



# JetCam

## High Speed Camera



April 2019  
User Guide

**(Part-No. KY-JetCam)**

International Distributor

**sky blue**  
microsystems

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Version	Date	Notes
0.1	13/03/17	Initial Release
0.2	03/08/17	Added GPIO connector support
0.3	15/02/18	Updated LED behavior Trigger support via communication link and external GPIO UserSet control - camera parameters save/load User Non-volatile memory operation
0.4	13/03/18	Updated GPIO connector pin out
0.5	08/04/18	Added QSFP+ installation instructions
0.6	24/04/18	Updated power connector description
0.7	07/05/18	Added image processing (gain, offset, LUT) Increased maximum frame rate Added optional exposure indication over GPIO Modified SDI output behavior GPIO Hirose connector change from male to female
0.8	08/07/18	Updated GPIO connector pin out
0.9	21/08/18	Added new image processing features (defected pixel and FPN correction) Added new test patterns (Diagonal and Vertical sensor data overwrite)
1.0	23/12/18	Added new JetCam13HS model description
1.1	08/01/19	Updated the FW update section Added 13HS mono sensor quantum efficiency
1.2	02/04/19	Hardware information section was moved to JetCam Datasheet document

### 4.1 Safety Precautions

With your *JetCam* camera in hand, please take a minute to read carefully the precautions listed below in order to prevent unnecessary injuries to you or other personnel or cause damage to property.

- **Before using the product, read these safety precautions carefully to assure correct use.**
- **These precautions contain serious safety instructions that must be observed.**
- **After reading through this manual, be sure to act upon it to prevent misuse of product.**



#### Caution

**In the event of a failure, disconnect the power supply.**

If the product is used as is, a fire or electric shock may occur. Disconnect the power supply immediately and contact our sales personnel for repair.

**If an unpleasant smell or smoking occurs, disconnect the power supply.**

If the product is used as is, a fire or electric shock may occur. Disconnect the power supply immediately. After verifying that no smoking is observed, contact our sales personnel for repair.

**Do not disassemble, repair or modify the product.**

Otherwise, a fire or electric shock may occur due to a short circuit or heat generation. For inspection, modification or repair, contact our sales personnel.

**Do not touch a cooling fan.**

As a cooling fan rotates in high speed, do not put your hand close to it. Otherwise, it may cause injury to persons. Never touch a rotating cooling fan.

**Do not place the product on unstable locations.**

Otherwise, it may drop or fall, resulting in injury to persons or failure.

**If the product is dropped or damaged, do not use it as is.**

Otherwise, a fire or electric shock may occur.

**Do not touch the product with a metallic object.**

Otherwise, a fire or electric shock may occur.

**Do not place the product in dusty or humid locations or where water may splash.**

Otherwise, a fire or electric shock may occur.

**Do not get the product wet or touch it with a wet hand.**

Otherwise, the product may break down or it may cause a fire, smoking or electric shock.

**Do not touch a connector on the product (gold-plated portion).**

Otherwise, the surface of a connector may be contaminated with sweat or skin oil, resulting in contact failure of a connector or it may cause a malfunction, fire or electric shock due to static electricity.

**Do not use or place the product in the following locations.**

- Humid and dusty locations
- Airless locations such as closet or bookshelf
- Locations which receive oily smoke or steam
- Locations close to heating equipment
- Closed inside of a car where the temperature becomes high
- Static electricity replete locations
- Locations close to water or chemicals

Otherwise, a fire, electric shock, accident or deformation may occur due to a short circuit or heat generation.

**Do not place heavy things on the product.**

Otherwise, the product may be damaged.

**Be sure to drain static electricity from body before you touch any electronics component**

The electronic circuits in your computer and the circuits on Komodo board are sensitive to static electricity and surges. Improper handling can seriously damage the circuits. In addition, do not let your clothing come in contact with the circuit boards or components.

Otherwise, the product may be damaged.

## 4.2 Disclaimer

This product should be used for capturing and processing images. KAYA Instruments assumes no responsibility for any damages resulting from the use of this product for purposes other than those stated.

Even if the product is used properly, KAYA Instruments assumes no responsibility for any damages caused by the following:

- Earthquake, thunder, natural disaster or fire resulting from the use beyond our responsibility, acts caused by a third party or other accidents, the customer's willful or accidental misuse or use under other abnormal conditions.
- Secondary impact arising from use of this product or its unusable state (business interruption or others).
- Use of this product against the instructions given in this manual or malfunctions due to connection to other devices.



KAYA Instruments assumes no responsibility or liability for:

- Erasure or corruption of data arising from use of this product.
- Any consequences or other abnormalities arising from use of this product, or damage of this product not due to our responsibility or failure due to modification.

Repair of this product is carried out by replacing it on a chargeable basis, not repairing the faulty devices. However, non-chargeable replacement is offered for initial failure if such notification is received within two weeks after delivery of the product.

### 5.1 Overview

The JetCam family is a high speed low-cost global shutter CMOS cameras, with Fiber interfaces, which supports high quality video at high frame rates, wide dynamic ranges, high resolution and a large field of view. The camera incorporates global shutter sensor and a direct lens control (optional) without need of external devices. With compact outline and low power design the camera can be fitted into tight spaces. The 3G SDI output enables connection of local monitor as viewfinder or an installation aid.

### 5.2 Areas of Application

This camera is ideally suited for:

- Aerospace Machine Vision Systems
- Industrial Machine Vision
- Defense Systems
- Broadcasting and Sports Replay Applications

### 5.3 Features

- 40 Gbps fiber optic interface
- Up to 80km cable length
- Nikon F mount
- B4 2/3" mount with integrated lens control (optional)
- PL mount with integrated lens control (optional)
- Canon EF lens mount
- 3G SDI output for local monitor
- Compatible with KAYA Vision Point™ SDK
- Compatible with KAYA Komodo™ Frame Grabbers
- Supports Gen<i>Cam standard
- Customization as per user requirements

## 5.4 Product Applications

- Slow Motion
- 3D
- Broadcasting
- Sports analytics and judgment
- Special Effects
- AOI
- Printing inspection
- High-speed DVRs
- Defense remote systems
- Surveillance

## 5.5 Related documents and accessories

### Documents:

- Vision Point Software Installation Guide
- Vision Point App User Guide for Acquisition Mode
- Vision Point API Data Book
- Komodo Fiber Reference Guide

### Accessories:

- Fiber cables (Multi or Single mode)
- QSFP+ Module

### 6.1 System Structure

The system uses Komodo Fiber Frame Grabber that is able to acquire video directly from fiber optic cables, providing high resolution image acquisition interface for distances up to 80km in single-mode and up to 300m in multi-mode. Link supports standard up to 40 Gbps over fiber optic interface. The JetCam system configuration includes the following parts:



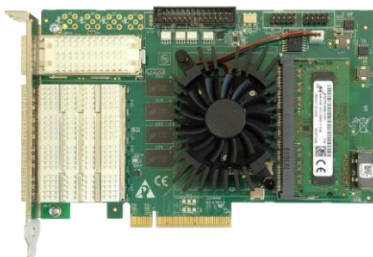
One of JetCam Cameras  
The modules specifications listed in Table 2



Nikon F mount  
(other lens mounts available)



3G SDI output for local monitor



Komodo Fiber Frame Grabber



12V Power Supply



QSFP+ Modules

Fiber Cable

Vision Point Software and SDK

Friendly Software environment, includes Video management, GUI, SDK and API

Table 1 : JetCam Camera system components

For more information about the system components, please refer the documents listed in the previous section.

Example of the system is described in Figure 1.

