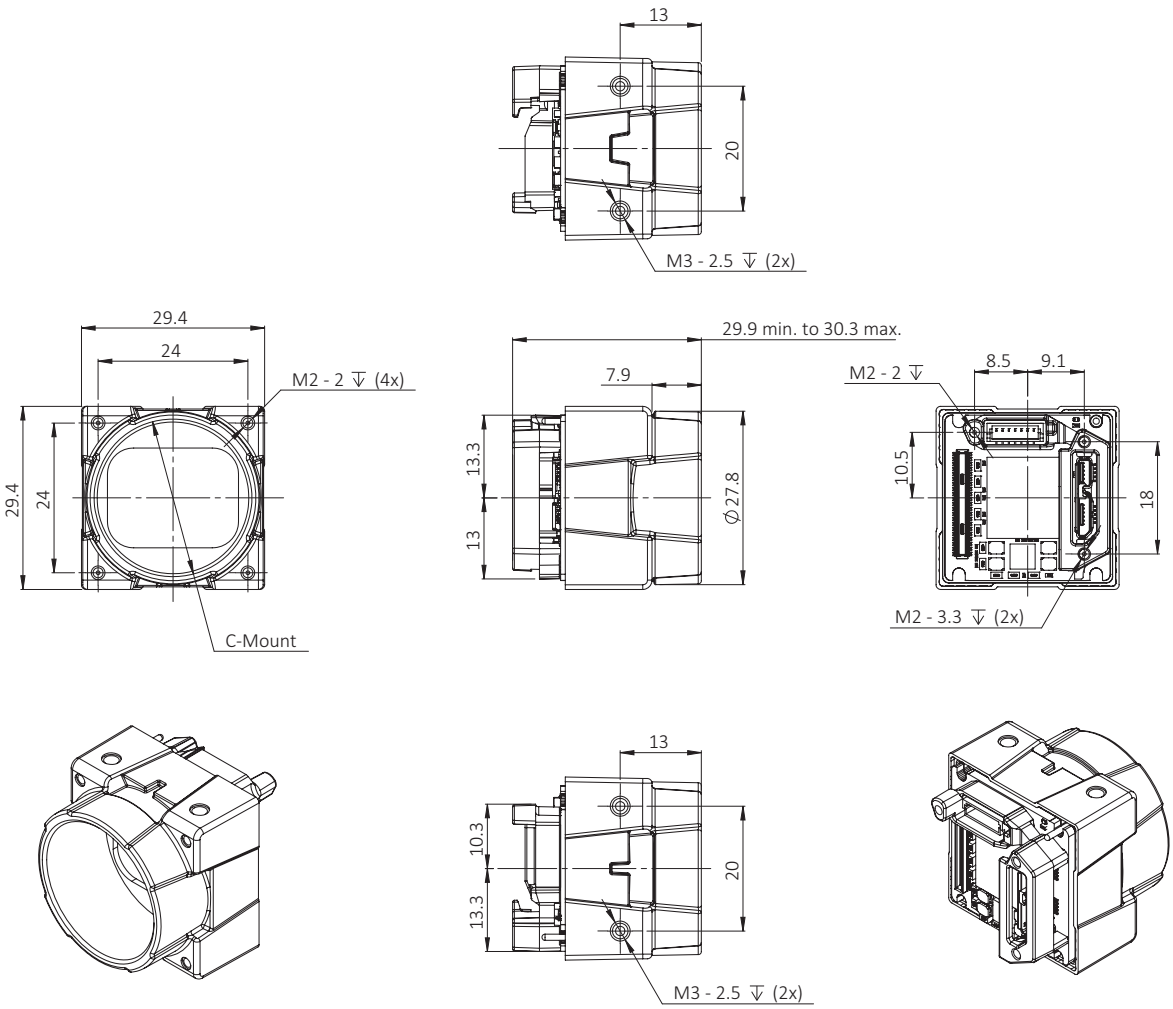


Figure 33: Open Housing C-Mount dimensions

Open Housing S-Mount 90°

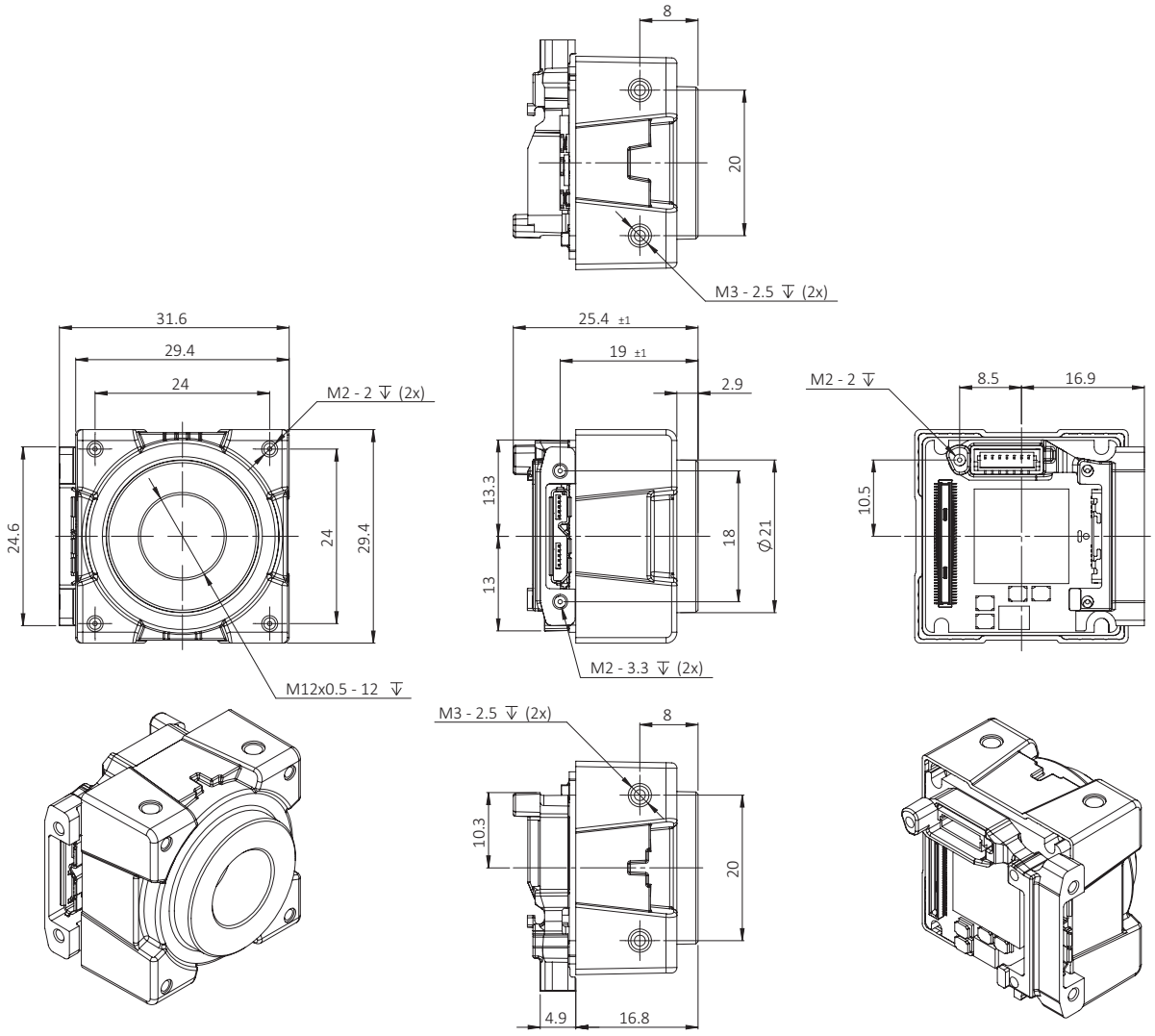


Figure 34: Open Housing S-Mount 90° dimensions

Open Housing CS-Mount 90°

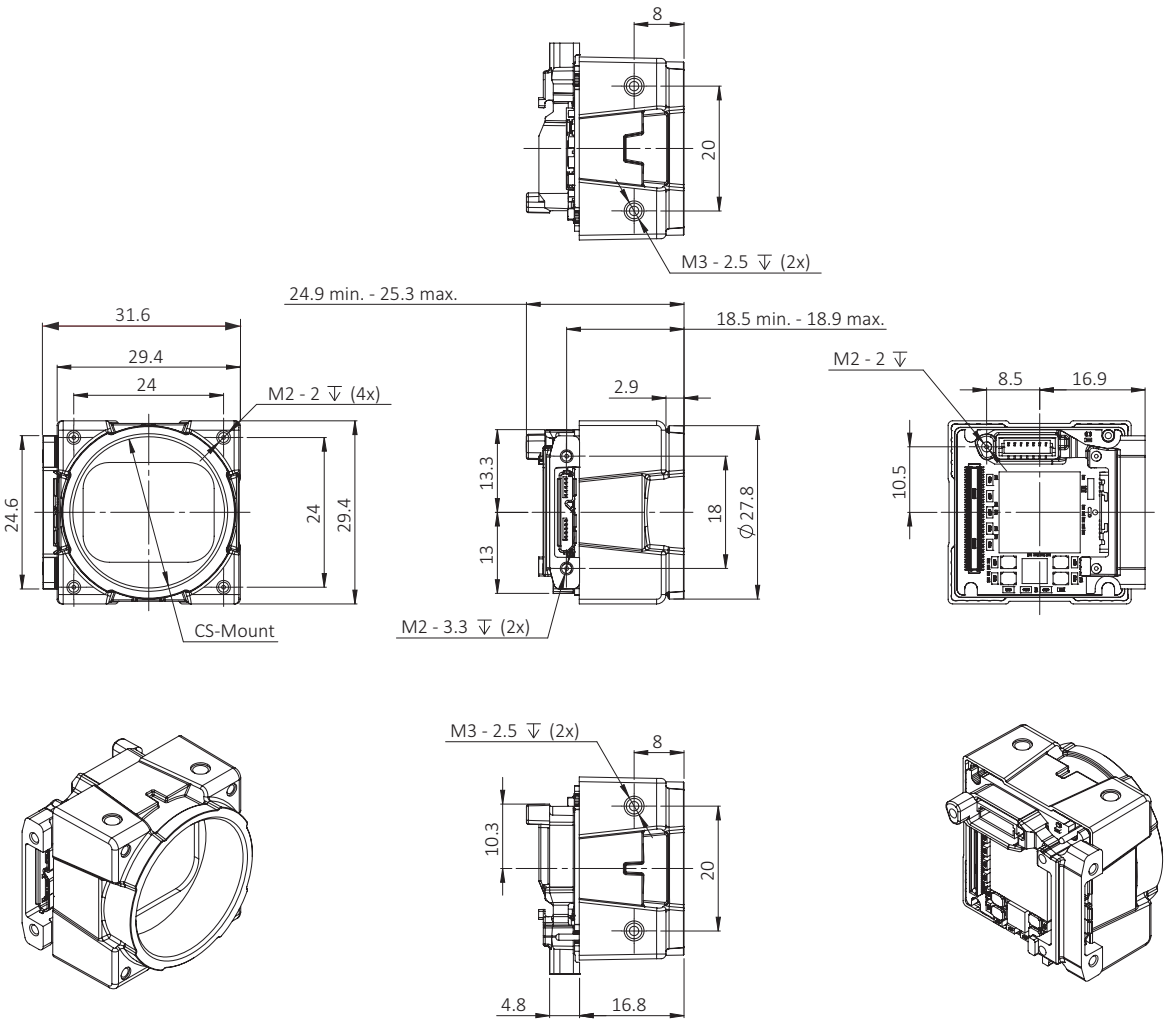


Figure 35: Open Housing CS-Mount 90° dimensions

Open Housing C-Mount 90°

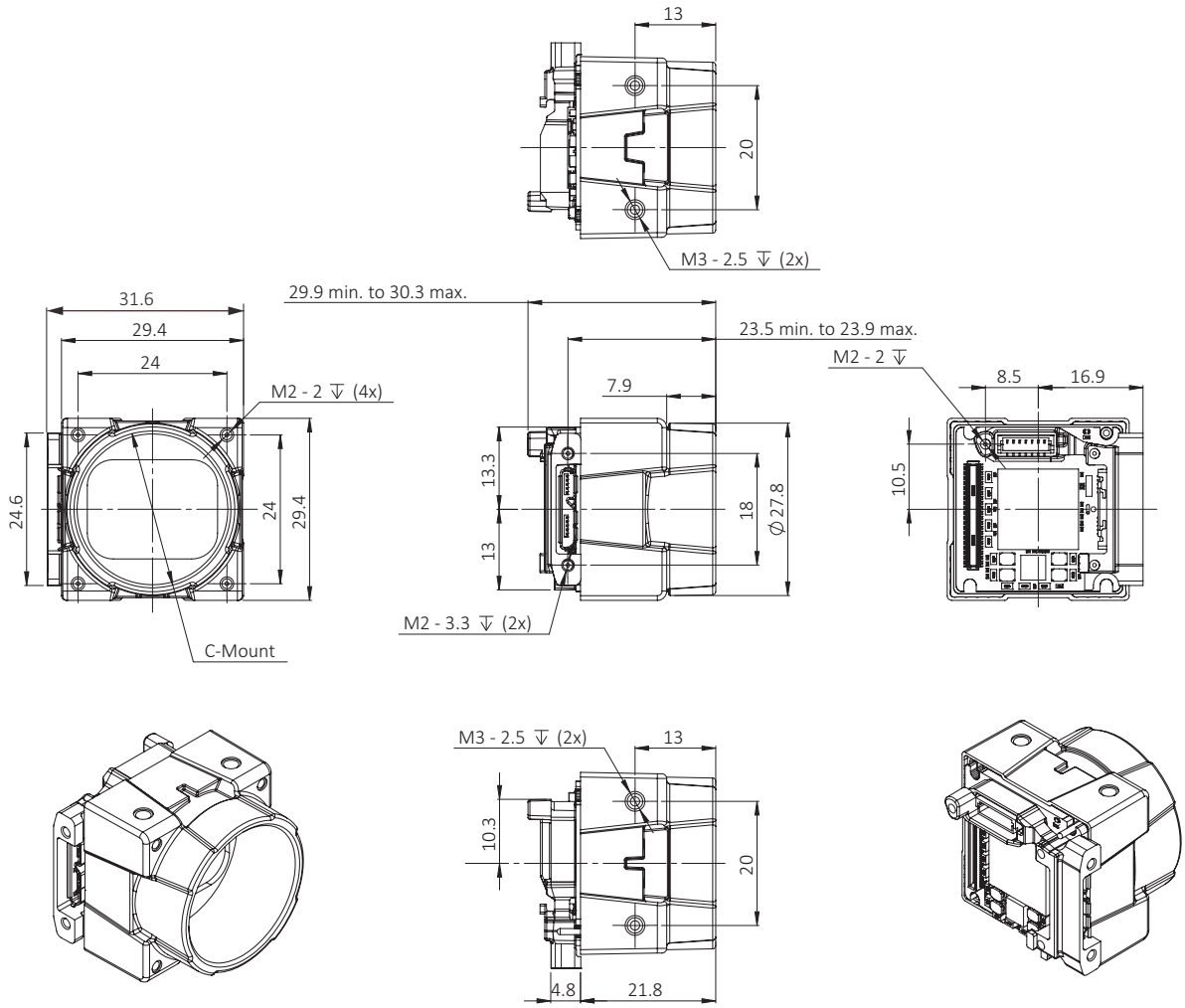


Figure 36: Open Housing C-Mount 90° dimensions

Closed Housing S-Mount

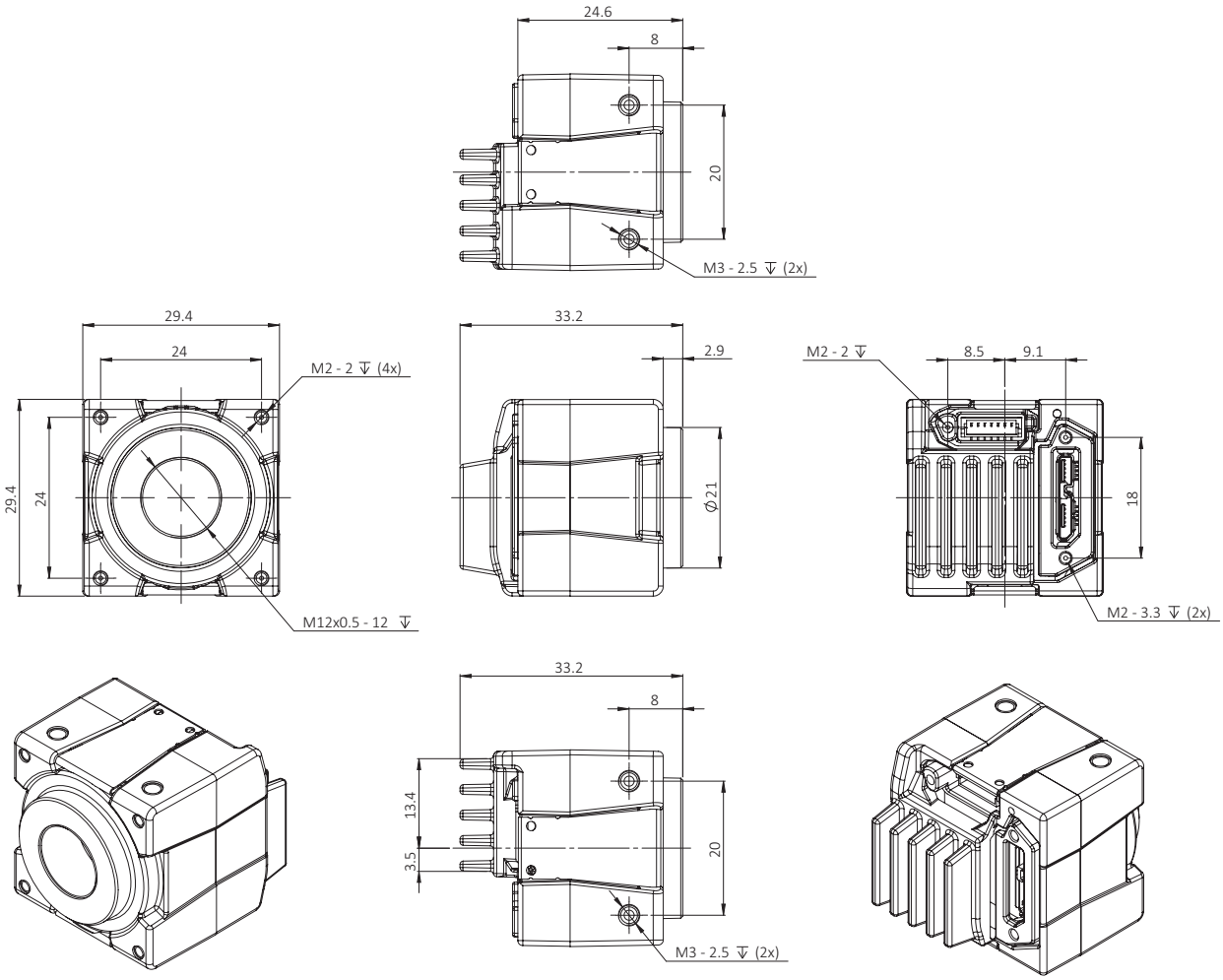


Figure 37: Closed Housing S-Mount dimensions

Closed Housing CS-Mount

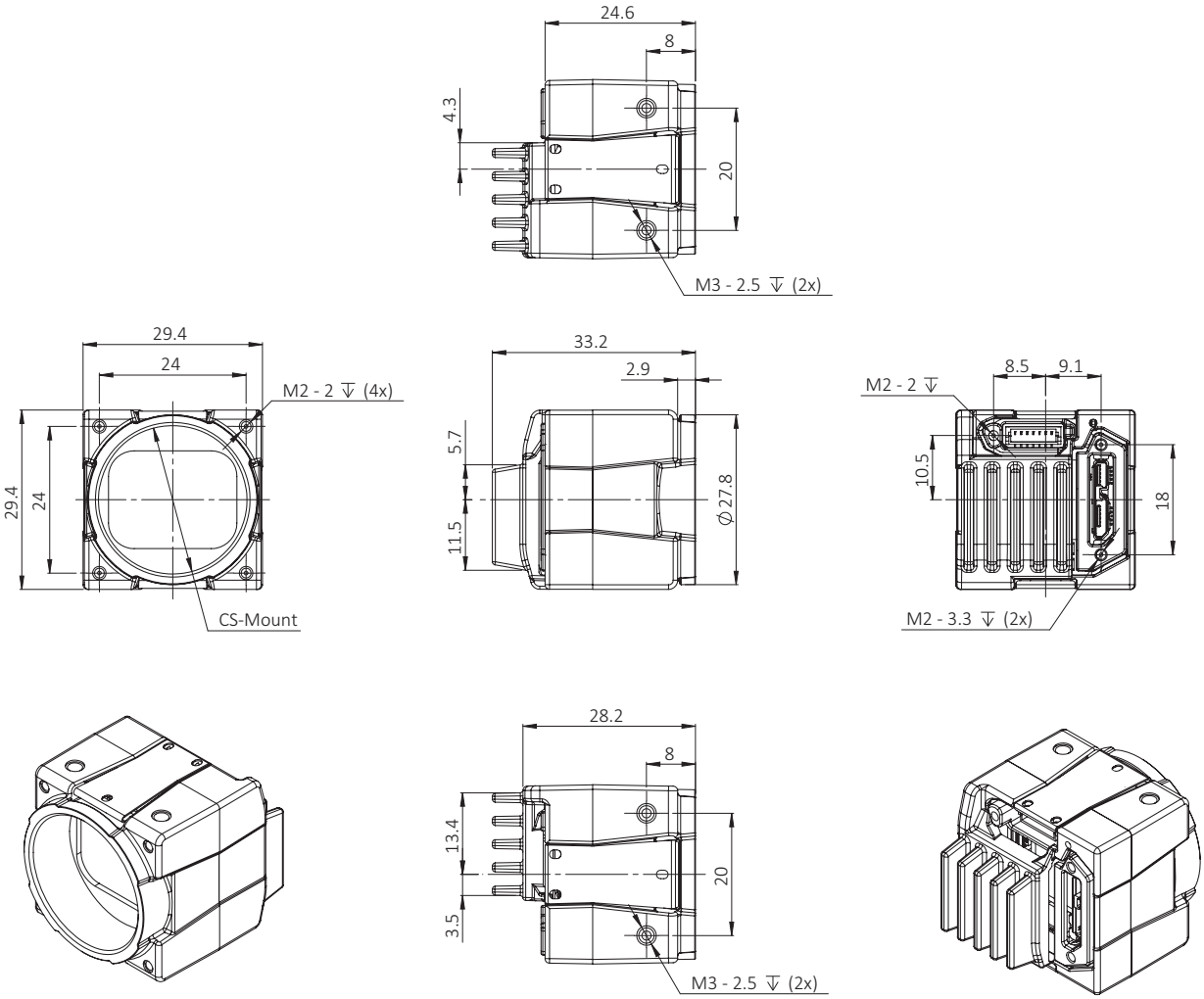


Figure 38: Closed Housing CS-Mount dimensions

Closed Housing C-Mount

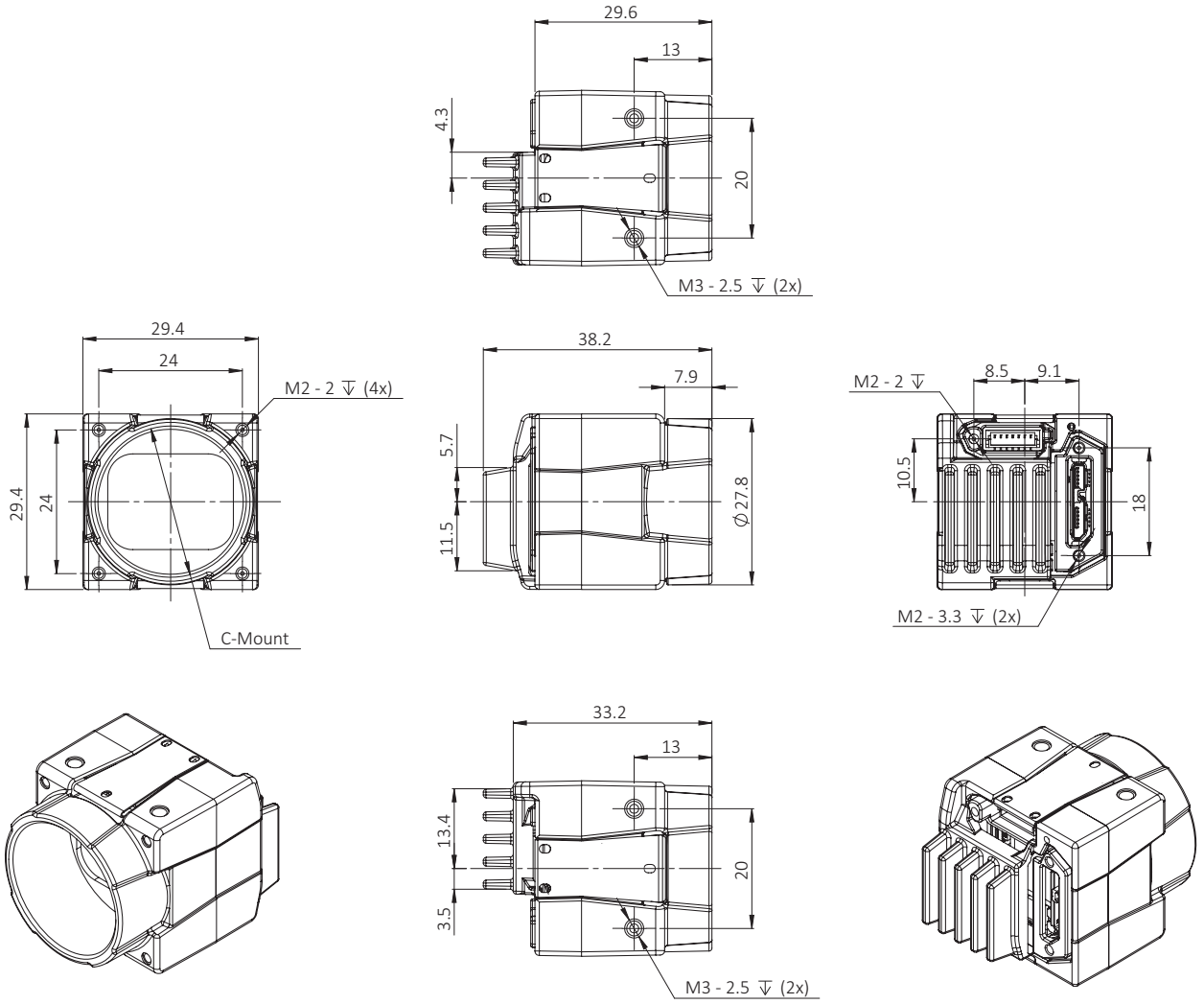


Figure 39: Closed Housing C-Mount dimensions

Closed Housing S-Mount 90°

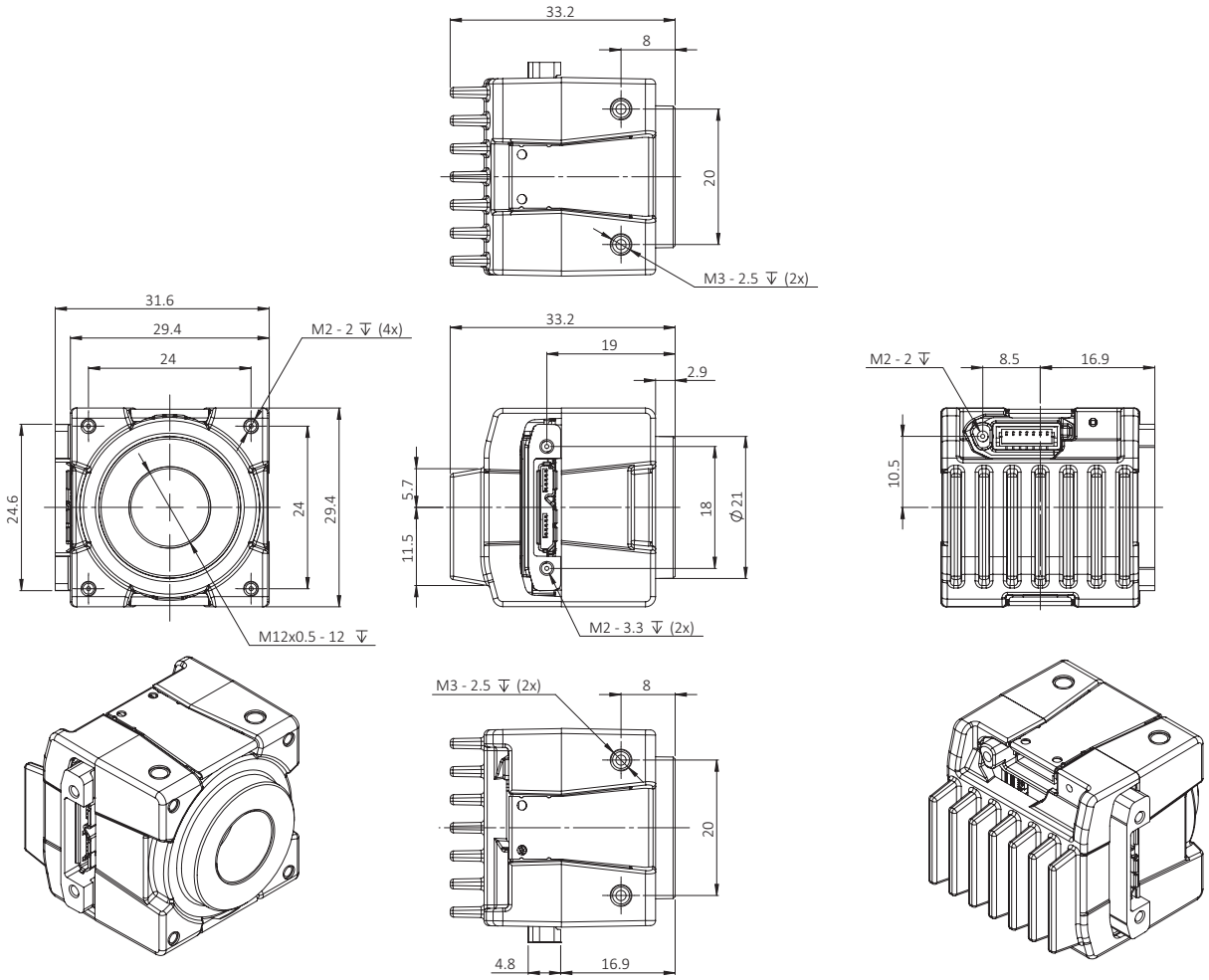


Figure 40: Closed Housing S-Mount 90° dimensions

