![KAYA INSTRUMENTS logo]

Fiber Extender FXP acquisition system Hardware Reference and Installation Guide

(Part-No. KY-FXP)

May 2018

1 Contents

Revision History

Version	Date	Notes
1.0	20.07.15	Initial Release
1.1	07.08.17	Minor changes in configuration modes section 5.1
1.2	11.04.18	Added SFP and QSFP installation section
1.3	24.05.18	Minor corrections

Figures

Tables

3.1 Safety Precautions

With your *Komodo FXP* system components 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 interfacing of CoaXPress camera and acquiring of CoaXPress video streams. 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.

4.1 Overview

Komodo FXP system is the industry first CoaXPress image acquisition system without range limitations. The system uses fiber optic cables to provide high resolution image acquisition interface for distances up to 80km in single-mode and up to 300m in multi-mode. The Komodo FXP system is capable of receiving video streams from up to 4 CoaXPress links in single, dual or quad modes. It is used for simultaneous capture from up to four cameras. Each link supports standard CoaXPress bitrates up to 6.25 Gbps. This system is ideally suited for industrial, defense and aerospace Machine Vision Systems and applications. The system consists of Komodo Fiber frame grabber and KY-FEXT-D remote unit. The remote unit converts CoaXPress links to fiber optic interface. The Komodo Fiber FXP system uses a high performance flow through DMA to transmit video streams to computer memory through PCIe interface with minimal latency. This product also provides GPIO for machine control signals, such as triggers, shaft encoders, exposure control and general I/O, which can be control aside video stream acquisition.

The Frame Grabber utilizes PCIe Gen3 x8 links for communication with Host PC for video uploading and configuration.

4.2 Features

- Solves distance limitation of CoaXPress
- Extention for distances up to 80km in single-mode and up to 300m in multi-mode
- Plug and Play , no need to configure
- 1 to 4 CoaXPress links support
- PCIe Gen3 x8 Half-length card
- Up to 144 Gb image buffer
- Multi-stream support
- Camera controls and triggers
- Per-link LED indication on card bracket
- Flexible machine I/O:
    - 4 TTL configurable I/Os
    - 4 LVCMOS configurable I/Os
    - 2 LVDS inputs
    - 2 LVDS outputs
    - 4 opto-isolated outputs

- 4 opto-isolated inputs
- 8 quadrature rotary encoders
- Integrated strobe controller

- CoaXPress V1.1 compliant

- Power over CoaXPress with 13W per link

- Multiple Camera synchronization

- Multiple Frame Grabbers synchronization

- DIN 1.0/2.3 connectors for CoaXPress links

- GUI interface

- Supporting Windows and Linux OS

- API for developing custom applications

- Plug-ins modules for Matlab, HALCON and Labview

- Gen<i>Cam compliant

- GenTL support

- Data rates up to 6.25 Gbps per link

- Transfer Rate of up to 55 Gbps

- 0°C to 50°C operating environment temperature

- -40°C to 70°C operating environment temperature (industrial grade, optional for extender device)

4.3 Product Applications

- AOI

- Printing inspection

- 3D

- Broadcasting and sports analytics

- High-speed DVRs

- Defense remote systems

- Surveillance

4.4 Related documents and accessories

Documents:

- Vision Point App User Manual

- Vision Point API Reference Book

- CoaXPress standard 1.1

Accessories:

- CoaXPress cables (DIN to DIN)

- CoaXPress cables (DIN to BNC)

- Fiber cables (Multi or Single mode)

5.1   System Structure

The Komodo FXP system consists of a CoaXPress camera, a CoaXPress extender box (KY-FEXT-D) that translates the CoaXPress interface to fiber optic interface and a Komodo Fiber frame grabber that is able to acquire video directly from fiber optic cables.

The Komodo Frame Grabber supports multiple modes of configuration and system topology. Few of these are presented in following diagrams.

Single Extender - Single Camera Topology:

One Single, Dual or Quad CoaXPress links with up to 6.25 Gb per link topology.
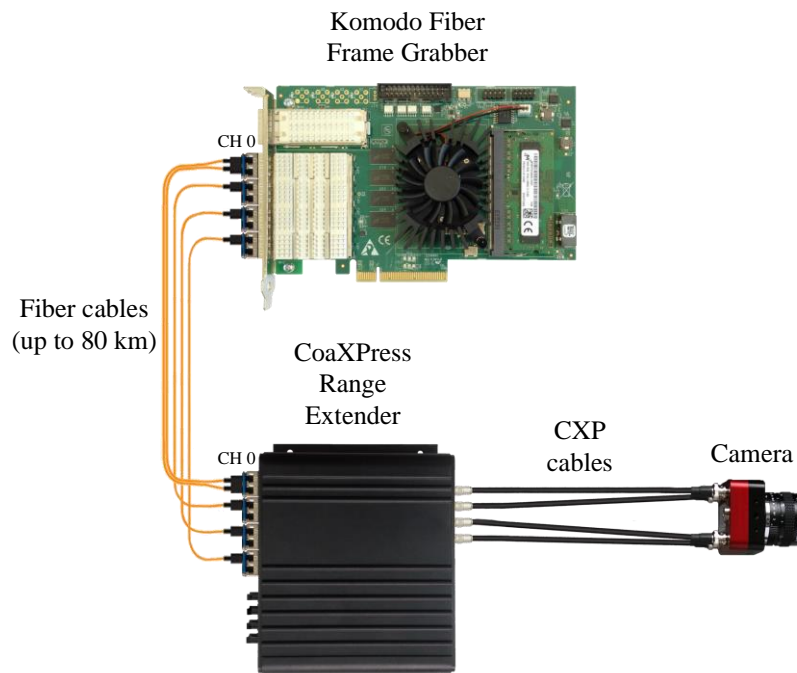
Figure 1: Single FEXT - Single camera topology diagram

