JetCam

High Speed Camera User Guide

(Part-No. KY-JetCam)

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Revision History

Version	Date	Notes
0.1	13/3/207	Initial Release
0.2	3/8/2017	Added GPIO connector support

3.1 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.

3.2 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.

4 Key Features

4.1 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.

4.2 Areas of Application

This camera is ideally suited for:

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

4.3 Features

- 40 Gbps fiber optic interface
- Up to 10Km 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

4.4 Product Applications

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

4.5 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

5.1 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 10km 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.

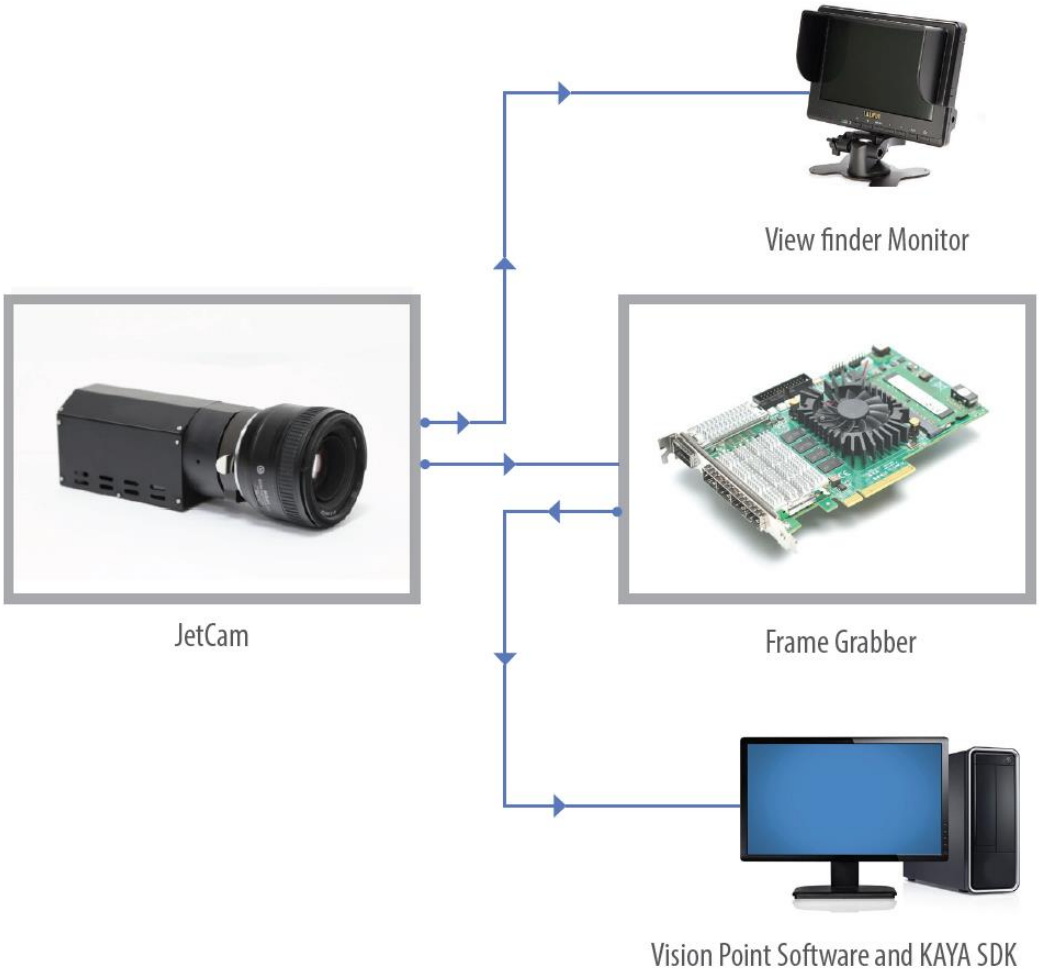


Figure 1 : JetCam Camera system structure diagram

5.2 JetCam Camera available models

Type	JetCam19	JetCam25	JetCam160
Pixel size	10µm	4.5µm x 4.5µm	3.9µm 5T shutter pixel with CDS
Sensor resolution	1952 (H) x 1088 (W)	5120 (H) x 5120 (W)	4736 (H) x 3424 (W)
Effective Resolution	1920 (H) x 1080 (W)	5120 (H) x 5120 (W)	4704 (H) x 3424 (W)
Sensor	LUX19HS	PYTHON 25K	LUX160
Optical Format	4/3”	APS-H	4/3”

Video output	Fiber interface up to 40 Gbps, CoaXPress up to 25 Gbps, CLHS up to 40 Gbps, 10GiGE up to 10Gbps	Fiber interface up to 40 Gbps, CoaXPress up to 25 Gbps, CLHS up to 40 Gbps, 10GiGE up to 10Gbps	Fiber interface up to 40 Gbps, CoaXPress up to 25 Gbps, CLHS up to 40 Gbps, 10GiGE up to 10Gbps
Frame rate	2400 fps @8bit resolution 1920 fps @10bit resolution	82 fps	300+ fps
Electronic shutter	Global shutter	Global shutter	Global shutter
Responsivity at 550 nm	20V/Lux.s (at 500nm)	5.8 V/lux.s	TBD
Conversion Gain	TBD	0.085 LSB10/e-, 130 V/e-	TBD
Temporal Noise	10 e-	< 14 e- (Non−Zero ROT, 1x gain)	TBD
Parasitic Light Sensitivity (PLS)	TBD	< 1/5000	TBD
Full Well Charge	15000 e-	> 12000 e-	TBD
Dynamic range	63dB	59 dB	TBD
Signal-to-Noise Ratio (SNR max)	39dB	41 dB	TBD
Quantum Efficiency (QE) X FF	>45% (at 550 nm)	50% at 550 nm	TBD
Pixel FPN	4 mV rms	< 0.9 LSB10	TBD
PRNU	<1.5% rms	< 1%	TBD
Shortest Exposure	1us	TBD	TBD
Image acquisition	Continuous / Triggered	Continuous / Triggered	Continuous / Triggered
Output resolution	8 or 10 bit	8 or 10 bit	8 or 10 bit
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)
Weight (without lens)	1260g	1260g	1260g
Power consumption	<12W	<12W	<12W

Operating temperature	0°C to 50°C (Optional -40°C)	0°C to 50°C (Optional -40°C)	0°C to 50°C (Optional -40°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
On camera processing	• Defect pixel correction • White balance • ROI • Image flip • Frame counter • Flat field correction • LUT • Gain (Analog / Digital) • Auto black level • Nonvolatile storage	• Defect pixel correction • White balance • ROI • Image flip • Frame counter • Flat field correction • LUT • Gain (Analog / Digital) • Auto black level • Nonvolatile storage	• Defect pixel correction • White balance • ROI • Image flip • Frame counter • Flat field correction • LUT • Gain (Analog / Digital) • Auto black level • Nonvolatile storage
Programmable I/O	2x RS232 (RS485 and custom optional)	2x RS232 (RS485 and custom optional)	2x RS232 (RS485 and custom optional)
Lens control (optional)	• Fujinon lens control • Custom lens through RS232/RS485	• Fujinon lens control • Custom lens through RS232/RS485	• Fujinon lens control • Custom lens through RS232/RS485
Complimentary video output	3G SDI	3G SDI	3G SDI

Table 2 : JetCam Camera Models

6.1 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 availably 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.

