Allied Vision


CoaXPress Cameras

# Bonito PRO

# Technical Manual

V1.0.1

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

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# Bonito PRO at a glance

The Bonito PRO is Allied Vision's brand new high-bandwidth camera series with a CoaXPress interface. Equipped with four DIN 1.0/2.3 connectors the camera is capable to transmit 25 Gbps via quad CXP-6 (6.25 Gbps) high-speed connections. The Bonito PRO features a rugged, fan-less housing design and its powerful feature set make this camera an ideal choice for high-definition imaging applications demanding high-throughput, robustness, and system design-in flexibility.

**Read this manual carefully**

Learn how to protect your camera from damage and fully understand its functions.

## What else do you need?

| Content | URL |
|---|---|
| Bonito PRO Features Reference<br>Camera data sheets<br>Modular Concept<br>3D CAD STEP files<br>Firmware downloads | https://www.alliedvision.com/en/support/technical-documentation/bonito-PRO-documentation.html |
| Technical papers and knowledge base | https://www.alliedvision.com/en/support/technical-papers-knowledge-base.html |
| JIIA CoaXPress Vision Standard Version 1.1.1 | http://jiia.org/en/ |
| EMVA GenICam SFNC Version 2.2 | http://www.emva.org/standards-technology/genicam/genicam-downloads/ |

# Contact us

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

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# Contents

# Document history and conventions

This chapter includes:

- Document history
- Layout styles and symbols used in this manual
- Abbreviations and acronyms used in this manual

# Document history

| Version | Date | Remarks |
|---|---|---|
| V1.0.0 | 2018-May-31 | • New manual release status |
| V1.0.1 | 2018-Jul-10 | • Updated RoHS statement to include amendment 2015/863/EU<br>• Various minor corrections and enhancements |

*Table 1: Document history*

# Manual conventions

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

## Styles

| Style (example) | Function |
|---|---|
| **Emphasis** | Some important parts or items of the text are emphasized to make them more visible. |
| `Feature names` | GigE features names are displayed as monospaced text. |
| `Feature options` | Features options and register's options that are selectable by the user are displayed as monospaced italicized text. |
| **UI Element** | Text that is displayed, or output, by the system for the user, like parts of the GUI, dialog boxes, buttons, menus, important information, windows titles. |
| Web Reference | References to other documents or web pages, like web links, hypertext links, emails, but also cross references, that include a link the user can follow by clicking. |

*Table 2: Markup conventions used in this manual*

## Symbols and notes

**NOTICE**

**Material damage**

Precautions as described.

**NOTICE**

**Material damage by electrostatic discharge (ESD)**

Precautions as described.

**CAUTION**

**Personal injuries**

Precautions as described.

**Safety related instructions to avoid malfunctions**

This symbol indicates important or specific instructions or procedures that are related to product safety. You have to follow these instructions to avoid malfunctions.

**Practical hint**

This symbol highlights a practical hint that helps to better understand the camera's features and functions, and to make better use of it.

**Further information available online**

This symbol highlights URLs for further information. The URL itself is shown in blue. Example:

https://www.alliedvision.com

# Abbreviations and acronyms

The following table provides a list of abbreviations and acronyms used in this document.

| Abbreviation or acronym | Description |
|---|---|
| ADC | Analog-to-digital converter |
| AIA | Automated Imaging Association |
| CMOS | Complementary metal-oxide semiconductor |
| EMVA | European Machine Vision Association |
| ESD | Electrostatic discharge |
| FIFO | First-in first-out |
| GND | Ground (power) |
| GPO | General purpose output |
| H × V | Horizontal × Vertical (sensor resolution measurement) |

*Table 3: Abbreviations and acronyms used in this document*

| Abbreviation or acronym | Description |
|---|---|
| I/O | Input/Output |
| JIIA | Japan Industrial Imaging Association |
| LUT | Look-up table |
| MSDS | Material safety data sheet |
| NIR | Near Infrared |
| PA | Planarity adjustable |
| PoCXP | Power over CoaXPress |
| QE | Quantum efficiency |
| ROI | Region of interest |
| SDK | Software Development Kit |
| SFNC | Standard Feature Naming Convention |
| ToE | Trigger over Ethernet Action Command |
| TTL I/O | Transistor-transistor logic input/output |
| TxD and RxD | Transmit and receive |
| VDC | Volts of direct current |

*Table 3: Abbreviations and acronyms used in this document (continued)*

# Compliance and intended use

This chapter includes:

- Compliance notifications for Europe, the U.S., and Canada
- Information about application and intended use of the camera

# Compliance notifications

## For customers in Europe

Allied Vision has demonstrated the fulfillment of the requirements relating to the Bonito PRO camera family:

- Directive 2014/30/EU (Electromagnetic compatibility)
- Directive 2011/65/EU, including amendment 2015/863/EU (RoHS)

## For customers in the U.S.

**Class B digital device**

Note: 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 or TV technician for help.

We caution the user that 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

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

CAN ICES-3 (A)/NMB-3 (A)

## Pour utilisateurs au Canada

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

CAN ICES-3 (A)/NMB-3 (A)

## Avoid electromagnetic interferences

For all power and interface connections, only use shielded cables or cables recommended by Allied Vision.

# Camera applications and intended use

## General use

- The user is responsible for operating the camera within the specifications that are defined in this document, and within appropriate environmental conditions and technical prerequisites, to ensure trouble-free camera operation.
- The camera is compliant with current data communication standards; however, those standards do not allow for self-monitoring. Thus, the camera cannot be used as a standalone device for security-related monitoring operations.
- The camera is a hardware product. Only when used with appropriate accompanying software, the camera produces the desired results. The realization of intelligent solutions requires additional software that is suitable to run with the camera.
- The camera is a component, it is neither a complete product, nor is it a ready-made technical solution.
- The camera-supporting software can be obtained and installed separately from the camera. Usage of the software is solely the responsibility of the user.
- The camera must not be opened. For all repair tasks, contact Allied Vision or one of Allied Vision's authorized representatives.
- Observe the intended use. The camera must only be used for purposes that are in conformity with the stated intended use.
- Additionally, refer to the warranty information on the Allied Vision website.

## Use in medical devices

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

# Copyright and trademarks

# Installation and hardware

This chapter describes the components required for your vision system including configuring the host computer, frame grabber settings, and connecting your Bonito PRO camera.

# Precautions

## Heat risks

**CAUTION**

**Burns to skin possible by a hot camera**

During operation, cameras get hot. Touching a hot camera with bare hands may lead to injuries.

- For operation, keep the camera temperature below +70 °C.
- Ensure that instructed persons only handle cameras.
- Wear protective gloves when touching a heated-up camera.

## Electrical connections

**NOTICE**

**ESD**

The phenomenon is commonly known: when walking on a carpet, we get charged. Touching a door handle, we get an electric shock. ESD is dangerous for electronic devices, especially when tools or hands get in contact with connectors. We recommend measures to avoid damage by ESD:

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

**NOTICE**

**Do not operate the camera beyond the environmental specifications**

See environmental specifications limits in the Specifications chapter of this document. Special care must be taken to maintain a reasonable operating temperature.

**NOTICE**

**Verify all external connections**

Verify all external connections in terms of voltage levels, power requirements, voltage polarity, and signal integrity prior to powering the device.

**NOTICE**

**Heat can cause damage to the camera**

Operation outside the specified temperature range can damage the camera. For best performance and to protect the camera from damage, keep the housing temperature between the specified operating temperature.

Observe the following:

- Keep the camera passive cooling fins free of dust and other contaminants.
- For maximum heat dissipation, affix the camera to a heat sink, using the mounting threads.
  - Use mounting base and heat sink with large surface areas.
  - Use a mounting base with a high thermal conductivity.
- Reduce ambient temperature. For example, in an outdoor application with direct sunlight, provide shading by an enclosure.
- Provide ventilation or other active cooling of camera, mounting base, and heat sink.

# Optical components

**NOTICE**

**Image sensor**

Image sensors are sensitive to excessive radiation: focused sunlight, lasers, and X-rays can damage the sensor. Monochrome and NIR models are not fitted with filter or protection glass. Consider, when removing the lens or dust cap on these cameras, the sensor is not protected against dirt or scratches.

**NOTICE**

**Cleaning optical components**

The Bonito PRO camera can be damaged by some volatile cleaning agents. Avoid cleaning the image sensor unless absolutely necessary. See the Cleaning optical components chapter in this document.

Allied Vision can clean your camera as a service for you, if necessary. For more information, contact Allied Vision support at https://www.alliedvision.com/en/support/contact-support-and-repair.html.

**NOTICE**

**Lenses**

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

To keep dirt out of the lens mount, hold the camera with the lens mount facing the ground. Keep filter and camera back lens clean, because dirt becomes more visible the closer it gets to the sensor.

## Shock and vibration

Cameras were successfully tested for compliance with:

- IEC 60068-2-6, Sinusoidal vibration testing
- IEC 60068-2-27, Non-repetitive shock testing
- IEC 60068-2-27, Repetitive shock testing
- IEC 60068-2-64, Random vibration testing

# Recommended frame grabbers

| Model tested | Remarks |
|---|---|
| Euresys Coaxlink Quad G3 | PCIe 3.0 four-connection CoaXPress frame grabber, four CoaXPress CXP-6 connections, 2,500 MBps camera bandwidth, PCIe 3.0 (Gen 3) × 4 bus, 3,300 MBps bus bandwidth, PoCXP, Windows drivers |
| Active Silicon FireBird Quad CXP-6 | Quad input CoaXPress frame grabber, four CoaXPress connections each at 6.25 Gbps, Windows support (32-bit and 64-bit), PoCXP |

*Table 4: Recommended frame grabbers*

Not all frame grabbers support all Bonito PRO features.

For a complete list of supported frame grabbers including limitations, see the Hardware Selection for Bonito PRO Cameras application note.

https://www.alliedvision.com/en/support/technical-papers-knowledge-base.html

Contact your Allied Vision Sales representative or your local Allied Vision distribution partner for lens recommendations:

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

The Euresys Coaxlink Quad G3 frame grabber and GenICam browser were used to create the screenshots in this document.

# Powering the camera

A camera power adapter for each Bonito PRO camera is available from Allied Vision. See the Specifications chapter for connector definition and voltage specifications.

**NOTICE**

**Powering the camera**

- Use only DC power supplies with insulated cases.
- Do not exceed the wattage as specified in the Specifications chapter.
- For all power connections use only shielded cables to avoid electromagnetic interference.
- Bonito PRO cameras can be powered from either the Hirose I/O port or via PoCXP. Power supplied via Hirose I/O takes priority over power supplied via PoCXP.
- When powering the camera via the Hirose I/O port, use a power supply recommended by Allied Vision

**CXP-6**

Bonito PRO cameras stream images at CXP-6 speeds with four connections only.

**PoCXP**

A frame grabber that supports PoCXP is required providing the camera with required power as per the specifications. Each connection supports up to 13 watts.

**Line1 is master**

- When connecting the camera to power always connect Line1 last.
- Some frame grabbers require that the master connection is always on line 1 and line 1 is connected to line 1 on the frame grabber.
- As power is provided by all lines, you must disconnect all four cables to power cycle the camera.

# Connecting your camera

**CoaXPress cabling**

CoaXPress uses 75 Ω coaxial cable as a physical medium.

**Maximum cable length**

The maximum cable length between the Bonito PRO camera and the host computer is dependent on the bit rate and the type of coax cable used. For more information refer to the JIIA CoaXPress Standard Version 1.1.1.

The procedure to obtain the first image from your Bonito PRO camera is dependent on the frame grabber GenICam browser or SDK. The Euresys Coaxlink Quad G3 CXP-6 frame grabber GenICam browser was used to create the screenshots in this document. These screenshots are not representative of every frame grabber GenICam browser.

Follow the steps to connect your camera and obtain the first image:

1. Install the frame grabber in your host computer and configure the frame grabber software including drivers, utilities, and libraries. Ensure the system BIOS version is compatible with the frame grabber. For additional information, see the frame grabber quick start guide or other documentation provided by the manufacturer.
2. Connect your Bonito PRO camera to your frame grabber via four 75Ω coaxial cables.
3. The camera can by powered via the Hirose I/O port using a compatible power supply or it can be powered via a PoCXP frame grabber.
4. Mount a lens to the camera

5. Start the frame grabber GenICam browser and wait for the camera to be discovered. When discovered, the Bonito PRO camera is listed under **Remote Devices**.

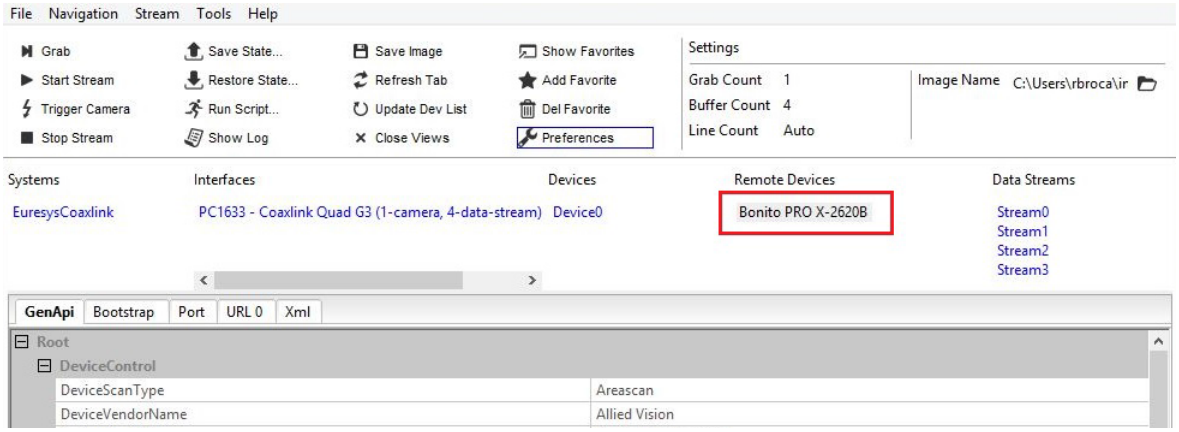



*Figure 1: Camera is listed under Remote Devices*

6. Double-click the camera name and then click the **GenApi** tab

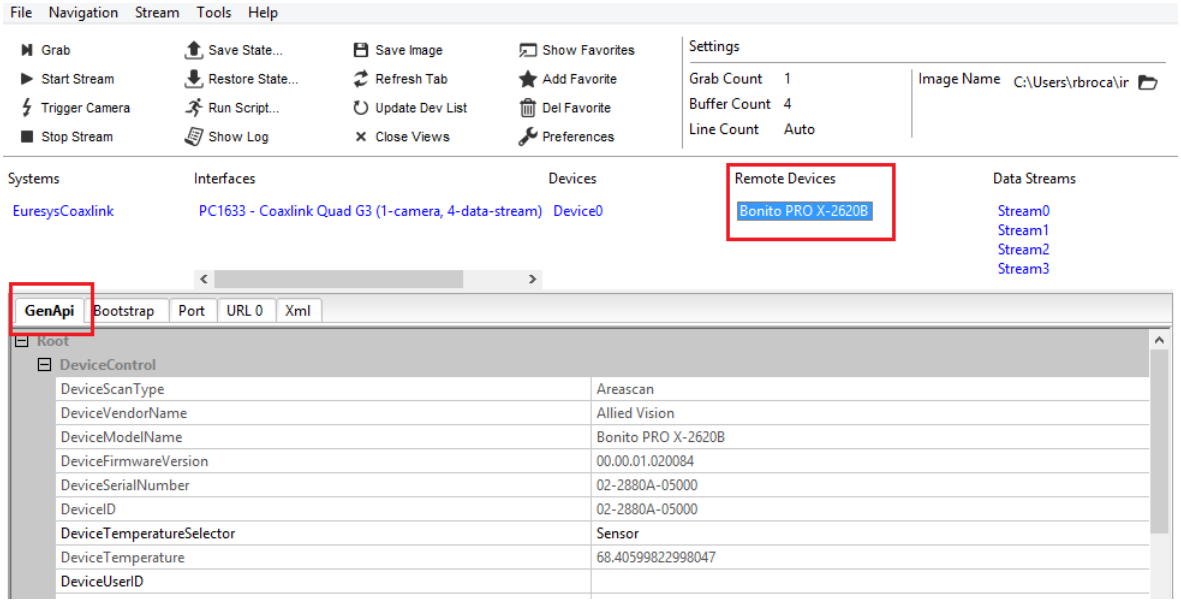



*Figure 2: Double-click the camera and GenApi tab*

7. Configure camera settings as required.
8. Click the **Start Stream** button to start streaming images.
9. Click the **Stop Stream** button to stop streaming images.

# Optics

Bonito PRO cameras offer various mechanical interfaces for installing a lens including F-Mount (default mount), F-Mount PA, M42-Mount, M42-Mount PA, M58-Mount, M58-Mount PA, and Canon EF-Mount PA. Lenses can be purchased directly from Allied Vision or from an Allied Vision distribution partner. Users need to select the desired focal length and appropriate optical format for the target camera model.

For more information on mechanical interface options for your Bonito PRO camera, see the Modular Concept at https://www.alliedvision.com/en/support/technical-documentation.html.