Single Extender - Dual Camera Topology:

Two Single or Dual CoaXPress links with up to 6.25 Gb per link topology.
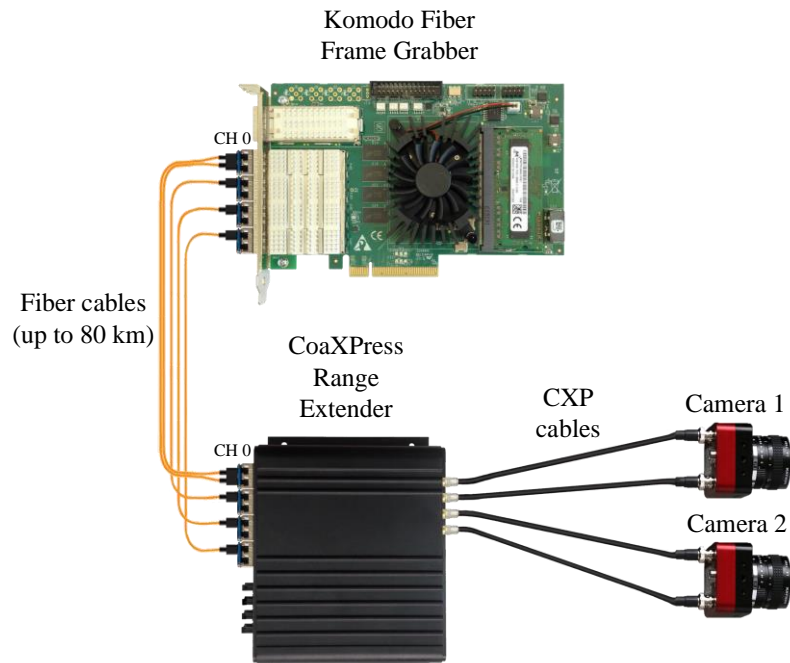
Figure 2: Single FEXT - Dual camera topology diagram

Single Extender - Quad Camera Topology:

Four Single CoaXPress links with up to 6.25 Gb per link topology.
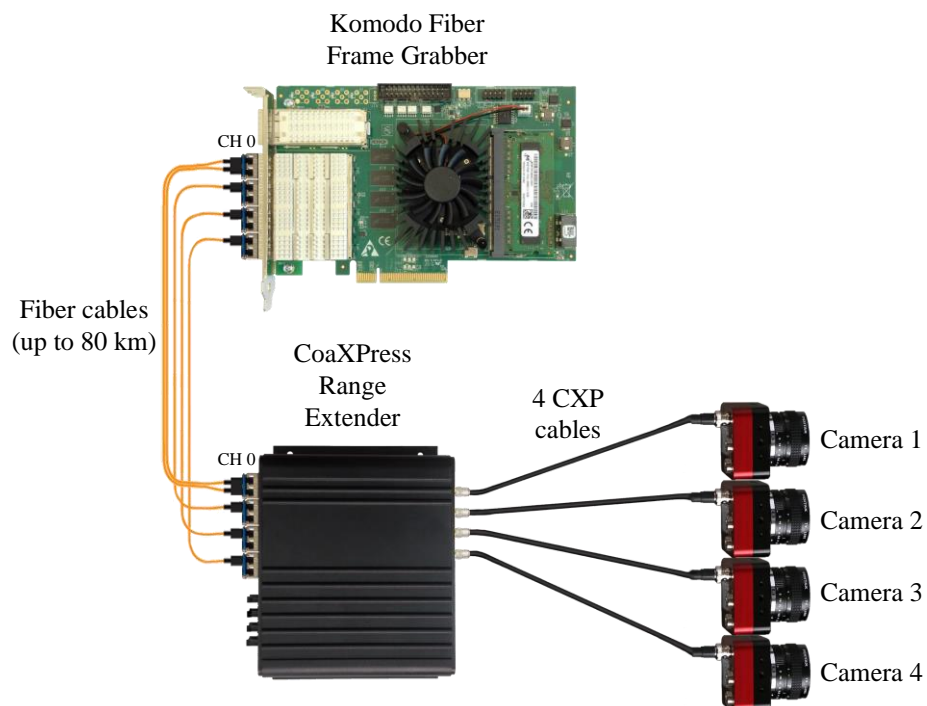
Figure 3: Single FEXT - Quad camera topology diagram

Dual Extender - Single Camera Topology:

Four Single CoaXPress links with up to 6.25 Gb per link topology.
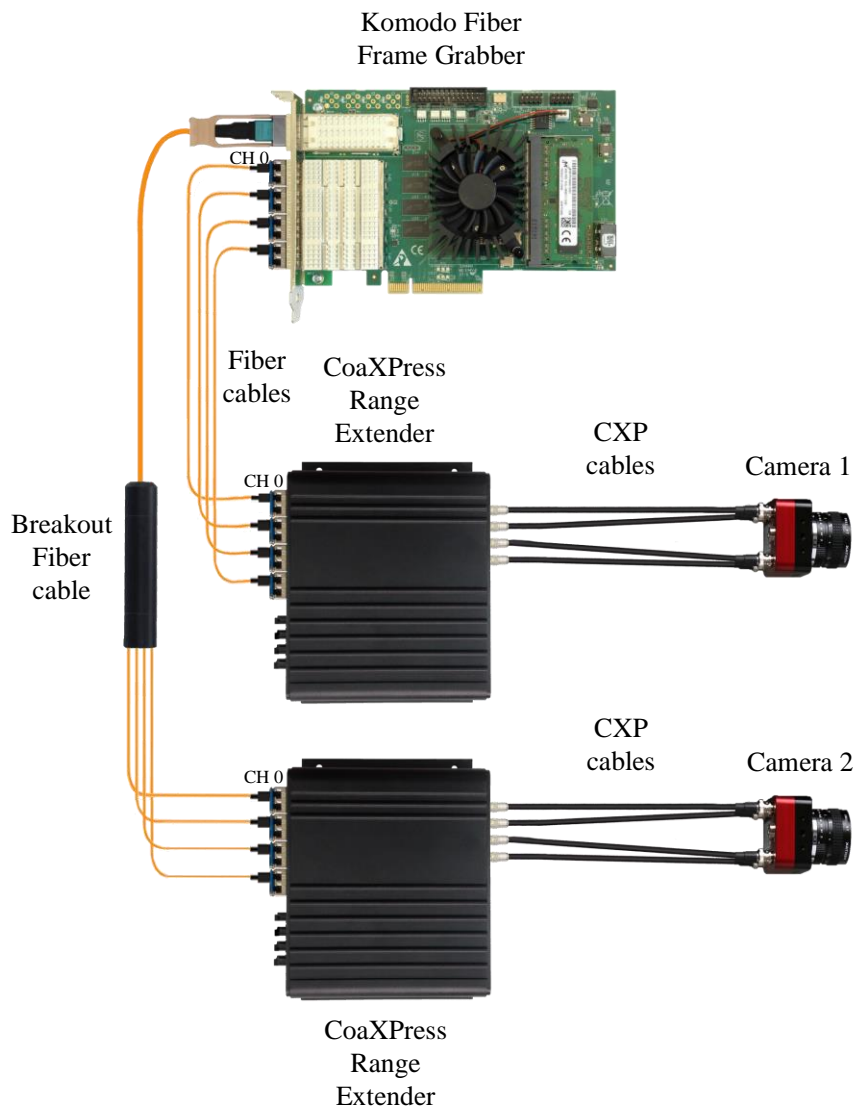
Figure 4: Dual FEXT - Single camera topology diagram

5.2 External View of the Komodo Fiber Frame Grabber
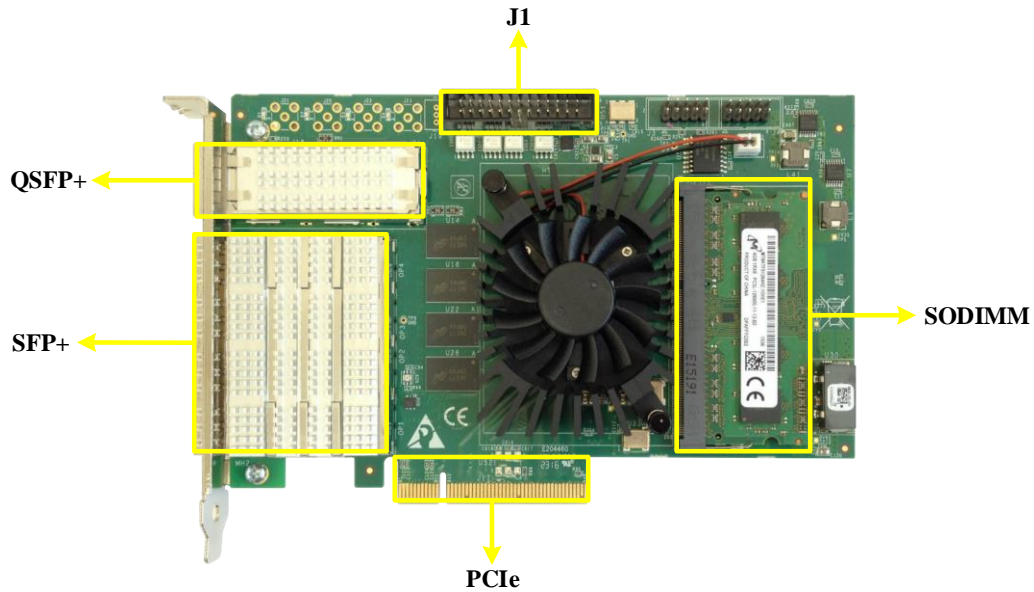
Figure 5: Komodo board external view

5.3 External View of the KY-FEXT-D

Each *KY-FEXT-D* unit is housed in a compact, metal enclosure. Each unit has a power connector, 4 coax connectors, 4 SFP+ cages and a Mini USB Terminal interface, as shown in Figure 6.
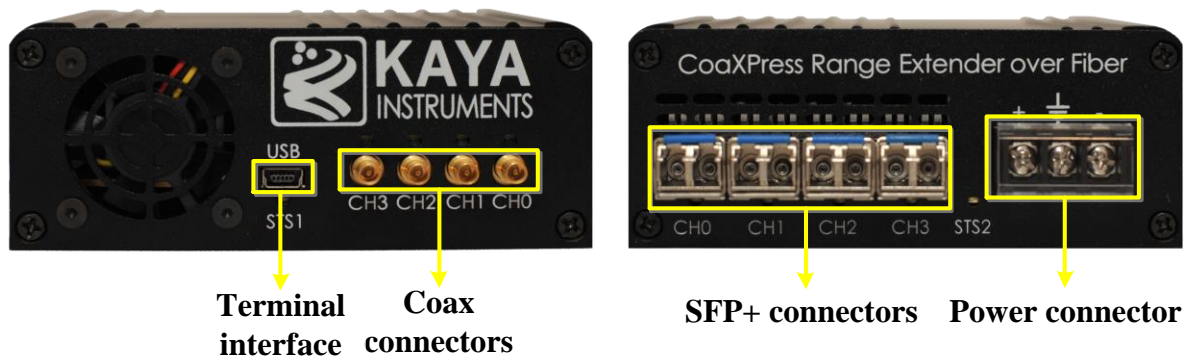
Figure 6: KY-FEXT-D external view

Each of the 4 coax and SFP+ connector is paired with a status LED and there is a system status LED (see section 7.2.1 describing the LED status).