Closed Housing CS-Mount 90°

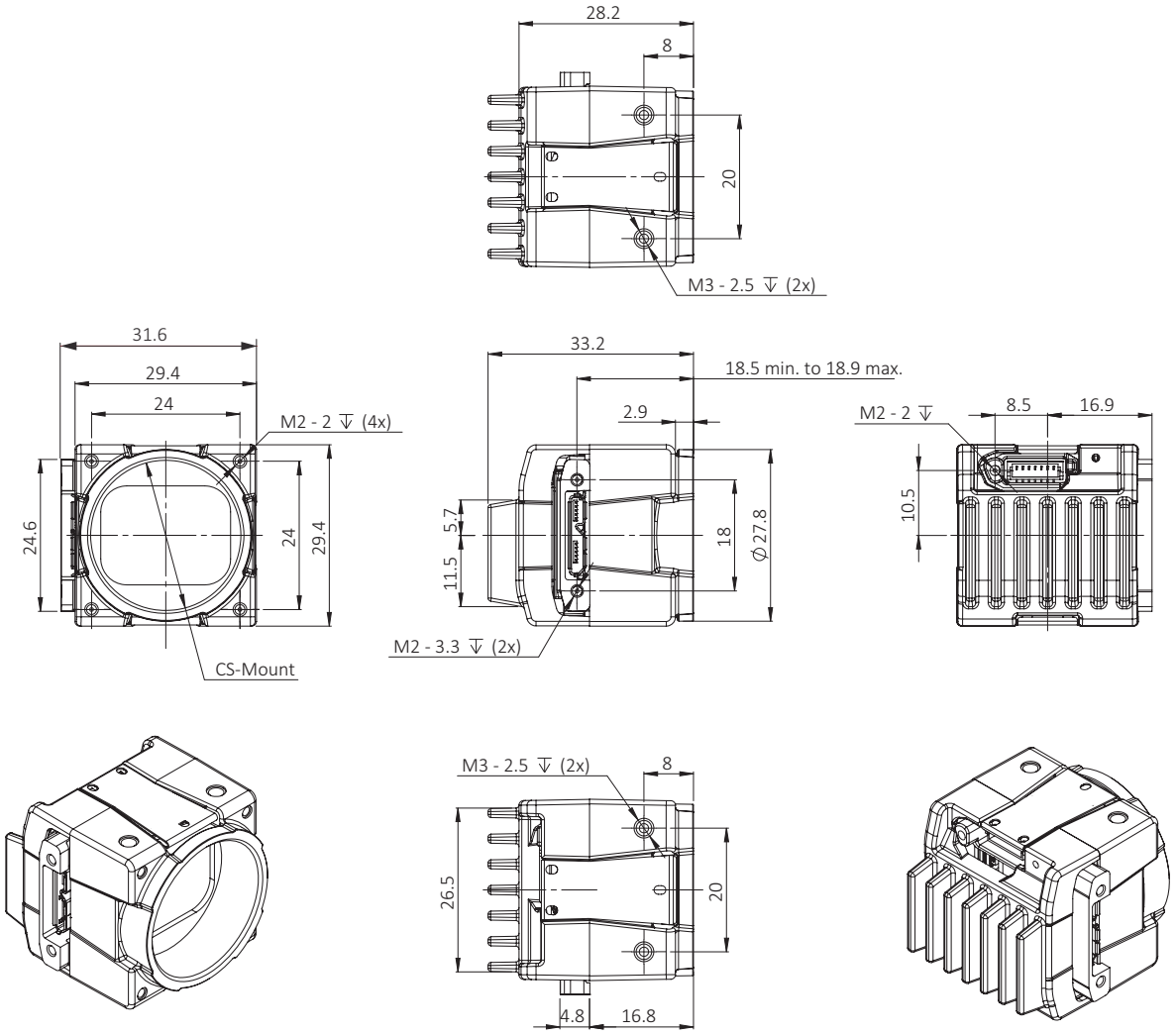


Figure 41: Closed Housing CS-Mount 90° dimensions

Closed Housing C-Mount 90°

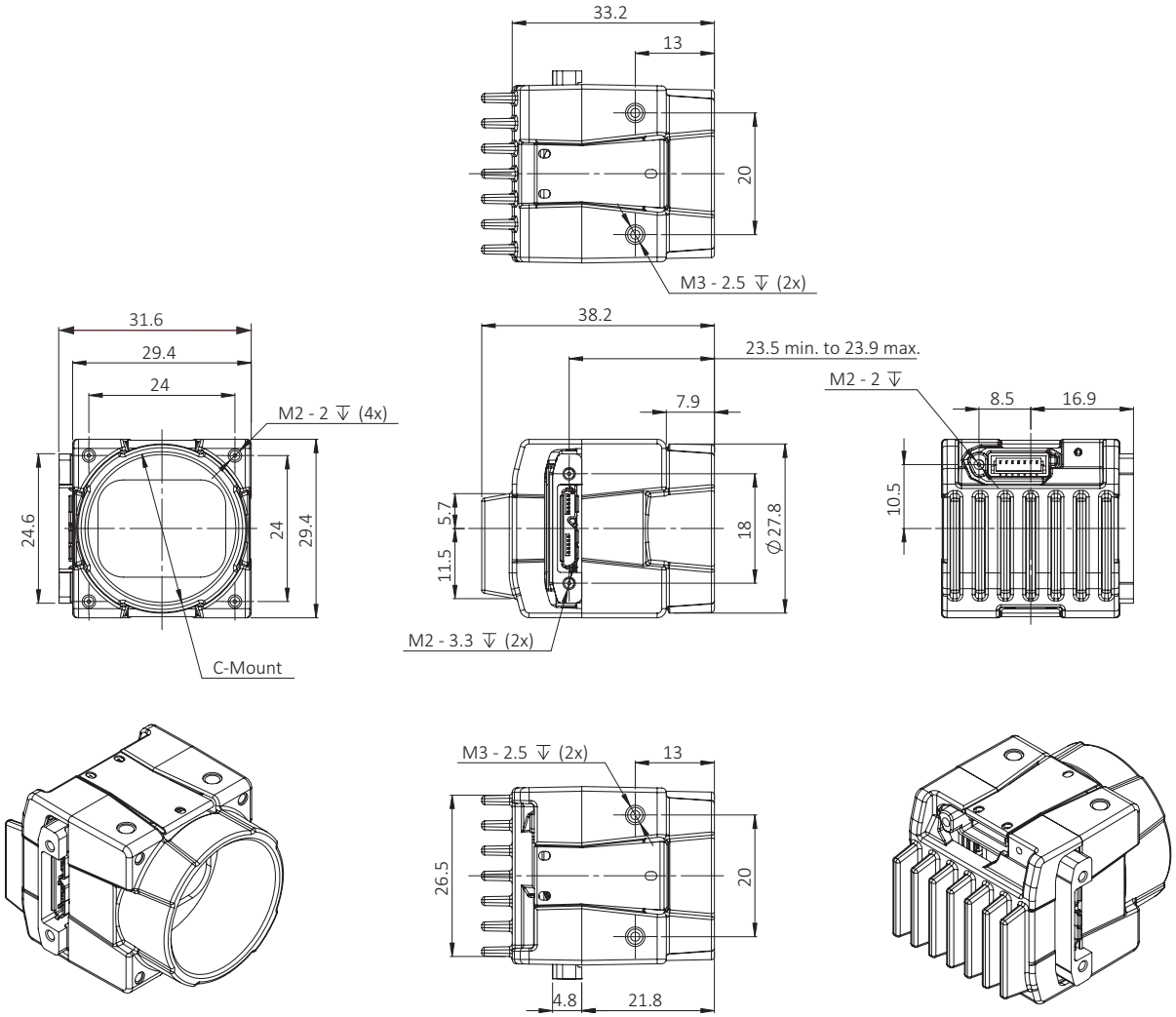
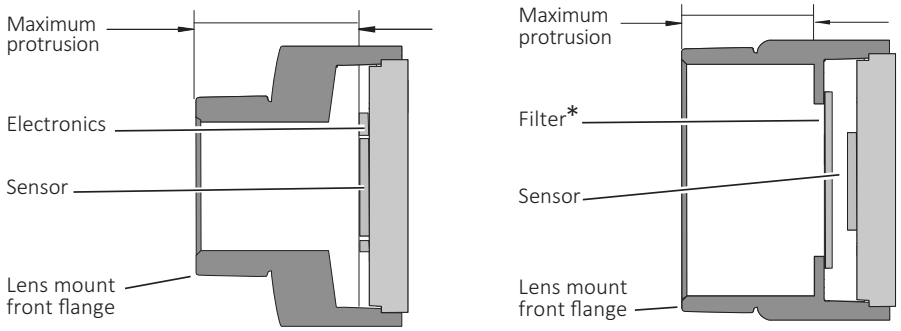


Figure 42: Closed Housing C-Mount 90° dimensions

Lens mounts 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.



*Only color models are equipped with an IR cut filter

Figure 43: Maximum protrusion S-Mount (left); CS-Mount and C-Mount (right)

Figure 43 shows schematics for maximum protrusion of lenses, Table 55 shows values for maximum protrusion.

NOTICE

Damage to sensor or optics by unsuitable lenses

The sensor, filter, lens, or camera electronics 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 55.
- See Mounting the lens on page 144.
- For S-Mount lenses, see Mounting and focusing S-Mount lenses on page 145.

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

Table 55: Alvium USB cameras maximum protrusion

IR cut filter

Table 56 shows which Alvium models are equipped with an IR cut filter. The filter is permanently installed and cannot be removed.

Color or monochrome model	Bare board	S-Mount	CS-Mount	C-Mount
Color	No filter		Type Hoya C5000 IR cut filter	
Monochrome	No filter			

Table 56: Optical filter availability

Cameras **without** IR cut filter have a higher sensitivity for low-light imaging. Moreover, spectral sensitivity is increased.

Cameras **with** IR cut filter are more accurate in reproduction of color, contrast, and sharpness, as the filter absorbs near-IR wavelengths. See Figure 44 for filter transmission.

Spectral transmission values

The following curve shows typical transmission for type Hoya C5000 IR cut filter. Values may vary slightly by filter lot.