Contact your Allied Vision Sales team or your local Allied Vision distribution partner for information on accessories and lens recommendations:

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

# Accessories

Allied Vision offers a wide range of accessories for the use of Bonito PRO CXP-6 cameras and the easy integration in already existing applications including:

- CXP-6 cables
- Lenses for corresponding sensor sizes and resolutions

Contact your Allied Vision Sales team or your local Allied Vision distribution partner for information on accessories and lens recommendations:

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

**Recommended accessories**

A list of recommended accessories is available on the Allied Vision website. For supported frame grabbers, see the Hardware Selection for Bonito PRO Cameras application note at https://www.alliedvision.com/en/support/technical-papers-knowledge-base.html.

# Specifications

This chapter provides:

- Applied standards
- Technical specifications
- Absolute QE plots
- ROI height versus frame rate plots
- Feature availability in Bonito PRO camera models

# Applied standards

**JIIA CoaXPress**

The JIIA is the Japanese machine vision standards body. The JIIA CoaXPress Technical Committee is responsible for the preparation and maintenance of the CoaXPress Standard.

**GenICam™**

GenICam is a machine vision standard hosted by the EMVA. The aim of GenICam is to provide a generic configuration interface for cameras and devices independent of the used interface technology. This approach enables proper interoperability between GenICam compliant hardware and software solutions without the need for customization.

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

# Notes on specifications

**Dimensions and mass**

Dimensions include connectors and default lens mount (F-Mount) but not the tripod and lens.

Mass does not include the tripod and lens.

Both dimensions and mass values in the specification tables are for the default configuration of the camera (default housing and lens mount).

**Modular options**

Bonito PRO cameras can be ordered with several modular options including lens mount and optical filter options. For more information, see the Modular Concept.

**NOTICE**

**Monochrome and NIR models**

As monochrome and NIR models do not have an optical filter always attach a dust cap when a lens is not attached to minimize the possibility of contaminants falling on the sensor surface.

# Resolution and ROI frame rate

Resolution and ROI frame rate is listed after the specification table. The resulting frame rate from changing sensor height from full image to 16 lines. Unless otherwise noted, sensors do not give an increase in readout speed with a reduction in width. However, in cases where a camera is limited by frame rate due to bandwidth restrictions, a reduction in width gives a frame rate increase.

**Frame rate and readout**

Although the sensor is capable of higher frame rates, readout is limited by bandwidth and exposure value. You can improve frame rates with a reduced region of interest and shorter exposure values.

# Absolute quantum efficiency plots

All measurements were done without protection glass or IR cut filter. With protection glass or filters, QE decreases by approximately 10%.

The uncertainty in measurement of the QE values is ±10.25%. This is mainly due to uncertainties in the measuring apparatus itself (Ulbricht sphere, 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.

# Specifications common to all models

| Feature | Specification |
|---|---|
| Electronic shutter | Global shutter |
| Default lens mount | F-Mount |
| Optional lens mounts | EF-Mount PA, F-Mount, F-Mount PA, M42-Mount, M42-Mount PA, M58-Mount, M58-Mount PA |
| Default optical filter | Monochrome and NIR models: No optical filter<br>Color models: IRC30 IR cut filter |
| Optional optical filters | • IRC30 IR cut filter<br>• Protection Glass (ASG)<br>• IRC Filter Schneider 486 |
| TTL (non-isolated) I/Os | 1 input, 2 outputs |
| Opto-isolated I/Os | 1 input, 2 outputs |
| Voltage requirements | 24 VDC ± 2.4 VDC, PoCXP |
| Digital interface | CoaXPress (CXP-6), 4 x DIN 1.0/2.3 type connectors<br>75 Ω coaxial cable; up to 6.25 Gbps data rate per cable |
| Interface standard | CoaXPress Standard Version 1.1.1 |
| Temperature monitoring | Available for main board and sensor board.<br>Resolution: 0.031; Accuracy: ±1 °C |
| Body dimensions (L × W × H) | 114.9 × 70 × 70 mm (with F-Mount and connectors) |
| Mass (typical) | ~500 g (depending on lens mount type) |
| Operating temperature | -20 °C to +70 °C housing temperature (without condensation) |
| Storage temperature | -20 °C to +70 °C ambient temperature (without condensation) |
| Operating humidity | 20 to 80% non-condensing |

*Table 5: Specifications common to all Bonito PRO models*

# Bonito PRO X-1250B, X-1250B NIR, X-1250C

| Feature | Specification | |
|---|---|---|
| | **Bonito PRO X-1250B, X-1250B NIR** | **Bonito PRO X-1250C** |
| Resolution (H × V) | 4096 × 3072 (V)<br>12.5 MP | |
| Sensor | ON Semi PYTHON 12K<br>(NOIP1SN012KA, NOIP1FN012KA) | ON Semi PYTHON 12K<br>(NOIP1SE012KA) |
| Sensor type | CMOS | |
| Sensor format | Type 4/3 | |
| Sensor size | 23.04 mm diagonal | |
| Pixel size | 4.5 µm × 4.5 µm | |
| Maximum frame rate at full resolution | 142.6 fps (8-bit)<br>136.6 (10-bit) | |
| Maximum image bit depth | 10-bit | |
| Monochrome pixel formats | Mono8, Mono10 | |
| RAW pixel formats | | BayerRG8, BayerRG10 |
| Exposure control | 1 µs to 1 s, 1 µs increments | |
| Gain control | 0 to 22 dB | |
| Binning | Horizontal: 1, 2, 4, columns<br>Vertical: 1, 2, 4, 8 rows | |
| Decimation X/Y | Horizontal and vertical: 1, 2, 4, 8 factor | |
| Power consumption | ~15.7 W at 24 VDC<br>~15.7 W PoCXP | |
| Trigger latency | T.B.D. | |
| Trigger jitter | T.B.D. | |
| Propagation delay ($t_{pd}$) | T.B.D. | |

*Table 6: Bonito PRO X-1250 specifications*

## Absolute QE

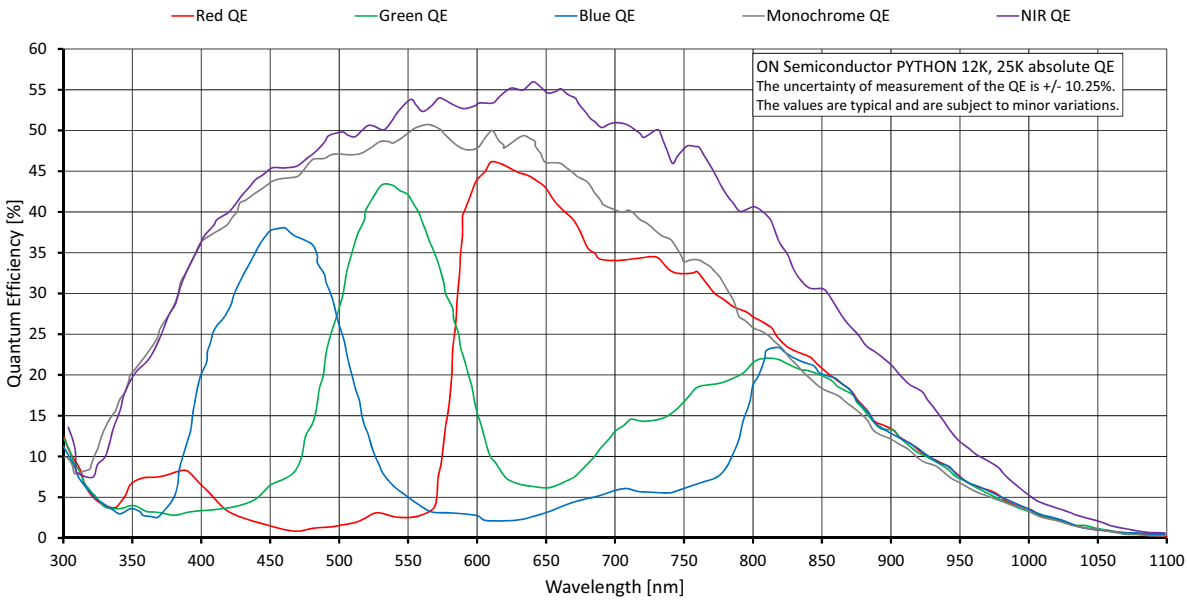



*Figure 3: Bonito PRO X-1250 (ON Semi PYTHON12K) absolute QE*

## ROI frame rate

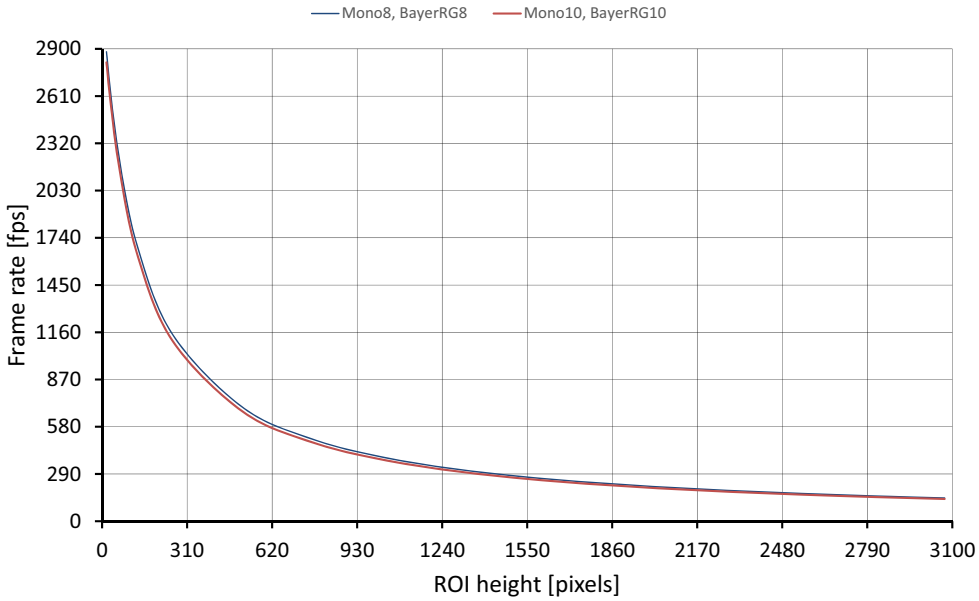



*Figure 4: Bonito PRO X-1250 frame rate as a function of ROI height*

## 8-bit pixel formats (Mono8, BayerRG8)

| Height | Frame rate (fps) |
|---|---|
| 3072 | 142.6 |
| 2816 | 154.9 |
| 2560 | 169.9 |
| 2304 | 187.4 |
| 2048 | 209.2 |
| 1792 | 236.9 |

| Height | Frame rate (fps) |
|---|---|
| 1536 | 273 |
| 1280 | 322.2 |
| 1024 | 392.9 |
| 768 | 503.2 |
| 512 | 699.7 |
| 256 | 1149.4 |

| Height | Frame rate (fps) |
|---|---|
| 128 | 1692 |
| 64 | 2212.3 |
| 32 | 2617.8 |
| 16 | 2881.8 |

*Table 7: Bonito PRO X-1250 frame rate as a function of ROI height (Width=4096 pixels)*

## 10-bit pixel formats (Mono10, BayerRG10)

| Height | Frame rate (fps) |
|---|---|
| 3072 | 136.6 |
| 2816 | 148.5 |
| 2560 | 162.6 |
| 2304 | 179.6 |
| 2048 | 200.6 |
| 1792 | 227.2 |

| Height | Frame rate (fps) |
|---|---|
| 1536 | 261.9 |
| 1280 | 309.2 |
| 1024 | 377.2 |
| 768 | 483.5 |
| 512 | 673.8 |
| 256 | 1109.8 |

| Height | Frame rate (fps) |
|---|---|
| 128 | 1639.3 |
| 64 | 2155.1 |
| 32 | 2557.5 |
| 16 | 2816.9 |

*Table 8: Bonito PRO X-1250 frame rate as a function of ROI height (Width=4096 pixels)*

# Bonito PRO X-2620B, X-2620B NIR, X-2620C

| Feature | Specification | |
|---|---|---|
| | **Bonito PRO X-2620B, X-2620B NIR** | **Bonito PRO X-2620C** |
| Resolution (H × V) | 5120 × 5120<br>26.2 MP | |
| Sensor | ON Semi PYTHON 25K<br>(NOIP1SN025KA, NOIP1FN025KA) | ON Semi PYTHON 25K<br>(NOIP1SE025KA) |
| Sensor type | CMOS | |
| Sensor format | Type APS-H | |
| Sensor size | 32.6 mm diagonal | |
| Pixel size | 4.5 µm × 4.5 µm | |
| Maximum frame rate at full resolution | 79.7 fps (8-bit)<br>70.1 fps (10-bit) | |
| Maximum image bit depth | 10-bit | |
| Monochrome pixel formats | Mono8, Mono10 | |
| RAW pixel formats | | BayerRG8, BayerRG10 |
| Exposure time control | 1 µs to 1 s, 1 µs increments | |
| Gain control | 0 to 22 dB | |
| Binning | Horizontal: 1, 2, 4, 8 columns<br>Vertical: 1, 2, 4, 8 rows | |
| Decimation X/Y | Horizontal and vertical: 1, 2, 4, 8 factor | |
| Power consumption | ~15.7 W at 24 VDC<br>~15.7 W PoCXP | |
| Trigger latency | T.B.D. | |
| Trigger jitter | T.B.D. | |
| Propagation delay ($t_{pd}$) | T.B.D. | |

*Table 9: Bonito PRO X-2620 specifications*

# Absolute QE

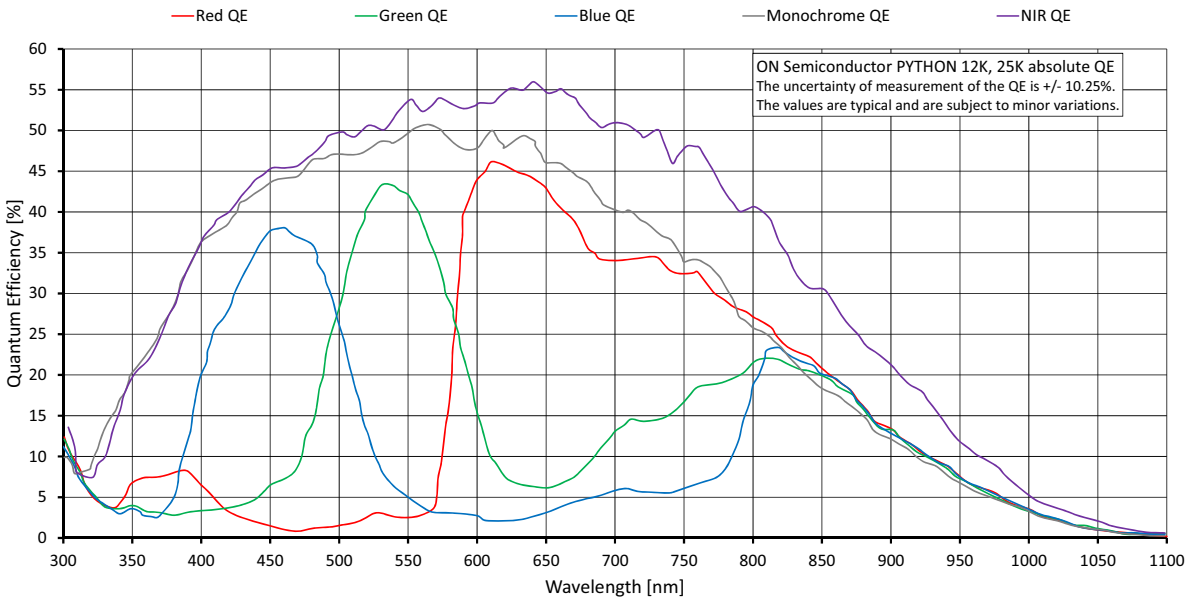



*Figure 5: Bonito PRO X-2620 (ON Semi PYTHON 25K) absolute QE*

# ROI frame rate

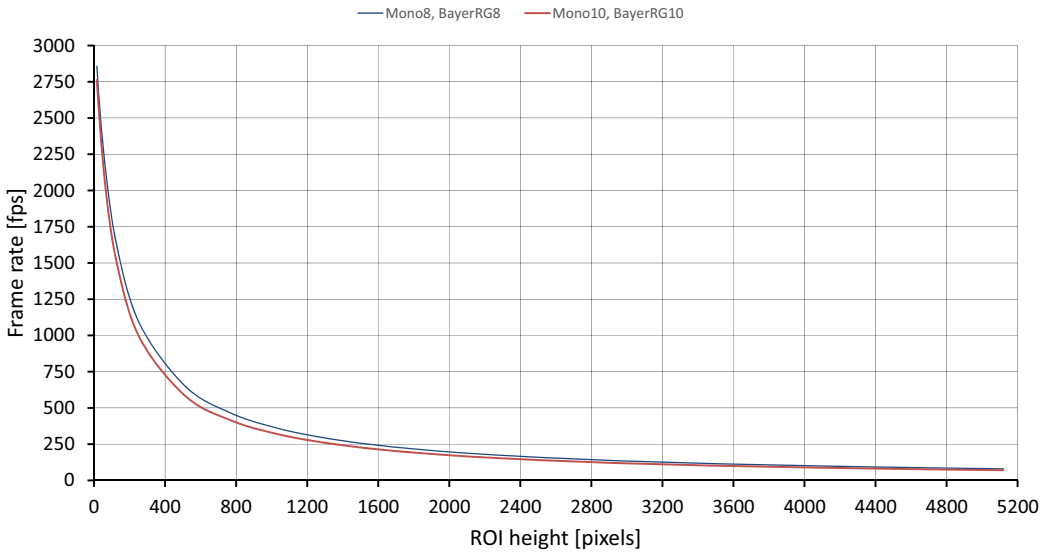



*Figure 6: Bonito PRO X-2620 frame rate as a function of ROI height*

## 8-bit pixel formats (Mono8, BayerRG8)

| Height | Frame rate (fps) | Height | Frame rate (fps) | Height | Frame rate (fps) |
|---|---|---|---|---|---|
| 5120 | 79.7 | 3072 | 130.7 | 1024 | 362.5 |
| 4864 | 83.8 | 2816 | 142 | 768 | 465.7 |
| 4608 | 88.3 | 2560 | 155.5 | 512 | 651.4 |
| 4352 | 93.3 | 2304 | 171.9 | 256 | 1082.2 |
| 4096 | 99 | 2048 | 192.1 | 128 | 1618.1 |
| 3840 | 105.4 | 1792 | 217.7 | 64 | 2150.5 |
| 3584 | 112.4 | 1536 | 251.1 | 32 | 2570.6 |
| 3328 | 121 | 1280 | 296.7 | 16 | 2857.1 |