6.2 Installation instructions

The typical *JetCam* system is connected as described in Figure 2:

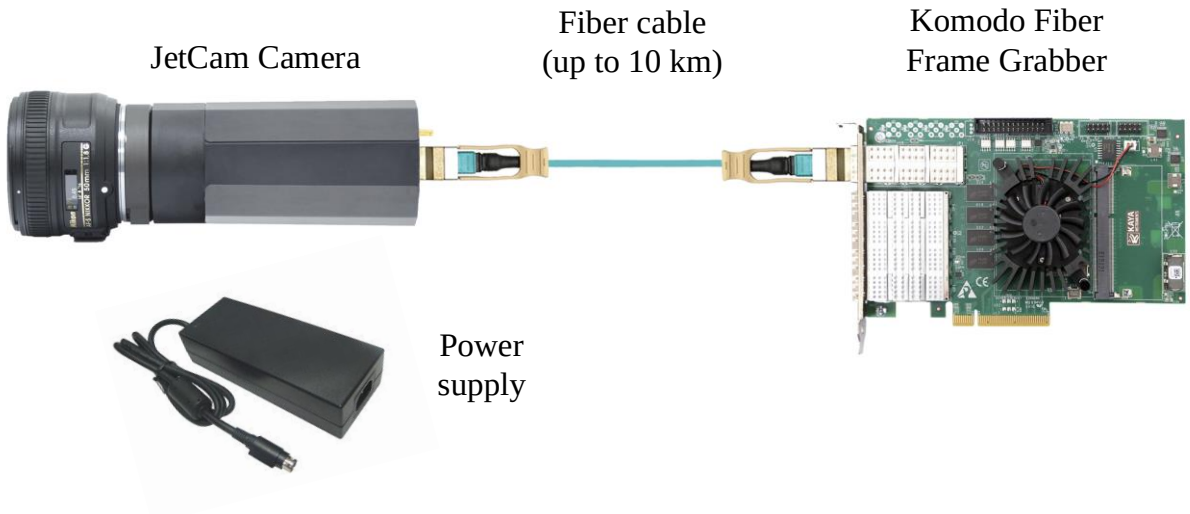


Figure 2 : JetCam Camera system connection diagram

The first stage of the system installation is Komodo board installation as described in section 6.2.1 below. The second stage is connection of the camera as described in section 6.2.2.

6.2.1 Komodo board installation

Before system installation the Komodo board should be installed into the host computer. Komodo board 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: Board should be installed before you install your software.

1. Before installing, turn off the power of the computer and its peripherals.
2. Firmly insert the Komodo board to PCIe connector of the motherboard.
3. Anchor the PCIe bracket to the computer chassis using M3 screw.
4. Verify the Komodo board inserted correctly to the PCIe slot.
5. Power up the computer.
6. 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 the compatible drivers for Komodo board will be installed during installation of Vision Point App software.

You can install and use multiple Komodo boards in a single computer.

The number of Komodo boards 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.

6.2.2 Completing the JetCam installation

In order to properly complete the JetCam system installation, the following steps must be taken for initial power up:

a. Make sure there is no dirt or any other foreign matter inside the QSFP+ module, or blocking any of the connectors.
b. Make sure that the male connectors on the QSFP+ module will align with the female connectors inside the cage.
c. Insert the QSFP+ modules into the ***JetCam Camera and Komodo Fiber board*** and close the locking mechanism (*).

d. Connect the fiber cables as described in Figure 2.

   Connect the Power Adaptor to the ***JetCam*** power supply connector. The ***JetCam*** requires 12V power supply for proper function for camera. Please, refer **section 7.1.2** of this document for exact Power Supply requirements.

e. Turn on the camera and the frame grabber on and start your application software.

The system supports the following QSFP+ modules:

Module	Description	P/N	Compatible Cable
	Single mode fiber QSFP+ Allows of up to 10km connection over single mode fiber cable (8 cores)	KY-QSFP-10	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

NOTE:

To remove the QSFP+ module, first remove the fiber cable connected to it, then gently pull the QSFP+ module's locking mechanism (see Figure 3 and Figure 4) and remove module.

Please contact KAYA representative for details of those options.

Figure 3 : QSFP+ Module with fiber cable inserted

Figure 4 : QSFP+ Module's locking mechanism

NOTES:

1. A fiber cable should match the QSFP+ type. If a single mode QSFP+ is used a single mode fiber (yellow) should be used with it. If a multi-mode QSFP is used a multi-mode fiber (orange) should be used.
2. The Fiber cable is connected between TX output (marked with TX or Arrow outwards the QSFP+) on JetCam unit and RX input (marked with RX or Arrow inwards the QSFP+) on Komodo Fiber frame grabber.
3. If more than a single cable is used to connect to the same Frame Grabber, the cables must be of the same type and length.

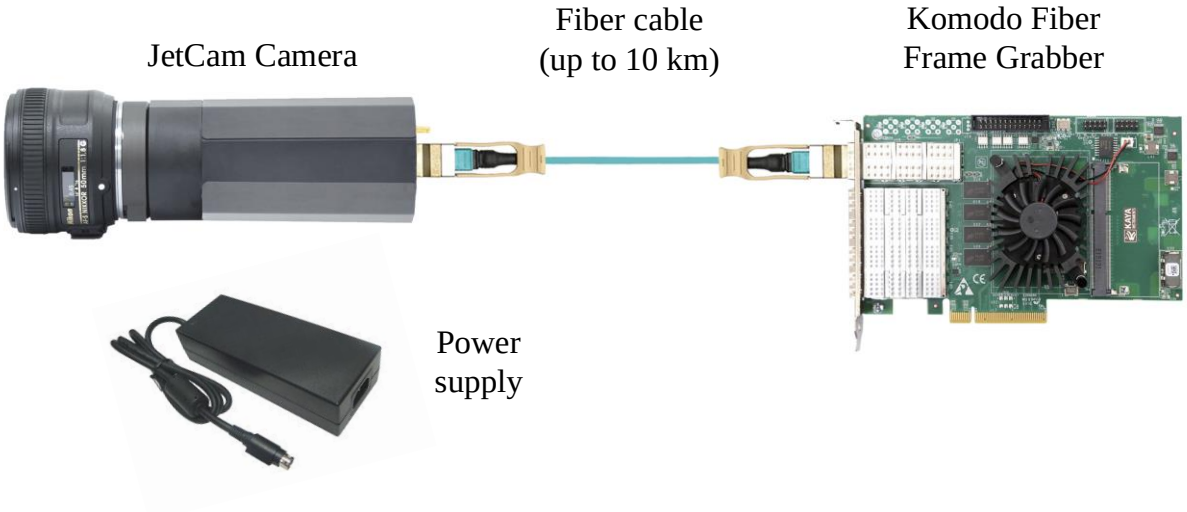


Figure 5 : JetCam Camera connection example

7.1 JetCam unit Hardware Reference

This section provides information on JetCam camera unit hardware. It covers architecture, features and pin assignments for various connectors.

7.1.1 JetCam unit LEDs

The JetCam unit has several status LEDs, as seen in Figure 6.