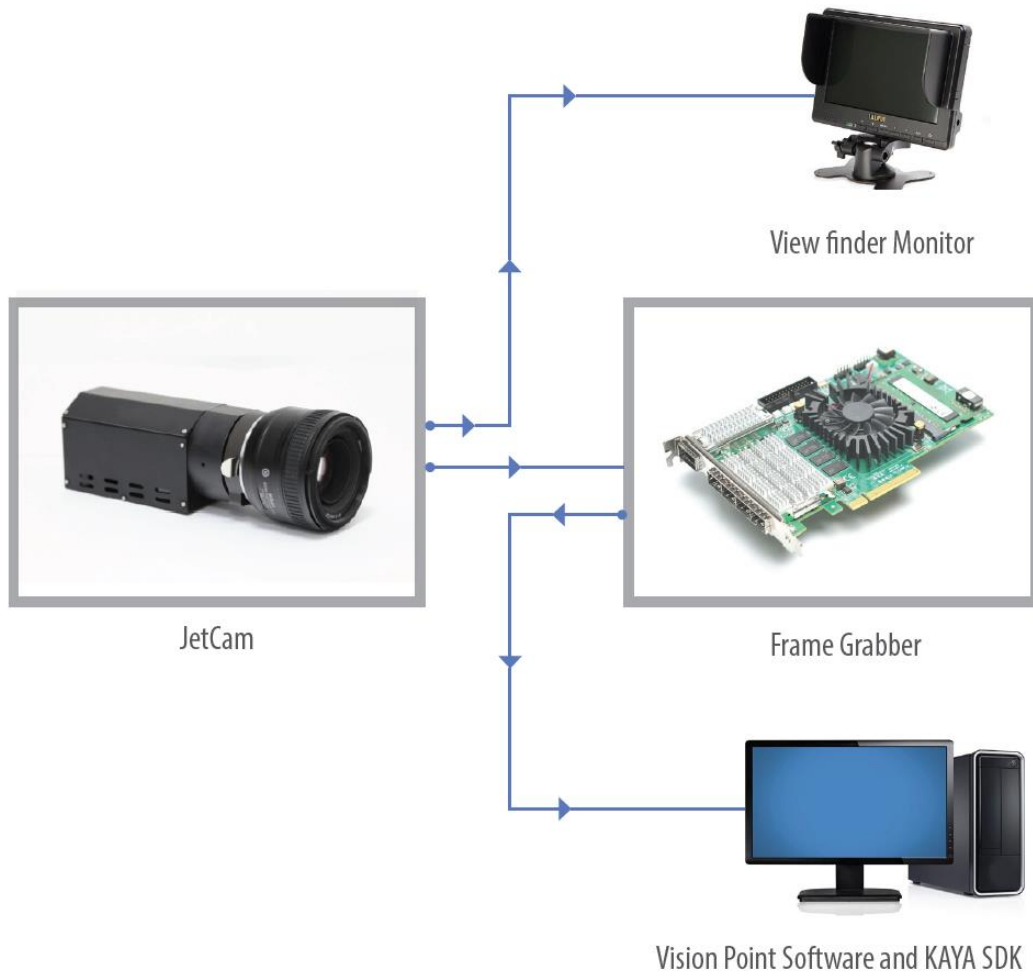


Figure 1 : JetCam Camera system structure diagram

## 6.2 JetCam Camera available models

Type	JetCam13	JetCam19	JetCam25	JetCam160
Pixel size	13.7 $\mu$ m	10 $\mu$ m	4.5 $\mu$ m x 4.5 $\mu$ m	3.9 $\mu$ m 5T shutter pixel with CDS
Sensor resolution	1296 (H) x 864 (W)	1952 (H) x 1088 (W)	5120 (H) x 5120 (W)	4736 (H) x 3424 (W)
Effective Resolution	1280 (H) x 864 (W)	1920 (H) x 1080 (W)	5120 (H) x 5120 (W)	4704 (H) x 3416 (W)
Sensor	LUX13HS	LUX19HS	PYTHON 25K	LUX160
Optical Format	4/3"	4/3"	APS-H	4/3"
Video output	Fiber interface up to 40 Gbps CoaXPress up to 25 Gbps 10GiGE up to 10Gbps	Fiber interface up to 40 Gbps CoaXPress up to 25 Gbps 10GiGE up to 10Gbps	Fiber interface up to 40 Gbps CoaXPress up to 25 Gbps 10GiGE up to 10Gbps	Fiber interface up to 40 Gbps CoaXPress up to 25 Gbps 10GiGE up to 10Gbps
Frame rate	3500 fps	2365 fps @8bit resolution 1900 fps @10bit resolution	80 fps	227 fps @8bit resolution 213 fps @10bit resolution
Electronic shutter	Global shutter	Global shutter	Global shutter	Global shutter
Responsivity at 550 nm	25V/Lux.s (at 550nm)	20V/Lux.s (at 500nm)	5.8V/lux.s (at 500nm)	5V/lux.s (at 550 nm)
Conversion Gain	-	-	0.085 LSB10/e-, 130 V/e-	-
Temporal Noise	14 e-	10 e-	< 14 e- (Non-Zero ROT, 1x gain)	10 e-
Parasitic Light Sensitivity (PLS)	-	-	< 1/5000	-
Full Well Charge	20000 e-	15000 e-	> 12000 e-	10000 e-

## System Description

Dynamic range	60 dB at 520 nm	56.9321 dB at 520 nm	54.6332 dB at 520 nm	50.73dB at 520 nm
Signal-to-Noise Ratio (SNR max)	TBD dB at 520 nm	41.2759 dB at 520 nm	39.2761 dB at 520 nm	38 dB
Quantum Efficiency (QE) X FF	45% at 550 nm	54.275% at 520 nm	43.1276% at 520 nm	59.7% at 520 nm
Pixel FPN	4 mV rms	4 mV rms	< 0.9 LSB10	4 mV rms
PRNU	<1.5% rms	<1.5% rms	< 1%	< 1.25%
Shortest Exposure	1us	1us	1us	1us
Image acquisition	Continuous / Triggered	Continuous / Triggered	Continuous / Triggered	Continuous / Triggered
Output resolution	8 or 10 bit	8 or 10 bit	8 or 10 bit	8 or 10 bit
Monochrome/ color	Monochrome / Color	Monochrome / Color	Monochrome / Color	Monochrome / Color
Power input	12 VDC (optional 24 VDC)	12 VDC (optional 24 VDC)	12 VDC (optional 24 VDC)	12 VDC (optional 24 VDC)
Weight (without lens)	1260g	1260g	1260g	1260g
Power consumption	<7.5W	<12W	<12W	<12W
Operating temperature	0°C to 50°C	0°C to 50°C	0°C to 50°C	0°C to 50°C
Lens mount	F-Mount, B4, C-mount, PL mount, Canon EF, custom	F-Mount, B4, C-mount, PL mount, Canon EF, custom	F-Mount, B4, C-mount, PL mount, Canon EF, custom	F-Mount, B4, C-mount, PL mount, Canon EF, custom
On camera processing	<ul style="list-style-type: none"> <li>• Defect pixel correction</li> <li>• White balance</li> <li>• ROI</li> <li>• Image flip</li> <li>• Frame counter</li> </ul>	<ul style="list-style-type: none"> <li>• Defect pixel correction</li> <li>• White balance</li> <li>• ROI</li> <li>• Image flip</li> <li>• Frame counter</li> </ul>	<ul style="list-style-type: none"> <li>• Defect pixel correction</li> <li>• White balance</li> <li>• ROI</li> <li>• Image flip</li> <li>• Frame counter</li> </ul>	<ul style="list-style-type: none"> <li>• Defect pixel correction</li> <li>• White balance</li> <li>• ROI</li> <li>• Image flip</li> <li>• Frame counter</li> </ul>



	<ul style="list-style-type: none"> <li>• Flat field correction</li> <li>• LUT</li> <li>• Gain (Analog / Digital)</li> <li>• Auto black level</li> <li>• Nonvolatile storage</li> </ul>	<ul style="list-style-type: none"> <li>• Flat field correction</li> <li>• LUT</li> <li>• Gain (Analog / Digital)</li> <li>• Auto black level</li> <li>• Nonvolatile storage</li> </ul>	<ul style="list-style-type: none"> <li>• Flat field correction</li> <li>• LUT</li> <li>• Gain (Analog / Digital)</li> <li>• Auto black level</li> <li>• Nonvolatile storage</li> </ul>	<ul style="list-style-type: none"> <li>• Flat field correction</li> <li>• LUT</li> <li>• Gain (Analog / Digital)</li> <li>• Auto black level</li> <li>• Nonvolatile storage</li> </ul>
Programmable I/O	2x RS232 (RS485 and custom optional)	2x RS232 (RS485 and custom optional)	2x RS232 (RS485 and custom optional)	2x RS232 (RS485 and custom optional)
Lens control (optional)	<ul style="list-style-type: none"> <li>• Fujinon lens control</li> <li>• Canon lens control</li> <li>• Custom lens through RS232/RS485</li> </ul>	<ul style="list-style-type: none"> <li>• Fujinon lens control</li> <li>• Canon lens control</li> <li>• Custom lens through RS232/RS485</li> </ul>	<ul style="list-style-type: none"> <li>• Fujinon lens control</li> <li>• Canon lens control</li> <li>• Custom lens through RS232/RS485</li> </ul>	<ul style="list-style-type: none"> <li>• Fujinon lens control</li> <li>• Canon lens control</li> <li>• Custom lens through RS232/RS485</li> </ul>
Complimentary video output	3G SDI	3G SDI	3G SDI	3G SDI

Table 2 : JetCam Camera Models

### 7.1 Essentials to get started

To begin using your JetCam system, you must have the following:

- ✓ A computer with the following:
  - Processor with an Intel 64-bit architecture, or equivalent.
  - An available x4 (or x8 or x16) PCIe slot. Gen 3 support is recommended for faster data transfer.
  - Vision Point Application installation
- ✓ JetCam camera
- ✓ Komodo Fiber board
- ✓ Fiber QSFP+ Modules
- ✓ Fiber optic cable

NOTE: KAYA Instruments doesn't guarantee compatibility with all computers that have the above specifications. Please, consult KAYA representative for any specific issue.

### 7.2 Installation instructions

The first stage of the system installation is Komodo board installation as described in section 7.2.1 below. The second stage is installation of the QSFP+ modules and fiber cable allowing the connection between the JetCam camera and the Frame Grabber, described in section 7.2.2. The third stage is connection of the camera as described in section 7.2.3 and the last step of Vision Point application installation described in section 7.2.4.

#### 7.2.1 Komodo Frame Grabber installation

Before system installation the Komodo Fiber Frame Grabber should be installed into the host computer. Komodo Fiber Frame Grabber is standard PCIe card with 8 lanes connector.

It can be installed in any PCIe connector of the motherboard with 8 lanes and up.

**Note:** The Frame Grabber should be installed before you install your software.

1. Before installing, turn off the power of the computer and its peripherals.
2. Use an ESD-preventive glove, wrist or ankle strap and follow its instructions for use.

3. Make sure there is no dust or any other foreign matter inside the PCIe slot and the Frame Grabbers PCIe connector, or blocking any of the connectors.
4. Firmly insert the Komodo board to PCIe connector of the motherboard.
5. Anchor the PCIe bracket to the computer chassis using M3 screw.
6. Verify the Komodo board inserted correctly to the PCIe slot.
7. Power up the computer.
8. After OS is up, you will be asked to install a driver for new Multimedia Device. At this stage, you should cancel the installation.