*Table 10: Bonito PRO X-2620 frame rate as a function of ROI height (Width=5120 pixels)*

## 10-bit pixel formats (Mono10, BayerRG10)

| Height | Frame rate (fps) | Height | Frame rate (fps) | Height | Frame rate (fps) |
|---|---|---|---|---|---|
| 5120 | 70.1 | 3072 | 115.1 | 1024 | 321.9 |
| 4864 | 73.7 | 2816 | 125.2 | 768 | 415.1 |
| 4608 | 77.7 | 2560 | 137.2 | 512 | 584.1 |
| 4352 | 82.2 | 2304 | 151.7 | 256 | 985.2 |
| 4096 | 87.1 | 2048 | 169.6 | 128 | 1499.2 |
| 3840 | 92.8 | 1792 | 192.4 | 64 | 2023.5 |
| 3584 | 99.2 | 1536 | 222.2 | 32 | 2469.1 |
| 3328 | 106.6 | 1280 | 262.9 | 16 | 2762.4 |

*Table 11: Bonito PRO X-2620 frame rate as a function of ROI height (Width=5120 pixels)*

# Camera features

Bonito PRO cameras support a number of standard and extended features. The following table identifies a selection of capabilities and compares the availability of features in Bonito PRO camera models.

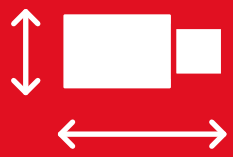
**Camera features reference**

For a complete description of individual features, see the Bonito PRO Features Reference.

| | | X-1250 | X-2620 |
|---|---|---|---|
| **Image optimization features** | Auto gain | ✓ | ✓ |
| | Auto exposure | ✓ | ✓ |
| | Auto white balance (color models only) | ✓ | ✓ |
| | Binning (horizontal and /or vertical), (sum or average) | ✓ | ✓ |
| | Black level (offset) | ✓ | ✓ |
| | Defect pixel control (DPC) | ✓ | ✓ |
| | Decimation X/Y | ✓ | ✓ |
| | Gamma correction | ✓ | ✓ |
| | Three look-up tables (LUTs) | ✓ | ✓ |
| | Defect Pixel Correction | ✓ | ✓ |
| | Fixed Pattern Noise Correction | ✓ | ✓ |
| **Camera control features** | Multiple regions of interest (Multi-ROI) | ✓ | ✓ |
| | Sequencer Control | ✓ | ✓ |
| | Trigger over CoaXPress | ✓ | ✓ |
| | EF lens control (order option-18) | ✓ | ✓ |
| | Storable user sets | ✓ | ✓ |
| | Sync out modes: Trigger ready, input, exposing, readout, imaging, strobe, GPO | ✓ | ✓ |
| | Temperature monitoring (main board and sensor board) | ✓ | ✓ |

*Table 12: Camera features*

# Mechanical dimensions



This chapter includes:

- Mechanical drawings and dimensions of Bonito PRO housing and mounts
- Sensor position accuracy
- Maximum protrusion and filter diameter for F-Mount (default)

Bonito PRO cameras are available with different lens mount options. For more information, see the Modular Concept document at:

https://www.alliedvision.com/en/support/technical-documentation.html

# Precautions

**NOTICE**

Modifying the factory default adjustment is under the responsibility of the user. Exercise caution when modifying the planarity adjustment. Use a 1.5 mm hex ball driver to loosen the three spring loaded screws, adjust the tilt adjustment screws as required, then secure the screws.

# Bonito PRO housing and mounts

## F-Mount (default mount)

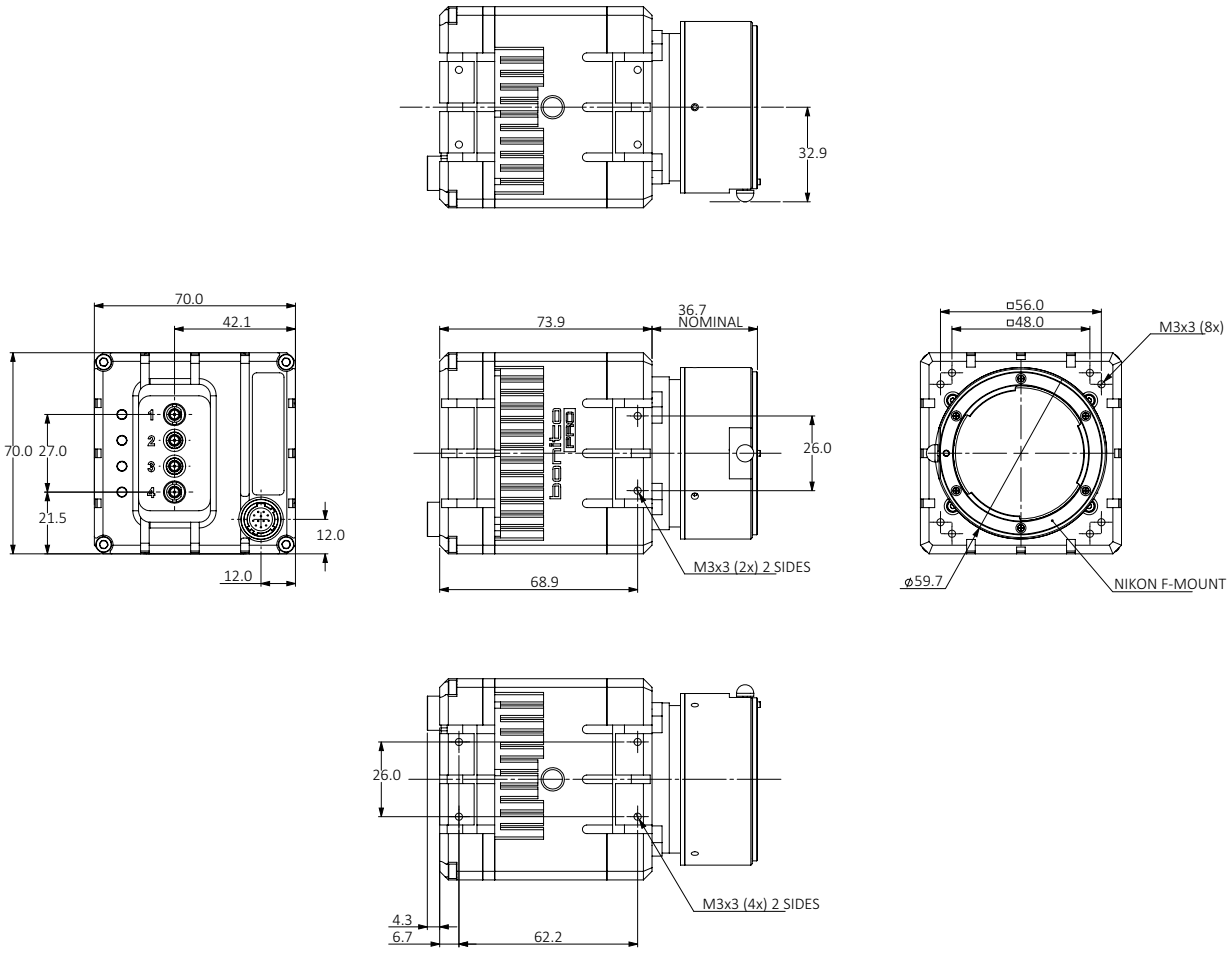



*Figure 7: Bonito PRO camera with F-Mount mechanical dimensions*

# F-Mount PA

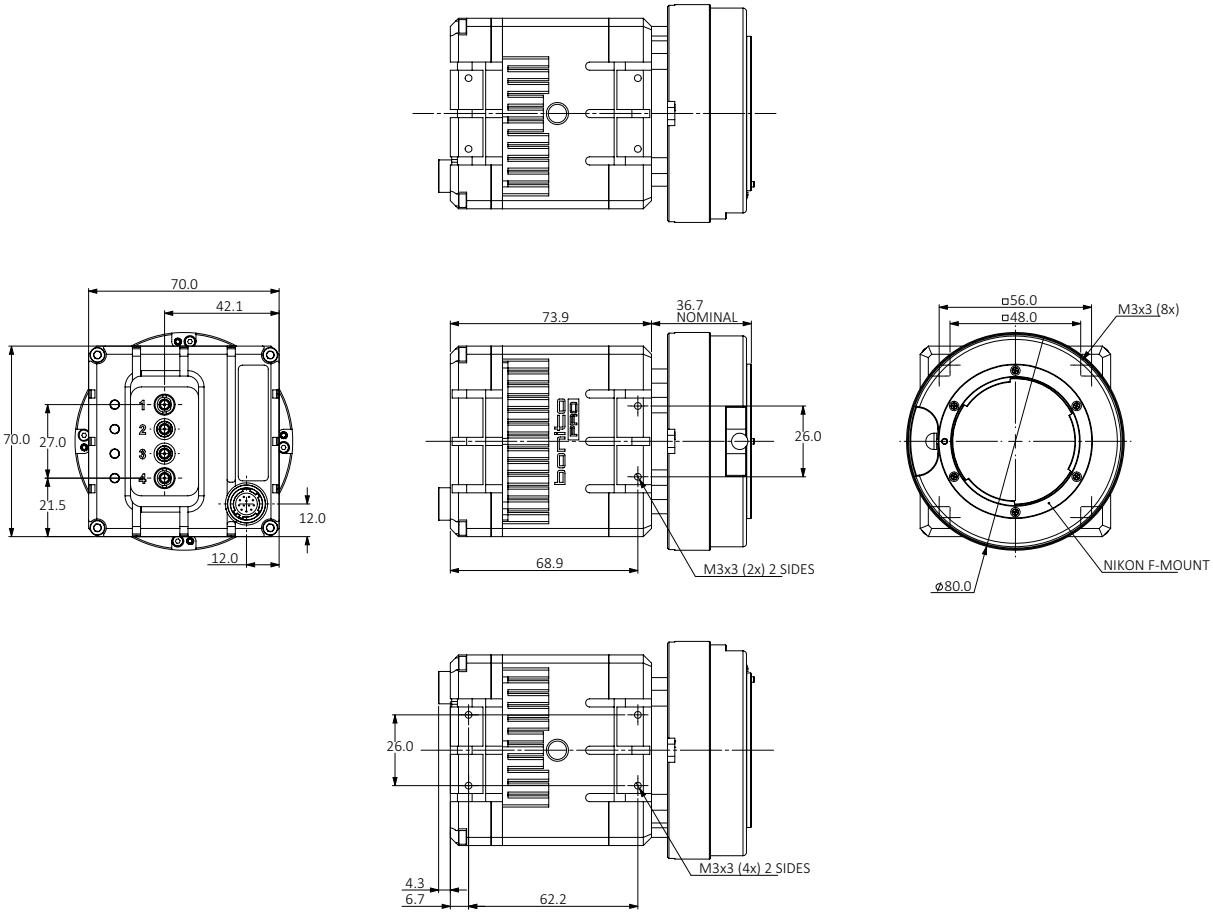



*Figure 8: Bonito PRO camera with F-Mount PA mechanical dimensions*

**F-Mount PA order code**

Contact the Allied Vision Sales team to purchase the Bonito PRO series camera with F-Mount PA option (order code Bonito PRO...-03).

# EF-Mount PA

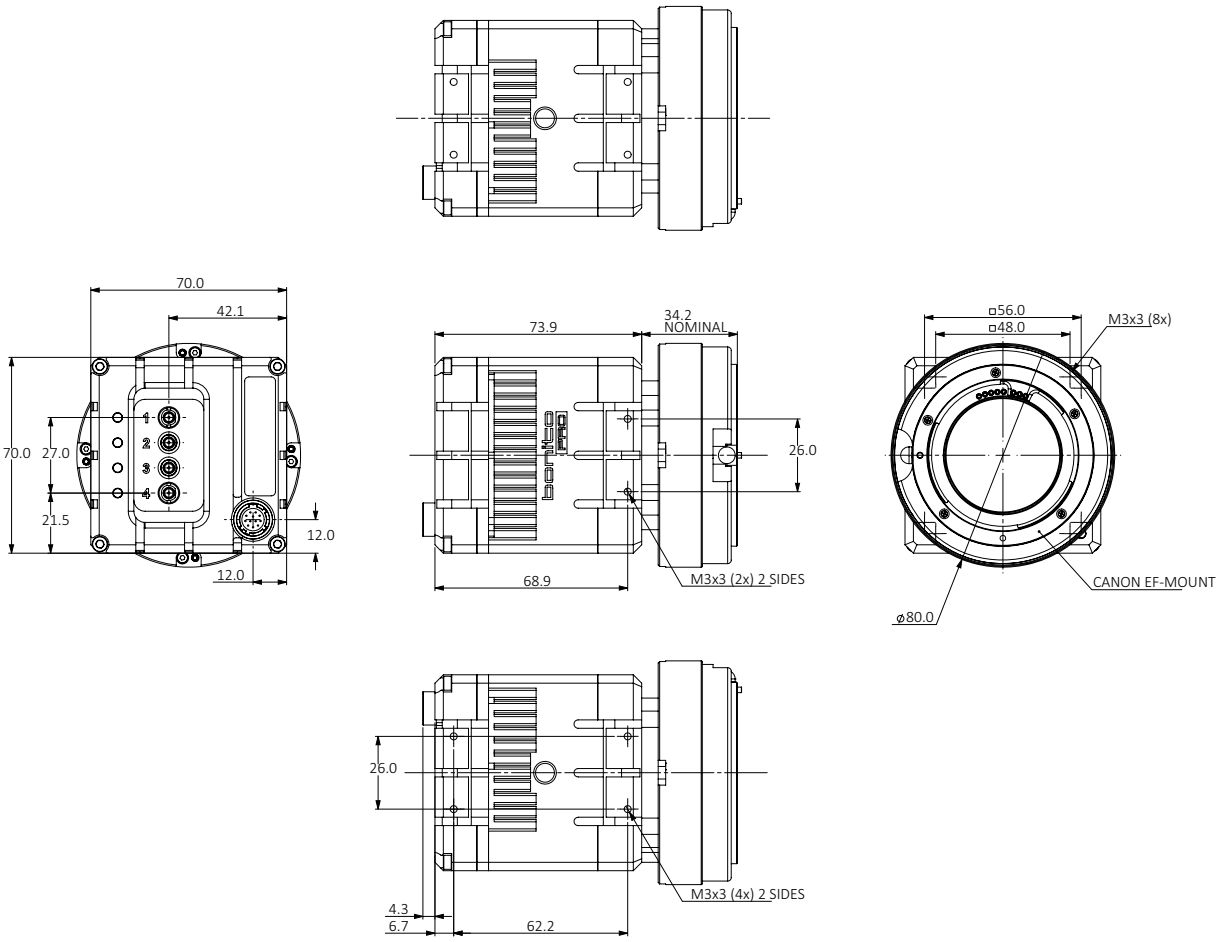



*Figure 9: Bonito PRO camera with EF-Mount PA mechanical dimensions*

**EF-Mount PA order code**

Contact the Allied Vision Sales team to purchase the Bonito PRO series camera with EF-Mount PA option (order code Bonito PRO...-18).