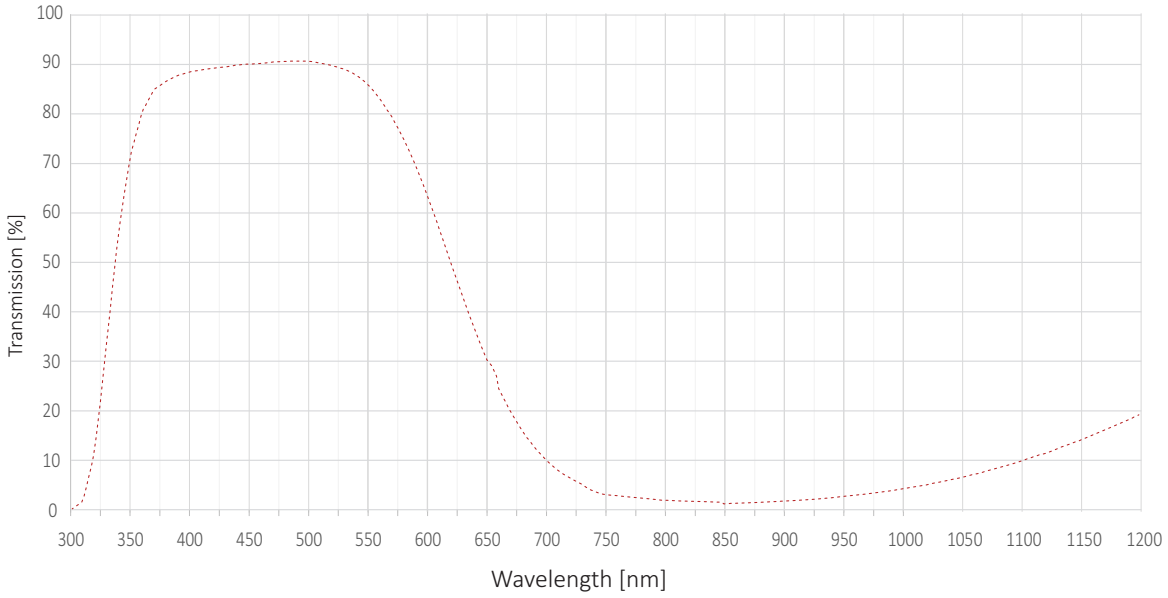


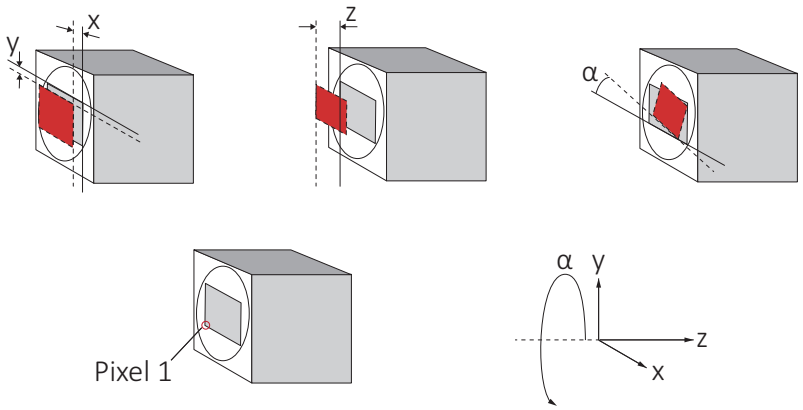
Figure 44: Type Hoya C5000 IR cut filter spectral transmission

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 www.alliedvision.com/en/support/technical-documentation/accessory-documentation under Lenses.

Sensor position accuracy

Sensor shift and rotation



Gray rectangle: Reference sensor position Red rectangle: Current position
Straight line: Reference edge Dotted line: Current reference edge

The orientation of the z-axis deviates from scientific conventions to define tolerances of the flange focal distance.

Figure 45: Sensor shift and rotation

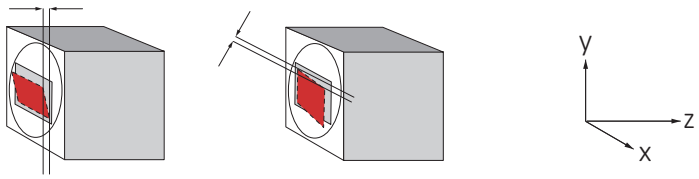
The following table defines the manufacturing accuracy for sensor shift.

Criteria	Subject	Properties
Alignment method		Optical alignment of the photosensitive sensor area into the camera front module (lens mount front flange)
Reference Points	Sensor	Center of the pixel area (photo sensitive cells)
	Camera	Center of the lens mount
Accuracy	x/y-axis	±150 µm[1] (sensor shift)
	z	0 to -100 µm[2] (optical back focal length)
	α	±0.5 deg (sensor rotation as the deviation from the parallel to the camera bottom)

[1]For Alvium 1800 U-2050 models, the complete offset is ±200 µm, common tolerances do not have to be added.

Table 57: Alvium USB cameras, criteria of sensor position accuracy

Sensor tilt



Gray rectangle: Reference sensor position Red rectangle: Current position

Figure 46: Sensor tilt

The following table defines sensor tilt as the variance between highest and lowest pixel of a sensor along the z-axis, measured in micrometers.

Alvium model	Pixel size [µm]	Maximum tilt [µm]
Alvium 1800 U-040m/c	6.9	95
Alvium 1800 U-050m/c	4.8	47
Alvium 1800 U-120m/c	3.75	29
Alvium 1800 U-158m/c	3.45	24
Alvium 1800 U-240m/c	3.45	24
Alvium 1800 U-319m/c	3.45	24
Alvium 1800 U-500m/c	2.2	12
Alvium 1800 U-501m NIR	2.2	12
Alvium 1800 U-507m/c	3.45	24
Alvium 1800 U-508m/c	3.45	24
Alvium 1800 U-1236m/c	3.45	24
Alvium 1800 U-1240m/c	1.85	12
Alvium 1800 U-2050m/c	2.4	12

Table 58: Sensor tilt

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.

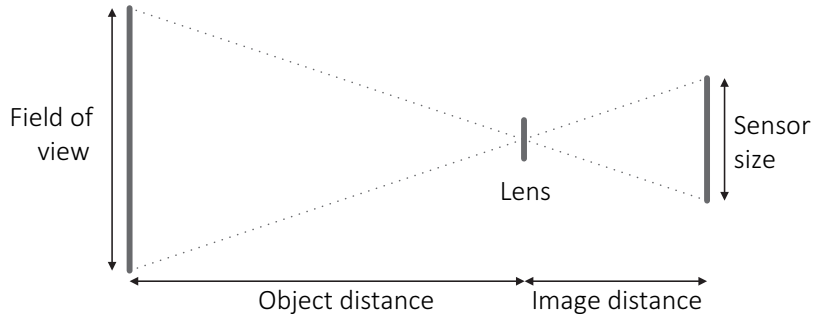


Figure 47: Parameters used in tables for focal length versus FOV

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 www.alliedvision.com/en/support/technical-documentation/accessory-documentation under Lenses.

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 do not define the principal plane position. Production spread causes tolerances for all values, including actual focal lengths. Calculations apply for image reproduction without distortion. Therefore, values do not apply for fisheye lenses.

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 S-Mount models have no filter. For typical applications, we recommend using S-Mount lenses with an integrated IR cut filter for a better image quality.

Read Mounting and focusing S-Mount lenses on page 145 to avoid damage when using S-Mount lenses.

Focal length vs. field of view

Model overview

Model	Type	Page
Alvium 1800 U-040m/c	1/2.9	135
Alvium 1800 U-050m/c	1/3.6	134
Alvium 1800 U-120m/c	1/3	134
Alvium 1800 U-158m/c	1/2.9	135
Alvium 1800 U-240m/c	1/2.3	136
Alvium 1800 U-319m/c	1/1.8	136
Alvium 1800 U-500m/c	1/2.5	135
Alvium 1800 U-501m NIR	1/2.5	135
Alvium 1800 U-507m/c	2/3	137
Alvium 1800 U-508m/c	2/3	137
Alvium 1800 U-1236m/c	1.1	138
Alvium 1800 U-1240m/c	1/1.7	137
Alvium 1800 U-2050m/c	1	138

Table 59: Model overview

Type 1/3.6 (4.9 mm diagonal) sensors

Values apply to **1800 U-050m/c** cameras.

Focal length [mm]	Field of view (H × V [mm])	
	Object distance = 500 mm	Object distance = 1000 mm
2.8	689 × 517	1381 × 1036
3.6	535 × 401	1073 × 805
4.8	400 × 300	804 × 603
6	319 × 239	643 × 482
8	239 × 179	481 × 361
12	158 × 118	319 × 239
16	117 × 88	239 × 179
25	74 × 55	151 × 113

Table 60: Focal length versus field of view (Type 1/3.6 sensor cameras)

Type 1/3 (6 mm diagonal) sensors

Values apply to **1800 U-120m/c** cameras.

Focal length [mm]	Field of view (H × V [mm])	
	Object distance = 500 mm	Object distance = 1000 mm
2.8	852 × 639	1709 × 1282
3.6	662 × 496	1329 × 996
4.8	495 × 371	995 × 746
6	395 × 296	795 × 596
8	295 × 221	595 × 446
12	195 × 146	395 × 296
16	145 × 109	295 × 221
25	91 × 68	187 × 140

Table 61: Focal length versus field of view (Type 1/3 sensor cameras)

Type 1/2.9 (6.3 mm diagonal) sensors

Values apply to **1800 U-040m/c and U-158m/c** cameras.

Focal length [mm]	Field of view (H × V [mm])	
	Object distance = 500 mm	Object distance = 1000 mm
2.8	892 × 667	1789 × 1337
3.6	693 × 518	1390 × 1039
4.8	518 × 387	1041 × 778
6	414 × 309	832 × 622
8	309 × 231	623 × 465
12	204 × 153	414 × 309
16	152 × 114	309 × 231
25	95 × 71	196 × 146

Table 62: Focal length versus field of view (Type 1/2.9 sensor cameras)

Type 1/2.5 (7.1 mm diagonal) sensors

Values apply to **1800 U-500m/c and 1800 U-501NIR** cameras.

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 63: Focal length versus field of view (Type 1/2.5 sensor cameras)

Type 1/2.3 (7.9 mm diagonal) sensors

Values apply to **1800 U-240m/c** cameras.

Focal length [mm]	Field of view (H × V in [mm])	
	Object distance = 500 mm	Object distance = 1000 mm
4.8	691 × 433	1389 × 871
6	552 × 346	1110 × 696
8	412 × 258	831 × 521
12	272 × 171	552 × 346
16	203 × 127	412 × 258
25	127 × 80	261 × 164
35	89 × 56	185 × 116
50	60 × 38	127 × 80

Table 64: Focal length versus field of view (Type 1/2.3 sensor cameras)

Type 1/1.8 (8.9 mm diagonal) sensors

Values apply to **1800 U-319m/c** cameras.

Focal length [mm]	Field of view (H × V in [mm])	
	Object distance = 500 mm	Object distance = 1000 mm
4.8	735 × 550	1476 × 1104
6	586 × 439	1180 × 882
8	438 × 328	883 × 661
12	290 × 217	586 × 439
16	215 × 161	438 × 328
25	135 × 101	278 × 208
35	95 × 71	196 × 147
50	64 × 48	135 × 101

Table 65: Focal length versus field of view (Type 1/1.8 sensor cameras)

Type 1/1.7 (9.33 mm diagonal) sensors

Values apply to **1800 U-1240m/c** cameras.

Focal length [mm]	Field of view (H × V in [mm])	
	Object distance = 500 mm	Object distance = 1000 mm
4.8	763 × 578	1534 × 1161
6	609 × 461	1226 × 928
8	455 × 344	918 × 694
12	301 × 228	609 × 461
16	224 × 169	455 × 344
25	141 × 106	289 ×218
35	98 × 74	204 × 154
50	67 × 50	141 × 106

Table 66: Focal length versus field of view (Type 1/1.7 sensor cameras)

Type 2/3 (11.1 mm diagonal) sensors

Values apply to **1800 U-507m/c and 1800 U-508m/c** cameras.

Focal length [mm]	Field of view (H × V in [mm])	
	Object distance = 500 mm	Object distance = 1000 mm
6	700 × 584	1408 × 1175
8	523 × 436	1054 × 880
12	346 × 288	700 × 584
16	257 × 215	523 × 436
25	162 × 135	332 × 277
35	113 × 94	234 × 196
50	77 × 64	162 × 135

Table 67: Focal length versus field of view (Type 2/3 sensor cameras)

Type 1 (15.86 mm diagonal) sensors

Values apply to **1800 U-2050m/c** cameras.

Focal length [mm]	Field of view (H × V in [mm])	
	Object distance = 500 mm	Object distance = 1000 mm
8	811 × 542	1636 × 1093
12	536 × 358	1086 × 726
16	399 × 267	811 × 542
25	251 × 167	514 × 344
35	175 × 117	364 × 243
50	119 × 79	251 × 167
75	75 × 50	163 × 109
85	64 × 43	142 × 95
100	53 × 35	119 × 79

Table 68: Focal length versus field of view (Type 1 sensor cameras)

Type 1.1 (17.6 mm diagonal) sensors

Values apply to **1800 U-1236m/c** cameras.

Focal length [mm]	Field of view (H × V in [mm])	
	Object distance = 500 mm	Object distance = 1000 mm
8	872 × 638	1759 × 1287
12	577 × 422	1168 × 854
16	429 × 314	872 × 638
25	270 × 197	553 × 405
35	188 × 138	391 × 286
50	128 × 93	270 × 197
75	80 × 59	175 × 128

Table 69: Focal length versus field of view (Type 1.1 sensor cameras)

Installing the camera

This chapter includes:

Touching hot cameras

CAUTION

Risk of burns

A camera in operation can reach temperature levels which could cause burns.

- Wear protective gloves when you touch a camera that is heated up.
- Ensure proper cooling of the camera.

Bare board cameras

If you intend to design an application using bare board cameras, please consider:

- Aligning the sensor to the lens is extremely difficult and expensive. Therefore, we recommend you to do evaluation with housed cameras first.
- Bare board cameras are specialized components. We cannot give all data needed for any application in advance.
- Please let us partner with you for bare board camera applications to ensure a successful design.