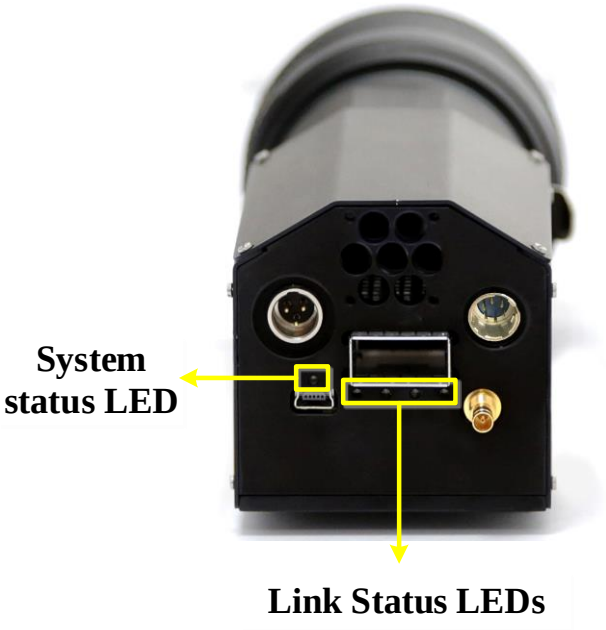


Figure 6 : JetCam camera status LEDs

The System status LED, located on the back, always slow pulses in green while the system is ON. While in firmware update mode, this LED slow pulses orange. In any case of system failure, the LED will constantly light orange.

The QSFP+ LED's behavior is described in Table 4:

LED state	Condition
Fast flash red	QSFP+ is unplugged
Solid red	QSFP is not compatible
Slow pulse red	No signal detected on optic fiber
Fast flash green	Link speed is being negotiated
Solid green	Link is active

Table 4 : QSFP+ status LEDs behavior

7.1.2 JetCam Power Connector

The JetCam unit requires 12V power supply for proper function. Please, refer to Electrical specification section of this document for exact Power Supply requirements.

The positive pin of the power supply connected to the right pin of the connector, shown as "+", the negative pin connected to the left pin of the connector, shown as "-". The power connector is shown in Figure 7.

Figure 7 : 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.

7.1.3 SDI Interface connector

The JetCam camera supports SMPTE 424M interface standard, 3G-SDI (high-definition serial digital interface) video stream, for digital video transmission over a single-link coaxial cable. The data transmission speed of the system is at 3 Gbps.

- SMPTE 424M standard
- Supports 3G-SDI with a resolutions of 1080p60
- Single-link standard coaxial 75-ohm cable
- Streams serial digital video
- 10-bit YCrCb 4:2:2 encoding

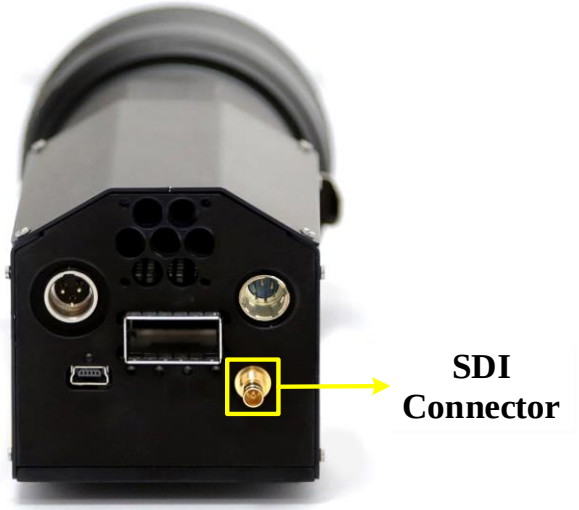


Figure 8 : JetCam camera SDI connector

7.2 JetCam Serial connector

The JetCam cameras configuration is possible via USB using a serial emulated terminal. The USB connector is shown in Figure 9.

Figure 9 : JetCam camera USB connector

7.3 JetCam GPIO connector

The JetCam cameras have a GPIO connector that can be used by the user for various purposes.

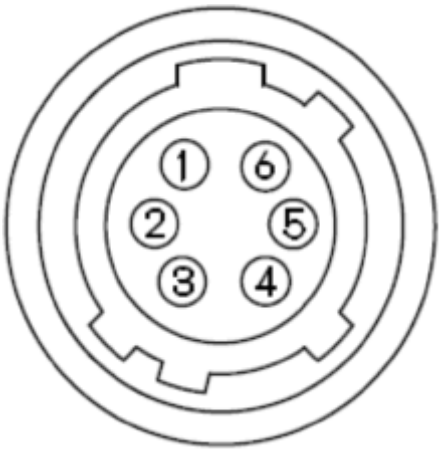
Figure 10 : JetCam camera USB connector

The following table describes the pin out of the Hirose 6 pin connector:

Pin number	Pin description
1	GND
2	RS232 TX1
3	RS232 RX1
4	RS232 TX2
5	RS232 RX2
6	5V (output)

Table 5 : GPIO connector pin out

A HR 10 A - 7 P - 6 S (Hirose Electric) or equivalent should be used on the cable side:



7.4 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
	**Nikon F-mount** three-lug bayonet mount with a 44 mm throat and a flange to focal plane distance of 46.5 mm.
	**Canon EF-mount** short flange focal distance of 44.0 mm
	**PL-mount** Four pronged flanges, each contain a notch towards the center, with a 52.00 mm Flange focal distance.
	**B4-mount** Flange focal distance of 48 mm

Table 6 : JetCam supported mount models

7.5 Mechanical dimensions

The exact device mechanical dimensions are as defined in Figure 11.

For more detailed information please, contact KAYA Instruments representative.