# M42-Mount

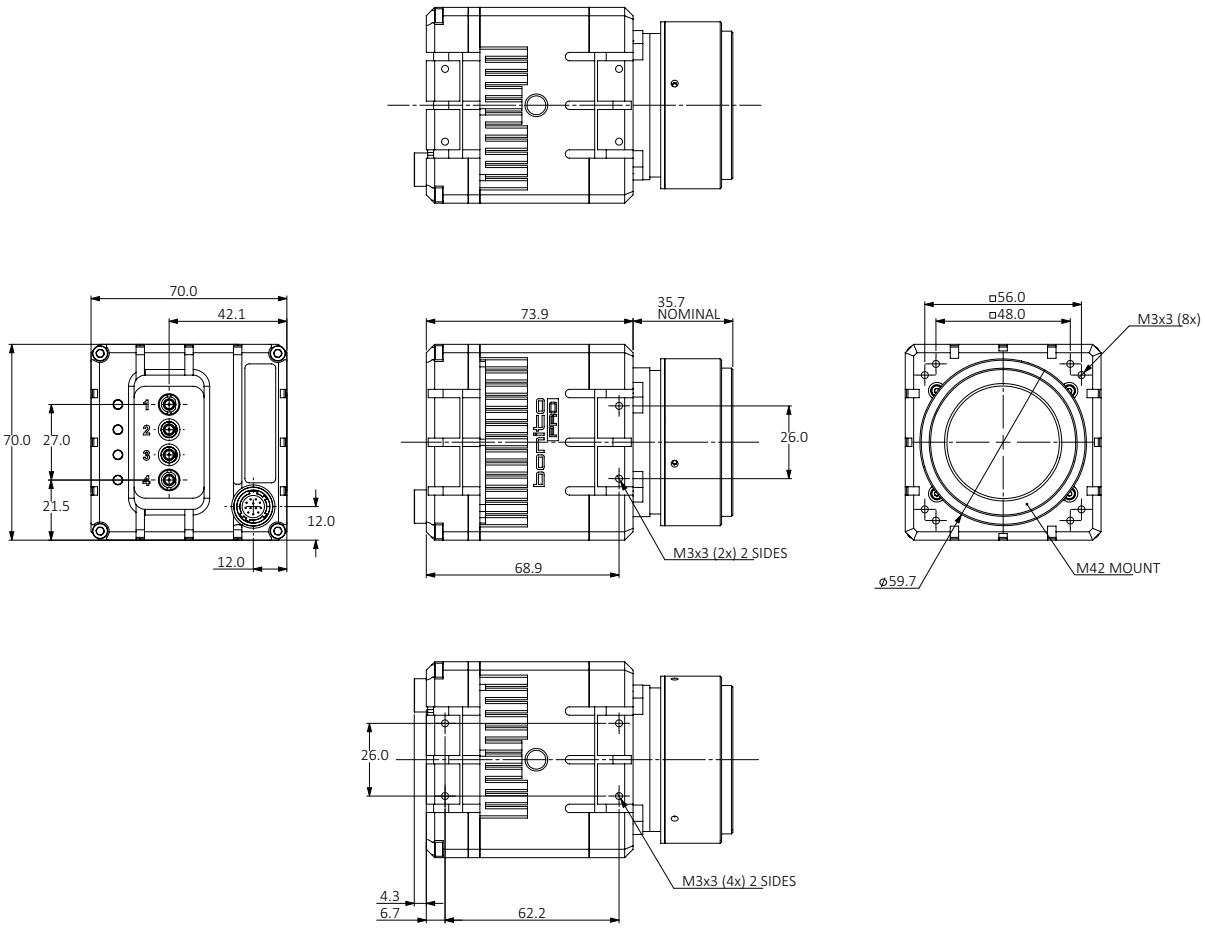



*Figure 10: Bonito PRO camera with M42-Mount mechanical dimensions*

**M42-Mount order code**

Contact the Allied Vision Sales team to purchase the Bonito PRO series camera with M42-Mount option (order code Bonito PRO...-31).

# M42-Mount PA

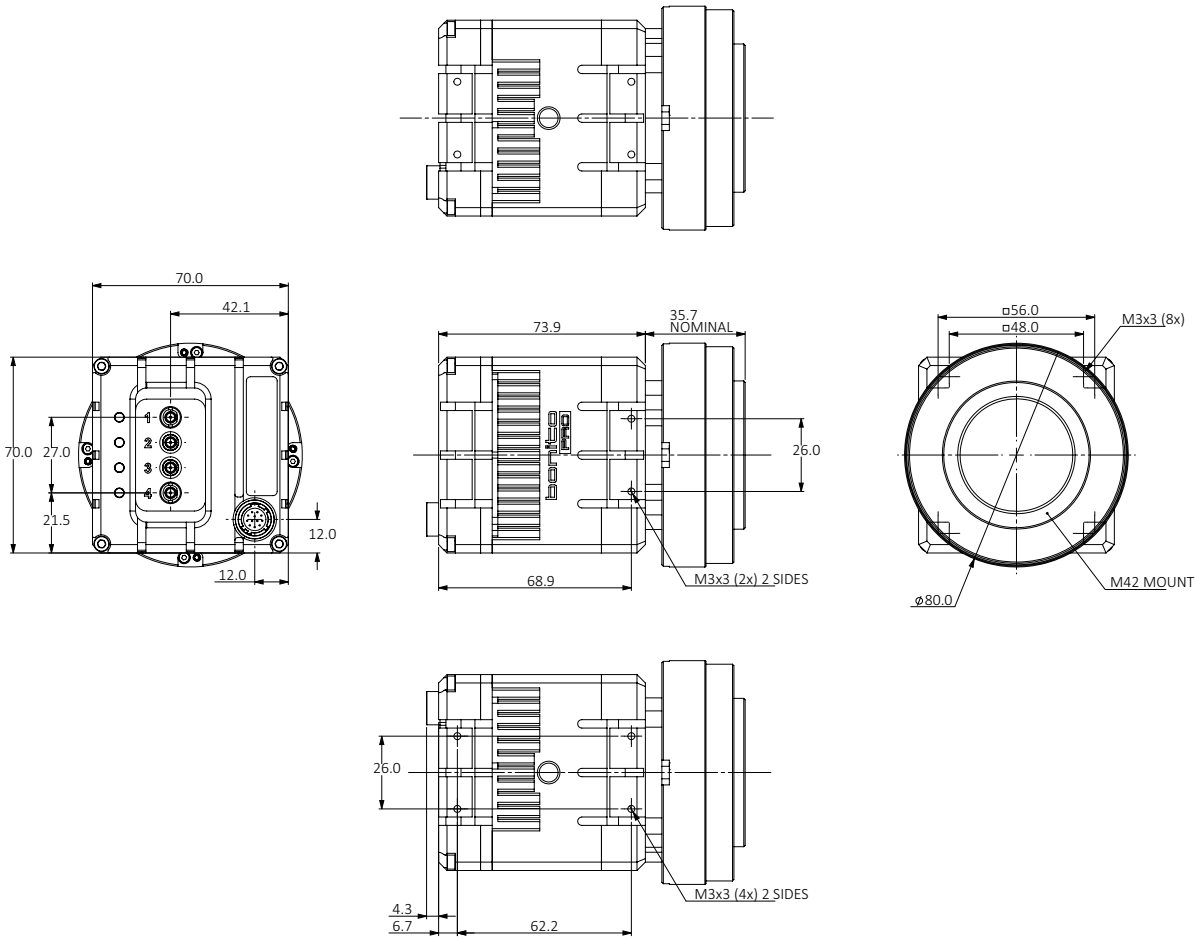



*Figure 11: Bonito PRO camera with M42-Mount PA mechanical dimensions*

**M42-Mount PA order code**

Contact the Allied Vision Sales team to purchase the Bonito PRO series camera with M42-Mount PA option (order code Bonito PRO...-25).

# M58-Mount

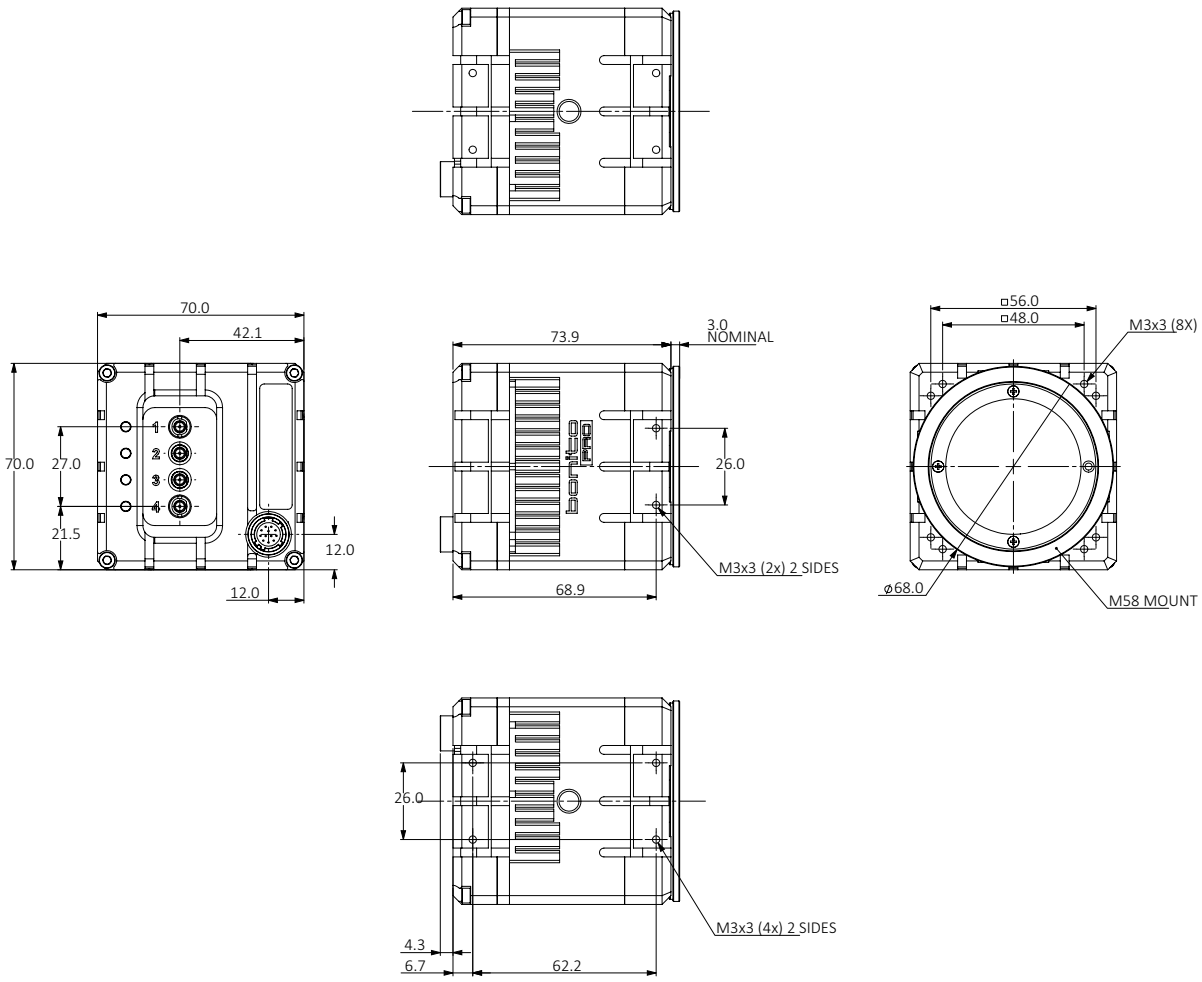



*Figure 12: Bonito PRO camera with M58-Mount mechanical dimensions*

**M58-Mount order code**

Contact the Allied Vision Sales team to purchase the Bonito PRO series camera with M58-Mount option (order code Bonito PRO...-12).

# M58-Mount PA

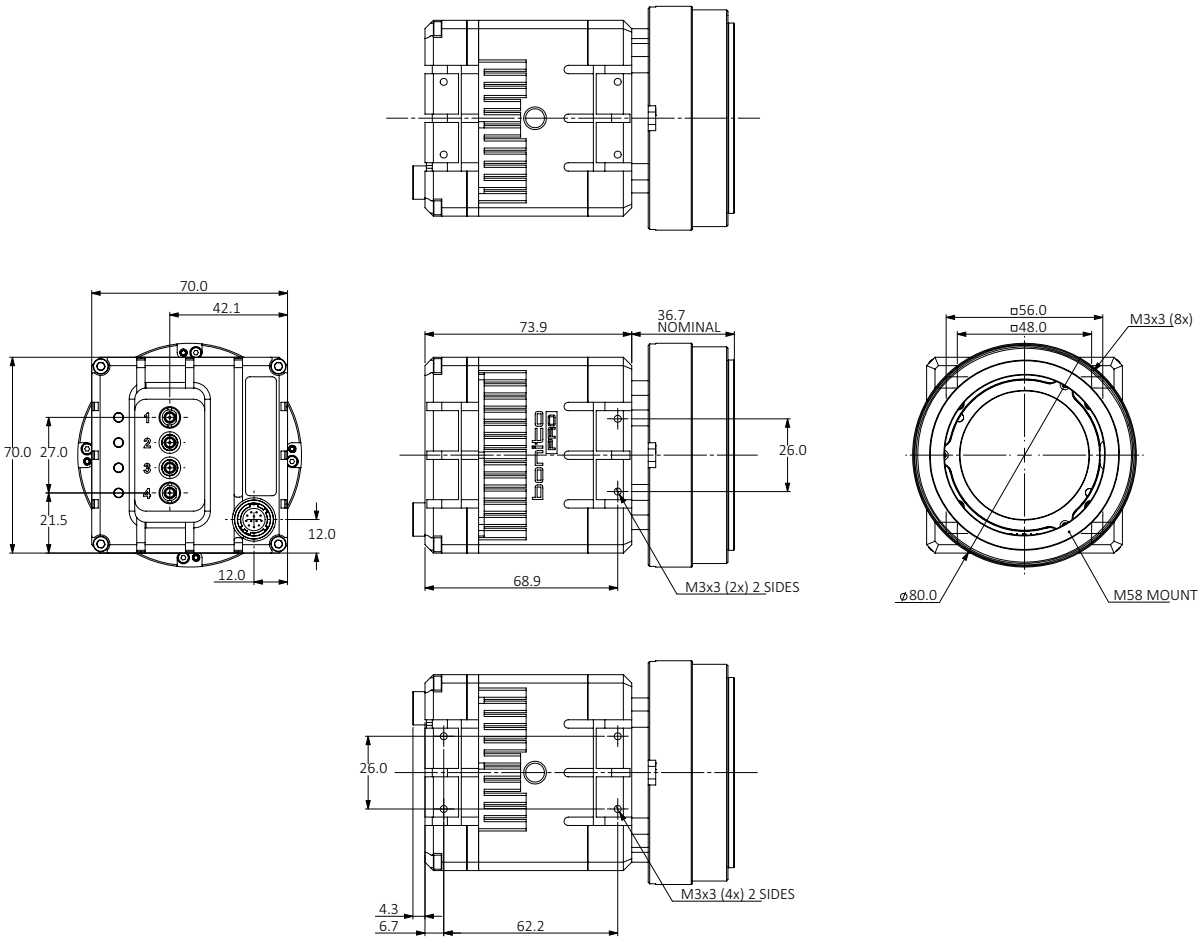



*Figure 13: Bonito PRO camera with M58-Mount PA mechanical dimensions*

**M58-Mount PA order code**

Contact the Allied Vision Sales team to purchase the Bonito PRO series camera with M58-Mount PA option (order code Bonito PRO...-13).

# Flange focal distance

## F-Mount

Flange focal distance is the optical distance from the mounting flange to image sensor die. Bonito PRO F-Mount cameras are calibrated to a standard 46.50 mm flange focal distance.

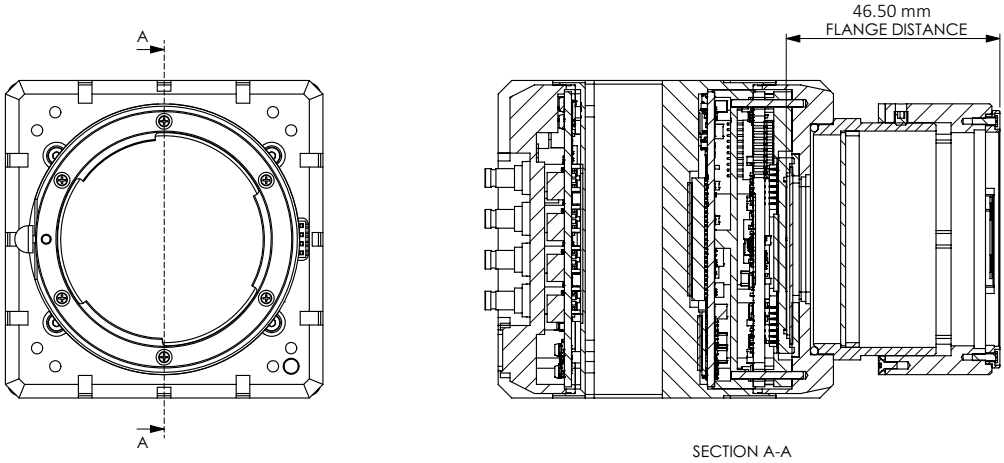



*Figure 14: F-Mount flange distance cross section*

## F-Mount PA

Bonito PRO F-Mount PA cameras are calibrated to a standard 46.50 mm flange focal distance.