Mounting the heat sink

Keep the operating temperature in the specified range to enable best image quality and to protect the camera from damage. We recommend you to equip Alvium bare board and open housing cameras with heat sinks.

Optimizing heat dissipation

For details, see the Optimum Heat Dissipation for Housed Alvium Cameras application note at www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

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 lens.

- 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.

Connect components in the cooling areas (blue areas in Figure 48) 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° models are the same as for standard models.

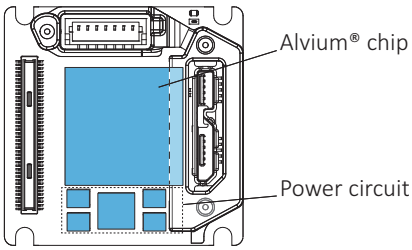


Figure 48: Cooling areas for Alvium USB bare board cameras

Mounting the camera

CAUTION

Injury by falling cameras or lenses

A falling camera or lens can cause injury.

- Ensure proper mounting of cameras and lenses, especially for dynamic applications.
- Mount cameras as described in the instructions.
- Use a lens support for heavy lenses.

Mounting bare board cameras

Heat dissipation and electromagnetic compatibility for bare board cameras

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

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

See www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

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

a = Mounting hole
b = Mounting hole and chassis ground

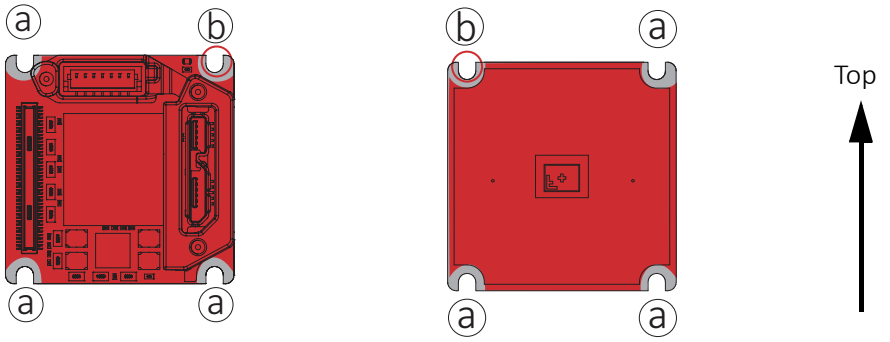


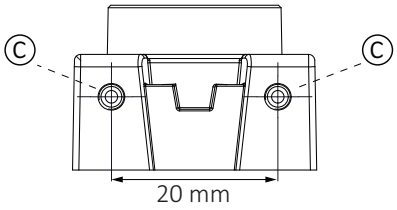
Figure 49: Mounting area of Alvium USB bare board cameras connector side (left); sensor side (right)

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

Mounting housed cameras

Bottom or top mounting

Camera top and bottom mounting is done the same way.

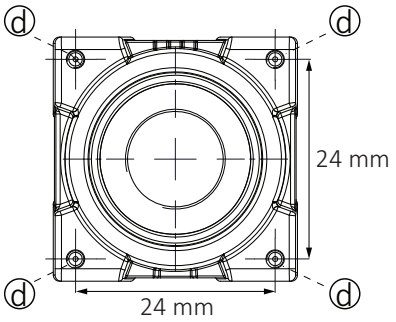


c = Mounting thread M3 ↓2.5

Figure 50: Top and bottom with mounting threads

1. Mount the camera to the base using suitable M3 screws at 0.35 Nm maximum torque for a thread engagement of 2.5 mm between screws and mounting threads, see Figure 50. For technical drawings, see Dimensions and mass on page 109.
2. Continue with Mounting the lens on page 144.

Front mounting



d = Mounting thread M2 ↓2

Figure 51: Camera front 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 51. For technical drawings, see Dimensions and mass on page 109.
   We recommend you to additionally use bottom and top mounting threads for a more solid connection.
2. Continue with Mounting the lens on page 144.

Tripod adapter

For more information, see the Alvium Cameras Accessory Guide at www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

Mounting the lens

Observe the following notes before you mount lenses to Alvium USB cameras.

CAUTION

Injury by falling cameras or lenses

A falling camera or lens can cause injury.

- Ensure proper mounting of cameras and lenses, especially for dynamic applications.
- Mount cameras as described in the instructions.
- Use a lens support for heavy lenses.

CAUTION

Risk of cuts by sharp edges of lens mounts

The threads of the lens mount can have sharp edges.

Be careful when mounting or unmounting lenses.

NOTICE

Damage to sensor, optics, or electronics by unsuitable lenses

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

- Use lenses only up to the specified maximum protrusion, see Lens mounts and maximum protrusion on page 106.
- S-Mount lenses must be screwed into the camera at less than maximum protrusion (11.0 mm), see Mounting and focusing S-Mount lenses on page 145.
- Avoid short S-Mount lenses falling into the camera.

NOTICE

Damage to sensor, optics, or electronics by unsuitable lenses

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

- Use lenses only up to the specified maximum protrusion, see Lens mounts and maximum protrusion on page 127.
- S-Mount lenses must be screwed into the camera at less than maximum protrusion (11.0 mm), see Mounting and focusing S-Mount lenses on page 145.
- 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 www.alliedvision.com/en/support/technical-documentation/accessory-documentation under Lenses.

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.

Fixing nuts

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

We recommend using pinch nose pliers to tighten fixing nuts.

Figure 52 shows how fixing nuts lock S-Mount lenses.

Follow the instructions to lock the lens in focus position.

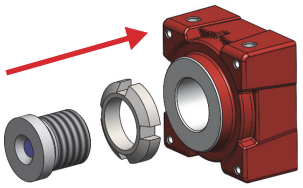


Figure 52: Fixing nut locking an S-Mount lens

NOTICE

Damage to sensor, optics, or electronics by improper handling

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

- Screw in the lens at less than 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 mounted lens, measured from lens mount front flange
   b: maximum protrusion (11.0 mm)
   c: length of the lens

   See Lens mounts and maximum protrusion on page 127.
3. Set a gauge to the length of (a).

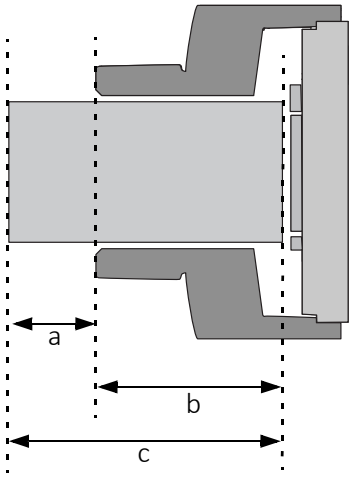


Figure 53: S-Mount lens and maximum protrusion

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.

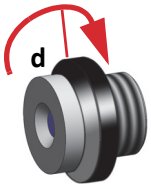


Figure 54: Lens and fixing nut

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 in and unscrew the lens until you have found the most accurate focus.

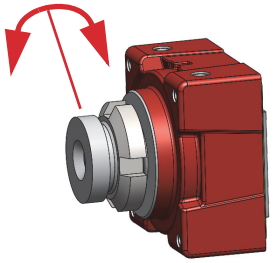


Figure 55: Adjusting focus

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 hand tight to keep the lens in a fixed 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.

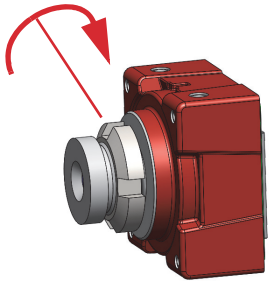


Figure 56: Tightening the fixing nut

Checking focus is set and locked properly

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

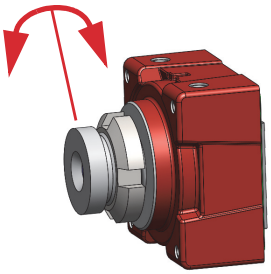


Figure 57: Checking lens is safely locked

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

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 www.alliedvision.com/software.

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

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

You need the following accessories:

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

Compatible USB 3.0 or 3.1 Gen 1 accessories

See the Alvium Cameras Accessory Guide at www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

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 Performance and troubleshooting on page 168.

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 the host adapter and Vimba

1. Install the USB 3.0 or 3.1 Gen 1 host controller card and driver according to the manufacturer's instructions.
2. Download and install **Vimba**: www.alliedvision.com/software.
3. Continue with Installing the camera driver.

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 or 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, included in the **Vimba** download.

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:

1. Connect your Alvium USB camera to the computer using a USB 3.0 or 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 3.0.0 in the example).

4. Open **Install driver > USB3 Vision Camera** and click the driver popup.

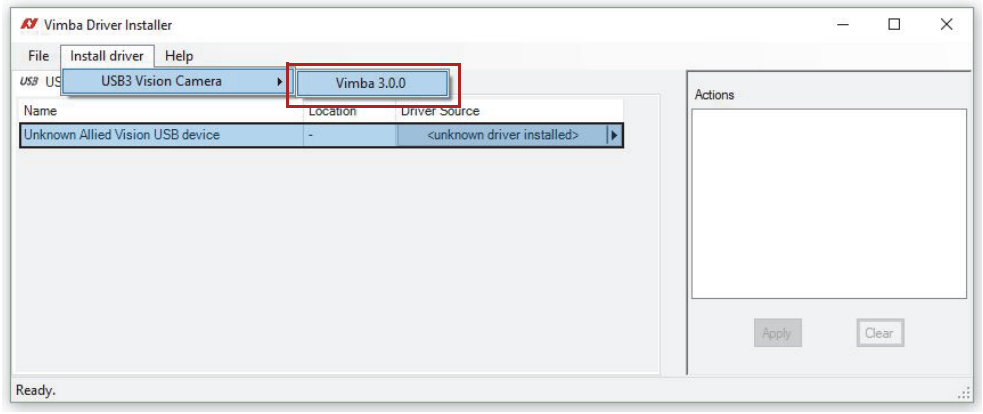


Figure 58: Vimba Driver Installer, camera driver not installed

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

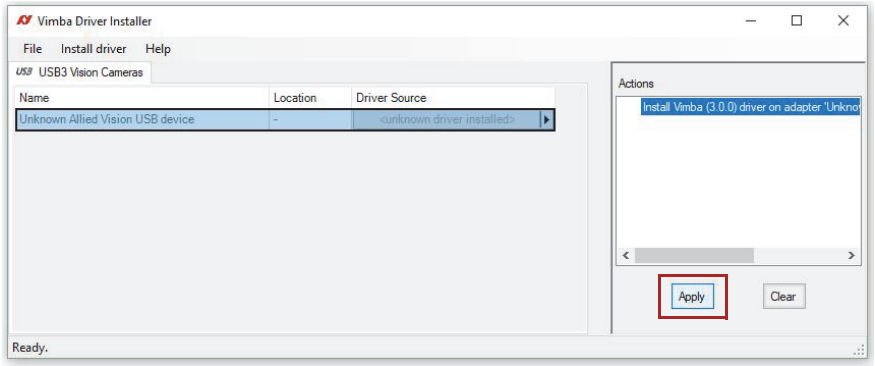


Figure 59: Vimba Driver Installer, driver installation started

The driver has been installed successfully, the camera is recognized.

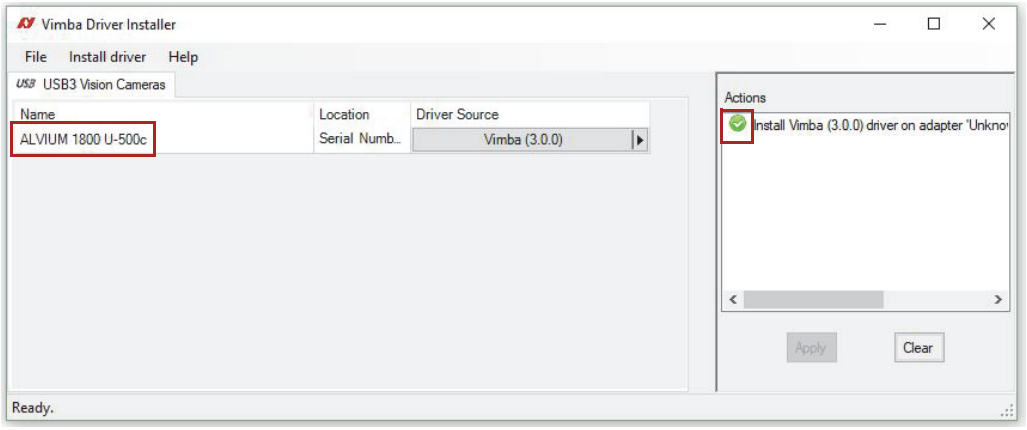


Figure 60: Vimba Driver Installer, driver installed successfully

Manual Vimba Driver installation

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

Installing the camera driver with Windows tools

As an 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.

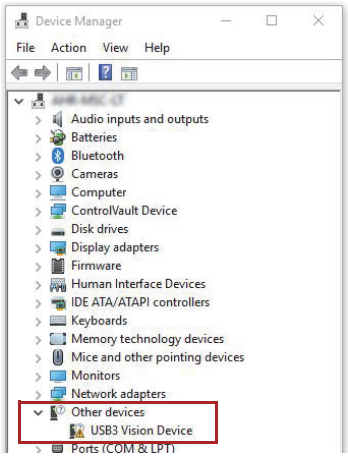


Figure 61: Windows Device Manager, unrecognized USB3 Vision camera

If no **USB3 Vision Device** is shown 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 61.

3. Right-click the unrecognized **USB3 Vision Device** and select *Update driver*.

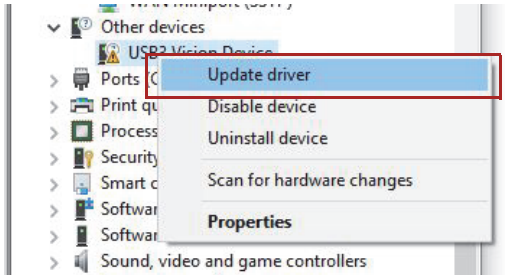


Figure 62: Windows Device Manager, Windows Driver Installer

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.