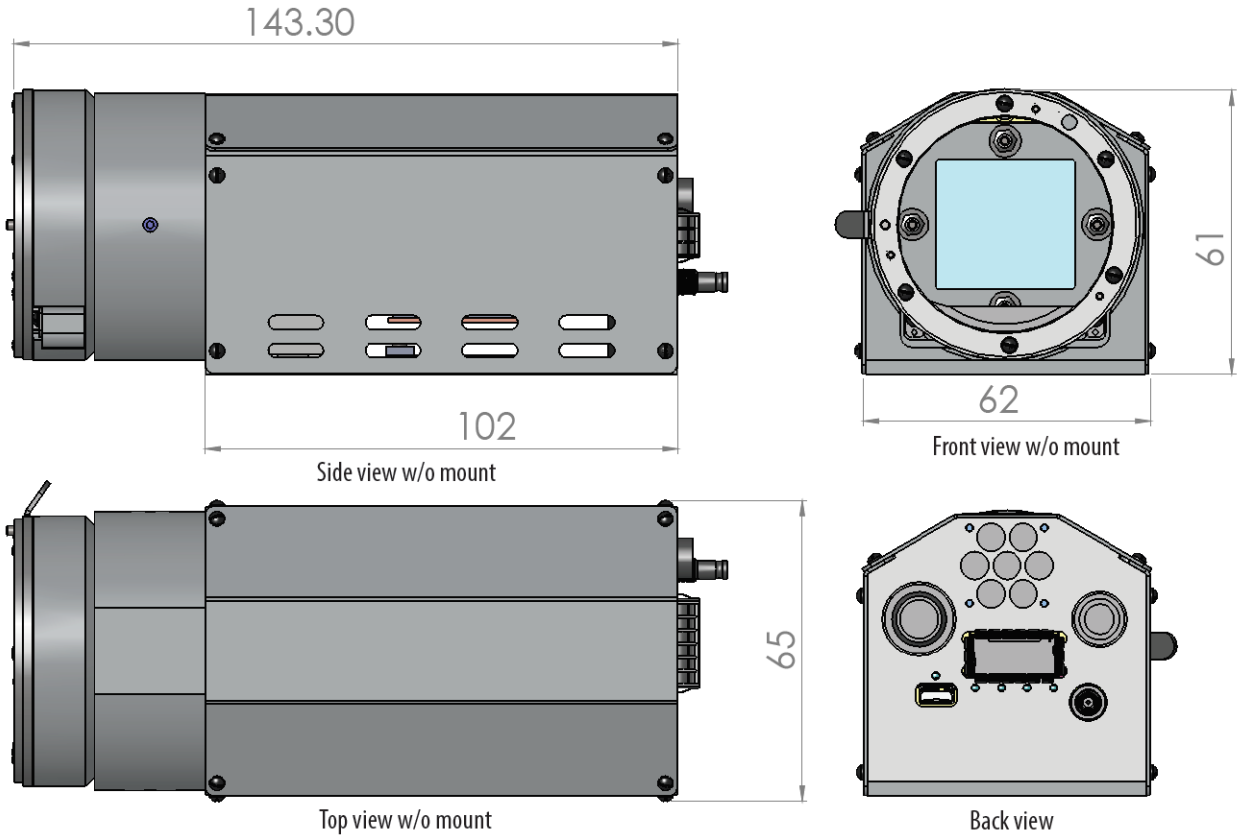


Figure 11 : JetCam Mechanical Dimensions

7.6 Komodo Fiber indication LEDs

Komodo Fiber is equipped with indication bi-color LED for each QSFP+ and SFP+ channel. The LEDs' different states and behavior are described in Table 7.

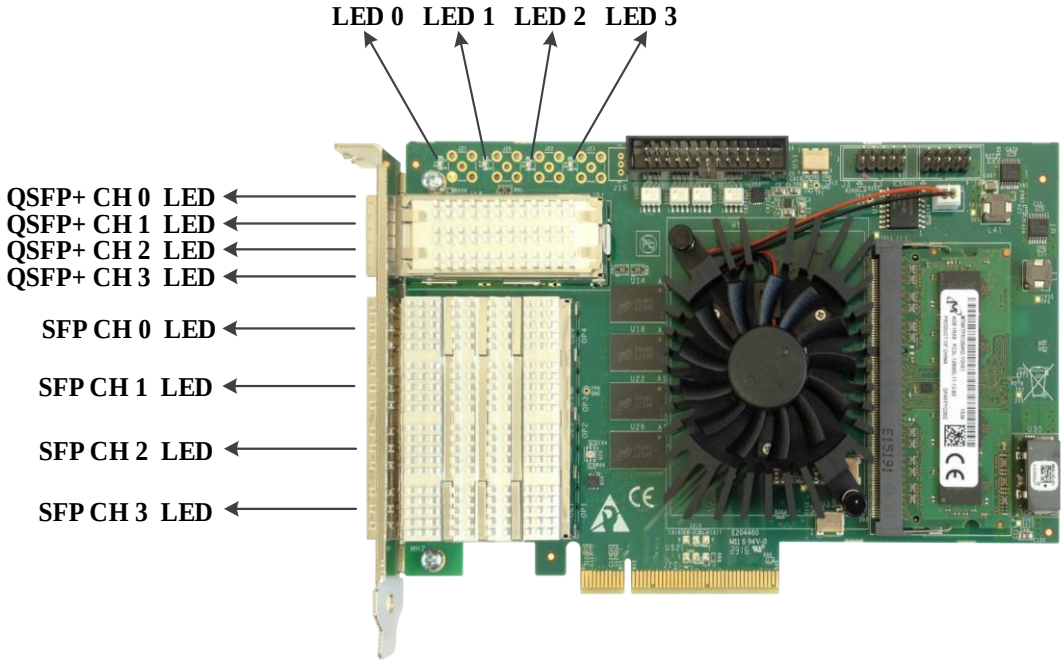


Figure 12 : Komodo Board LED's locations

LED state	Description
Solid orange	System is not initialized
Slow pulse red	No camera is connected
Fast flash alternate green / orange	Connection detection in progress
Fast flash orange	Connection detection in progress
Solid red	TBD
Solid green	Camera is connected, no data being transferred
Slow pulse orange	Camera connected. Waiting for trigger event
Fast flash green	Camera connected , data is being transferred
Slow flash alternate green / orange	Connection test packets being sent

Table 7 : Komodo Fiber links status LED's

In additional to SFP+ and QSFP+ links LEDs, the Komodo Board is equipped with status LEDs, their functionality is described in Table **8**.

LED #	Description
LED 0	Alive led. Blinks when the board receives clock from PCIe
LED 1	PCIe L0 state. When lit, indicates that the PCIe interface is powered up at active state.
LED 2	Gen3 PCIe indicator. When lit indicates that PCIe is working as Gen3. When not lit the boards works either as PCIe Gen1 or Gen2
LED 3	Lane's indicator. When lit, indicates that all 8 PCIe lanes are up. If not lit, one or four lanes are up.

Table 8 : Komodo Fiber board status LED’s

8.1 Absolute maximum ratings

Specification	Values
12V power supply	-0.3V to 14V
Storage temperature	-55°C to 125°C
Operating ambient temperature	0°C to 50°C (-40°C optional)

Table 9 : Absolute maximum ratings

8.2 Absolute maximum ratings for GPIO

Specification	Minimum voltage [V]	Maximum voltage [V]
RS232	-0.3	5.5

Table 10 : Absolute maximum ratings for GPIO

8.3 Operating conditions

Parameter	Description	Minimum	Typical	Maximum
12V V_{cc}	12V Supply voltage	11.04V	12V	12.96V
12 I_{cc}	Supply Current from 12V	-	2A	-

Table 11 : operating conditions

Symbol	Parameter	Test condition	MIN	MAX	Units
V_{IH}	Input High Voltage	$V_{OUT} \geq V_{OH\ (min)}$ or	2.4	3.6	V
V_{IL}	Input Low Voltage	$V_{OUT} \leq V_{OL\ (max)}$	0	0.8	V
I_{IN}	Input Current	V_{IN} = 0 V or V_{IN} = V_{DD}		±5	µA

Table 12 : RS232 specifications

Symbol	Parameter	Test condition	MIN	MAX	Units
V_{OH}	Output High Voltage	V_{DD} = min, I_{OH} = -2 mA	2.4		V
V_{OL}	Output Low Voltage	V_{DD} = min, I_{OL} = 2 mA		0.4	V

Table 13 : RS232 output specifications

9.1 Getting Started

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

9.2 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 14:

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

Table 14 : 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 9.3 chapter for firmware update information
Status	Prints the system and individual link status and general information

Table 15 : Terminal commands

NOTE: The commands are not case sensitive.

9.3 JetCam Firmware update

The JetCam Cameras supports firmware update via USB using a serial emulated terminal. The Serial connector is shown in Figure 13.

To initiate a firmware update follow the next steps:

1. 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).
2. Open serial emulated terminal (usage of Tera Term terminal is recommended) and set serial communication protocol as described in the Table 14.
3. 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:"
4. 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).