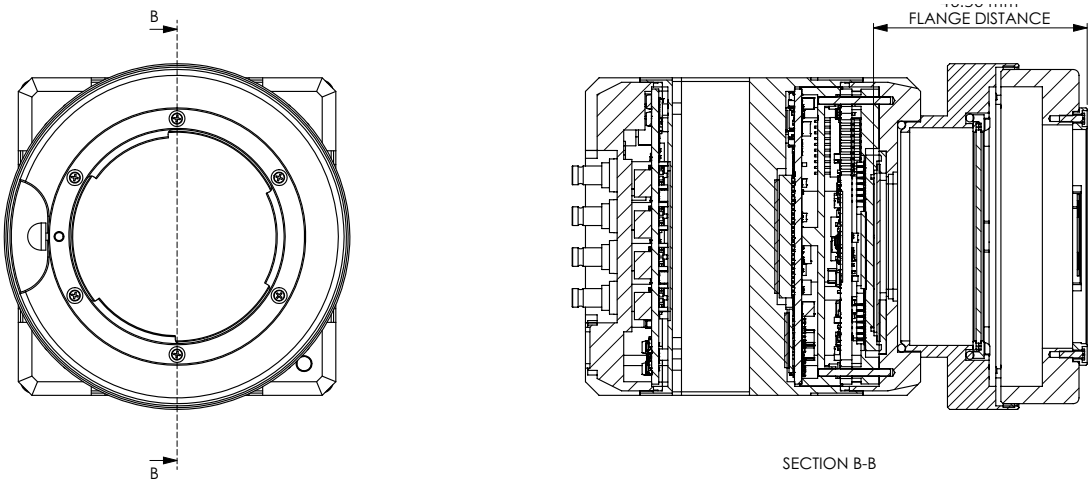



*Figure 15: F-Mount PA flange distance cross section*

# EF-Mount PA

Bonito PRO M58-Mount cameras are calibrated to a standard 44.00 mm flange focal distance.

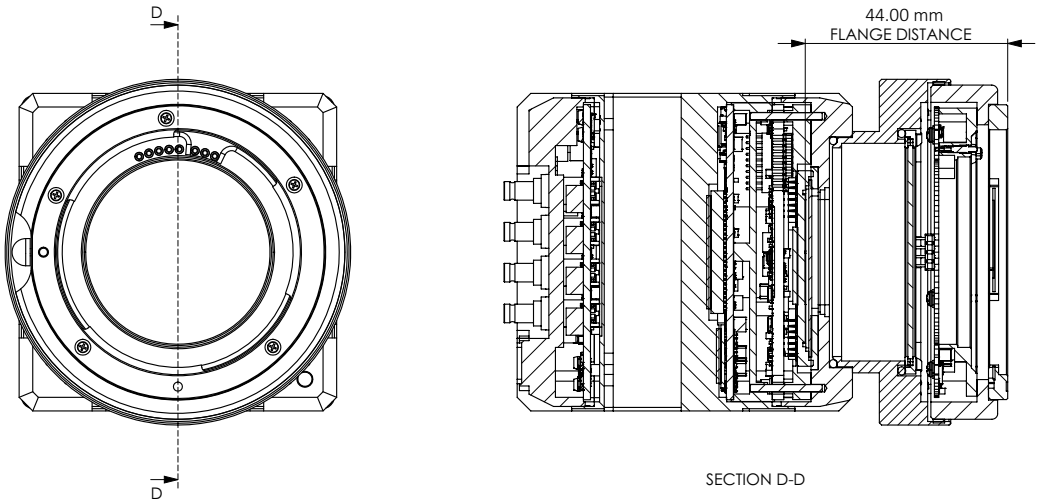



*Figure 16: EF-Mount PA flange distance cross section*

# M42-Mount

Bonito PRO M42-Mount cameras are calibrated to a standard 45.46 mm flange focal distance.

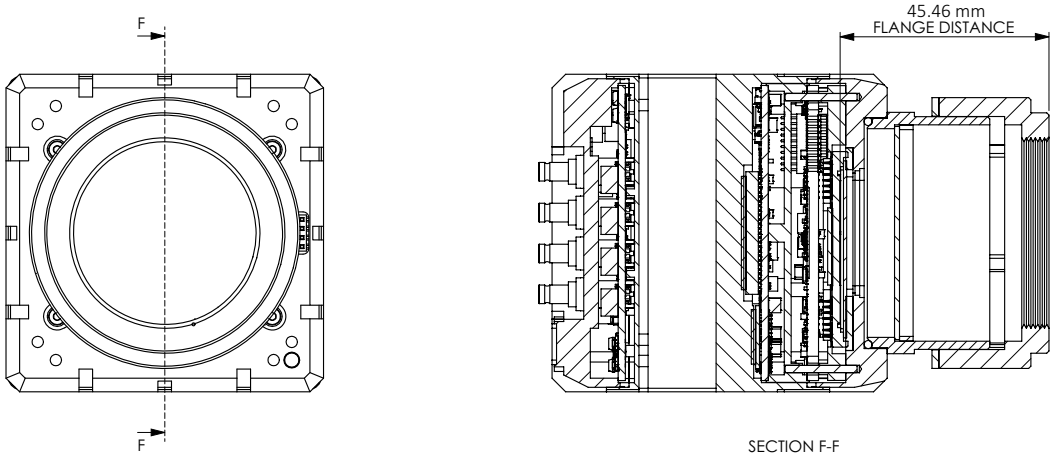



*Figure 17: M42-Mount flange distance cross section*

# M42-Mount PA

Bonito PRO M42-Mount PA cameras are calibrated to a standard 45.46 mm flange focal distance.

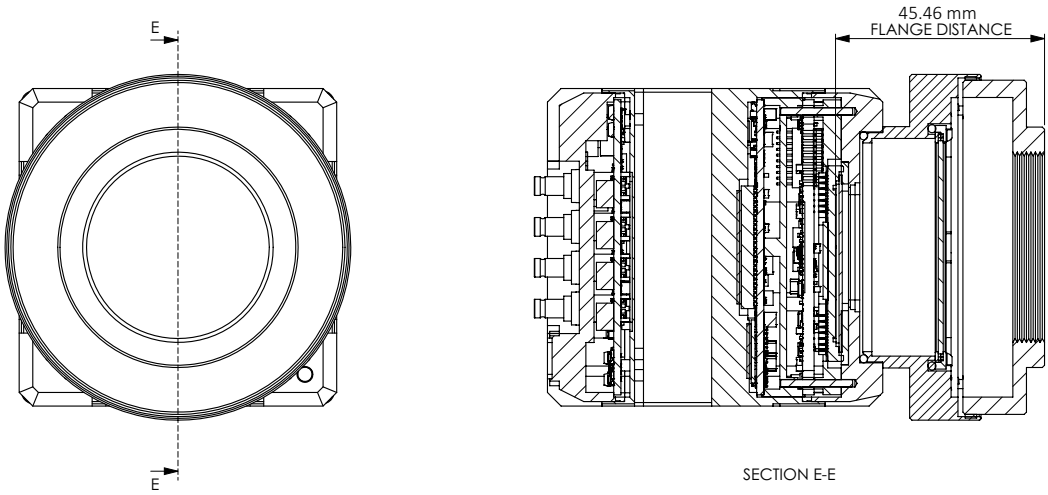



*Figure 18: M42-Mount PA flange distance cross section*

# M58-Mount

Bonito PRO M58-Mount cameras are calibrated to a standard 12.71 mm flange focal distance.

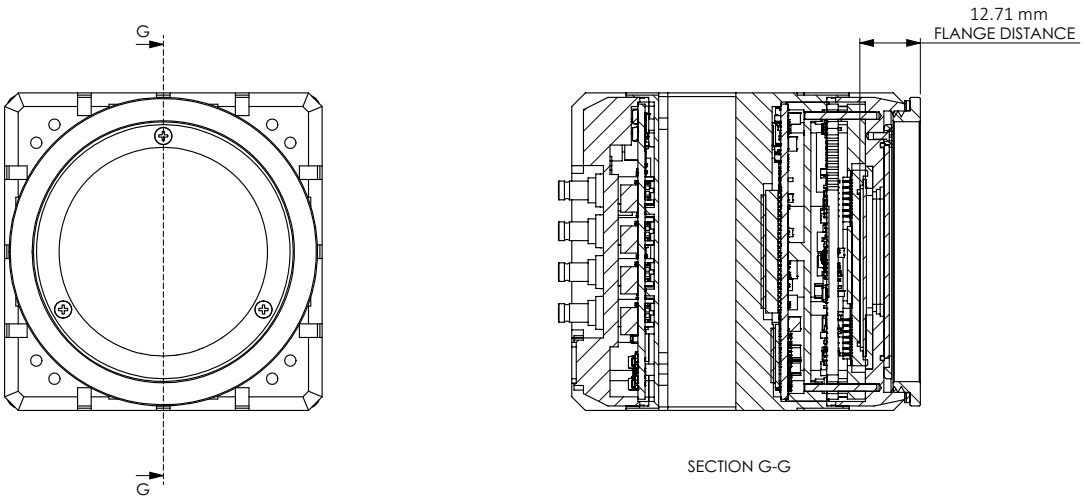



*Figure 19: M58-Mount flange distance cross section*

## M58-Mount PA

Bonito PRO M58-Mount cameras are calibrated to a standard 46.50 mm flange focal distance.

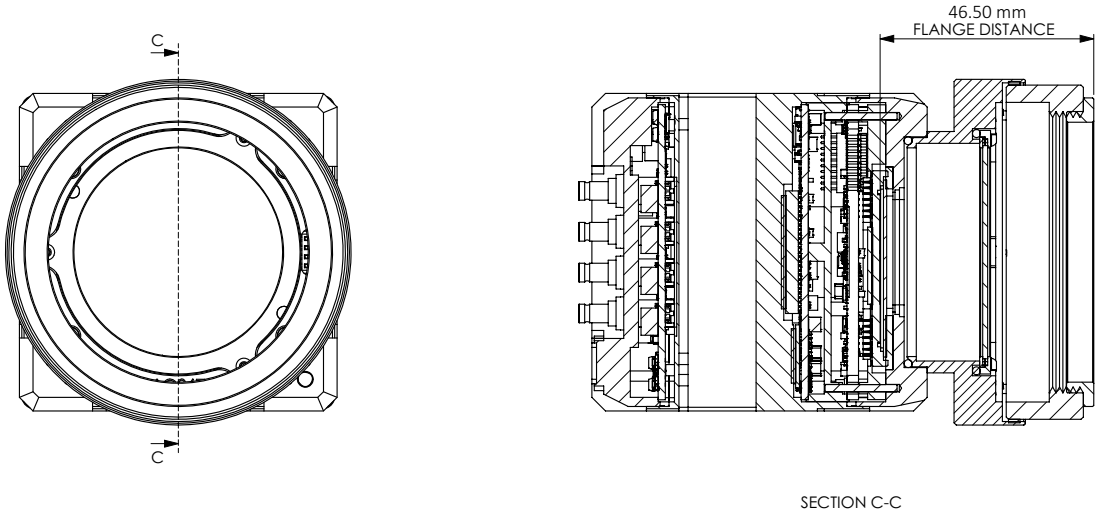



*Figure 20: M58-Mount PA flange distance cross section*

# Adjustment of F-Mount

The F-Mount is adjusted at the factory and should not require adjusting. If for some reason the lens mount requires adjustment, use the following method.

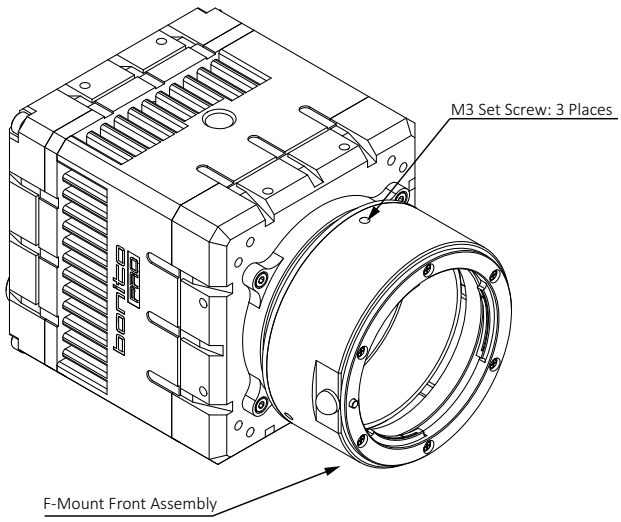



*Figure 21: Bonito PRO camera with F-Mount isometric view*

### Adjusting the F-Mount

Prerequisite: Use an F-Mount compatible lens that allows an infinity focus.

1. Attaching F-Mount compatible lens
   Attach the lens to the camera using a counter-clockwise rotation of about a quarter turn. The lens snaps into place and the lens flange and camera flange mates over the full circumference.
2. Loosening F-Mount front assembly
   Pressing the F-Mount assembly against the camera body, loosen the three set screws with a 1.5 mm hex ball driver.
3. Imaging to infinity
   Set the lens to infinity and image a distant object (10 to 15 meters).
4. Gently move the F-Mount front assembly until focused and lock it in place.

# Planarity adjustable mounts

Bonito PRO cameras allow planarity adjustment of the mount relative to the camera sensor. Adjustment can be made for overall flange focal distance (Z distance), and planarity (Z-tilt). The following steps describe Z adjustment using a standard lens and a target. However, measurement tools such as an optical depth micrometer could also be used.

**NOTICE**

Modifying the factory default adjustment is under the responsibility of the user. Exercise caution when modifying the planarity adjustment. Use a 1.5 mm hex ball driver to loosen the three spring loaded screws, adjust the tilt adjustment screws as required, then secure the screws.

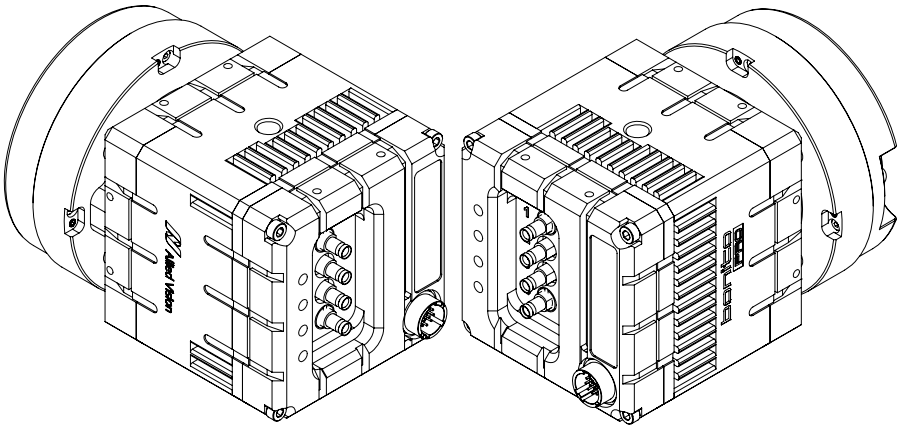


*Figure 22: Location of tilt adjustment screws*

1. Using a compatible lens, set the lens to infinity and image on a target (10 to 15 meters). Target should highlight focus levels at center image and at the corners of the image. A lens with a long focal length, or adjustable zoom lens, allows more precision for this operation and reduce the overall size of your target.
2. Use a 1.5 mm hex ball head driver to loosen the screws.
   Adjust the three tilt adjustment screws, until all targets are in focus.
3. Tighten the three screws and recheck the focus.

# Sensor position accuracy

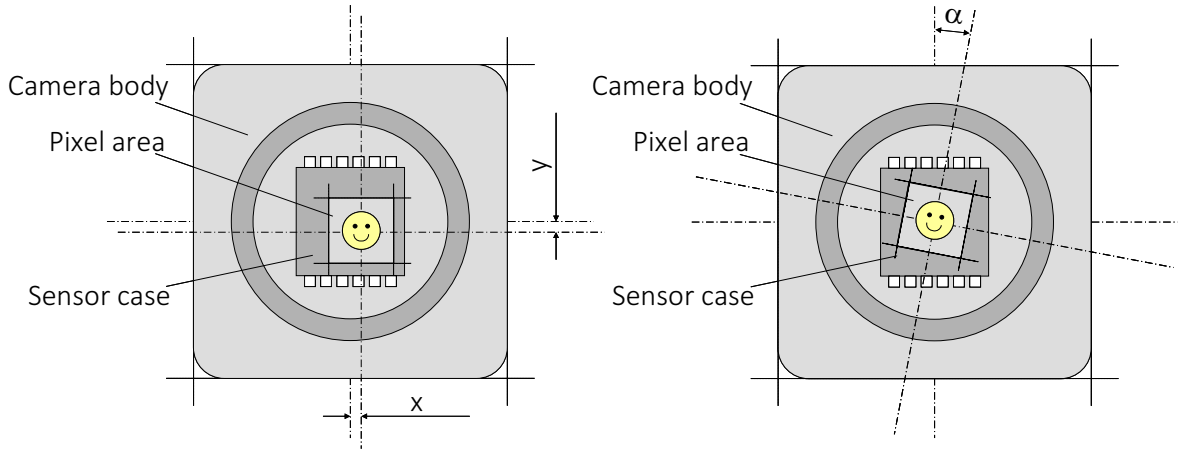



*Figure 23: Sensor position accuracy*

The following table defines the manufacturing accuracy of fitting sensors into Bonito PRO cameras.

| Criteria | Subject | Properties |
|---|---|---|
| Reference Point | Sensor | Center of pixel area (photo sensitive cells) |
| | Camera | Center of camera front flange (outer case edges) |
| Accuracy | x-axis<br>y-axis | ±250 µm (sensor shift) |
| | z-axis | ±10 µm (optical back focal length) |
| | α | < 1° (sensor rotation) |
| Alignment | | Optical alignment of photo sensitive sensor area into camera front module (lens mount front flange). |

*Table 13: Sensor position accuracy criteria*

# IR cut filter

All Bonito PRO color models are equipped with an infrared block filter (IR cut filter). This filter prevents infrared light from passing to the sensor. In the absence of an IR cut filter, images are dominated by red and incapable of being properly color balanced. Monochrome and NIR models do not use an IR cut filter.