Under Windows and Linux OS the compatible drivers for Komodo Fiber Frame Grabber will be installed during installation of Vision Point App software.

You can install and use multiple Komodo Fiber Frame Grabbers in a single computer.

The number of Komodo Fiber Frame Grabbers that can be installed in a computer depends on the number of available PCIe slots.

For more information please refer to Vision Point Software Installation Guide documentation.

### 7.2.2 Installing and Removing QSFP+ Module

The purpose of this section is to demonstrate how to install a QSFP+ transceiver module, attach an optical network cable and remove a QSFP+ transceiver module. It is necessary to understand the correct way of installing and removing a QSFP+ transceiver, as correct operation can protect the module from being damaged and ensure its stable performance.

Before removing or installing a QSFP+ module, please follow the precautions and installation instructions.

#### 7.2.2.1 Precautions

1. Use an ESD-preventive wrist or ankle strap and follow its instructions for use.
2. Make sure there is no dust or any other foreign matter inside the QSFP+ module, or blocking any of the connectors.
3. Clean the optic surfaces of the fiber cables before plugging them into the optical ports of a QSFP+ module.
4. Removing and inserting a module can shorten its useful life, so you should not remove and insert the module any more often than is absolutely necessary.

5. Insert the clean dust covers into the module after the cables are removed. Do not remove the dust plug until you are ready to attach the network interface cable.
6. Do not install or remove the QSFP+ module with fiber-optic cables attached to it because of the potential of damaging the cable, the cable connector, or the optical interfaces in the module.
7. Disconnect all cables before removing or installing a module.
8. Place the removed module on an antistatic mat or a static shielding bag if you plan to return it to the factory.
9. Protect the line card by inserting clean module cage covers into the optical module cage when there is no module installed.
10. Keep the protective dust plugs installed in the unplugged fiber-optic cable connectors and in the transceiver optical bores until you are ready to make a connection.

### 7.2.2.2 Installing the QSFP+ Module

In order to install the QSFP+ module, follow these steps:

1. The JetCam and the Komodo Fiber Frame Grabber supporting the following QSFP+ modules:
  - KY-QSFP-1.4 – MTP/MPO single mode, up to 1.4km over single mode fiber cable
  - KY-QSFP-3M – MTP/MPO multi-mode, up to 300m over multi-mode fiber cable
  - KY-QSFP-CWDM – LC single mode, duplex cable, up to 10km connection over single mode fiber cable
2. Remove the dust plugs from the module as shown in Figure 2.
3. The QSFP+ module has a pull-tab latch that used to remove or install the module.  
Hold the transceiver so that the identifier label is on the top.
4. Align the QSFP+ transceiver in front of the module's transceiver socket opening and carefully slide the QSFP+ transceiver into the socket until the transceiver makes contact with the socket electrical connector, as shown in Figure 3.
5. Make sure that the male connectors on the module will align with the female connectors inside the cage.
6. Verify that the modules are completely seated and secured in their assigned receptacles on the line card by firmly pressing on the module with your thumb to fully seat the transceiver in the module's transceiver socket. In case the module is not completely seated and secured in the

receptacle, you will hear a click as the triangular pin on the bottom of the module snaps into the hole in the receptacle.

7. Follow the exact steps to insert additional module into the Frame Grabber.

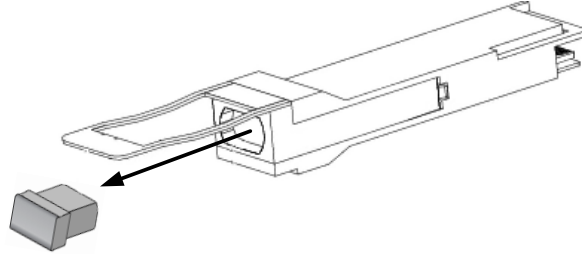


Figure 2 : QSFP+ Module with pull tab latch open

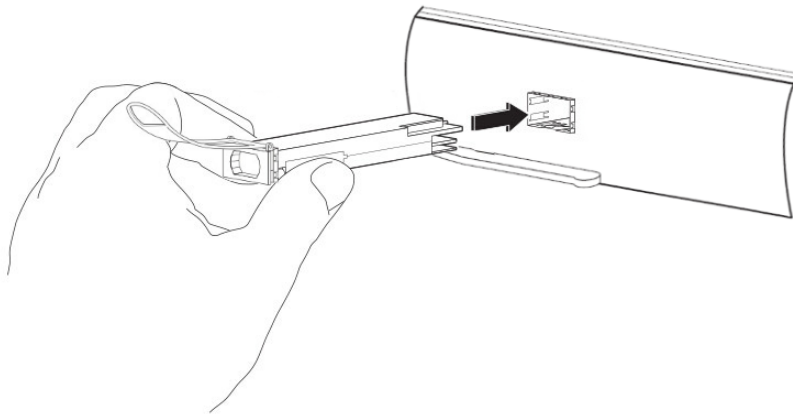


Figure 3 : Installing a QSFP+ Module into a port

### 7.2.2.3 Connecting the interface cable to QSFP+ Module

In order to properly connect the fiber optic cables, the following steps must be taken:

1. Remove the protective dust cover from the fiber-optic cable connector.
2. Insert the fiber cable into the module, as shown in Figure 4.
3. Firmly push on each cable, until you will hear a click.

NOTE: Additional connectivity option is available using QSFP+ to SFP+ Fiber Breakout cable.

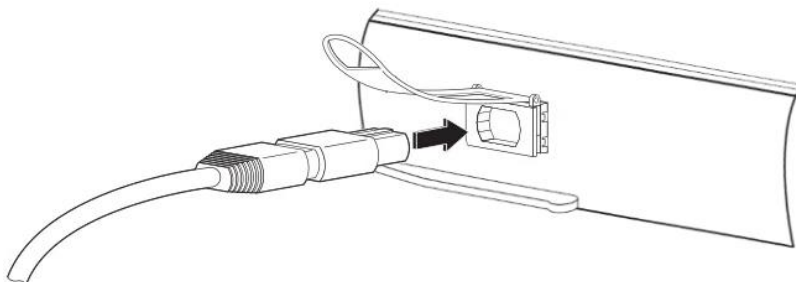


Figure 4 : Connecting the cable to QSFP+ Module

#### 7.2.2.4 Removing the QSFP+ Module

In order to remove the QSFP+ module, follow these steps:

1. Turn the camera and the JetCam camera and the Frame Grabber off.
2. Disconnect and remove all interface cables from the ports.
3. Hold the pull-tab latch on the QSFP+ module with your index finger, and gently pull to release the transceiver from the socket, as shown in Figure 5.
4. Grasp the module between your thumb and index finger and carefully remove it from the port, as shown in Figure 6.
5. Insert the clean dust covers into the module, as shown in Figure 7.

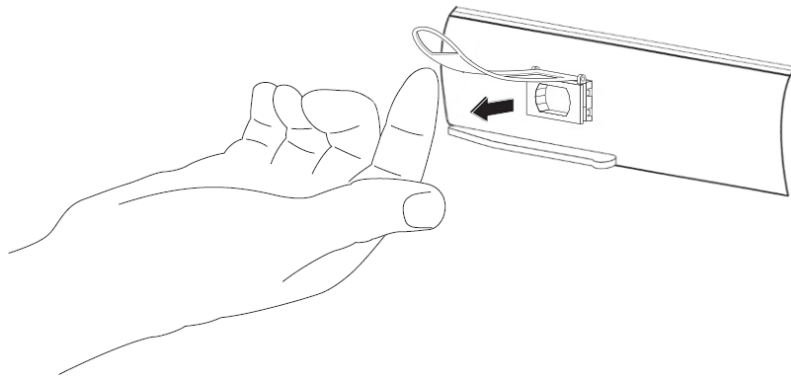


Figure 5 : Pulling the pull tab latch of a QSFP+ Module

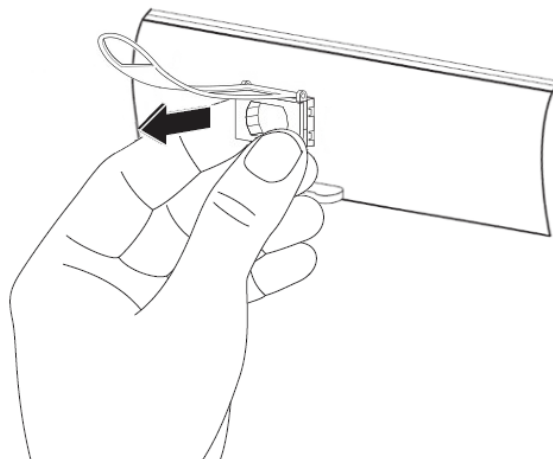


Figure 6 : Removing a QSFP+ Module from the port

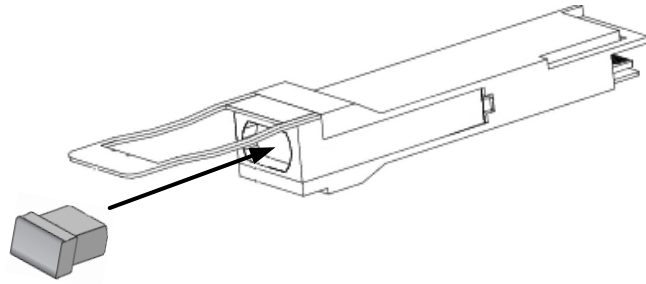


Figure 7 : QSFP+ Module with pull tab latch open

### 7.2.2.5 Supported QSFP+ Modules

The system supports the following QSFP+ modules:




Module	Description	P/N	Compatible Cable
	Single mode fiber QSFP+ Allows of up to 1.4km connection over single mode fiber cable (8 cores)	KY-QSFP-1.4	MTP/MPO single mode
	Single mode fiber QSFP+ Allows of up to 10km connection over single mode fiber cable (2 cores)	KY-QSFP-CWDM	LC single mode, duplex cable
	Multi-mode fiber QSFP+ Allows of up to 300m connection over multi-mode fiber cable (8 cores)	KY-QSFP-3M	MTP/MPO multi-mode

Table 3 : JetCam supported QSFP+ modules

### 7.2.3 JetCam camera connectivity

In order to properly complete the *JetCam* system installation, connect the Power Adaptor to the *JetCam* power supply connector. The *JetCam* requires 12V power supply for proper function for camera. Please, refer to JetCam Datasheet document for exact Power Supply requirements.