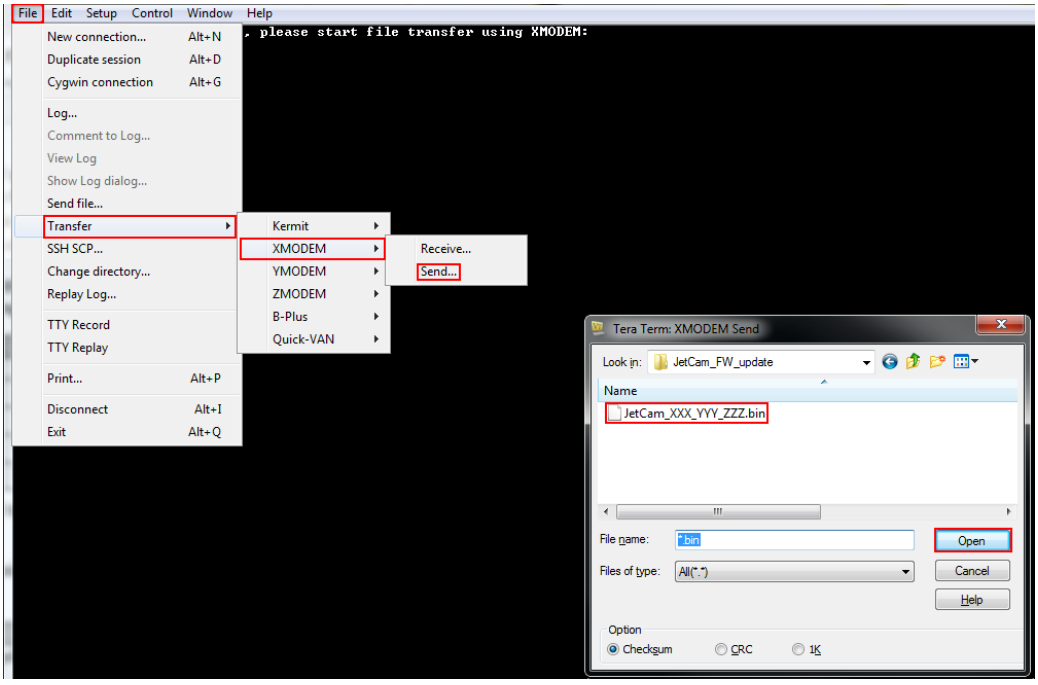


Figure 13 : Firmware terminal initiation

5. 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.
6. The firmware update process will take about 10 minutes.
7. A successful update will result in an appropriate message
8. To apply the new firmware, the camera should be power cycled.

9.4 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:

1. Selecting a grabber board
2. Opening, creating and closing a project
3. Adjusting the grabber parameters
4. Scanning and adjusting the camera parameters
5. 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 14.

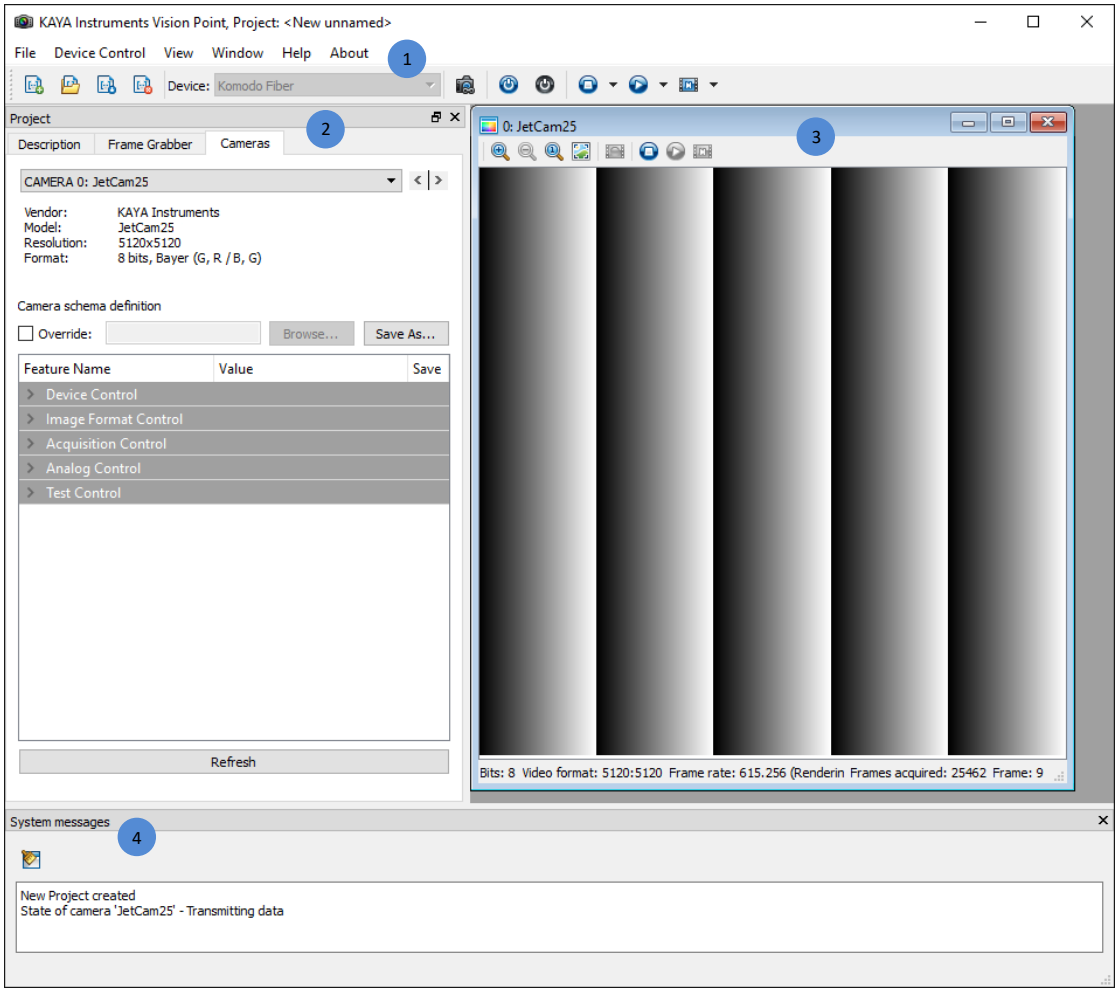


Figure 14 : Vision Point App main window

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.

9.5 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 15.

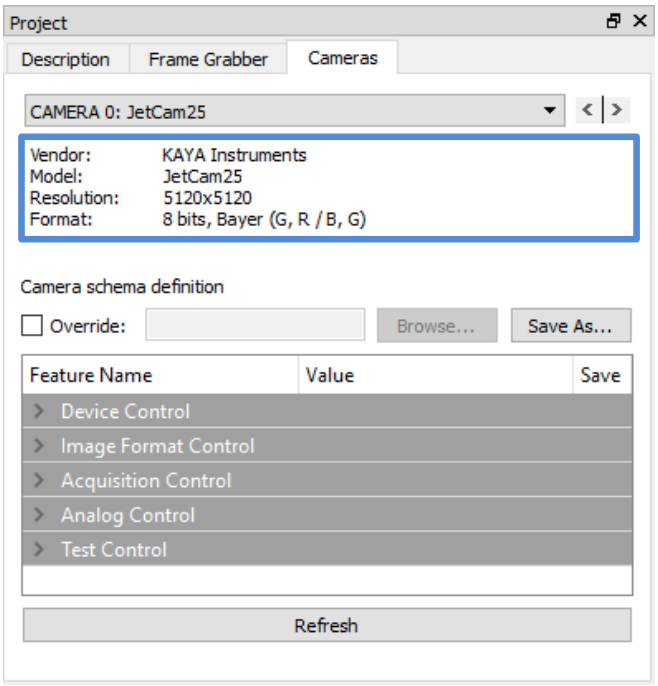


Figure 15 : JetCam description parameters

9.6 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.