KY-FEXT-D unit also has mount ears for an easy and secure installation on any flat surface.

6.1 Essentials to get started

To begin using your *Komodo FXP* 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 to faster data transfer.

  - Vision Point Application installation

- ✓ CoaXPress camera

- ✓ CoaXPress cables

- ✓ Fiber optic cables

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 **Komodo FXP** system is connected as described in Figure 7:
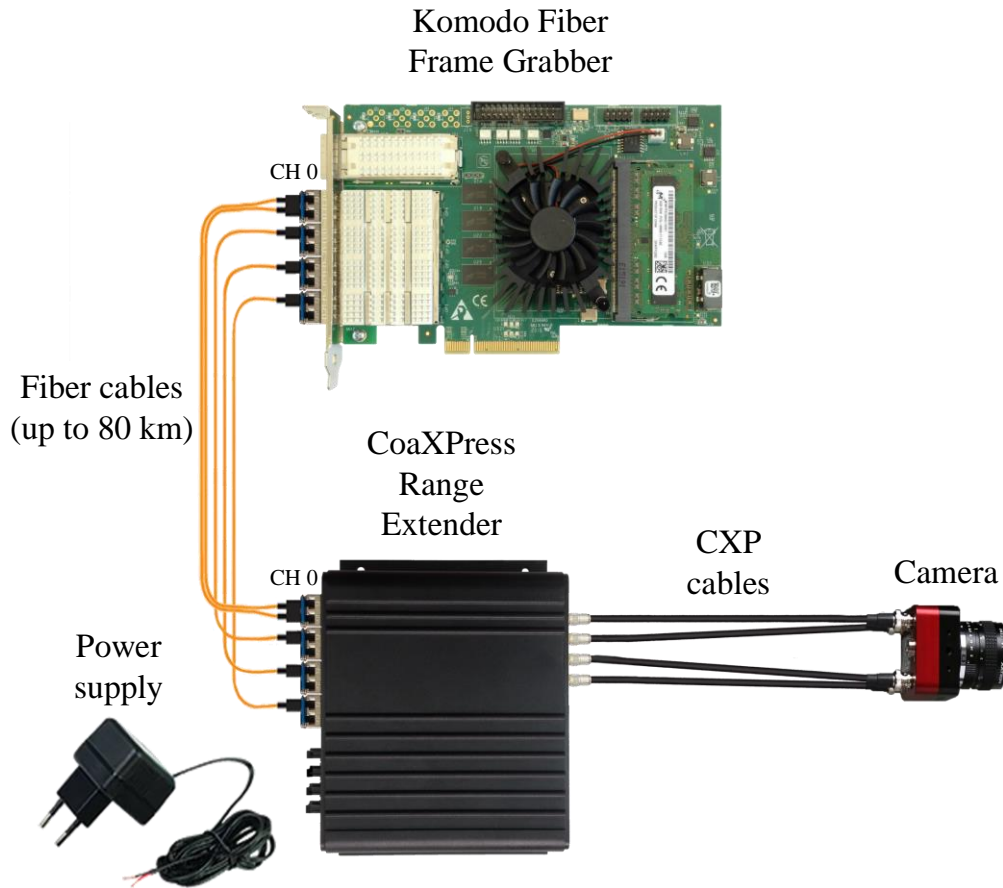
Figure 7: Komodo FXP system connection diagram

The first stage of the system installation is **Komodo Fiber Frame Grabber** board installation as described in section 6.2.1. The second stage is installation of the SFP+ and QSFP+ modules and fiber cable allowing the connection between the **CoaXPress Extender Device (KY-FEXT-D)** and the **Komodo Fiber Frame Grabber**, described in section 6.2.2. The third stage is connection of **KY-FEXT-D** unit and **CoaXPress camera** as described in section 6.2.10.

6.2.1 Komodo Fiber board installation

Before system installation the **Komodo Fiber Frame Grabber** board should be installed into host computer. Komodo Fiber 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. 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 Fiber board to PCIe connector of the motherboard.
5. Anchor the PCIe bracket to the computer chassis using M3 screw.
6. Verify the Komodo Fiber board inserted correctly to the PCIe slot.
7. 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 boards that can be installed in a computer depends on the number of available PCIe slots.

6.2.2 Installing and Removing SFP+ and QSFP+ Modules

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

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

6.2.3 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 SFP+ and 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 an SFP+ and 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 SFP+ and 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.

6.2.4   Installing the SFP+ Module

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

1. The *Komodo FXP* system supports the following SFP+ modules:

   KY-SFP-10G31-10 – Allows of up to 10km connection over single mode fiber cable.

   KY-SFP-10G85-3M – Allows of up to 300m connection over multi-mode fiber cable.

2. Remove the dust plugs from the module as shown in Figure 8.

3. The SFP+ module has a bale clasp that used to remove or install the SFP+ module.

4. Close the bale clasp before inserting the SFP+ module into the *Komodo Fiber* board.

5. Line up the module with the port and slide it into the port as shown in Figure 9.

6. Make sure that the male connectors on the module will align with the female connectors inside the cage.

7. Verify that the modules are completely seated and secured in their assigned receptacles on the line card by firmly pushing on each module. 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.