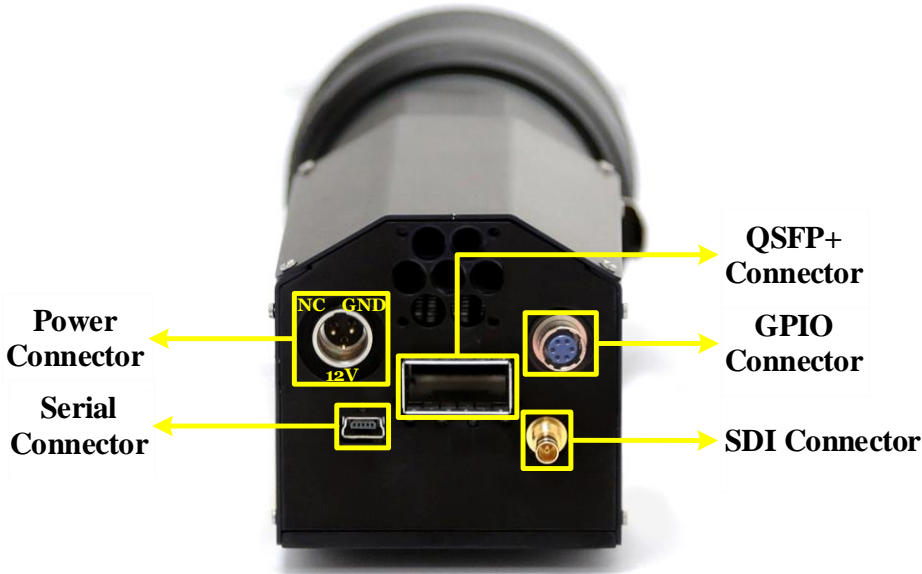


Figure 8 : JetCam camera power connector

NOTE: Powering up the camera will automatically start SDI transmission for local camera configuration. Detecting the camera using Vision Point application will turn off the SDI output and the image will be displayed only via Vision Point application interface. For SDI output, the camera should be powered cycle.



### 7.2.3.1 Mount connection

Mount interface confined to JetCam camera where the body allows interchangeable lenses mounts, which are used to connect optical components.

The JetCam camera supports the following mount models:

Module	Description
	<p><b>Nikon F-mount</b> Three-lug bayonet mount with a 44 mm throat and a flange to focal plane distance of 46.5 mm.</p>
	<p><b>Canon EF-mount</b> Short flange focal distance of 44.0 mm</p>
	<p><b>PL-mount</b> Four pronged flanges, each contain a notch towards the center, with a 52.00 mm Flange focal distance.</p>
	<p><b>B4-mount</b> Flange focal distance of 48 mm</p>

Table 4 : JetCam supported mount models

A typical *JetCam* system is connected as described in the figure below.

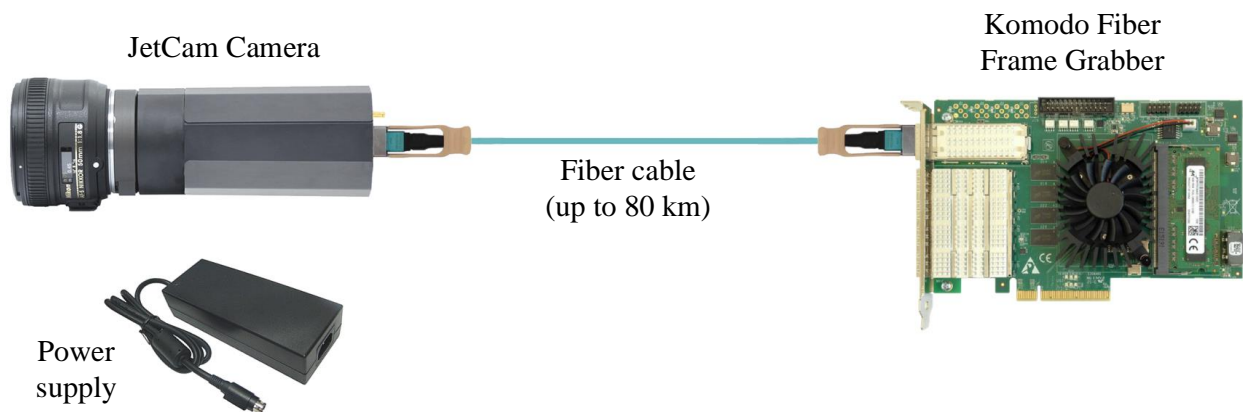


Figure 9 : JetCam Camera system connection diagram

### 7.2.4 Vision Point Application installation

1. Power up the computer and the camera.
2. After OS is up, you will be asked to install a driver for new Multimedia Device. At this stage, you should cancel the installation.
3. Run the *Vision Point Application* installation and follow the installation steps.

NOTE: Under Windows and Linux the compatible drivers for Komodo board will be installed during installation of Vision Point App software.

For more detailed information please refer to Vision Point Software Installation Guide documentation.

### 8.1 Getting Started

The Vision Point application is the main interface for all camera setting and configurations.

### 8.2 JetCam Terminal control

A Mini USB port is available for individual link & general information status and firmware update. The port uses a Silabs CP2101 chip. A driver from the Silabs website might have to be installed on certain PCs to gain access to the terminal port. Free supporting driver can be found at: <http://www.silabs.com/products/mcu/pages/usbtouartbridgevcpdrivers.aspx>

After driver installation and USB connection is acquired a serial emulated terminal (i.e Tera Term use is recommended) can be used with the following configurations, described in Table 5:

Parameter	Value
Baud rate	115200
Start bits	1
Stop bits	1
Parity	None
Flow Control	None

Table 5 : Serial emulated terminal configurations

The following commands are supported by the terminal; each command must be followed by carriage return (Enter) in order to execute:

Command	Description
Firmware	Sets the system to firmware update mode. See 8.3 chapter for firmware update information
Status	Prints the system and individual link status and general information

Table 6 : Terminal commands

NOTE: The commands are not case sensitive.

### 8.3 JetCam Firmware update

The JetCam Cameras supports firmware update via USB using a serial emulated terminal.

To initiate a firmware update follow the next steps:

1. Download the latest firmware from [KAYAs FTP server](#).
2. Please make sure to download the correct FW for the camera that you have, as installing an incorrect FW may cause the camera to malfunction.
3. Connect a USB cable between the computer and the camera and acquire connection using Silabs drivers (drivers need to be downloaded manually if an automatic download isn't initiated).
4. Open serial emulated terminal (usage of Tera Term terminal is recommended) and set serial communication protocol as described in the Table 5.

For example in the Tera Term terminal, this should look as following (the port number might be different):

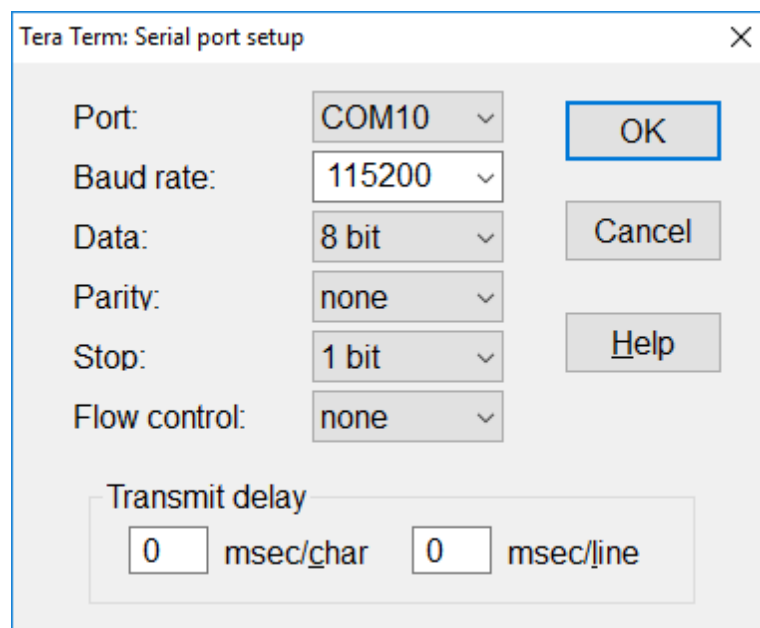


Figure 10 : Serial communication example

- Choose the firmware update option by entering “firmware” followed by a carriage return and wait for the following message: "Now starting firmware update, please start file transfer using XMODEM:"

```
STATUS          -- Print status
FIRMWARE        -- Firmware update

JETCAM:> firmware
Now starting firmware update, please start file transfer using XMODEM:█
```

Figure 11 : Firmware update execution

- Under the “File” tab use the terminal “transfer” capability using the XMODEM protocol to initiate the firmware update. Choose “Send” and the firmware update file: *JetCam\_XXX\_YYY\_ZZZ.bin* (where XXX is the model name and YYY\_ZZZ is the version number).