The following figure shows the transmission response for the IRC30 filter used in Bonito PRO color cameras.

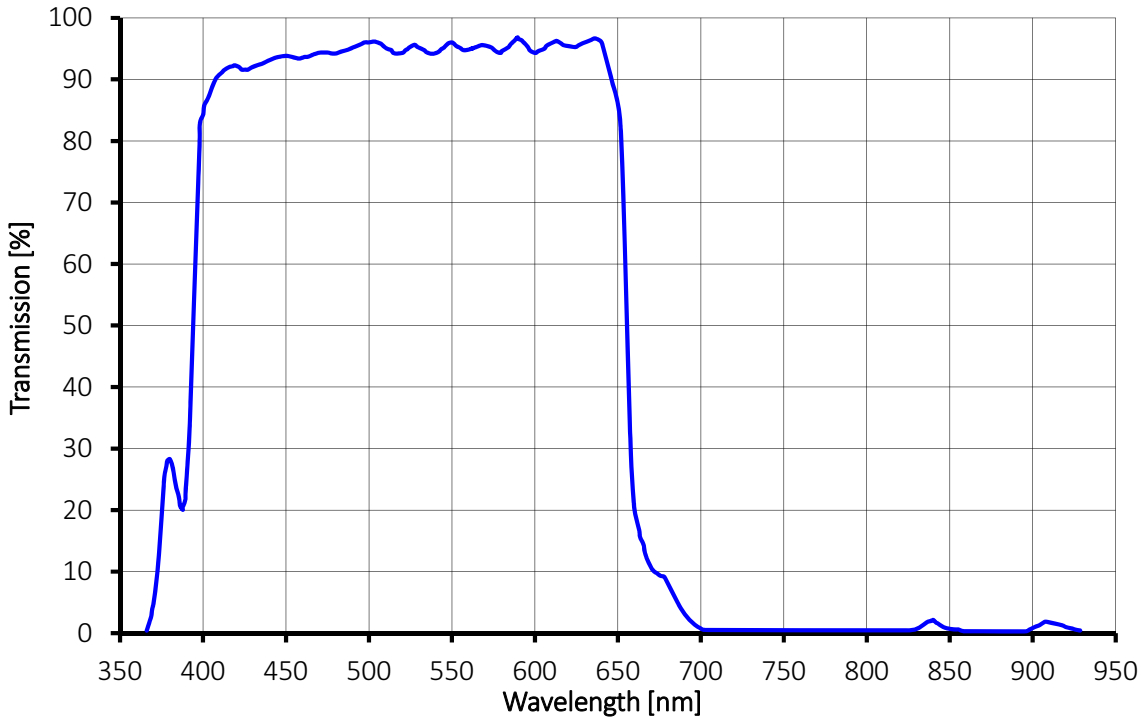
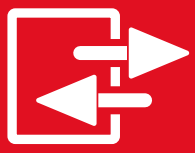



*Figure 24: IRC30 cut transmission response*

# Camera interfaces



This chapter includes:

- A general description of the inputs and outputs (including trigger features)
- I/O connector pin assignments
- I/O block diagrams
- A general description of trigger rules such as timing diagram and definitions

# Back panel

This section provides information on CoaXPress connectors, Hirose IO port, status LEDs, and trigger features.

**Accessories**

Contact your Allied Vision Sales representative or your local Allied Vision distribution partner for information on Bonito PRO  accessories:

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

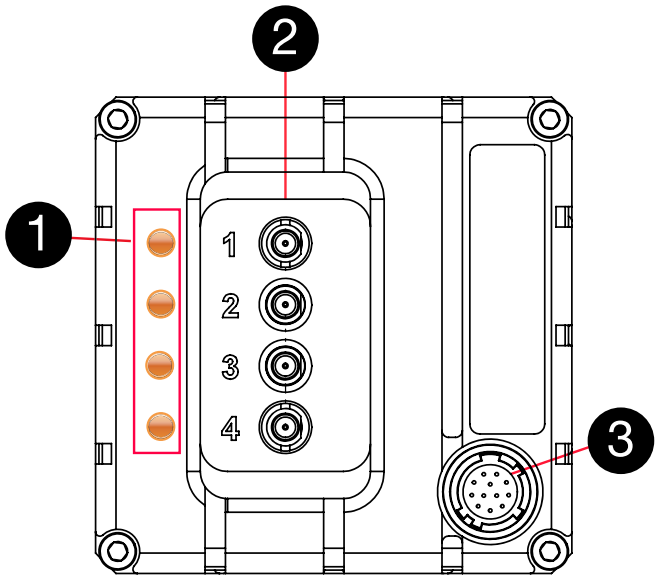



*Figure 25: Bonito PRO ports and LEDs*

| | |
|---|---|
| **1** | Status LEDs |
| **2** | 4 × 1.0, 2.3 DIN type connectors |
| **3** | Hirose I/O port, HR10A-10R-12PB connector |

# Status LEDs

The color and state of the LEDs has the following meaning.

| State | Indication |
|---|---|
| No power | Off |
| System booting | Solid orange |
| Powered, but not connected (not applicable to a device reliant on PoCXP power) | Slow pulse (1 Hz) red |
| Connection detection in progress, PoCXP active | Fast flash (12.5 Hz) alternate green and orange, shown for a minimum of one second even if the connection detection is faster |
| Connection detection in progress, PoCXP not in use | Fast flash (12.5 Hz) orange, shown for a minimum of one second even if the connection detection is faster |
| Device or host incompatible, PoCXP active | Slow flash (0.5 Hz) alternate red and green |
| Device or host incompatible, PoCXP not in use | Slow flash (0.5 Hz) alternate red and orange |
| Device or host connected, but no data being transferred | Solid green |
| Device or host connected, waiting for event (for example trigger, exposure pulse) | Slow pulse (1 Hz) orange |
| Device or host connected, data being transferred | Fast flash (12.5 Hz) green |
| Error during data transfer (for example CRC error, single bit error detected) | 500 ms red pulse<br>In case of multiple errors, there shall be at least two green fast flash pulses before the next error is indicated |
| Connection test packets being sent | Slow flash (0.5 Hz) alternate green and orange |
| Compliance test mode enabled | Slow flash (0.5 Hz) alternate red then green then orange |
| System error (for example internal error) | Fast flash (12.5 Hz) red |

*Table 14: Status of LEDs*

# CoaXPress interface

The Bonito PRO is powered through the 12-pin Hirose I/O port, or the CXP-6 four DIN 1.0, 2.3 connections by using any standard PoCXP supported frame grabber. The PoCXP interface supports power up to 13 watts per cable.

**Hardware Selection**

See the Hardware Selection for Allied Vision Bonito PRO Cameras application note for a list of supported CoaXPress (CXP-6) frame grabbers and cables:

https://www.alliedvision.com/en/support/technical-papers-knowledge-base.html

**Maximum cable length**

The maximum cable length between the Bonito PRO camera and the host computer is dependent on the bit rate and the type of coax cable used. For more information refer to the JIIA CoaXPress Standard Version 1.1.1.

## CoaXPress physical topology

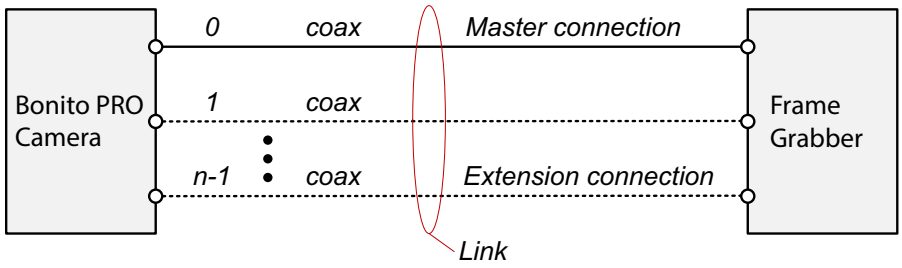



*Figure 26: CoaXPress physical topology*

Each connection provides the following signaling functions:

- High-speed serial (camera to frame grabber down connection), at up to 6.25 Gbps per line
- Low speed serial (frame grabber to camera up connection), at 20.83 Mbps
- Power (host to device), up to 13 watts.

A dedicated high-speed connection from host to device is allowed for high-speed triggers and camera control. This connection does not support power.

The link protocol defines the transfer of triggers, general purpose I/O, control data and high-speed streaming data over a link.

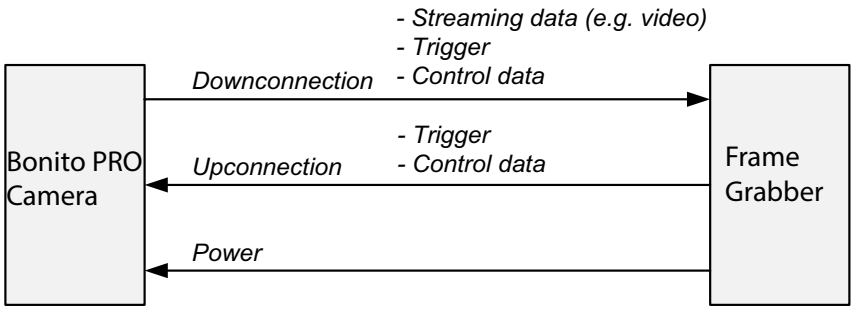


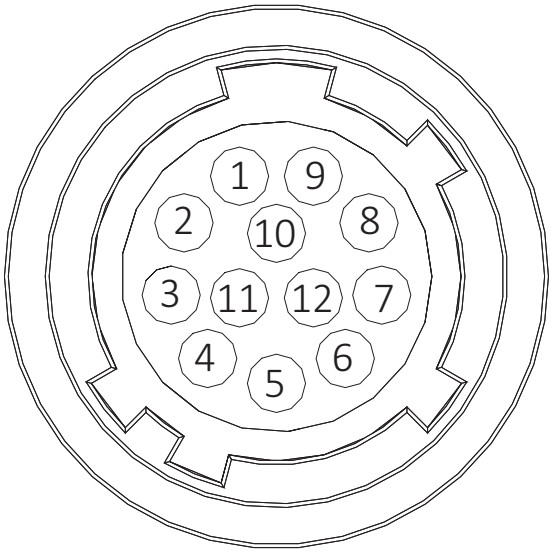

*Figure 27: Signaling connections and data flow*

Both the up connection and down connection use 8B/10B code. 8B/10B is an industry-standard code that maps 8-bit data to 10-bit data to achieve DC balance on the connection, while also allowing clock recovery by ensuring regular transitions.

**Discovery bit rate**

The discovery bit rate is CXP-1.

# Camera I/O connector pin assignment




| Camera side Hirose HR10A-10R-12PB connector | | | | | I/O cable color code |
|---|---|---|---|---|---|
| **Pin** | **Signal** | **Direction** | **Level** | **Description** | |
| 1 | Camera GND | In | 0 VDC | Ground for camera power supply | Blue |
| 2 | Camera Power | In | 24 VDC ± 2.4 VDC | Camera power supply | Red |
| 3 | Out 4 | Out | Open emitter maximum 5 mA | Opto-isolated Output 4 (SyncOut4) | Pink |
| 4 | In 1 | In | LVTTL maximum 3.3 VDC | Non-isolated Input 1 (SyncIn1) | Gray |
| 5 | Out 3 | Out | Open emitter maximum 5 mA | Opto-isolated Output 3 (SyncOut3) | Yellow |
| 6 | Out 1 | Out | 3.3 VDC LVTTL maximum 50 µA | Non-isolated Output 1 (SyncOut1) | Green |
| 7 | Isolated IO GND | In | 0 VDC | Isolated input signal ground | Brown |
| 8 | RxD RS232 | In | | Reserved for future use | White |
| 9 | TxD RS232 | Out | | Reserved for future use | Black |
| 10 | Isolated Out Power | In | Common VCC for outputs 5 to 24 VDC | Power input for opto-isolated outputs | Orange |

*Table 15: Camera I/O connector pin assignment and cable color coding*

| Camera side Hirose HR10A-10R-12PB connector | | | | | I/O cable color code |
|---|---|---|---|---|---|
| **Pin** | **Signal** | **Direction** | **Level** | **Description** | |
| 11 | In 2 | In | $U_{in}$(high) = 5 to 24 VDC<br>$U_{in}$(low) = 0 to 0.8 VDC | Input 2<br>opto-isolated (SyncIn2) | White and Black |
| 12 | Out 2 | Out | 3.3 VDC LVTTL<br>maximum 50 µA | Non-isolated Output 2<br>(SyncOut2) | White and Brown |

*Table 15: Camera I/O connector pin assignment and cable color coding (continued)*

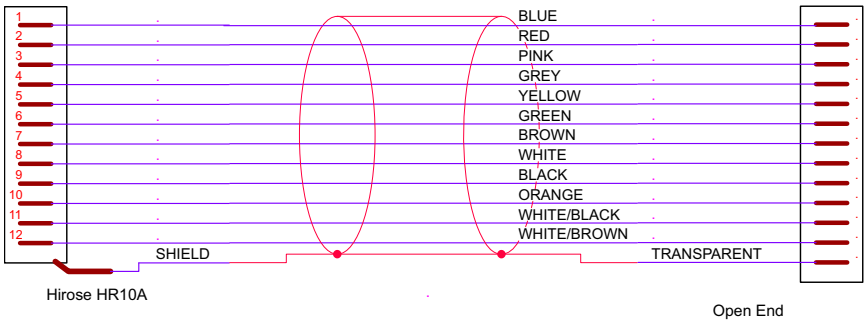



*Figure 28: Bonito PRO cable color coding*

The General Purpose I/O port uses a Hirose HR10A-10R-12PB connector on the camera side. The mating cable connector is Hirose HR10A-10P-12S.

**Hirose connector**

The cable side Hirose 12-pin female connector is available for purchase from Allied Vision. Order code: K7600040.

# I/O definition

## Camera Power

The Bonito PRO camera can be powered through the Hirose I/O port, via **Pin 1** Camera GND and **Pin 2** Camera Power, or through the CoaXPress interface if using a Power over CoaXPress (PoCXP) supported frame grabber.

Cameras powered by both the Hirose I/O port and the CoaXPress interface uses the power provided by Hirose I/O port only.

**Pin 2**, Camera Power, supports an input voltage of 24 VDC ± 2.4 VDC. The camera does not power in reverse polarity. Exceeding the 24 VDC ± 2.4 VDC could damage the camera.

## Input triggers

Input triggers allow the camera to be synchronized to an external event. The camera can be programmed to trigger on the rising edge, falling edge, both edges, or level of the signal. The camera can also be programmed to capture an image at some programmable delay time after the trigger event.

### In 1 (Non-isolated)

**In 1** is not electrically isolated and can be used when environmental noise is insignificant and faster trigger response is required. The required trigger signal is low voltage TTL 3.3 VDC. Tie trigger ground to Camera GND to complete the trigger circuit.

**NOTICE**

**Power caution**

Exceeding 5.1 VDC on **In 1** can permanently damage the camera.

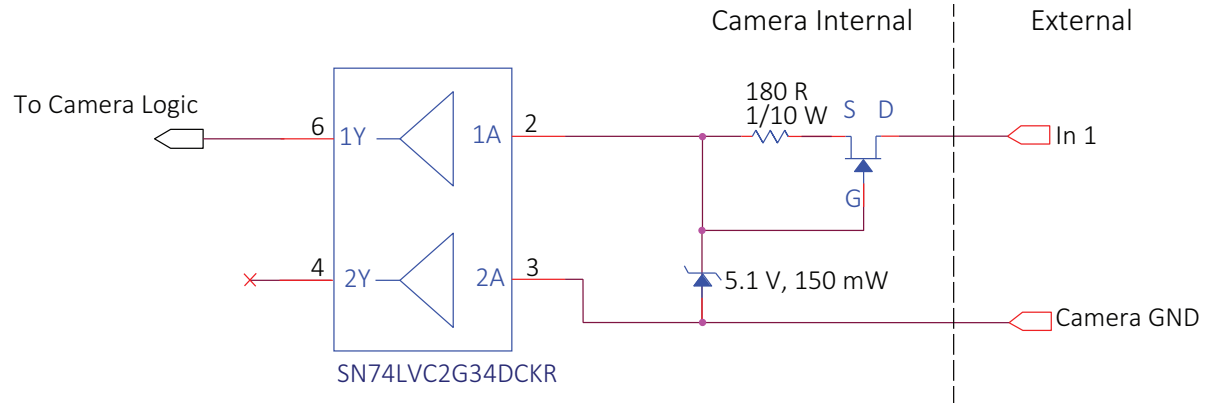



*Figure 29: Bonito PRO internal circuit diagram for non-isolated input trigger*

## In 2 (Opto-isolated)

**In 2** is optically isolated and can be used in electrically noisy environments to prevent false trigger events. Tie trigger ground to Isolated IO GND to complete the trigger circuit. Compared to the non-isolated trigger, **In 2** has a longer propagation time. It can be driven from 5 to 24 VDC with a minimum current source of 5 mA.