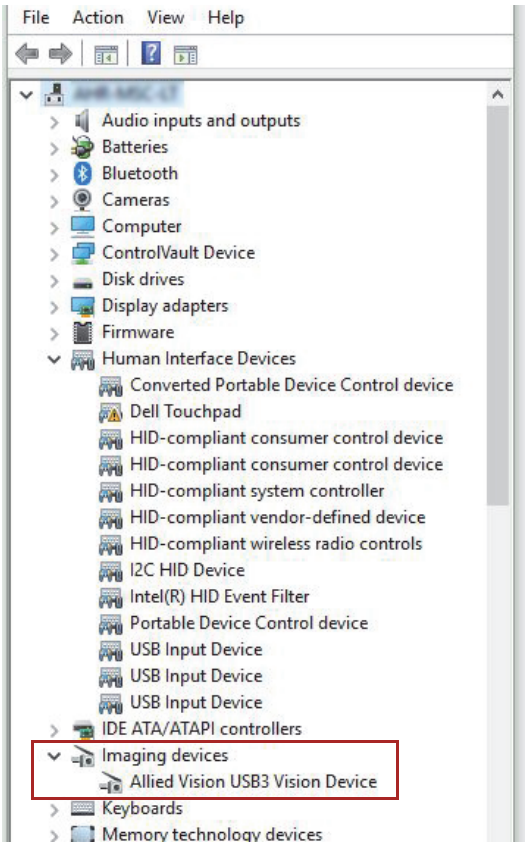
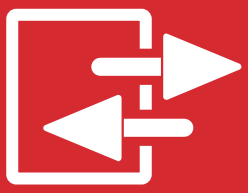


Figure 63: Windows Device Manager, USB3 Vision camera installed successfully

Camera interfaces



This chapter includes:

Recommended accessories

Compatible electronics accessories

See the Alvium Cameras Accessory Guide at www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

Back panel

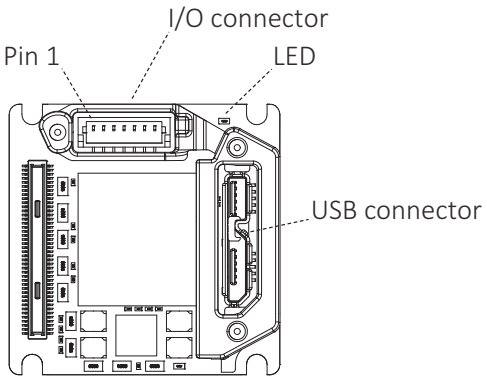


Figure 64: Bare board camera

Interface descriptions

Interface	Section in this user guide
I/O connector	Non-isolated, programmable GPIOs on page 156
Status LED	Status LED on page 158

Table 70: 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 www.jst.de for details.

I/O cables and electromagnetic interference (EMI)

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 housing, 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.

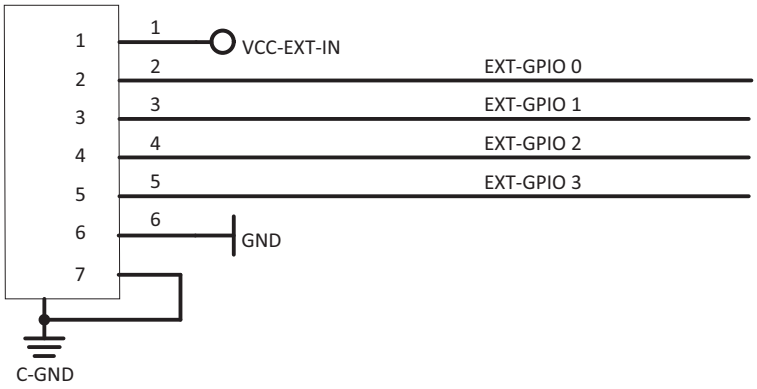


Figure 65: Pin assignment of JST BM07B-SRSS-TBT type I/O connector

Pin	Signal	Direction	Level	Description
1	VCC-EXT-IN	PWR IN	4.5 to 5.5 VDC	Power supply voltage See Camera power on page 37.
2	EXT-GPIO 0	IN/OUT	U_{in} (low) = -0.3 to 0.8 VDC U_{in} (high) = 2.0 to 5.5 VDC U_{out} (low) = 0 to 0.4 VDC U_{out} (high) = 2.4 to 3.3 VDC at max. 12 mA	GPIOs 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 71: 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 meters.

GPIOs description

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

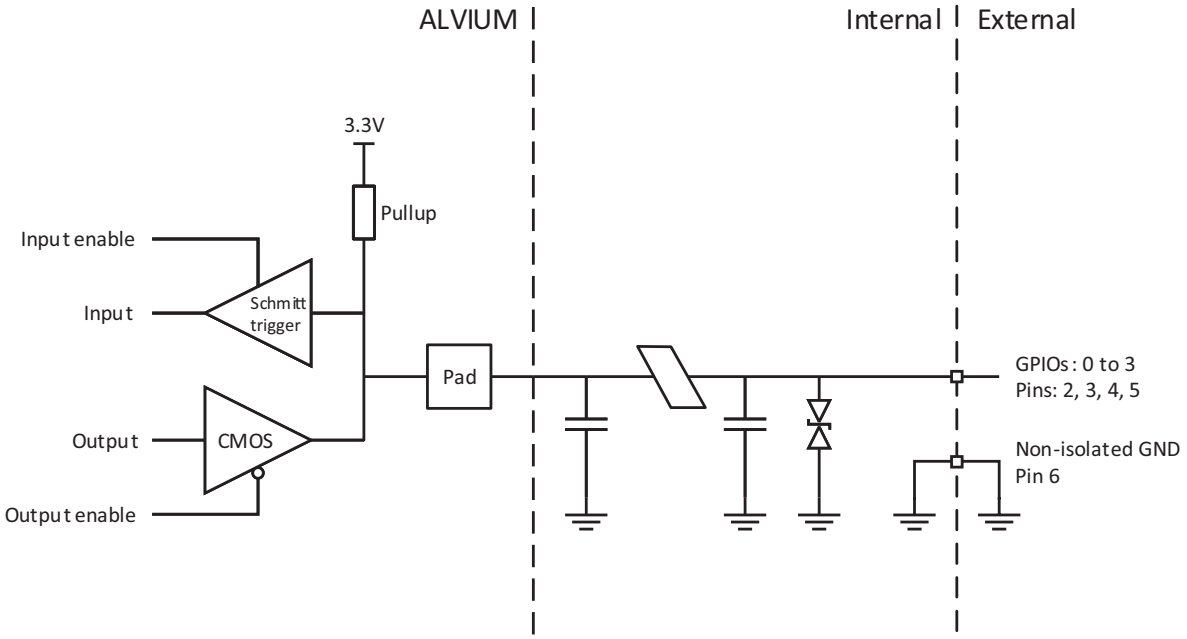


Figure 66: GPIOs block diagram

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 72: 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:

- Maximum current = 12 mA per output
- Maximum Out VCC = 3.3 VDC

Parameter	Value
External output voltage U_{out} (low)	0 to 0.4 VDC
External output voltage U_{out} (high)	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 73: GPIOs as output, current and voltage levels

Output voltage for U_{Out} (high) = 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 table describes the flashing pattern indicating different events. Inverse flashing: If the LED is already on, it is switched off for a short time.

LED settings

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 or idle state
	Irregular flashing	Command or image traffic, such as for camera startup
	Four short flashes and code sequence	Error state

Table 74: LED codes for normal operation

Error conditions

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

1. Restart the camera.
2. If the LED indicates error state again, please contact support@alliedvision.com.

Triggering

This chapter includes:

Trigger signal flow

Figure 67 shows an ideal 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 shown in the following graphic apply to Alvium USB cameras. Not all of the corresponding features may be supported. See the Alvium Cameras Features Reference at www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation for details.

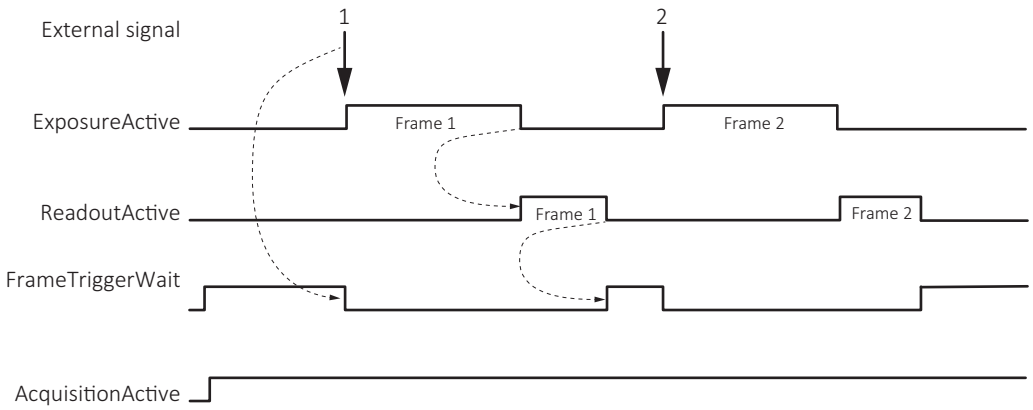


Figure 67: Schematic trigger signal flow

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 75: Trigger signal flow terms

Trigger latency

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

Rolling shutter (RS) cameras in this document also have exposure delay, depending on camera settings, see Triggering with rolling shutter cameras on page 161.

Triggering with rolling shutter cameras

This section describes triggering behavior for **1800 U-500m/c, U-501m NIR, U-1240m/c, and U-2050m/c** cameras with rolling shutter (RS) sensor. Figure 68 shows how an external signal triggers exposure and readout for cameras with rolling shutter (RS) sensors. Like for global shutter (GS) sensors, readout has a constant duration, acquisition must be active to enable exposure, the end of exposure starts readout.

Rolling shutter (RS) 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.

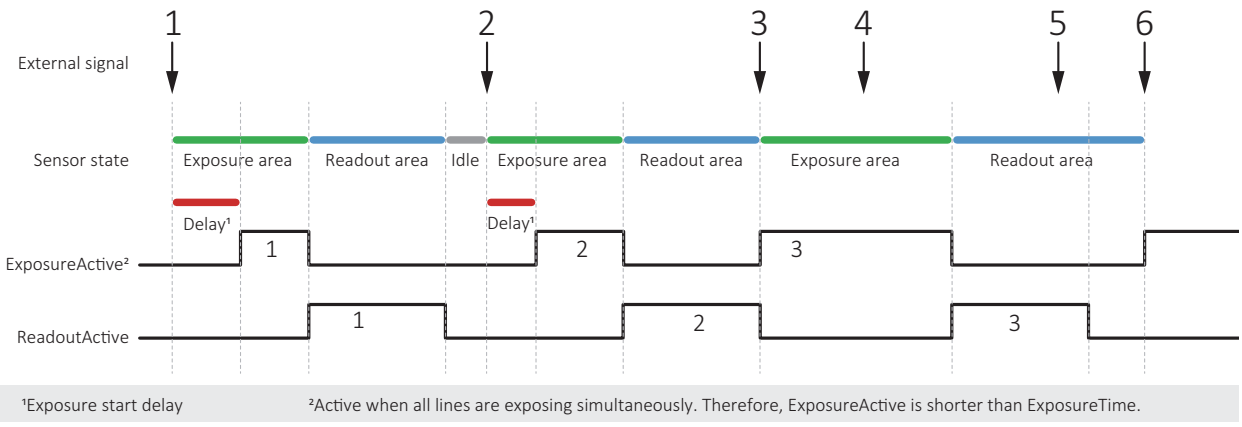


Figure 68: Triggering rolling shutter (RS) cameras

No	Conditions	Results
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

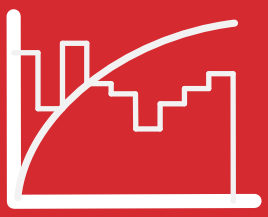
Table 76: Triggering conditions and results