8. Follow the exact steps to insert additional module into the *KY-FEXT-D* unit.
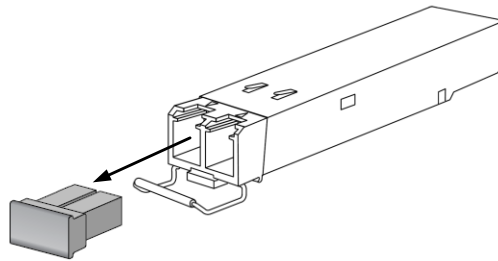
Figure 8: SFP+ Module with bale clasp open and dust plug removed
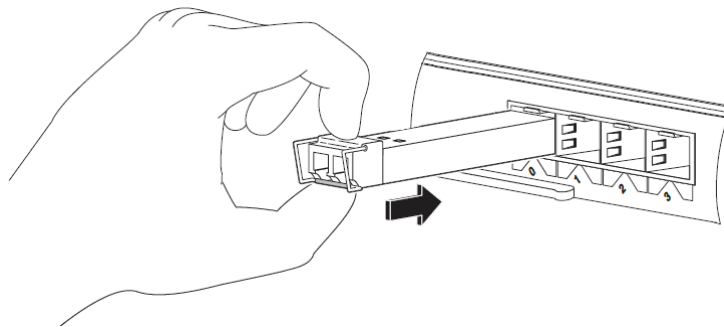
Figure 9: Installing an SFP+ Module into a port

6.2.5 Connecting the interface cable to SFP+ Module

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

1. Remove the protective dust plugs from the fiber-optic cable connectors.

2. Preform the connection according to the instructions below:

   a. Link 0 of the system must be always connected as controls are delivered with this port.

   b. A Fiber connection and CoaXPress connection must be done to the same port number all over the way from the *CoaXPress camera* to the *Komodo Fiber Frame Grabber*.

   c. A fiber cable should match an SFP+ type. If a single mode SFP+ is used a single mode fiber (yellow) should be attached to it. If a multi-mode SFP+ is used a multi-mode fiber (orange) should be attached.

   d. On Fiber channel 0 both the TX and RX fiber cables must be connected. On channels 1 through 3 only one fiber cable should be connected. This cable is connected between TX output (Marked with TX or Arrow outwards the SFP+) on the *KY-FEXT-D* unit and RX input (Marked with RX or Arrow inwards the SFP+) on the *Komodo Fiber Frame Grabber*, as shown in Figure 10.

   e. 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.

    f. In Komodo FXP system a standard DIN 1.0/2.3 connectors for CoaXPress interface. When attaching cables to your system, 75 Ω coaxial cables must be used. For best performance, it's recommended to use high quality cables, such as Belden 1694A.

3. Insert the fiber cable into the module, as shown in Figure 11.

4. Firmly push on each cable, until you will hear a click.

5. Connect the other side of the fiber cables to the ***KY-FEXT-D unit***.

Note: Additional connectivity option is available using Fiber QSFP+ to SFP+ Breakout cable. Insertion instructions of the QSFP+ described in section 6.2.7.
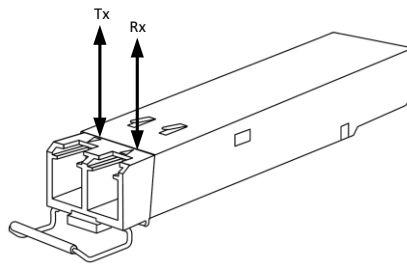
Figure 10: SFP+ Module with TX output and RX input marked
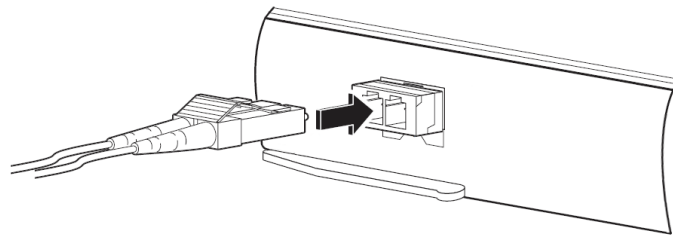
Figure 11: Connecting the cable to SFP+ Module

6.2.6 Removing the SFP Module

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

1. Turn the ***KY-FEXT-D*** and the computer off.

2. Disconnect and remove all interface cables from the ports.

3. Open the bale clasp on the SFP+ module with your index finger, or a small flat-blade screwdriver, in a downward direction, as shown in Figure 12.