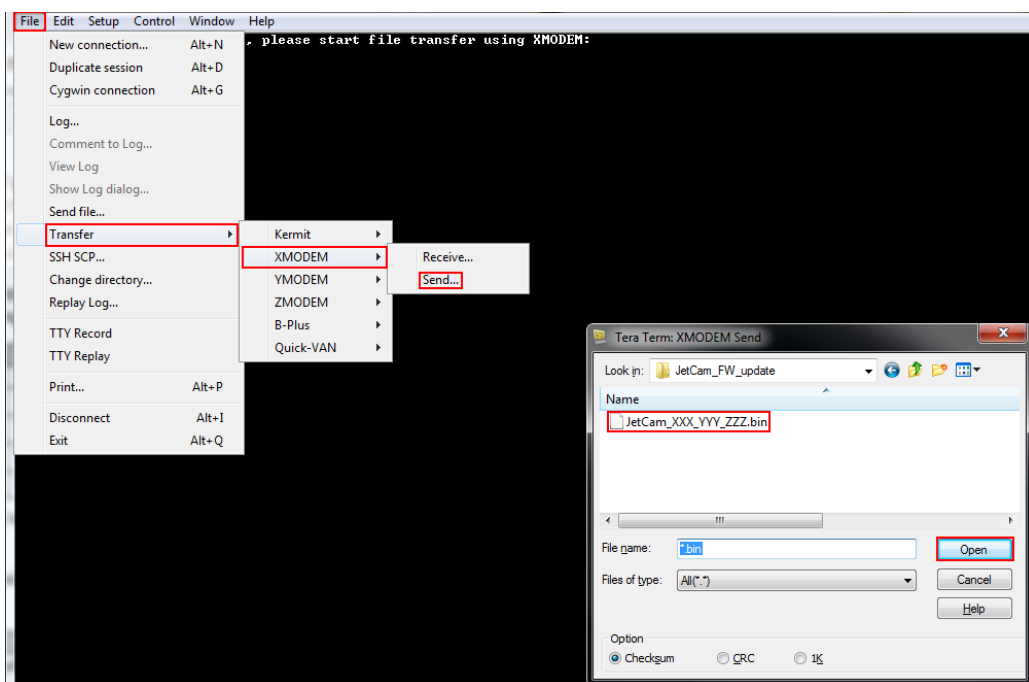


Figure 12 : Firmware terminal initiation

- If no firmware will be sent during 1 minute, or in case of an error, the firmware update will fail and return to the previous operation mode.

```
JETCAM:> firmware
Now starting firmware update, please start file transfer using XMODEM:
update has failed
```

Figure 13 : Firmware update fail

- The firmware update process will take about 10 minutes.

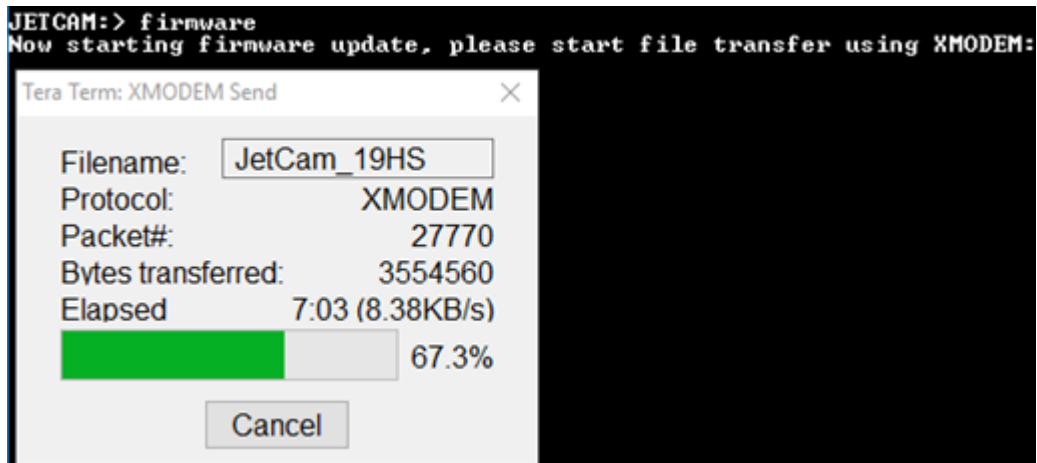


Figure 14 : Firmware update process

- A successful update will result in an appropriate message



Figure 15 : Firmware update succession

- To apply the new firmware, the camera should be power cycled by disconnecting the power supply from the camera and connecting it back after a few seconds.

## 8.4 Connect and configure the JetCam

The Vision Point Application allows to connect and configure the Frame Grabber and the connected JetCam camera. The basic steps include:

- Selecting a grabber board
- Opening, creating and closing a project
- Adjusting the grabber parameters
- Scanning and adjusting the camera parameters
- Starting an image acquisition

Different Frame Grabber boards may include different feature sets. The target board is selected from the combo box and is only available when there is no active project mounted. If a different target board to be selected, the active project should be closed first.

To select a target board:

- Click the ▼ button of the grabber selection combo box located on the Toolbar Menu.
- When the list of available target boards will open, select the required board/demo mode from the list.
- Click “Create new project” to create new project from scratch or “Open existing project...” to open an existing one.

The Vision Point App main window with all of its components as shown in Figure 16.

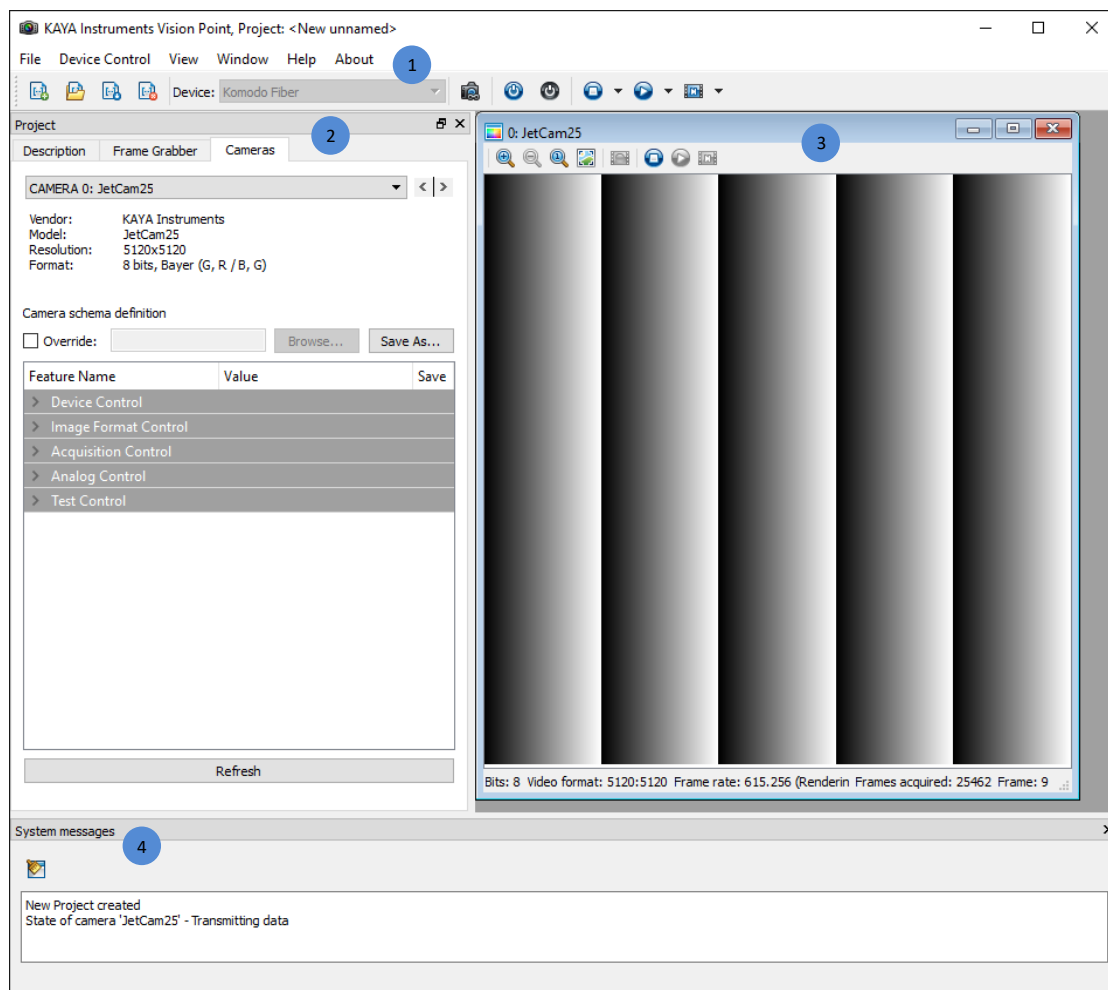


Figure 16 : Vision Point App main window

The basic components of the application are:

1. The toolbar Menu:

Includes project operation buttons, hardware selection and stream acquisition control buttons.

2. The project navigator:

Allows configuring and controlling the camera via standard Gen<i>Cam interface.

- a. A Description tab, used to specify the project name and description.
- b. A Frame Grabber tab, describing FG related information and configurations, e.g. I/O control and hardware information. These are controlled using Gen<i>Cam interface.
- c. A Camera tab enables configuring the camera Gen<i>Cam parameters listed in the camera XML file. An external XML file may be loaded in the absence of a native one from the camera.