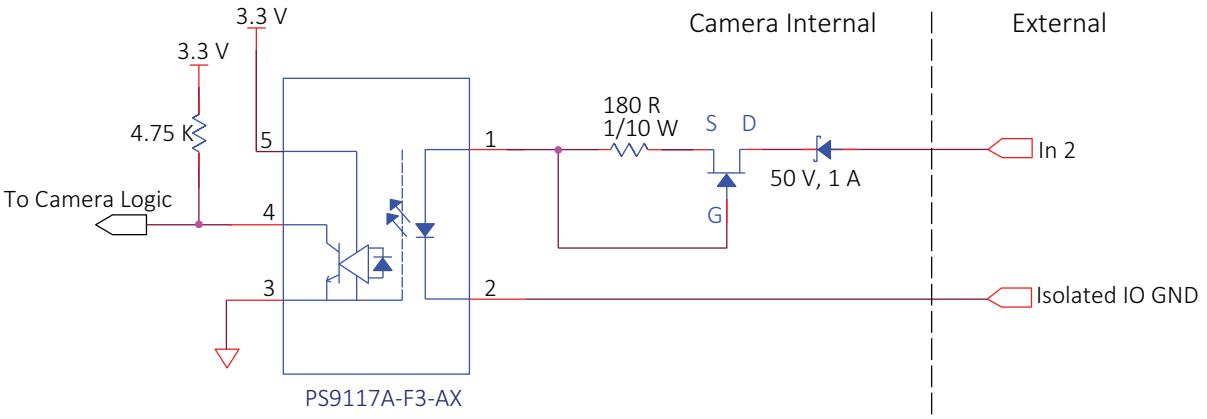



*Figure 30: Bonito PRO internal circuit diagram for opto-isolated input trigger*

## Isolated IO GND

The Isolated IO GND connection provides the user ground reference and return path for **In 2**. It is recommended that the ground wiring be physically close to the **In 2** wiring to prevent parasitic coupling. For example, a good cable design connects **In 2** to one conductor of a twisted pair, Isolated IO GND to the second conductor of the same twisted pair.

# Output signals

Output signals can be assigned to a variety of internal camera signals via software. They can be configured to active high or active low. The internal camera signals are listed as follows:

| | |
|---|---|
| **Exposing** | Corresponds to when camera is integrating light. |
| **Trigger Ready** | Indicates when the camera is ready to accept a trigger signal. |
| **Trigger Input** | A relay of the trigger input signal used to “daisy chain” the trigger signal for multiple cameras. |
| **Readout** | Valid when camera is reading out data. |
| **Imaging** | Valid when camera is exposing or reading out. |
| **Strobe** | Programmable pulse based on one of the previously defined events. |
| **GPO** | User programmable binary output. |

## Isolated Out Power

The Isolated Out Power connection provides power for isolated signals **Out 3** and **Out 4**. The voltage requirement is 5 to 24 VDC. The current requirement for this supply is a function of the optical isolator collector current and the number of outputs used in the system. Isolated Out Power wiring should be physically close to **Out 3** or **Out 4** wiring to prevent parasitic coupling.

## Out 1 and 2 (Non-isolated)

**Out 1** and **Out 2** signals are not electrically isolated and can be used when environmental electrical noise is insignificant and faster trigger response is required. Tie signal ground to Camera GND to complete the external circuit. The output signal is a low voltage TTL, maximum 3.3 VDC. It is not suitable for driving loads in excess of 50 µA.

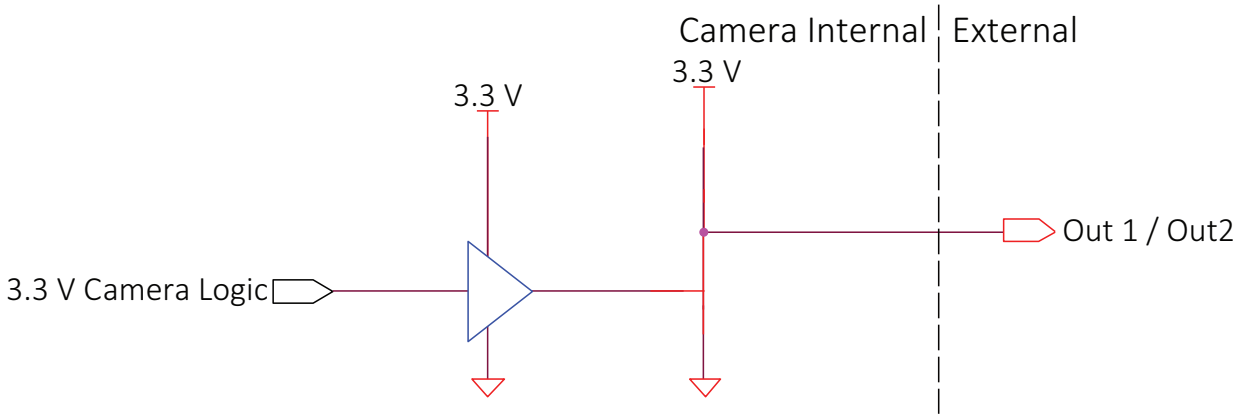



*Figure 31: Bonito PRO Out 1 or Out 2 trigger circuit*

## Out3 and Out4 (Opto-isolated)

**Out3** and **Out4** signals are optically isolated and require the user to provide a voltage level, Isolated Out Power. The **Out3, Out4** signal should be grounded by adding an external load resistor as shown in the following figure and table. Isolated Out Power can be configured between 5 to 24 VDC.

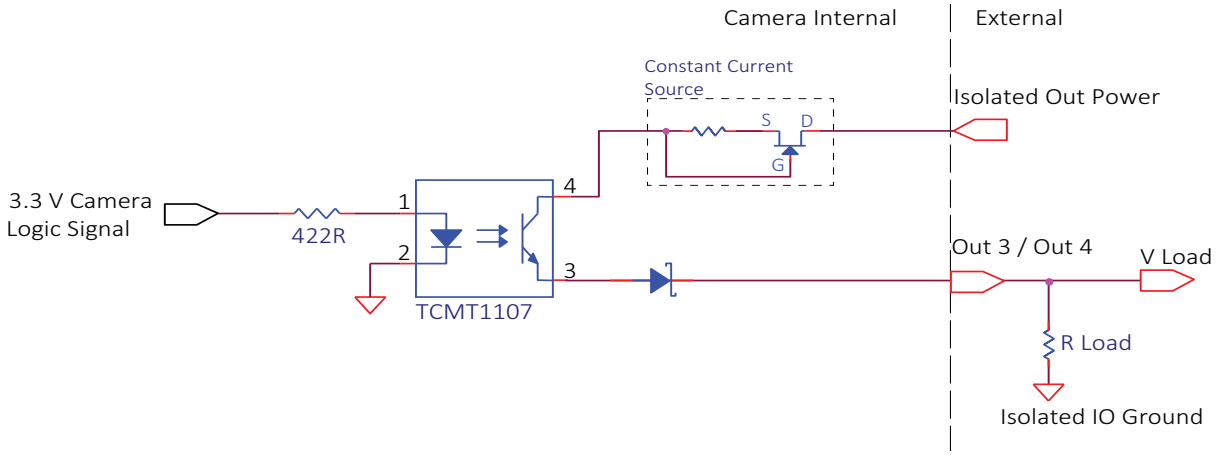



*Figure 32: Bonito PRO Out 3 and Out 4 trigger circuit*

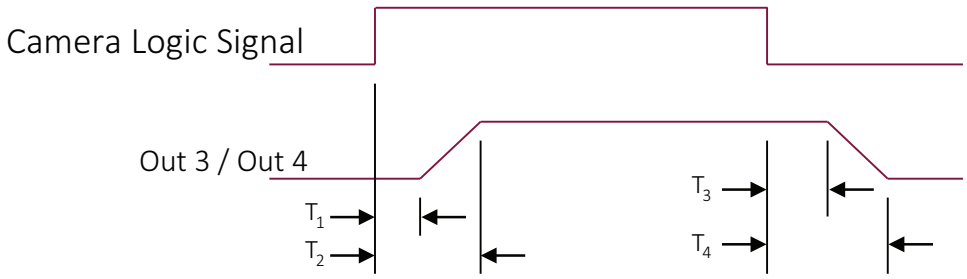



*Figure 33: Bonito PRO Out 3 and Out 4 timing diagram*

The influence of various Isolated Out Power values and load values on the timing response of the trigger is indicated in the following table. Trigger current, Out ICC, is a function of Isolated Out Power voltage and Load resistor R.

| Isolated Out Power | OUT ICC | R Load | V Load | R Power Dissipation | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
|---|---|---|---|---|---|---|---|---|
| 5 VDC | 8 mA | 500 Ω | 4.2 VDC | 35 mW | 1.2 µs | 5.4 µs | 5.6 µs | 64 µs |
| 5 VDC | 5 mA | 2.4 KΩ | 4.0 VDC | 6.7 mW | 1.2 µs | 5.4 µs | 4.4 µs | 34 µs |

*Table 16: Bonito PRO trigger circuit values*

| Isolated Out Power | OUT ICC | R Load | V Load | R Power Dissipation | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
|---|---|---|---|---|---|---|---|---|
| 12 VDC | 2.1 mA | 5 KΩ | 10.4 VDC | 21.6 mW | 1.2 µs | 10 µs | 4.0 µs | 47 µs |
| 24 VDC | 1.8 mA | 10 KΩ | 18.4 VDC | 33.9 mW | 1.2 µs | 15 µs | 3.4 µs | 70 µs |

*Table 16: Bonito PRO trigger circuit values (continued)*

# EF lens control

EF lens control is available for Bonito PRO cameras. EF lens control allows focus and aperture control via host software.

**Lens mount options**

See the Modular Concept for information on lens mount options available with Bonito PRO cameras:

https://www.alliedvision.com/en/support/technical-documentation/bonito-PRO-documentation.html

## Operation

1. Connect an EF lens to the camera before powering up the camera.
2. Power up the camera, and open the camera control software.

**NOTICE**

**Maximum power via PoCXP**

The maximum power supplied via PoCXP is 13 watts per cable at a nominal 24 VDC. EF lens power requirements varies from lens to lens; however, typical ratings are in the 3 to 4 watt range.

3. Use `EFLensInitialize` command to initialize the EF lens. This command is automatically executed on power up and/or when lens is attached to camera.
4. Adjust the focus and aperture using `EFLensFocus` and `EFLensFStop` controls, respectively.
5. If the lens does not operate as expected, see `EFLensState` and `EFLensLastError`.

**EF lens controls**

EF lens controls are described further in the `EFLensControl` section of the Bonito PRO Features Reference.

# Camera trigger

## Trigger timing diagram

The following diagram explains the general trigger concept.

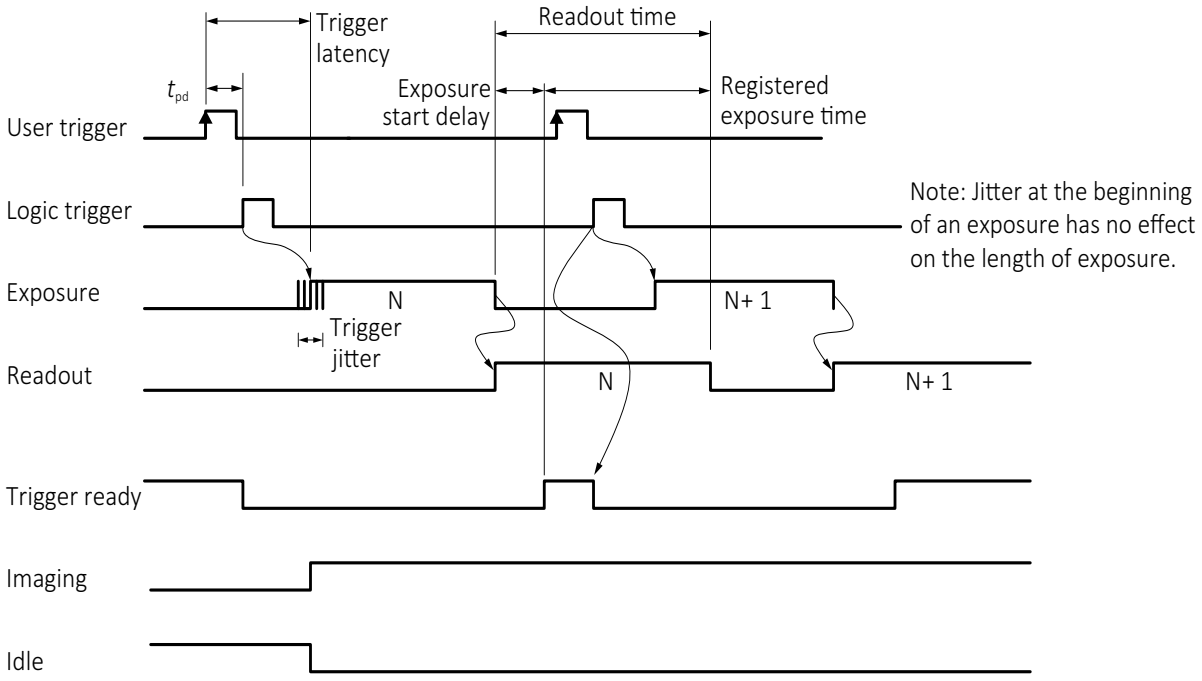



*Figure 34: Bonito PRO internal signal timing waveforms*

## Trigger definitions

| Term | Definition |
|---|---|
| User trigger | Trigger signal applied by the user (hardware trigger, software trigger). |
| Logic trigger | Trigger signal seen by the camera internal logic (not visible to the user). |
| $t_{pd}$ | Propagation delay ($t_{pd}$) between the user trigger and the logic trigger. |
| Exposure | High when the camera image sensor is integrating light. |
| Readout | High when the camera image sensor is reading out data. |
| Trigger latency | Time delay between the user trigger and the start of exposure. |
| Trigger jitter | Deviation from the trigger latency time. |

*Table 17: Explanation of signals in timing diagram*

| Term | Definition |
|---|---|
| Trigger ready | Indicates to the user that the camera accepts the next trigger. |
| Registered exposure time | Exposure time value currently stored in the camera memory. |
| Exposure start delay | Registered exposure time subtracted from the readout time and indicates when the next exposure cycle can begin such that the exposure ends after the current readout. |
| Interline time | Time between sensor row readout cycles. |
| Imaging | High when the camera image sensor is either exposing and/or reading out data. |
| Idle | High if the camera image sensor is not exposing and/or reading out data. |

*Table 17: Explanation of signals in timing diagram (continued)*

## Trigger rules

The user trigger pulse width should be at least three times the width of the trigger latency as indicated in the Specifications chapter.

- The end of exposure always triggers the next Readout.
- The end of exposure must always end after the current Readout.
- The start of exposure must always correspond with the Interline Time if Readout is true.
- Exposure start delay equals the readout time minus the registered Exposure Time.

## Triggering during the idle state

For applications requiring the shortest possible trigger latency and the smallest possible trigger jitter, the user trigger signal should be applied when Imaging is false and Idle is true. In this case, trigger latency and trigger jitter are as indicated in the Specifications chapter.

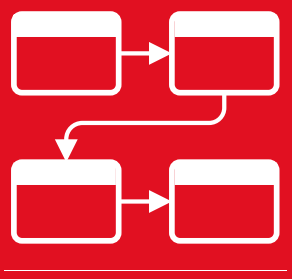
## Triggering during the readout state

For applications requiring the fastest triggering cycle time whereby the camera image sensor is exposing and reading out simultaneously, apply the user trigger signal as soon as a valid trigger ready is detected. In this case, trigger latency and trigger jitter can be up to one row time since Exposure must always begin on an Interline boundary.

For a more detailed description of the trigger concept for advanced users and special scenarios, see the Triggering Concept application note:

https://www.alliedvision.com/en/support/technical-papers-knowledge-base.html

# Image data flow



This chapter presents diagrams that illustrate data flow and bit resolution of the image data.

**Camera features reference**

For a complete description of individual features, see the Bonito PRO Features Reference.