4. Grasp the module between your thumb and index finger and carefully remove it from the port, as shown in Figure 13.

5. Insert the clean dust covers into the module, as shown in Figure 14.
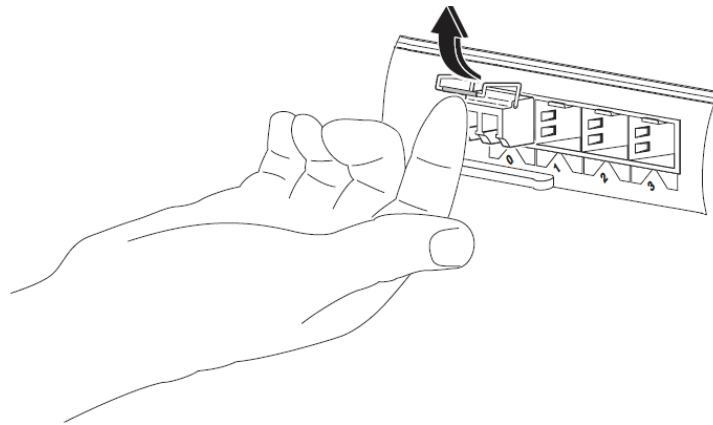
Figure 12: Opening the bale clasp of an SFP+ Module
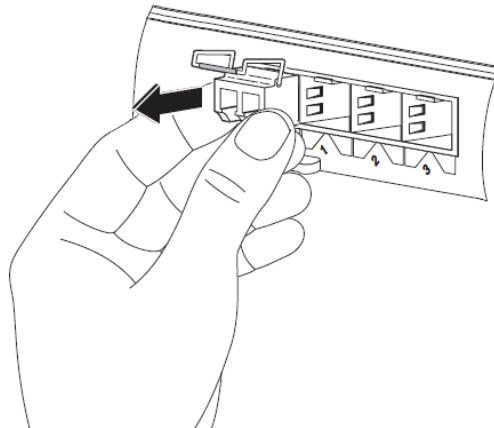
Figure 13: Removing an SFP+ Module from the port
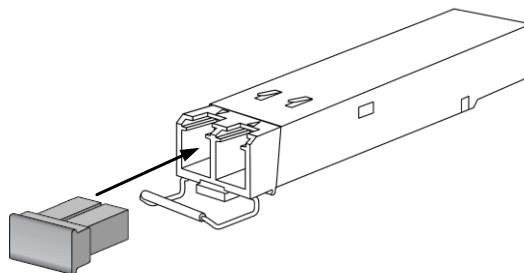
Figure 14: SFP+ Module with bale clasp open

6.2.7   Installing the QSFP+ Module

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

1. The Komodo FXP system supports 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 15.

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 of the **Komodo Fiber board**, as shown in Figure 16.

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 steps listed in section 6.2.4 for installation of 4 SFP+ modules into the **KY-FEXT-D unit**. The QSFP+ to 4 SFP+ connectivity option requires a Fiber QSFP+ breakout cable.
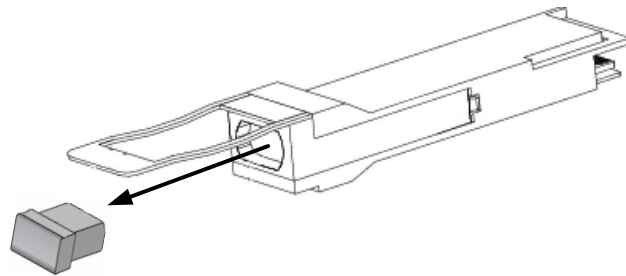
Figure 15: QSFP+ Module with pull tab latch
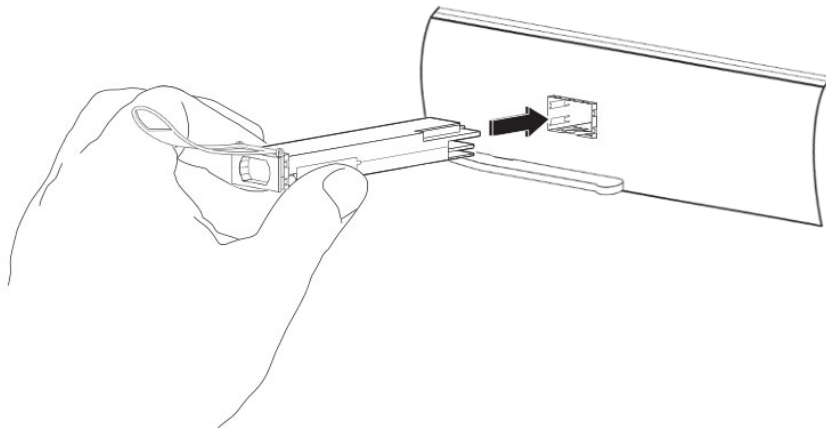
Figure 16: Installing a QSFP+ Module into a port

6.2.8 Connecting the interface cable to QSFP+ Module

In order to properly connect the QSFP+ Fiber Breakout cable, 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 17.
3. Firmly push on each cable, until you will hear a click.
4. Connect the other side of the QSFP+ Fiber Breakout cable to the ***KY-FEXT-D unit***. Follow the steps listed in section 6.2.5 for each of the SFP+ connections.
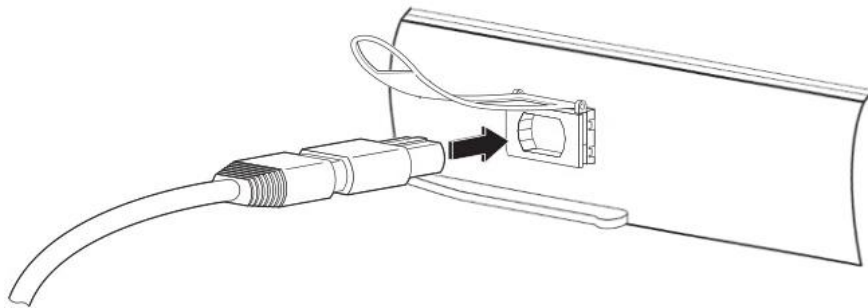
Figure 17: Connecting the cable to QSFP+ Module