3. The acquisition picture window:

Displays the last frame that has been grabbed. Information on frame rate and image format can be found at the bottom of the picture window.

4. The system messages window:

Displays general, runtime informational and error messages regarding the state of stream grabbing and changes to various components. If not needed, the message window can be hidden/shown via View tab of the Vision Point App menu bar.

### 8.5 Detecting the JetCam camera

After a Frame Grabber was chosen, use the  Toolbar Menu button, or click “Detect cameras” in the “Grabber Control” menu, to initiate a camera scan.

To successfully connect a camera to the Frame Grabber, the FG links should be first scanned to detect the connected cameras. A successful camera detection will display JetCam camera parameters in the “Cameras” tab, showing camera vendor, model, resolution and format, as shown in Figure 17.



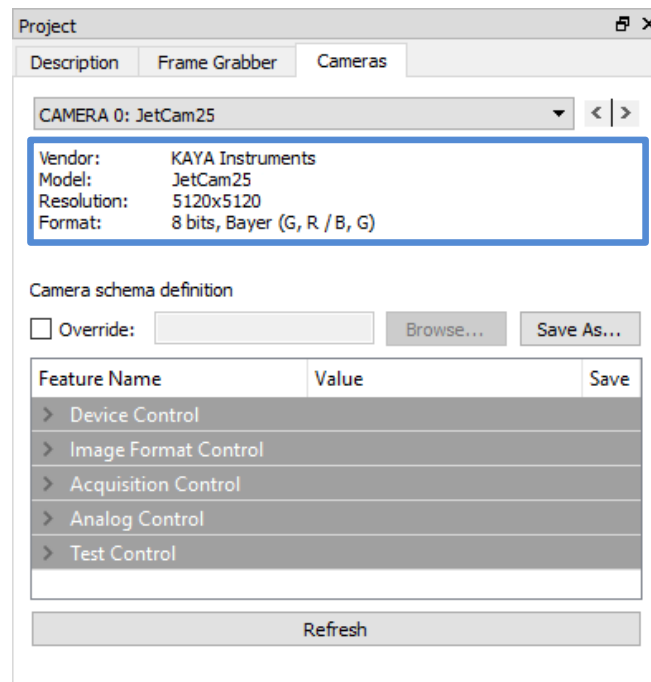



Figure 17 : JetCam description parameters


## 8.6 Starting and controlling acquisition

After JetCam camera was detected and configured, the stream acquisition can commence.

In order to start the acquisition, press the  button, located in the main toolbar.

To stop the acquisition, press the  button located in the main toolbar or the picture window. Acquisition can also be controlled from “Device Control” located in window menu and “Acquisition Control” category, located in the “Camera” tab.

## 8.7 Buffer Replay Mode

After the stream acquisition commenced, controlling acquisition and replaying frames can be made using the picture window toolbar. In order to switch between live acquisition and replaying frames, use the  button.

When Replay Mode is chosen, additional icons will appear in the Picture window toolbar.

## 8.8 Saving a captured image

In order to save a captured image, open “File” menu and click “Save Picture...” option. This will open a save dialog, where you should choose the image format, destination folder and file name. Click “Save” to save the image currently captured in the “Picture Window”.

### 8.9 Saving video buffer

In order to save a Video stream, open “File” menu and click “Save video buffer...” option. This will open a save dialog, where you should choose the destination folder and file name.

Click “Save” to save the currently captured video in the “Picture Window”.

For more detailed information about Vision Point application please refer to Vision Point App User Guide for Acquisition Mode documentation.

The “Camera” tab is the main interface for all camera settings. JetCam camera adjustments and configurations can be made from the “Camera” tab, as detailed in this section.

JetCam camera uses an internal XML that contains the following categories.

### 9.1 Device Control category

Feature Name	Value	Save
▼ Device Control		
Device Vendor Name	KAYA Instruments	<input type="checkbox"/>
1 Device Model Name	JetCam19	<input type="checkbox"/>
Device Manufacturer...	KAYA Instruments	<input type="checkbox"/>
2 Device Serial Number	30	<input type="checkbox"/>
3 Device Firmware Ver...	3.19.9382	<input type="checkbox"/>
4 Device Connection T...	QSFP	<input type="checkbox"/>
5 Device Reset	Execute	<input type="checkbox"/>
▼ Device Temperature ...	Processor	<input type="checkbox"/>
Device Temperat...	40.398438	<input type="checkbox"/>
6 Processor Temperature	41.013672	<input type="checkbox"/>
7 Sensor Temperature	28.500000	<input type="checkbox"/>
8 Serial Port Selector	Camera Serial Port	<input type="checkbox"/>
9 Serial Port Baud ...	Baud 115200	<input type="checkbox"/>

Figure 18 : Device Control category

1. Shows camera vendor, JetCam model and manufacturer
2. Device serial number
3. Device Firmware shows the current firmware version
4. Device connection type (QSFP\SFP\CXP)
5. Device Reset executes reset procedure to the JetCam device
6. Device Processor Temperature
7. Device Sensor Temperature
8. Serial Port Selector
9. Serial Port Baud Rate

## 9.2 Image Format Control category

Image Format Control			
1	Sensor Width	5120	<input type="checkbox"/>
	Sensor Height	5120	<input type="checkbox"/>
2	Region Selector	Region0	<input type="checkbox"/>
3	Region Mode	On	<input type="checkbox"/>
4	Width	5120	<input type="checkbox"/>
	Height	5120	<input type="checkbox"/>
5	OffsetX	0	<input type="checkbox"/>
	OffsetY	0	<input type="checkbox"/>
6	Pixel Format	BayerGR8	<input type="checkbox"/>
7	Scan Type	Areascan	<input type="checkbox"/>
8	Test Pattern	Gray Horizontal Ramp	<input type="checkbox"/>
	Vertical invert	<input type="checkbox"/> False	<input type="checkbox"/>
9	Horizontal invert	<input type="checkbox"/> False	<input type="checkbox"/>

Figure 19 : Image Format Control category

1. Sensor width and height
2. Region selector
3. Region mode
4. The Height and the width of the displayed image
5. Offset X/Y
6. Pixel format
7. Scan type (only “Area Scan” is available for now)
8. Test Pattern has 6 available options:
  - Grey Vertical Ramp
  - Gray Horizontal Ramp
  - Gray diagonal ramp
  - Sensor Native Chess Board Pattern
  - Sensor Override Grey Horizontal Ramp
  - Sensor Override Grey Vertical Ramp
9. Vertical and horizontal image invert

### 9.3 Acquisition Control category

Acquisition Control			
1	Acquisition Start	Execute	<input type="checkbox"/>
	Acquisition Stop	Execute	<input type="checkbox"/>
2	Frame Rate	1,200.000000	<input type="checkbox"/>
3	Exposure Mode	Timed	<input type="checkbox"/>
4	Exposure Time	800.000000	<input type="checkbox"/>
5	Exposure Strobe Monitor Mode	Off	<input type="checkbox"/>
6	Exposure Strobe Monitor Invert	<input type="checkbox"/> False	<input type="checkbox"/>
	Trigger Selector	FrameStart	<input type="checkbox"/>
7	Trigger Source	LinkTrigger0	<input type="checkbox"/>
8	Trigger software	Execute	<input type="checkbox"/>

Figure 20 : Acquisition Control category

1. Acquisition can also be controlled through executing the relevant commands from the “Acquisition Control” category
2. The Frame Rate <sup>(1)</sup> can be adjusted in steps of 0.01Hz. The camera will modify the exposure time if needed to achieve the desired frame rate. The Exposure Time-Frame Rate dependency detailed below
3. Exposure Mode:
  - a. Timed – continues mode
  - b. Trigger Timed – timed exposure initiated by received trigger. The exposure duration is set according to the exposure time parameter
  - c. Trigger Width - timed exposure initiated by received trigger. The exposure duration is set according to the width of the current trigger width
4. Setting Exposure Time <sup>(2)</sup>. If the desired exposure time is longer than 1 / frame rate, the exposure time will be set to the maximum according to the frame rate (1/ frame rate)
5. External exposure strobe enable
6. External exposure strobe polarity selection
7. Trigger Source:
  - a. Link trigger 0 – the source of the trigger is the master fiber link.
  - b. Line 1 – the source of the trigger is the external RX I/O of the first RS232 connection
8. Trigger software

(1) Frame Rate [fps] - rate of output image frames. Defined in units of frames per second.

(2) Exposure Time [μsec] - time in microseconds (μsec) in which sensor is exposed to light. This time is subject to the specified image frame rate:

$$exposure = \frac{1,000,000}{frame\ rate}$$

Additional delays might be taken to consideration in calculation of maximum exposure, like delay between frames, etc.

### 9.4 ISP Features

1. Single line defected pixel correction
2. Flat filed compensation
3. Analog controls
  - a. White balance (Gain per color)
  - b. Black level correction
4. LUT
  - a. Gamma correction
  - b. General purpose LUT per color

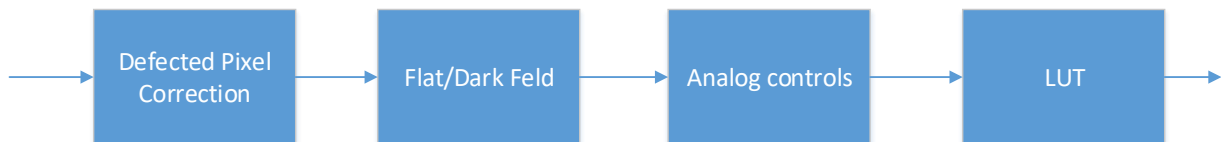


Figure 21 : ISP diagram flow

### 9.5 Pixel Correction Control

The defected pixel correction will correct up to 32 pixels in the sensor and up to 2 running pixels. The pixel correction coordinates represent pixels of sensor’s visible ROI, therefore identifying the correct X and Y coordinate should be done using default, full resolution image.