TriggerSelector values for rolling shutter (RS) cameras

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

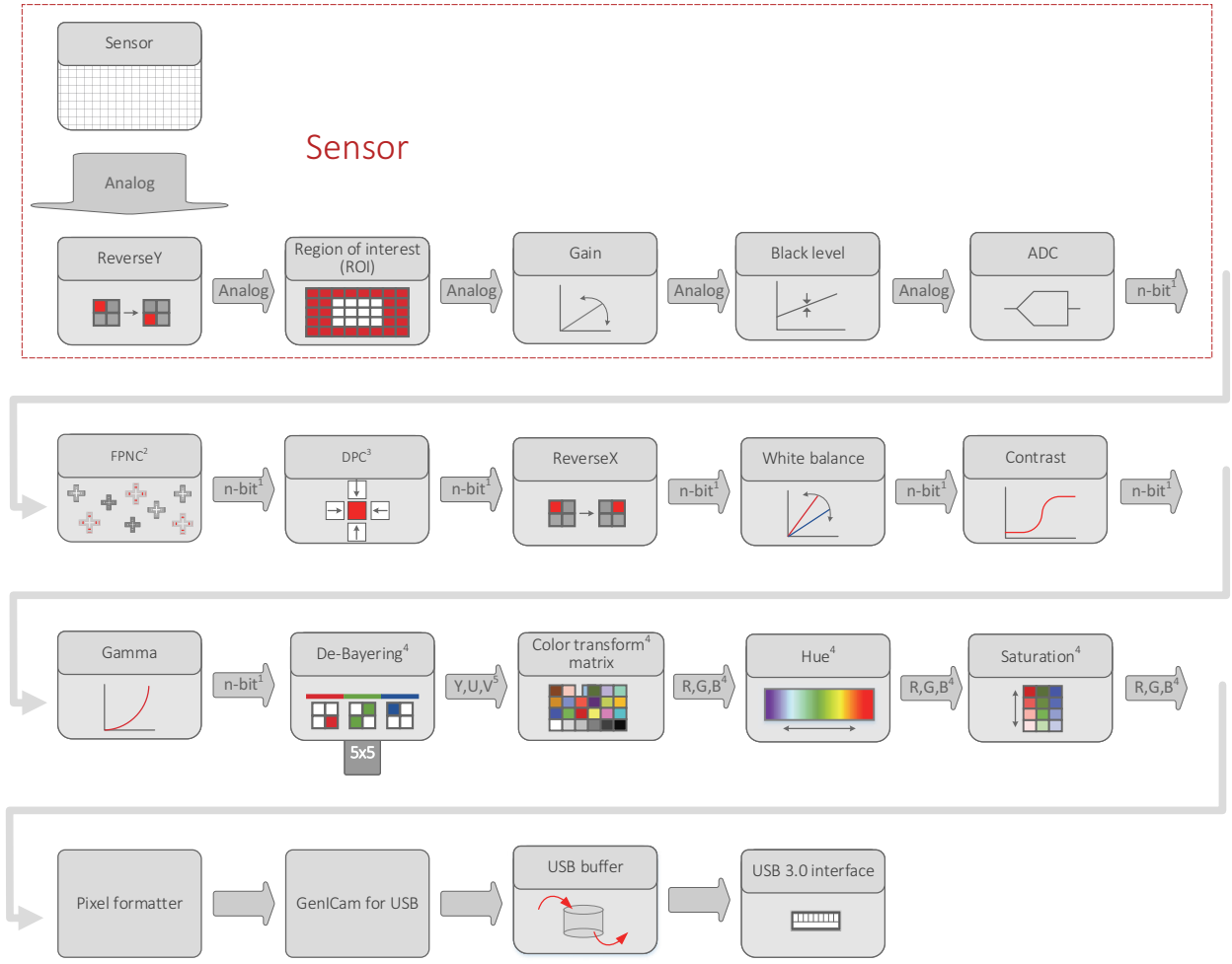
Cameras with rolling shutter (RS) **cannot** be triggered using *`ExposureStart`* or *`ExposureEnd`* for `TriggerSelector`.

Image data flow



This chapter includes the image data flow for Alvium USB cameras.

Figure 69 shows image data processing for Alvium USB cameras in general.



[1] Model dependent: See ADC bit depths in Table 77.

[2] Factory preset for FPNC = Fixed Pattern Noise Correction
currently only available for 1800 U-050m/c and 1800 U-120m/c

[3] Factory preset for DPC = Defect pixel correction

[4] Color models only

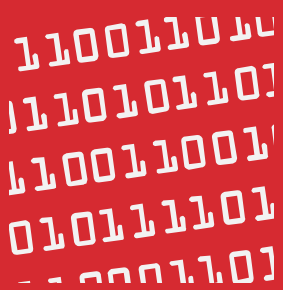
[5] For monochrome models: Y

Figure 69: Image data flow of Alvium USB cameras

Camera model	ADC bit depth
Alvium 1800 U-040m/c	12-bit
Alvium 1800 U-050m/c	10-bit
Alvium 1800 U-120m/c	12-bit
Alvium 1800 U-158m/c	12-bit
Alvium 1800 U-240m/c	12-bit
Alvium 1800 U-319m/c	12-bit
Alvium 1800 U-500m/c	10-bit
Alvium 1800 U-501m NIR	10-bit
Alvium 1800 U-508m/c	12-bit
Alvium 1800 U-158m/c	12-bit
Alvium 1800 U-1236m/c	12-bit
Alvium 1800 U-1240m/c	10-bit
Alvium 1800 U-2050m/c	10-bit

Table 77: ADC bit depth by model

Firmware update



This chapter describes how firmware is updated on Alvium USB cameras.

Please note

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

Consider: Any firmware update may not only add new features to a camera or fix known issues. It may also replace previous features or change camera characteristics. See firmware release notes for details.

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 you 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 firmware, follow the instructions of the Vimba Manual.

Downloads

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

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

If firmware update fails,

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

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

Performance and troubleshooting

This chapter includes:

Optimizing performance

Image transfer with rolling shutter cameras

Affected models: **Alvium 1800 U-120m/c, U-500m/c, U-501m NIR, U-1240 m/c, and U-2050m/c**

If acquisition is started and stopped in a short sequence, no image is transferred to the host. The duration cannot be predicted, because it depends on various factors.

Frame rate jitter

Affected models: **Alvium 1800 U-120m/c, U-500m/c, U-501m NIR, U-1240 m/c, and U-2050m/c**

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 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 `ExposureAuto` mode, the actual frame rate is less than the calculated value for the corresponding exposure time. Consider frame rate jitter for your application.

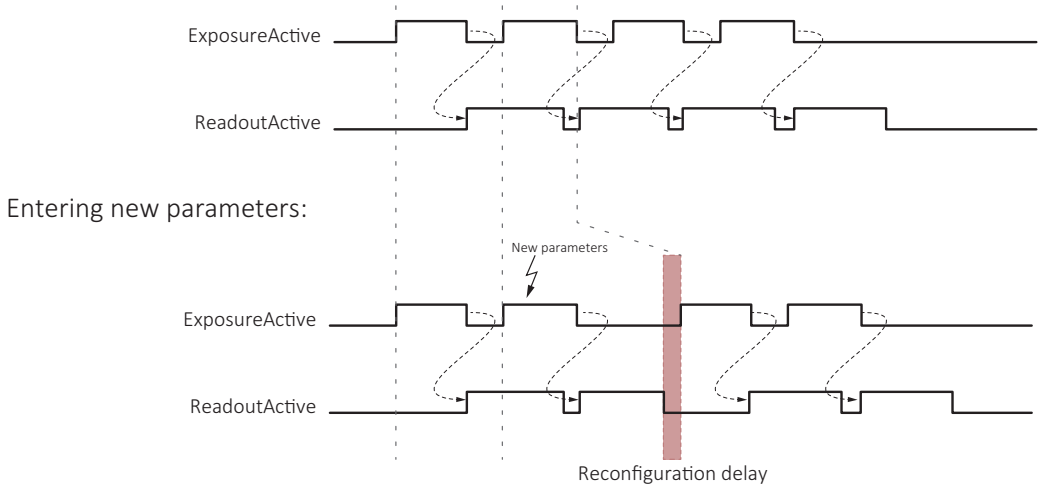


Figure 70: Delayed exposure due to parameter changes

Changing feature values while the camera is streaming

Only some features can be adjusted while the camera is streaming, these include:

- `AcquisitionFrameRate`
- `BalanceWhiteAuto`
- `BlackLevel`
- `ExposureAuto`
- `ExposureTime`
- `Gain`
- `GainAuto`
- `OffsetX`
- `OffsetY`

This list is not complete and will be updated in future document versions.

Latencies

Consider that value changes become effective with latencies based on the sensor and its operation mode (triggered or free run, shutter mode, frame rate).

Value changes by feature interdependencies

The conversion between time and clock cycles affects control values. Features for pixel format, bandwidth, ROI, 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 `PixelFormat` is changed subsequently. Figure 71 shows the interdependencies.

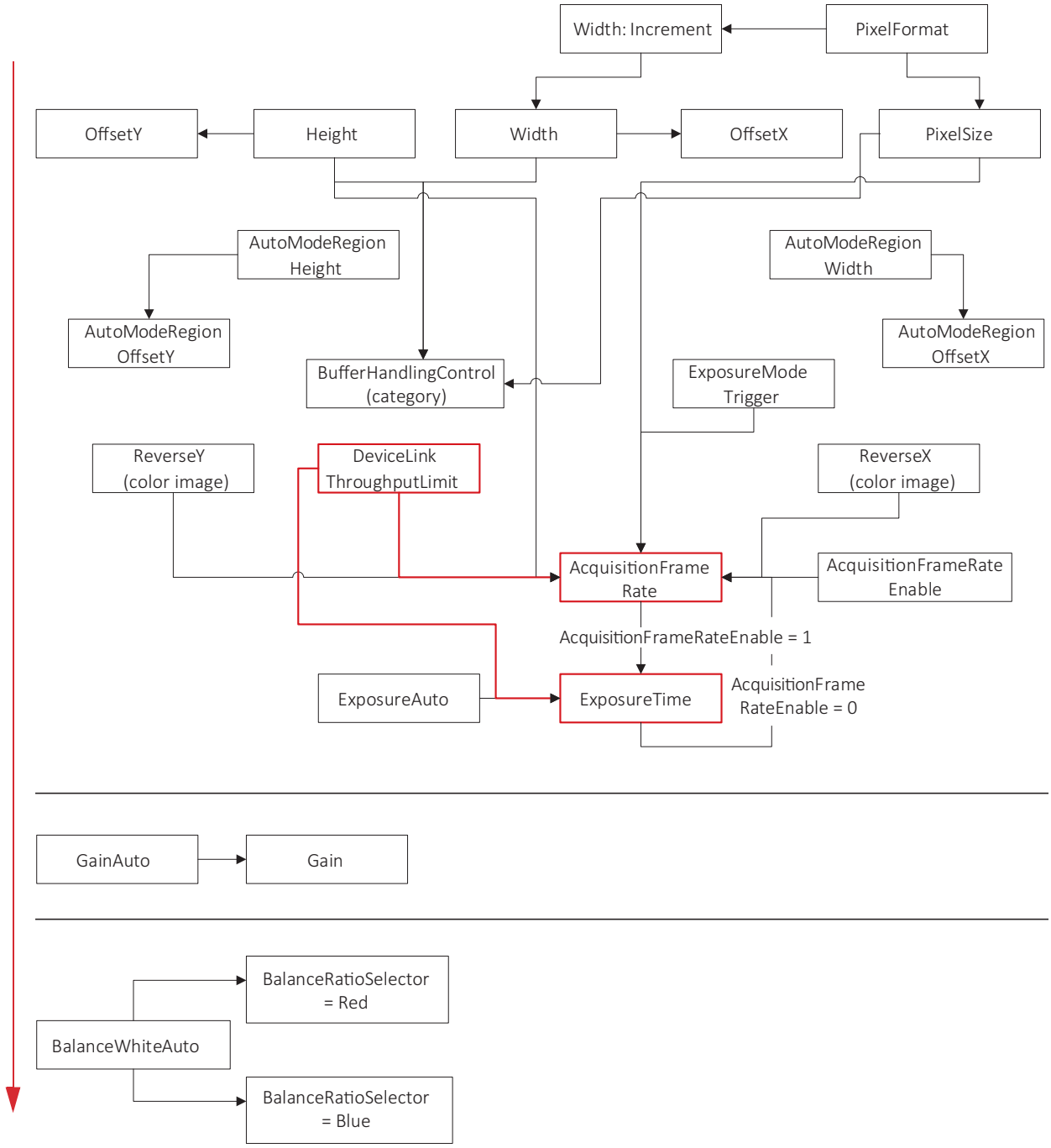


Figure 71: Interdependencies between features

Effects for the interdependent features

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

If: `Width` value is changed.
Then: Other values may be affected, such as for `AcquisitionFrameRate` 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`, also apply to `AutoExposure`.
- To avoid readjustments, apply settings in the order shown in Figure 71.

Impact by other features

Input	Output	
	Exposure time values	**Frame rate**
`AcquisitionFrameRate`	Not affected	Affected
`ExposureTime`	Affected as expected	Affected
`DeviceLinkThroughputLimit`	Affected	Affected
`Height`	Not affected	Affected
`Width`	May be affected	May be affected

Table 78: Impact by other features

Dark current compensation

All sensors accumulate dark current in the pixels. Dark current increases the signal level and black level. Most sensors in Alvium USB cameras compensate for this.

For **Alvium 1800 U-050m/c** with the ON Semi PYTHON 480 sensor, see Black level compensation for 1800 U-050m/c on page 174.

If cameras are operated at high temperatures or long exposure times, compensation reaches its limits. The typical compensation mechanism uses a **margin** to compensate for dark current. This works only until dark current reaches the size of the margin. The following table shows the relation of the margin and accumulated dark current for a pixel in 8-bit mode with a maximum value of 255.

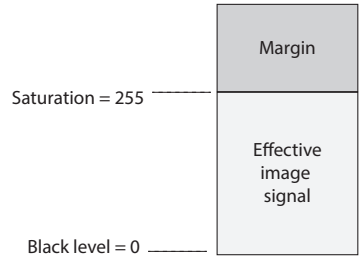
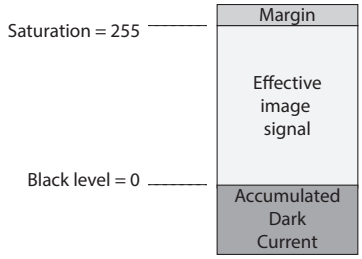
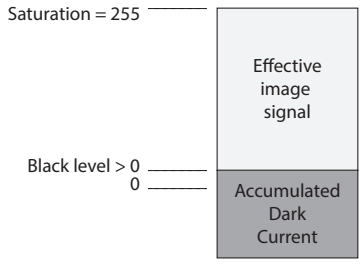
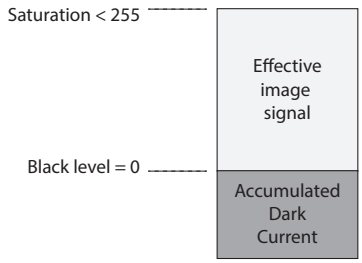
Effective signal versus noise	Description
	The pixel has accumulated no dark current, the margin has maximum size.
	The pixel has accumulated some dark current, reducing the size of the margin.
The following images show a pixel that has accumulated a higher dark current than the margin.	
	The pixel has accumulated dark current, the margin reduces to 0. **Type 1 compensation** • Dark current compensation is stopped. • Dark current increases the black level. • Fixed pattern noise increases.
	The pixel has accumulated dark current, the margin reduces to 0. **Type 2 compensation** (Typically used for sensor-internal compensation, often in the analog domain.) • Dark current compensation stays active. • Maximum saturation signal decreases. • Fixed pattern noise increases.