# Bonito PRO image data flow

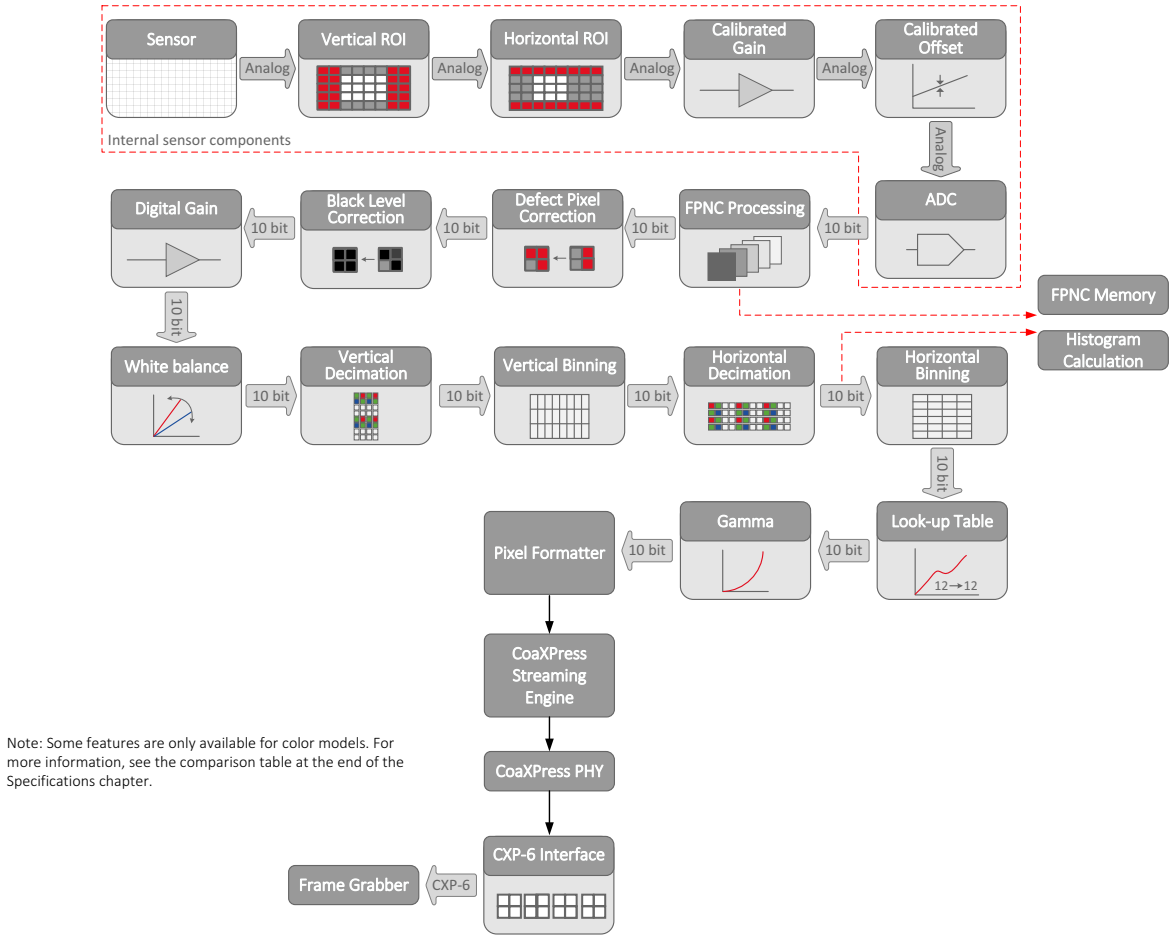



*Figure 35: Bonito PRO image data flow*

# Cleaning optical components

This chapter describes safety instructions and cautions for cleaning lenses, optical filters, or sensors.

Read these instructions before you contact Allied Vision or your Allied Vision distribution partner for assistance.

Contact Allied Vision or your Allied Vision distribution partner if you are not familiar with the procedures described in this chapter.

# Warranty

For details about camera warranty duration and sensor warranty terms, go to:

https://www.alliedvision.com/en/support/warranty

# Keep optical components clean

The best way to ensure the camera remains clean is to avoid penetration of foreign substances into the camera.

When screwing or unscrewing the camera lens or dust cap, hold the camera with the mount opening towards the floor. This minimizes the possibility of any contaminants falling on the glass surface. Always store cameras and lenses with dust-caps on.

# Identifying impurities

If you observe any image artifacts in your video preview of your Bonito PRO camera you may have impurities either on the lens, optical filter, or on the sensor protection glass. Every Bonito PRO camera is cleaned prior to sealing and shipment; however, impurities may develop due to handling or unclean environments.

As shown in the following figure, impurities (dust, particles, or fluids) on the sensor or optical components appear as a dark area, patch or spot on the image and remain fixed in the preview window while you rotate the camera over the target.

Do not confuse this with a pixel defect which appears as a distinct point. Particles can either rest loosely or can be more or less stuck to the optical surface.

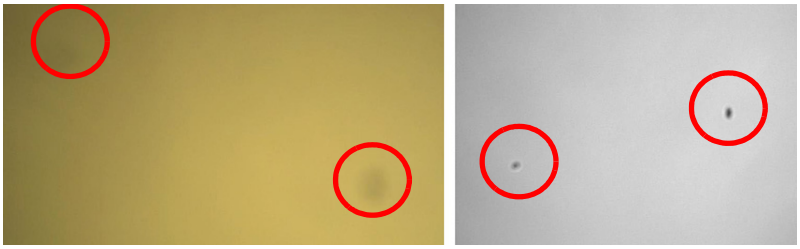


*Figure 36: Image with tiny dust on the filter (left) and dust on the sensor (right)*

# Locating impurities

Before you dismount the lens, you should find out if the impurity is on the filter, lens, or sensor.

1. Start acquiring a uniform image (for example, a white sheet of paper) with the camera.
2. To identify the affected surface, move the suspected optical component and see if the contamination follows this movement.
   a. If you move only the lens (not the camera) and the impurity moves as well, the impurity is on the lens.
   b. If you move the IR cut filter or protection glass window and the impurity moves as well, the impurity is on the filter or protection glass. Carefully remove the filter or protection glass and clean it on both sides using the techniques explained in the next section. If the impurity is neither on the lens nor the IR cut filter or protection glass, it is probably on the sensor.

**NOTICE**

**Removing the optical filter**

Do not attempt to remove the camera optical filter for Bonito PRO cameras. Contact support@alliedvision.com for assistance.

# Materials for cleaning optical components

**Use only these cleaning materials for optical components**

- Optic approved lens cotton, cloth, or tissue that is chemically pure and free from silicones and other additives.
- Optic approved low residue cleaning liquid.

**NOTICE**

- Dry swabs or tissue may cause scratches.
- Metal tools may cause scratches.
- Disposable cotton cosmetic swabs may contain contaminants harmful to optical glass.
- Cosmetic cotton my cause scratches or get caught in small gaps.
- Consumer eyeglass cleaning cloths may be pretreated with silicone harmful to optical glass.
- Aggressive cleaners like benzine, acetone, or spirits may damage the surface.

**Optical cleaning liquid material safety data sheets**

Read the material safety data sheet (MSDS) for the optical cleaning liquid before cleaning your camera and optics. The MSDS provides important information including hazard identification, first aid measures, handling and storage, and PPE.

# Cleaning Instructions

**Workplace conditions**

- Perform all cleaning operations (lenses, optical filter, and sensor) in a dust-free clean-room.
- Avoid touching the optical components with your fingers or any hard material.
- Nitrile cleanroom gloves or powder free latex gloves are recommended to maintain low particulate levels.
- Use an ESD mat to prevent damage from an electrostatic discharge.

1. Unplug the camera from any power supply before cleaning.
2. Apply a small amount of cleaning liquid to a new lens cleaning cotton, cloth, or tissue. The cotton, cloth, or lens tissue should be moist, but not dripping.

3. Hold the camera sensor diagonally upwards. Ensure that the camera is away from your body to prevent particles like skin flakes from falling on the sensor.

4. Wipe the glass surface with a spiral motion from the center to the rim. Normally, several spiral wipes are recommended. Wipe only on glass avoiding contact to metal surfaces, because microscopic dirt could be released and could cause scratches on the glass.
5. When you have finished cleaning, examine the surface in a strong light. Take an out-of-focus picture of a flat, illuminated surface to see if any dirt or dust remains.
6. If dust spots remain, repeat this procedure using new clean lens tissue.

**Cleaning issues**

If you notice that the camera lens or sensor is not clean after attempting to clean twice, or if you have any questions regarding cleaning your camera, contact your Allied Vision distribution partner.

# Cleaning with compressed air

Allied Vision does not recommend cleaning Bonito PRO cameras with compressed air.

**NOTICE**

- Compressed air at high pressure and/or shorter operating distances may push dust into the camera or lens and physically damage the camera, sensor, or optical components.
- Propellant from non-optic approved compressed air products may leave a residue on the camera or lens and may physically damage the camera, sensor, or optical components.
- Compressed air may contain oil or moisture that could contaminate or damage the optical components.
- Use an air blower or compressed air only if you are familiar with cleaning a camera using this method.

If you want to clean your camera with compressed air despite of all the warnings:

- Use an optic approved compressed air product or compressor.
- Use an anti-static ionizer attachment to reduce the risk of static-caused damage.
- Use a filter to remove moisture and oil from the air.
- Use short directed bursts of air to remove impurities.

**Compressed air pressure and operating distance**

- Keep the compressed air pressure at a moderate strength only. Pressure at the nozzle should be less than 100 kPa.
- Operating distance from the camera should be 5 to 30 cm.

# Firmware update

This chapter includes instructions on updating the firmware on your Allied Vision Bonito PRO camera.

Download the latest Bonito PRO firmware from the Allied Vision website:

https://www.alliedvision.com/en/support/firmware

**Saved camera user sets**

If new firmware contains a new feature or control, saved camera user sets are invalidated and erased!

Before loading new firmware, backup your current camera settings in the frame grabber SDK.

**NOTICE**

Do not unplug the CoaXPress cables or camera power supply during the update procedure. We recommend using auxiliary power instead of PoCXP for firmware updates.

**Firmware upgrade**

Allied Vision does not provide a firmware loader tool, you should perform firmware updates via the frame grabber SDK.

# Get remote port and device node map

### Active Silicon frame grabber

```
// Producer and Device handle can be taken from sample application provided by the SDK
CTLProducer *                   m_Producer;
GC::DEV_HANDLE                  m_Device;



GC::PORT_HANDLE                 m_RemotePortHandle;
std::shared_ptr<CPort>          m_RemotePort;
std::shared_ptr<CNodeMapRef>    m_RemoteDeviceMap;

m_Producer->DevGetPort(m_Device, &m_RemotePortHandle);
m_RemotePort = std::make_shared<CPort> (m_RemotePortHandle, m_Producer );
m_RemoteDeviceMap = m_RemotePort->GetNodeMap();
```

*Code listing 1: Active Silicon code snippet example*

# Collect features for FileAccess

**Active Silicon frame grabber**

```
CRegisterPtr            m_FileAccessBuffer;
CEnumerationPtr         m_FileSelector;
CEnumerationPtr         m_FileOpenMode;
CEnumerationPtr         m_FileOperationSelector;
CIntegerPtr             m_FileAccessLength;
CCommandPtr             m_FileOperationExecute;
CIntegerPtr             m_FileOperationResult;
CEnumerationPtr         m_FileOperationStatus;
CEnumerationPtr         m_FileStatus;


m_FileAccessBuffer      = m_RemoteDeviceMap->_GetNode("FileAccessBuffer");
m_FileSelector          = m_RemoteDeviceMap->_GetNode("FileSelector");
m_FileOpenMode          = m_RemoteDeviceMap->_GetNode("FileOpenMode");
m_FileOperationSelector = m_RemoteDeviceMap->_GetNode("FileOperationSelector");
m_FileAccessLength      = m_RemoteDeviceMap->_GetNode("FileAccessLength");
m_FileOperationExecute  = m_RemoteDeviceMap->_GetNode("FileOperationExecute");
m_FileOperationResult   = m_RemoteDeviceMap->_GetNode("FileOperationResult");
m_FileOperationStatus   = m_RemoteDeviceMap->_GetNode("FileOperationStatus");
m_FileStatus            = m_RemoteDeviceMap->_GetNode("FileStatus");
```

*Code listing 2: Active Silicon code snippet example*

# Firmware upload via FileAccess

Step 1: Open the device with your frame grabber SDK

Step 2: Open the firmware file and load it into an std::vector

Step 3: Open the firmware camera file

**Euresys frame grabber**

```
template <typename T>
static bool OpenCameraFile(EGrabber<T> &frameGrabber,const std::string &fileName)
{
    // basically fopen( fileName,"w")
    frameGrabber.setString<RemoteModule>("FileSelector", fileName);
    if( frameGrabber.getString<RemoteModule>("FileStatus") != "Closed")
    {
        CloseCameraFile(frameGrabber, fileName );
    }
    frameGrabber.setString<RemoteModule>("FileOperationSelector","Open");
    frameGrabber.setString<RemoteModule>("FileOpenMode", "Write");
    frameGrabber.execute<RemoteModule>("FileOperationExecute");
    if(     frameGrabber.getString<RemoteModule>("FileOperationStatus") == "Success"
        &&  frameGrabber.getString<RemoteModule>("FileStatus") == "Open")
    {
        return true;
    }
    return false;
}
```

*Code listing 3: Euresys code snippet example*

**Active Silicon frame grabber**

```
void open(const std::string& fileName, OpenMode mode)
    {
        if( FileStatus() != "Closed")
        {
            close( fileName );
        }
        m_FileSelector->FromString(  fileName.c_str() );
        m_FileOperationSelector->FromString("Open");
        m_FileOpenMode->FromString( toString(mode) );
        m_FileOperationExecute->Execute();
        if( FileStatus() != "Open")
        {
            throw RUNTIME_EXCEPTION( fileName + " could not be opened");
        }
    }
```

*Code listing 4: Active Silicon code snippet example*

## Step 4: Write the firmware data to the camera

### Euresys frame grabber

```
enum CameraRegister
{
    FileAccessBufferReg = 0x25200,
};

template <typename T>
static bool WriteCameraFile( EGrabber<T> & frameGrabber, const std::vector<char> &data )
{
    std::cout<<"\n";
    const int64_t dataToWrite = static_cast<int64_t>(data.size());
    int64_t maxWriteSize = frameGrabber.getInteger<RemoteModule>("FileAccessLength.Max");
    std::vector<char>::const_iterator dataPos = data.begin();
    frameGrabber.setString<RemoteModule>("FileOperationSelector", "Write");
    int64_t bytesWritten = 0;
    while (dataPos < data.end())
    {
        int writeSize = std::min( maxWriteSize, dataToWrite);
        frameGrabber.gcWritePortData<RemoteModule>(FileAccessBufferReg,&*dataPos, writeSize);
        frameGrabber.setInteger<RemoteModule>("FileAccessLength",writeSize);
        frameGrabber.execute<RemoteModule>("FileOperationExecute");
        if(     frameGrabber.getInteger<RemoteModule>("FileOperationResult") != writeSize
            ||  frameGrabber.getString<RemoteModule>("FileOperationStatus") != "Success" )
        {
            return false;
        }
        double percentWritten = (100.0* bytesWritten )/ dataToWrite;
        std::cout<<"\r"<<std::fixed<<std::setprecision(2)<<percentWritten<<" %     ";
        bytesWritten +=writeSize;
        dataPos +=writeSize;
    }
    return true;
}
```

*Code listing 5: Euresys code snippet example*

### Active Silicon frame grabber

```
void write( const data_vector &data ) const
    {
        std::cout<<"\n";
        const size_t maxWrite = static_cast<size_t>(m_FileAccessLength->GetMax());
        data_vector::const_iterator pos = data.begin();
        size_t sizeData = data.size();
        m_FileOperationSelector->FromString("Write");
        while( pos != data.end() )
        {
            int64_t sizeToWrite = static_cast<int64_t>( std::min( maxWrite,sizeData) );

            m_FileAccessLength->SetValue( sizeToWrite );
            m_FileAccessBuffer->Set(&*pos, sizeToWrite);
            m_FileOperationExecute->Execute();

            pos += sizeToWrite;
            sizeData -=sizeToWrite;
            double percent = 100.0- (sizeData*100.0)/data.size();

            std::cout<<std::fixed<<std::setprecision(2)<<"\r"<<percent<<"%         ";
        }
        std::cout<<"\n";
    }
```

*Code listing 6: Active Silicon code snippet example*

## Step 5: Close camera file

### Euresys frame grabber

```
    template <typename T>
    static bool CloseCameraFile(EGrabber<T> &frameGrabber, const std::string &fileName)
    {
        // basically fopen( fileName,"w")
        frameGrabber.setString<RemoteModule>("FileSelector", fileName);
        frameGrabber.setString<RemoteModule>("FileOperationSelector", "Close");
        frameGrabber.execute<RemoteModule>("FileOperationExecute");
        if (frameGrabber.getString<RemoteModule>("FileOperationStatus") == "Success"
            &&  frameGrabber.getString<RemoteModule>("FileStatus") == "Closed")
        {
            return true;
        }
        return false;
    }
```

*Code listing 7: Euresys code snippet example*

### Active Silicon frame grabber

```
void close( const std::string & fileName )
    {
        m_FileSelector->FromString(  fileName.c_str() );
        m_FileOperationSelector->FromString("Close");
        m_FileOperationExecute->Execute();
        if( FileStatus() != "Closed")
        {
            throw RUNTIME_EXCEPTION(fileName + " could not be closed");
        }
```

*Code listing 8: Active Silicon code snippet example*

### Step 6: Reboot the camera

# Index

## T