The Flat-field and Dark-field corrections are used to improve the quality of the image by removing the artifacts that are caused by fixed pattern noise and variations in the pixel-to-pixel sensitivity of the detector.

To make Dark/Flat field correction, two pictures should be taken. One with lens closed (offset should be boosted) and one with uniform illumination of around 40%.

The operator is per pixel and defined according to following formula:

$$\overline{P(x,y)} = Gain(x,y)[P(x,y) - P_{dark}(x,y)]$$

Where P(x,y) is the pixel at offset X in horizontal and Y in vertical. P<sub>dark</sub>(x,y) is the offset of the pixel at offset X in horizontal and Y in vertical that was measured during the calibration stage and Gain(x,y) is the gain of the pixel at offset X in horizontal and Y in vertical that was measured during the calibration stage.

This correction is valid for the specific camera settings and conditions (gain, exposure time, temperature etc.) which were selected during the calibration process.

Follow this steps to perform calibration process:

1. Prepare light source for specific calibration:
  - a. Dark field calibration: in this case, light should be blocked from the sensor. This can be achieved by covering the sensor with a solid cap.
  - b. Flat field calibration: in this case, uniform light should be applied across the sensor. This can be achieved by setting a uniform light source in front of the camera.
2. Select the “Calibration Mode” either “Dark” or “Flat”
3. Start camera’s stream either in free run or by applying an external trigger.
4. Initiate the selected calibration with “Field Calibration Start” command Execute.
5. NOTE that Flat field calibration should be performed after Dark field calibration has already be performed for the selected camera settings.

Pixel Correction Control			
1	Defect Pixel Correction Enable	<input type="checkbox"/> False	<input type="checkbox"/>
2	Defect Pixel Selector	0	<input type="checkbox"/>
3	Defect pixel X coordinate	-1	<input type="checkbox"/>
4	Defect pixel Y coordinate	-1	<input type="checkbox"/>
5	Defect Pixel Remove	Execute	<input type="checkbox"/>
6	Dark Field Correction Enable	<input type="checkbox"/> False	<input type="checkbox"/>
7	Flat Field Correction Enable	<input type="checkbox"/> False	<input type="checkbox"/>
8	Field Calibration Mode	Dark	<input type="checkbox"/>
9	Field Calibration Start	Execute	<input type="checkbox"/>

Figure 22 : Pixel Correction Control category

1. Enable the defected pixel correction
2. Selector of the defected pixel, in steps of 1, range from 0 to 31
3. The X coordinate of the selected defected pixel, in steps of 1, range from 0 to the maximum width of the full frame, minus 1 (i.e. 1919 for JetCam19)
4. The Y coordinate of the selected defected pixel, in steps of 1, range from 0 to the maximum height of the full frame, minus 1 (i.e. 1079 for JetCam19)
5. Remove the selected defected pixel entry
6. Enable the Dark filed correction
7. Enable the Flat filed correction
8. Selector of the calibration mode, Dark filed or Flat filed
9. Execution of calibration of the selected mode (available only when video is sent from the camera)

## 9.6 Analog Control category

$$\bar{P} = (P + BlackLevel) * Gain$$

Where P is the pixel that is being corrected, the Black Level is the offset of said pixel and the Gain is the gain of the pixel.

Analog Control			
1	GainSelector	DigitalAll	<input type="checkbox"/>
2	Gain	1.000000000000	<input type="checkbox"/>
3	Analog Gain	GainLevelx1	<input type="checkbox"/>
4	Black Level Selector	All	<input type="checkbox"/>
5	Black Level Value	0.000000	<input type="checkbox"/>
6	Analog Black Level	0.00000000	<input type="checkbox"/>

Figure 23 : Analog Control category

1. Selection of digital gain
  - a. Digital All – add gain to all the colors channels
  - b. Digital Red – add gain only to the red color channel
  - c. Digital Green – add gain only to the green color channel
  - d. Digital Blue – add gain only to the blue color channel
2. Digital Gain, in steps of 1/16384, range from 0 to (8 – 1/16384)



3. Analog Gain selection
4. Black level (offset) selection
  - a. All colors channels
  - b. Red color channel
  - c. Green color channel
  - d. Blue color channel
5. Digital Black Level, in steps of 1, range from -1023 to 1023
6. Analog Black Level, in steps of 1/256, range from -1.2 to 1.2

### 9.7 LUT control

The LUT should perform functionality such as gamma correction, it can be used to re-map the camera linear output in different manner. Mostly to compensate for the non-linear scene emission. Each index at the LUT corresponds to the pixel value and the LUT value at this index corresponds to the value that the pixels should be re-mapped to.

$$\overline{P(x,y)} = LUT[P(x,y)]$$

Where P(x,y) is the pixel at offset X in horizontal and Y in vertical.

LUT Control			
1	LUT Selector	Red	<input type="checkbox"/>
2	LUT Enable	<input type="checkbox"/> False	<input type="checkbox"/>
3	LUT Index	0	<input type="checkbox"/>
4	LUT Value	0	<input type="checkbox"/>

Figure 24 : LUT Control category

1. LUT color selection : Red, Green, Blue
2. LUT enable
3. LUT color index, in steps of 1, range from 0 to 1023
4. LUT color value, in steps of 1, range from 0 to 1023

## 9.8 User Set Control category

User Set Control			
1	▼ UserSetSelector	Default	<input type="checkbox"/>
2	Load User Configuration	Execute	<input type="checkbox"/>
3	Save User Configuration	Execute	<input type="checkbox"/>
4	User Set Default Selector	Default	<input type="checkbox"/>
	User Set Factory		<input type="checkbox"/>
5	User Memory Bulk Erase	Execute	<input type="checkbox"/>
6	▼ User Memory Page Selector	0	<input type="checkbox"/>
7	Save User Memory	Execute	<input type="checkbox"/>

Figure 25 : Saving camera parameter configuration

### 9.8.1 UserSet - save camera configuration

Eight user sets are available for saving different camera parameter configurations. In addition, a “Default” UserSet is available so it will be possible to revert back to default factory settings.

1. Selection between the different available user configuration  
 Default – Factory settings  
 UserSetX - Available user sets in non-volatile memory
2. Load the configuration of the selected user set
3. Save the configuration to the selected user set
4. Selection of the power up configuration

### 9.8.2 User Non-volatile Memory

Non-volatile memory is available for user usage. Data save to this memory space will not be erase upon camera power-down.

5. Execute an erase of the entire user memory on the camera
6. Selection of the memory page for saving
7. Execute a save to the selected memory page

Characteristics and restrictions:

1. Up to 65536 bytes can be saved into camera's non-volatile memory.
2. All data will be erased in 1 burst.
3. Data can be saved in bursts of 256 bytes each time. All 256 should be filled either with valid or padding data.
4. If data is loaded before erase operation is performed (1 time for all data), this data may be corrupted.
5. Data can be read at any time. (It is best not to read non-volatile memory while camera is streaming).
6. The access to non-volatile memory will be performed via GeniCam interface:  
Operation sequence.

The following function call sequence should be performed to achieve successful User Non-Volatile new memory save:

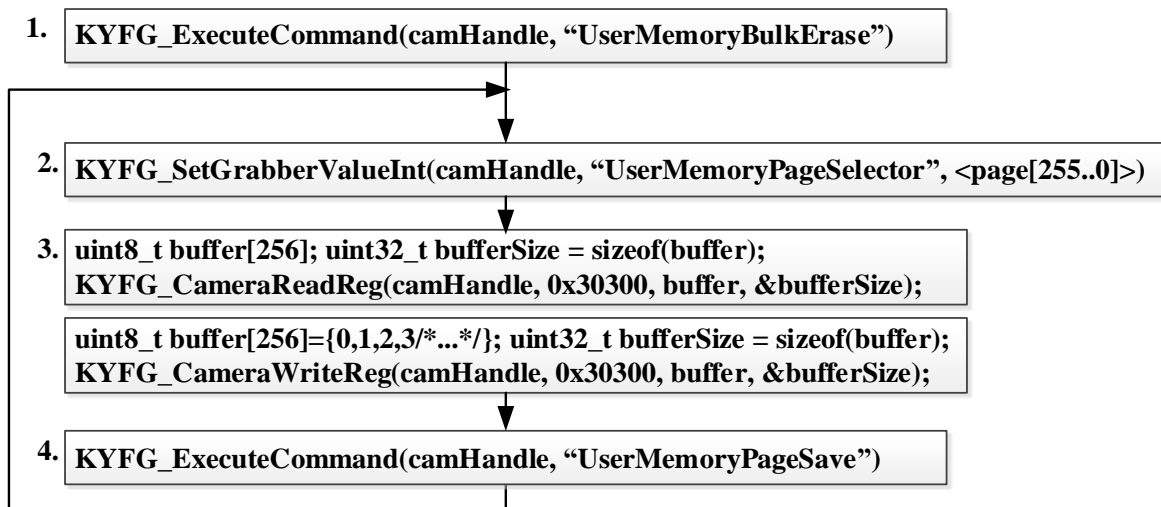


Figure 26 : Non-Volatile memory save function call sequence

1. "UserMemoryBulkErase" – erase all user non-volatile memory
2. "UserMemoryPageSelector" – select page[255..0] in memory (256 bytes for each page)
3. "UserMemoryPageAll" – array of 256 bytes to load data of specified page
4. "UserMemoryPageSave" – save selected page to non-volatile memory

## 10.1 Fiber cables

Optical fibers are widely used to permit transmission over longer distances and at higher bandwidths than other forms of communication. Fibers are used instead of metal wires because signals travel along them with less loss and are also immune to electromagnetic interference.