9.7 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.

9.8 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”.

9.9 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”.

9.10 Adjusting camera XML

JetCam camera uses a native XML. In order to adjust the JetCam parameters to users preferences, cameras native XML file should be saved **first**. Now adjustments can be made. Make sure to save the adjustments under different project name, to prevent erasing the native JetCam configurations.

Saving certain JetCam camera parameters, images and video buffer is possible, using the (“Save”) toolbar button or click “Save” or “Save As…” in the “File” menu.

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.

10.1 Device Control category

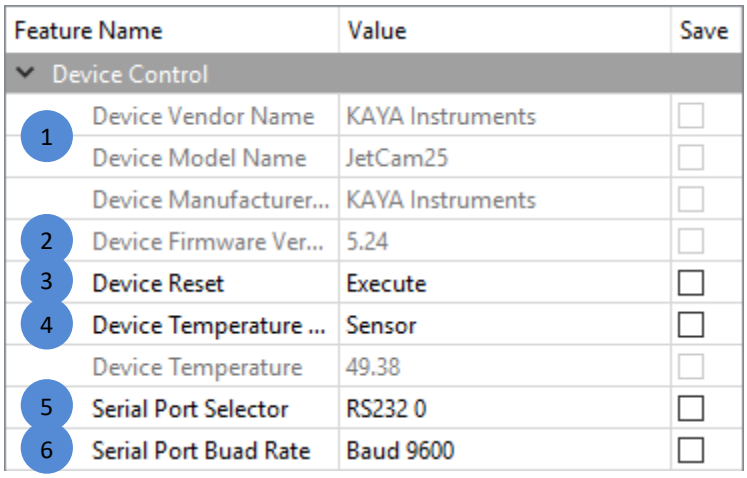


Figure 16 : Device Control category

1. “Device Control” shows camera vendor, JetCam model and manufacturer.
2. Device Firmware shows the current JetCam firmware.
3. Device Reset executes reset procedure to the JetCam device.
4. Device Temperature can be switched between Processor and Sensor. The device temperature displayed below, in accordance with the chosen device.
5. Serial Port Selector.
6. Serial Port Baud Rate.

10.2 Image Format Control category

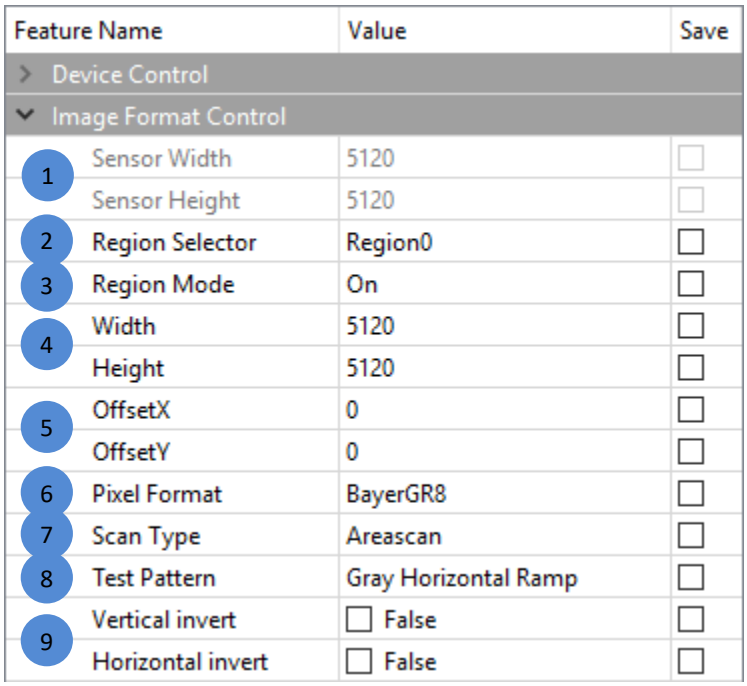


Figure 17 : Image Format Control category

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 two available options: Grey Vertical Ramp and Gray Horizontal ramp.
9. Vertical and horizontal image invert.

10.3 Acquisition Control category

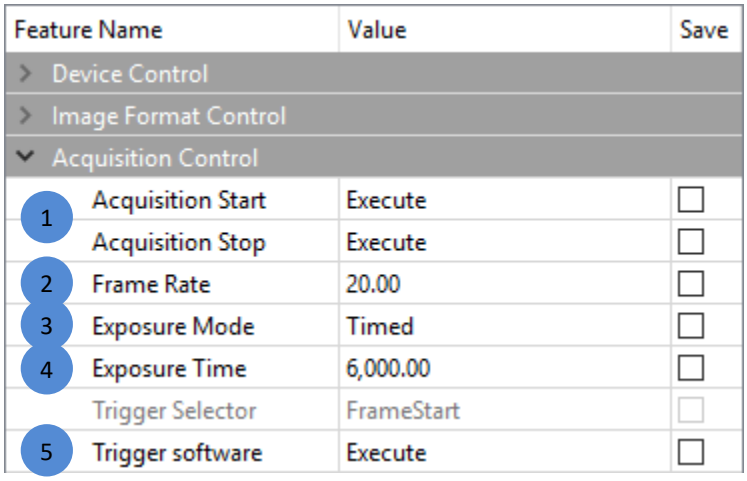


Figure 18 : Acquisition Control category

1. Acquisition can also be controlled trough executing the relevant commands from the "Acquisition Control" category.
2. The Frame Rate (1) 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.
4. Setting Exposure Time (2). 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. Trigger software.

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

(2) Exposure Time [usec]- time in microseconds (usec) 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.

10.4 Analog Control category

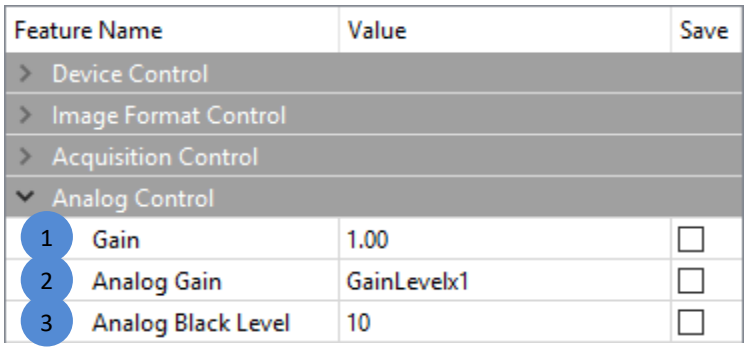


Figure 19 : Analog Control category

1. Gain
2. Analog Gain
3. Analog Black Level

11.1 Color Filter Array

The JetCam 25 color sensor is processed with a Bayer RGB color pattern as shown in Figure 19. Pixel (0, 0) has a red filter situated to the bottom left. Green1 and green2 have a slightly different spectral response due to (optical) cross talk from neighboring pixels. Green1 pixels are located on a green-red row, green2 pixels are located on a blue-green row.