Table 79: Accumulated dark current affecting the effective image signal

Additional compensation

If compensation limits are reached and you cannot decrease operating temperature or exposure time, what can you do to keep signal quality high?

Measures for type 1 compensation

Alvium 1800 U-050m/c supports compensation type 1. For additional compensation, see Black level compensation for 1800 U-050m/c on page 174.

Typically, there is no measure to improve the image signal.
The rising black level shifts black and dark gray values to gray.

Measures for type 2 compensation

All other Alvium camera models support compensation type 2.

You can increase the margin size by using gain, with the following side effects:

- To give space to a larger margin, the effective pixel capacity decreases.
- White and light gray values are shifted down to gray.

Black level compensation for 1800 U-050m/c

Because the ON Semi PYTHON 480 sensor does not have a dark current compensation, **Alvium 1800 U-050m/**c cameras have a typical black level value drift, depending on exposure time and `DeviceTemperature` (measured at the mainboard). The black level compensation adjusts this effect as shown in Table 80.

Temperature [°C]	ExposureTime [ms]							
	1	10	50	100	250	500	750	1,000
35								
40								
45								
50								
55								
60								
65								
70								
75								

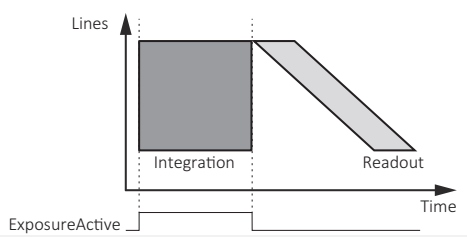
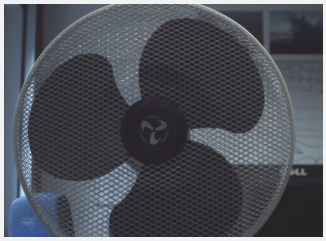
	Full compensation
	Basic compensation

Table 80: Exposure time and temperature affecting black level compensation

Should additional compensation be needed, we recommend cooling the camera.

Shutter types affecting image readout

Some Alvium USB camera models are operated using global shutter (GS):

Property	Line readout	Moving image
Global shutter (GS)		

Other models use rolling shutter (RS). Alvium 1800 U-2050 models with Sony IMX183 sensor offer global reset shutter (GRS) in addition:

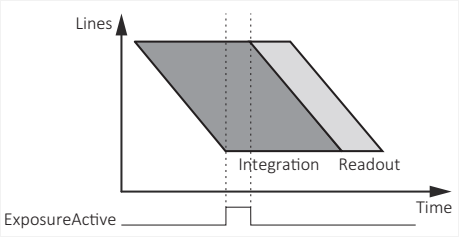
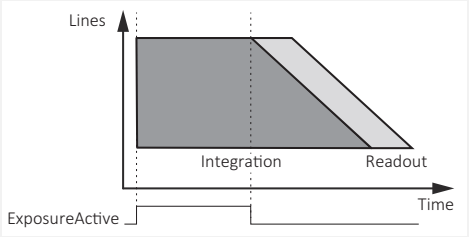
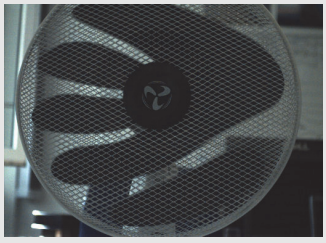
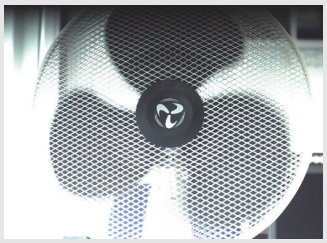
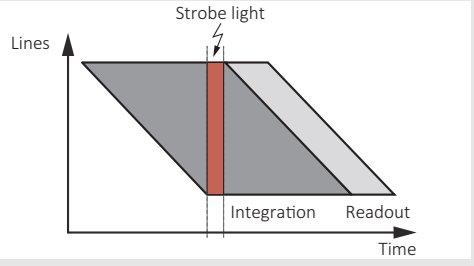
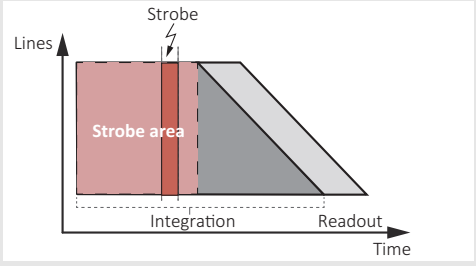
Property	Rolling shutter (RS)	Global reset shutter (GRS)
Line readout		
Line exposure start	Deferred from line to line	Common for all lines
Line exposure time	Common for all lines	Increases from line to line
Image acquisition of moving objects		
Image brightness	Constant over the image	Varying over the image
Moving objects	Distorted shape	Shape without distortion
Typical application	Static objects	Moving objects
Compensation	Use an additional mechanical or use a strobe light:	
		

Table 81: Shutter types affecting image readout

Operating systems and bandwidth

If the camera data output exceeds the bandwidth supported by the host computer, images may be corrupted. This section gives some background information to enable proper image transfer.

Sensor data output and camera data output

For cameras with an image buffer, the required bandwidth for image acquisition can be estimated for a given frame rate, pixel format, and resolution by over-the thumb calculations. Alvium cameras do not have an image buffer.

Figure 72 shows the bandwidth for a higher (1) and a lower (2) value for `DeviceLinkThroughputLimit`.

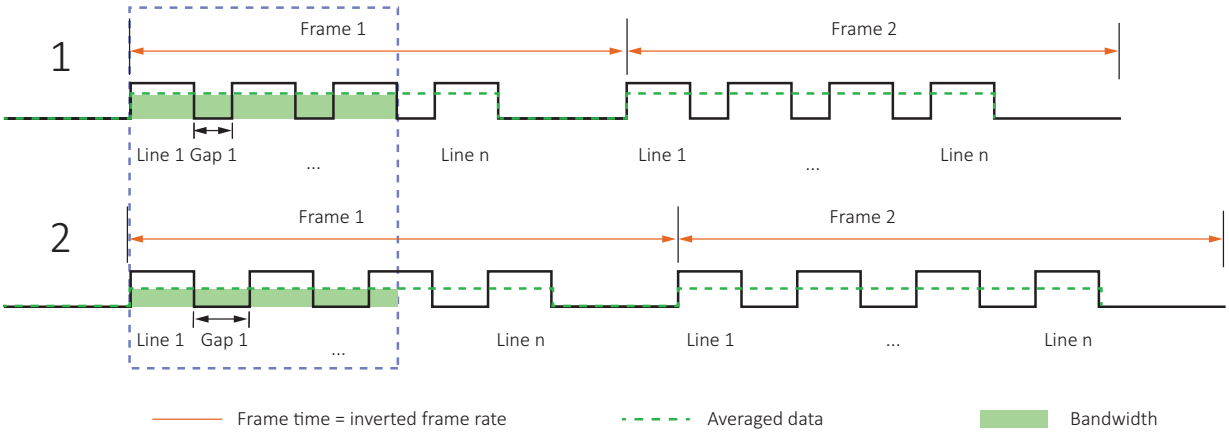


Figure 72: Sensor data output and camera data output

- Cameras **without** an image buffer like Alvium: Data is averaged over the line time.
- Cameras **with** an image buffer: Data rate is averaged over the frame time.
- Using `DeviceLinkThroughputLimit`: Reduced the maximum line data rate.

`DeviceLinkThroughputLimit` controls the maximum bandwidth of the data streamed out by the camera. When the value for this feature is reduced, the gaps between the lines are increased. This reduces the frame rate and therefore the bandwidth.

Additionally, you may reduce the frame rate to reduce bandwidth.

Consider that **Vimba Viewer** does not gray out values that exceed the bandwidth supported by the host computer.

More information on DeviceLinkThroughputLimit

For more information on `DeviceLinkThroughputLimit`, see the Alvium Cameras Features Reference at www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation.

Hardware and bandwidth

For a smooth data transfer of USB3 Vision cameras, the host computer must be equipped with a high-bandwidth USB controller. Hubs should support high bandwidths as well.

Suitable USB 3.0 accessories

See www.alliedvision.com/en/products/accessories for suitable USB 3.0 or 3.1 Gen 1 host controller cards and cables or contact your Allied Vision Sales representative.

Vimba settings

During freerun, 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.

For Linux

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.

Replace the **Vimba** default value (32768) for **Linux** by the default value (262144) for **Windows**.

Performance on reference systems

We have tested available frame rates on real systems, using an embedded board and a desktop PC. Cameras were operated in `AquisitionMode` = *`Continuous`*, frame rates were measured using **Vimba Viewer**.

Hardware and software

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

Table 82: Camera model and firmware

System component	Linux desktop system	Linux embedded system
Mainboard	Dell Precision T5600	NVIDIA Jetson TX2
CPU	Intel Xeon E5-2609 0 (4 cores)	ARMv8 (2x rev 0, 4x rev 3, 4 cores)
CPU frequency	2.40 GHz	2.0 GHz
RAM	8 GB	8 GB
Graphics controller	NVIDIA Quadro NVS 295	On-board
USB controller	ExSys EX-11092-2 (upper PCIe port)	On-board
Operating system	Ubuntu 18.04 64-bit, Kernel 4.15	Ubuntu 16.04 64-bit, Kernel 4.4

Table 83: Host computer hardware and operating system

Operating system and feature values

Feature	Linux desktop system	Linux embedded system
DeviceLinkThroughputLimit[1]	400000000 (400 MBps)	450000000 (450 MBps)
MaxTransferSize[2]	262144	
MaxTransferCount[2]	31 (default)	
[1] Camera feature [2] VimbaUSBTL.xml		

Table 84: Operating system and feature values

Frame rates and CPU payload

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

Table 85: CPU payload for RGB8

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

Table 86: CPU payload for Mono8

Dividing bandwidth between devices on a common USB 3.0 or 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 percent bus bandwidth.
- Cameras need 100 percent 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 percent bandwidth each.
  For three cameras, the bandwidth is 33.3 percent each.
- If one camera sends no data, the other camera will be assigned 100 percent bandwidth. To always assign 50 percent to both cameras, they have to be controlled to use no more than 50 percent bandwidth each.
- If the computer 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 devices, such as a monitor or a mouse, sharing bandwidth with the USB camera connected to the same bus.
- For maximum bandwidth, use a current version host controller card.
  See the Alvium Cameras Accessory Guide at www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.
- 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.

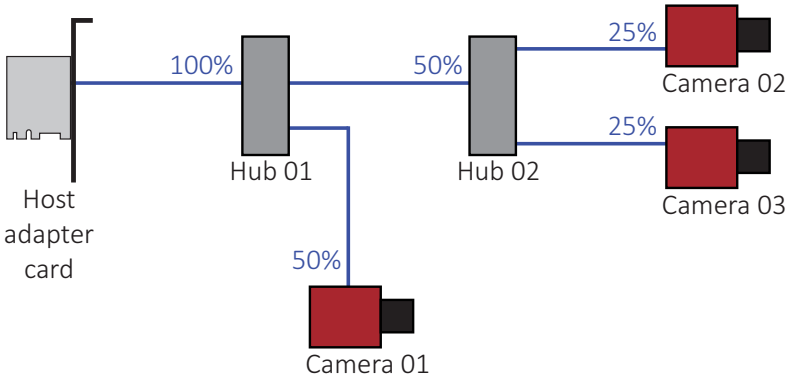


Figure 73: Bandwidth assignment for cascading hubs

Troubleshooting common issues

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 139.

Camera recognition

How can I make the computer and Vimba Viewer recognize the camera?

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

See the Alvium Cameras Accessory Guide at www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

Windows only

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

Windows 8 and later OS provide a USB 3.0 or 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 or 3.1 Gen 1 host controller driver.
To install the host controller card:

Download the manufacturer USB 3.0 or 3.1 Gen 1 host controller driver.
Install the driver on your computer.

Result: The installed driver enables the host controller.

Windows only

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

Follow the instructions in Installing the host adapter and Vimba on page 149.

4. The camera, **connected to a USB 3.0 or 3.1 Gen 1 hub**, is not recognized anymore. Check if the USB 3.0 or 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 computer**, 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 151.
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 shown by the **camera** Status LED.

   If: The status LED signals four short flashes followed by another sequence.
   Then: Restart the camera.
   If: If the status LED again signals four flashes.
   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 computer:

   1. Connect the camera with a **different cable** to a **different computer**.
   If: The camera works properly.
   Then: The camera is intact, but your previous computer 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 computer**.
   If: The camera works properly.
   Then: Replace the cable.
   3. Connect the camera with the **replaced cable** to the **previous computer**.
   If: The camera does not work properly.
   Then: Check the computer to fix the issue.

4. **Why does the camera not transfer images after restart?**
   This may happen if the value for `DeviceLinkThroughputLimit` is increased above the bandwidth supported by the host system.

   Check if sufficient bandwidth is assigned to the camera. See Operating systems and bandwidth on page 176.

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 www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

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 or 3.1 Gen 1 bus on page 180.

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

   Attach devices directly to a separate USB 3.0 or 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 or 3.1 Gen 1 bus on page 180.

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

   For recommended USB accessories, see the Alvium Cameras Accessory Guide www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

Radio signal interference

How can I avoid radio signal interference from wireless devices?

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

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

Even USB 3.0 and 3.1 Gen 1 cables can interfere harmfully with other electromagnetic devices. For example, despite shielding, a USB 3.0 or 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 Cameras Accessory Guide at www.alliedvision.com/en/support/technical-documentation/alvium-usb-documentation under Additional documents.

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