Fibers that support many propagation paths or transverse modes are called multi-mode fibers (MMF), while those that only support a single mode are called single-mode fibers (SMF). Multi-mode fibers generally are used for short-distance communication links and for applications where high power must be transmitted. Single-mode fibers are used for most communication links longer than 300 meters (1,200 ft.).

## 10.2 Optional peripheral add-ons

The JetCam can be connected to a Canon Birger lens control module that can be purchased and that can be controlled using JetCam's virtual communication port. Here is a brief explanation on how to make those connections and use Birger's lens control:

1. Power down the camera.

Connect the Birger adaptor to the Canon lens and to the camera via the GPIO connector.  
Connect the fiber cables and the USB cable and power up the camera.



Figure 27 : Camera with optional Birger adaptor

2. Open Vision point software and detect the camera.
3. After the camera was detected, under "Cameras" -> "Device Control" -> Serial Port Selector" select "RS232 0" and set the "Serial Port Buad Rate" to 115200.

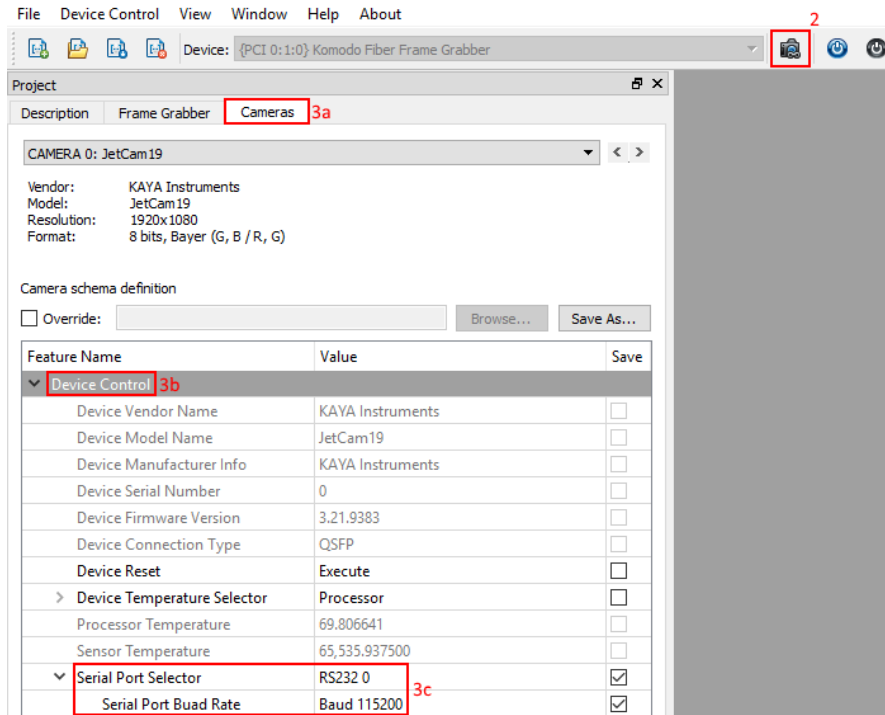


Figure 28 : Serial port setup at camera side

4. Under "Frame grabber" -> Extended Stream Features" -> "Camera selector 0" -> "Device Serial Port Control", set the "Serial Port Selector" to "PeripheralGPIO\_0", Set the "Serial Port Number" to any non-zero value and check the box next to "Serial COM Port Enable".

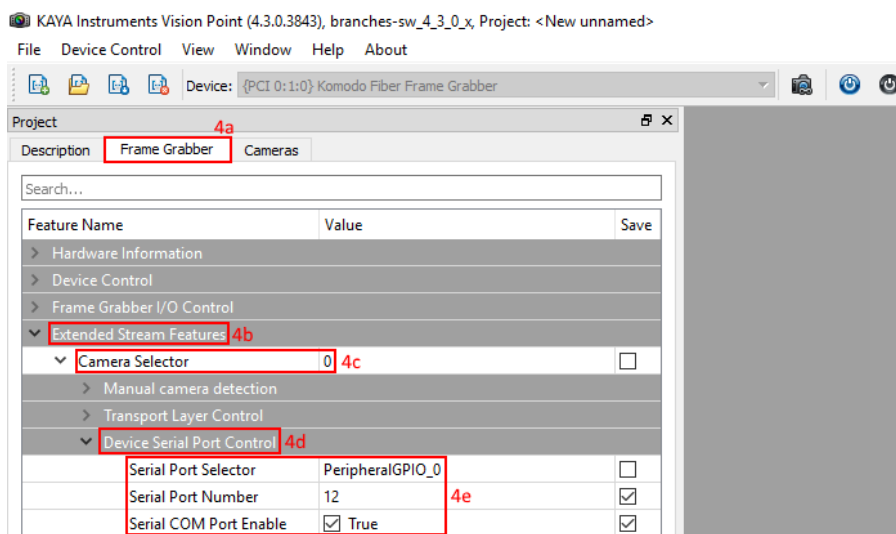


Figure 29 : Serial port setup at FG side

- Download and install the Birger software (BEI device interface) from the following [link](#). Open the BEI device interface software, select "File" -> "Preferences..." and make sure that in the bottom window ("Select the ports to ignore...") you see "JetCam X: RS232 0 (COM Y)", where X is the JetCam model and Y is the com port selected in the previous section (4e). Do not select anything in this window and click on "Cancel".

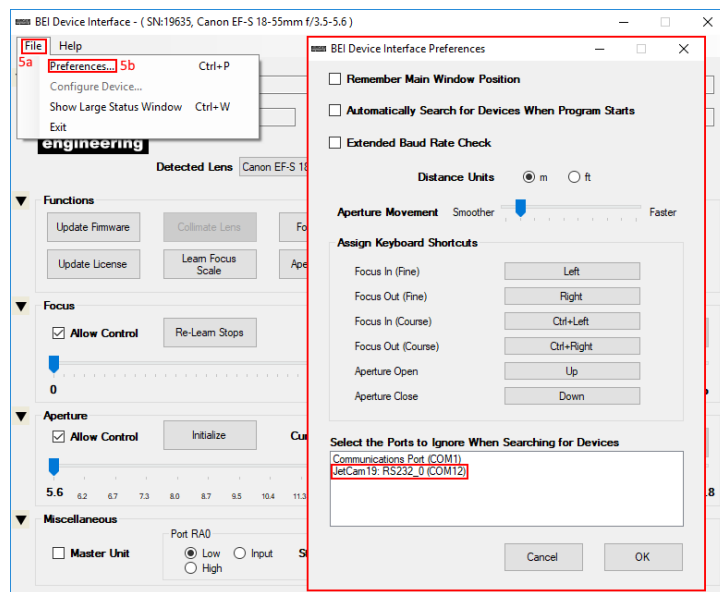


Figure 30 : Birger GUI setup 1

- Click on "Find BEI Device" and after a few moments you should see the lens properties.

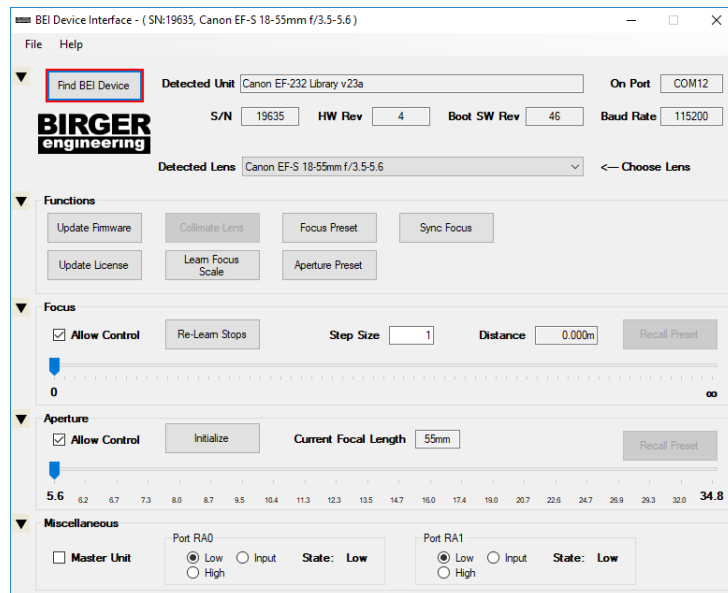


Figure 31 : Birger GUI setup 2

Item name	Item part number
JetCam Camera	JetCam 13/19/25/160
Komodo Fiber Frame Grabber	KY- FGF
QSFP+ - single-mode module	KY- QSFP-40G85
QSFP+ - multi-mode module	KY- QSFP-SR4-40G
QSFP+-CWDM single-mode module	KY-QSFP-10-CWDM
QSFP+ MTP/MPO single-mode Fiber cable X m	KY-FCA-MTP-SM
QSFP+ MTP/MPO multi-mode Fiber cable X m	KY-FCA-BO-MTP-MM
QSFP+ to SFP+ Fiber breakout cable	KY-QSFP-BRKT-MM/SM
Power supply 12V	KY-PWR12

Table 7 : Ordering Information

International Distributor



Sky Blue Microsystems GmbH  
 Geisenhausenerstr. 18  
 81379 Munich, Germany  
 +49 89 780 2970, info@skyblue.de  
 www.skyblue.de