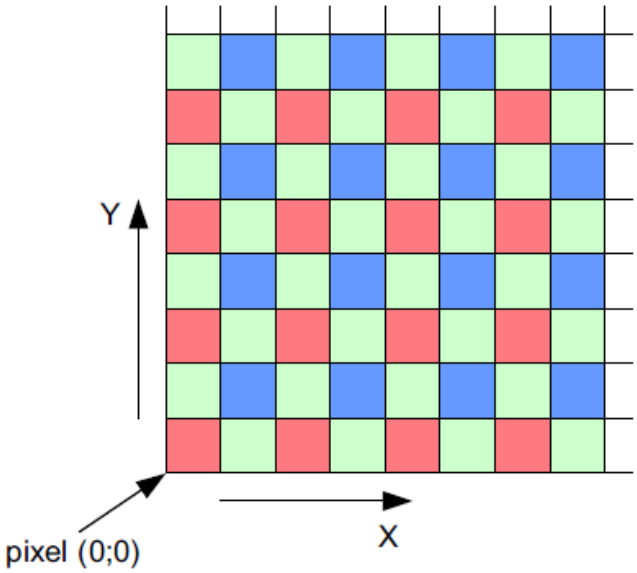


Figure 20 : Color Filter Array for the Pixel Array

Similarly, the JetCam 19 color sensor is processed with a Bayer RGB color pattern, but the Bayer type is GBRG in this case. Pixel (0, 0) has a green filter and in the same row there is a blue filter. On the other row there is a red filter and another green filter next to it.

11.2 Quantum Efficiency

The following figures show the quantum efficiency of the JetCam 25 camera:

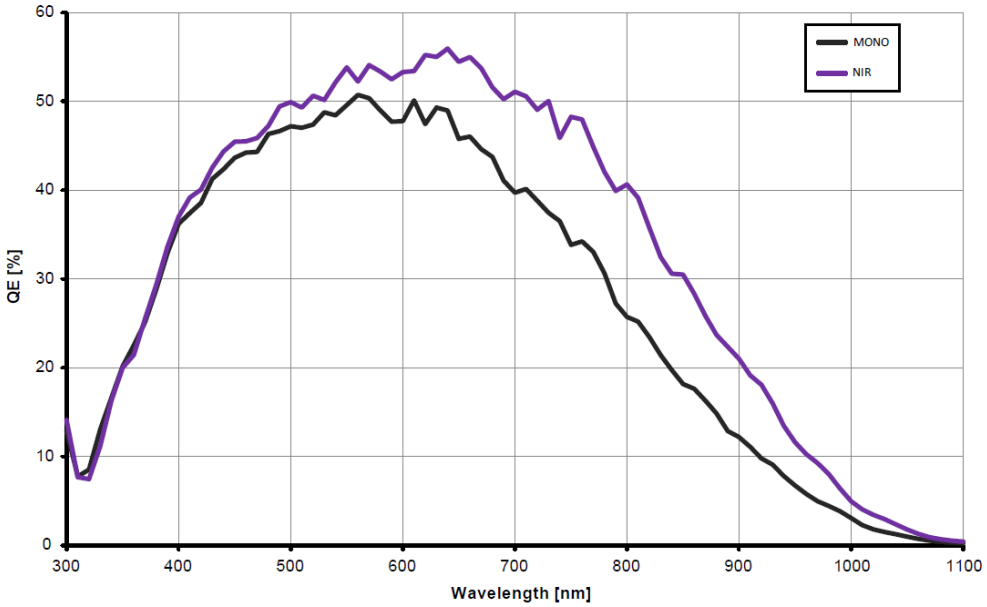


Figure 21 : JetCam 25 Quantum Efficiency Curve for Mono and Color

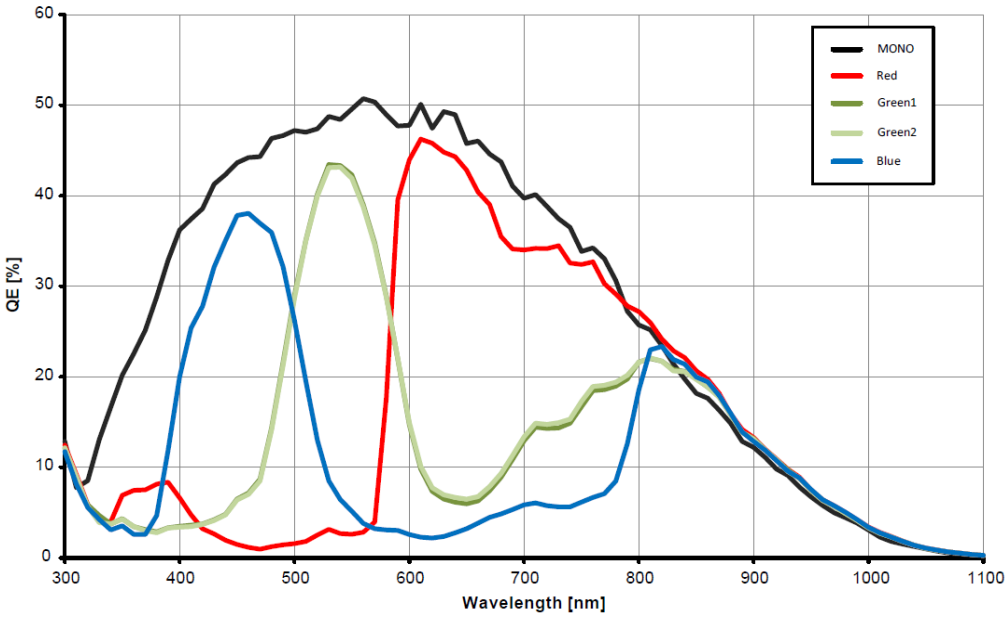


Figure 22 : JetCam 25 Quantum Efficiency Curve for Standard and NIR Mono

The following figures show the quantum efficiency of the JetCam 19 camera:

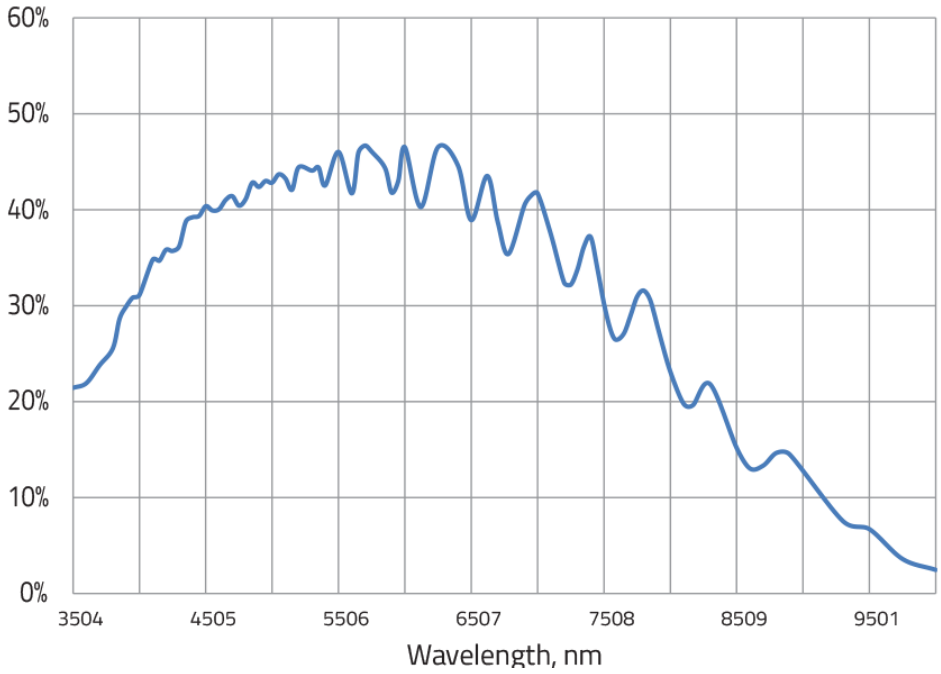


Figure 23 : JetCam 19 Quantum Efficiency Curve for Mono

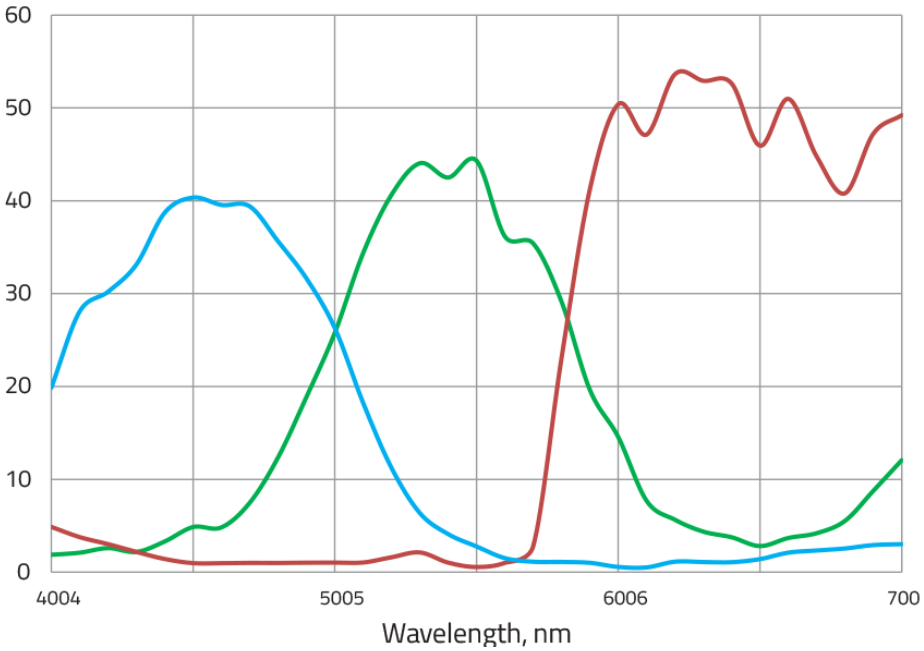


Figure 24 : JetCam 19 Quantum Efficiency Curve for Color

12.1 Features

1. Single line dead pixel correction
2. Flat filed compensation
3. Analog controls
    a. White balance (Gain per color)
    b. Black level correction
    c. Auto black level
4. LUT
    f. Gamma correction
    g. General purpose LUT per color

The ISP will be per single fiber channel and will accept 4 pixels in parallel. Each ISP should have its CSR and be as a closed unit with Avalon interfaces.

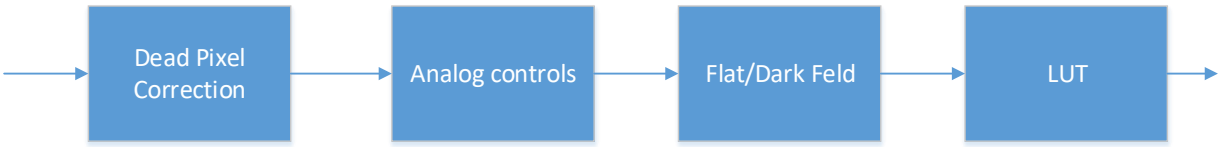


Figure 25 : ISP diagram flow

Group	Name	Description
Analog Controls	OffsetAutoEnable	Enables auto black pixel subtraction, 3 Modes: 0 - Disabled 1 - Once 2 - Continuous

Table 16 : ISP HW registers

12.2 Single line dead pixel correction

The dead pixel correction will correct up to 32 pixels in the sensor and up to 2 running pixels.

The GeniCam interface for this feature is described below:

Name	Interface	Values	Description
DefectPixelSelector	IEnumeration	0-31	Selects dead pixel to control
DefectPixelX[DefectPixelSelector]	IInteger	-1 to SensorWidth	X coordinate -1 to disable
DefectPixelY[DefectPixelSelector]	IInteger	-1 to SensorHeight	Y coordinate -1 to disable
DefectPixelCorrectionEnable	IBoolean		Enable defect pixel correction

Table 17 : Pixel Correction GeniCam names

The camera will re-calculate the pixel coordinates according to sensor mirror options, sort the coordinates in ascending order and write them to hardware memory. It will also specify the total number of pixels to be corrected.

12.3 Flat field

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%.

There will be TBD tables stored in the camera (For each gain, temperature, etc,).

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

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

The GeniCam interface for this feature is described below:

Name	Interface	Values	Description
Calibration	Icategory		
DarkFieldCorrectionEnable	IBoolean		
FlatFieldCorrectionEnable	IBoolean		

Table 18 : Field Correction GeniCam names

12.4 Analog controls

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

The GeniCam interface for this feature is described below:

Name	Interface	Values	Description
AnalogControl	Icategory		
GainSelector	IEnumeration	DigitalAll DigitalRed DigitalGreen DigitalBlue	Selects digital gain to control
Gain [GainSelector]	IFLoat		Specifies the gain. The gain written to register is GainAll*GainX, where X is the color
AnalogGain	IEnumeration	1 2 4 8	Analog gain.
BlackLevelSelector		DigitalAll DigitalRed DigitalGreen DigitalBlue AnalogAll	Selects black level to control
BlackLevel [BlackLevelSelector]	IFloat	-1024 to 1024	Controls the DC offset applied to each channel. The value written to register will be All+Color. If selected AnalogAll the control is done with VOFF + VOFF invert bit in SSI
BlackLevelAuto	IEnumeration	Off DigitalOnce DigitalContinuous AnalogOnce AnalogContinuous	

Table 19 : Analog controls GeniCam names

12.5 LUT

The LUT should perform functionality such as gamma correction.

The GeniCam interface for this feature is described below:

Name	Interface	Values	Description
LUTControl	ICategory		
LUTSelector	IEnumeration	Red Green Blue	
LUTEnable[LUTSelector]	IBoolean	True False	
LUTIndex[LUTSelector]	IInteger	0-1023	
LUTValue[LUTSelector][LUTIndex]	IInteger	0-1023	
LUTValueAll[LUTSelector]	IRegister		

Table 20 : LUT GeniCam

13.1 Fiber cables

Optical fibers are widely used to permits 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.).

14.1 Ordering information

Item name	Item part number
JetCam Camera	JetCam19/25/160
Komdo Fiber Frame Grabber	KY- FGF
QSFP+ single-mode module	KY-QSFP-10
QSFP+-CWDM single-mode module	KY-QSFP-10-CWDM
QSFP+ multi-mode module	KY-QSFP-3M
QSFP+ MTP/MPO single-mode Fiber cable X m	TBD
QSFP+ MTP/MPO multi-mode Fiber cable X m	TBD
Power supply 12V	KY-PWR12

Table 21 : Ordering Information