6.2.9 Removing the QSFP+ Module

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

1. Turn the ***KY-FEXT-D*** and the ***Komodo Fiber 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 18.
4. Grasp the module between your thumb and index finger and carefully remove it from the port, as shown in Figure 19.
5. Insert the clean dust covers into the module, as shown in Figure 20.
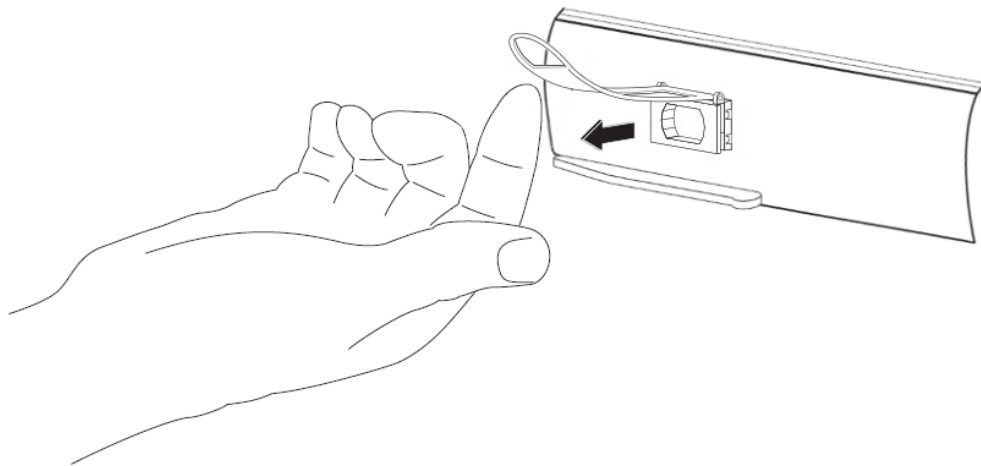
Figure 18: Pulling the pull tab latch of a QSFP+ Module
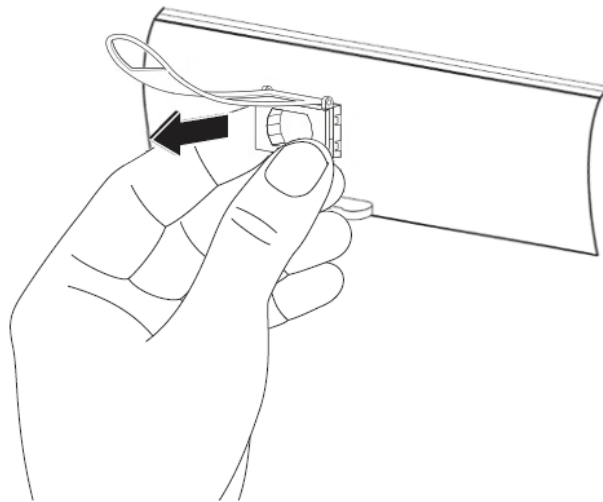

Figure 19: Removing a QSFP+ Module from the port
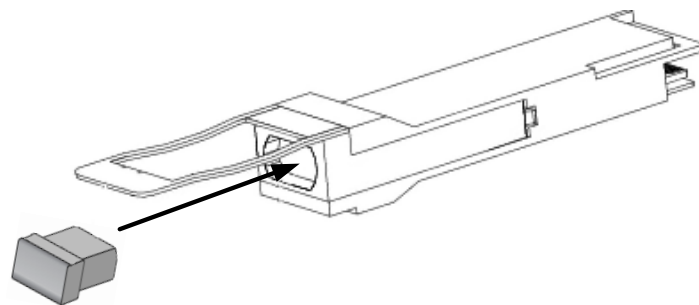
Figure 20: Inserting dust covers into the QSFP+ module

6.2.10 Completing the Komodo FXP system installation

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

1. Make sure the fiber cable is connected properly, as described in previous section, and using one of the configuration below.
2. Connect the Coax cables between the camera and *KY-FEXT-D* unit in the right order, using one of the configurations available:

6.2.10.1 SFP+ Single connectivity
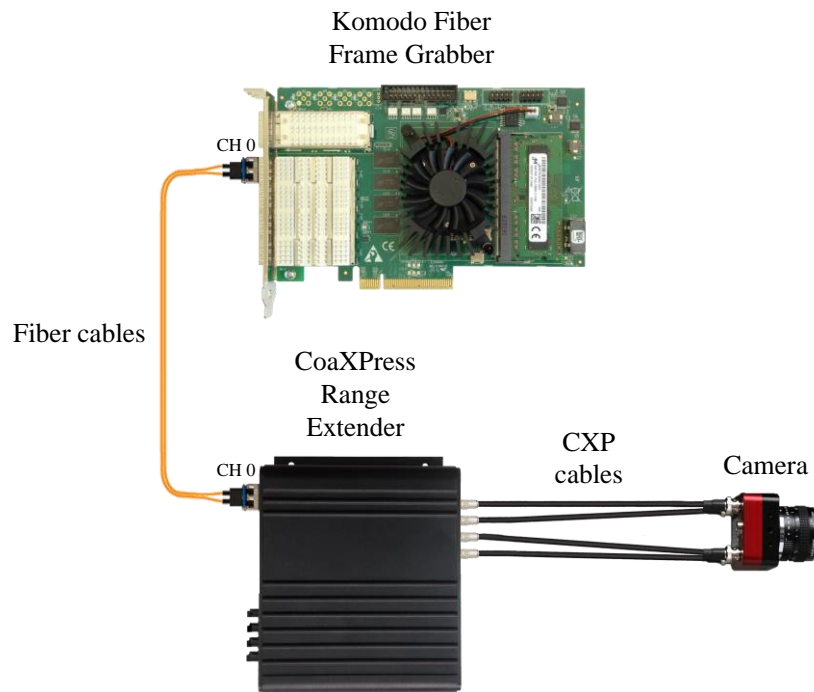
Figure 21: SFP+ Single connectivity order

6.2.10.2 SFP+ Dual connectivity
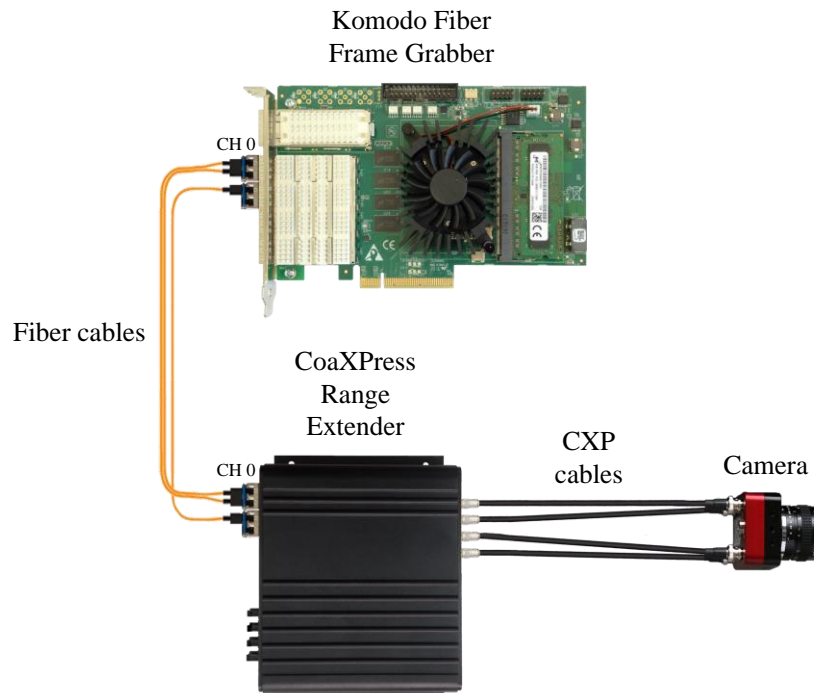
Figure 22: SFP+ Dual connectivity order

6.2.10.3 SFP+ Quad connectivity
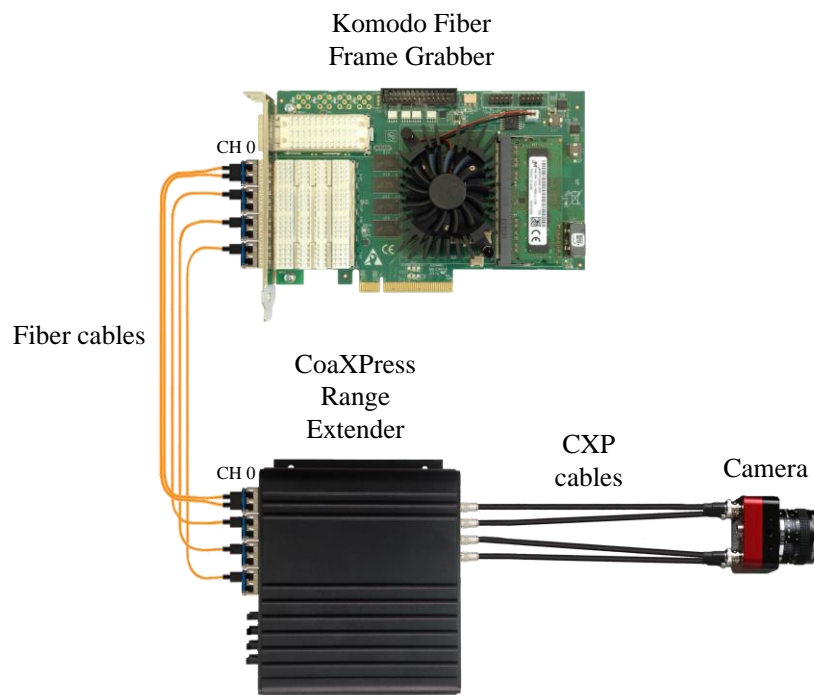
Figure 23: SFP+ Quad connectivity order

6.2.10.4 QSFP+ Quad connectivity
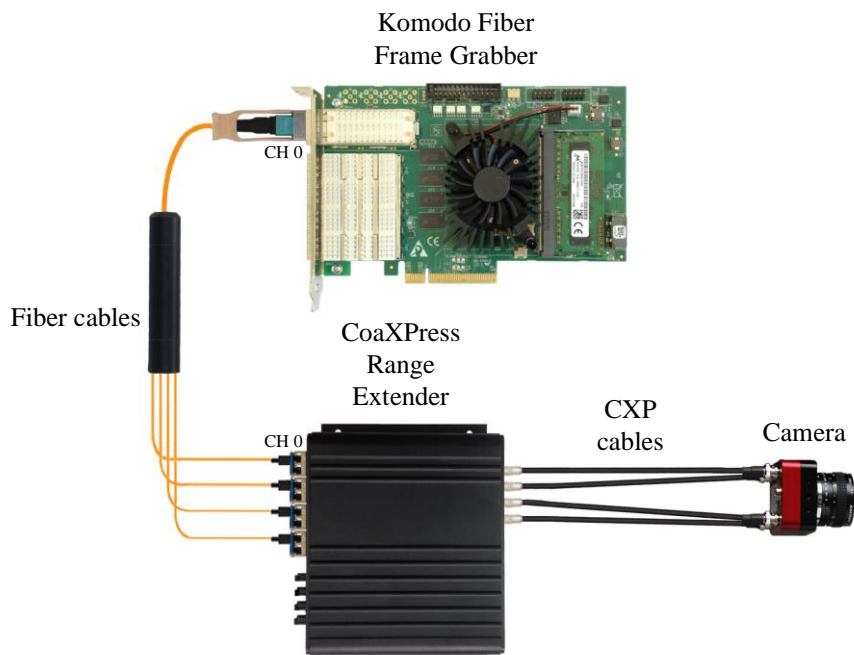
Figure 24: QSFP+ Quad connectivity order

6.2.10.5   QSFP+ and SFP+ Quad connectivity
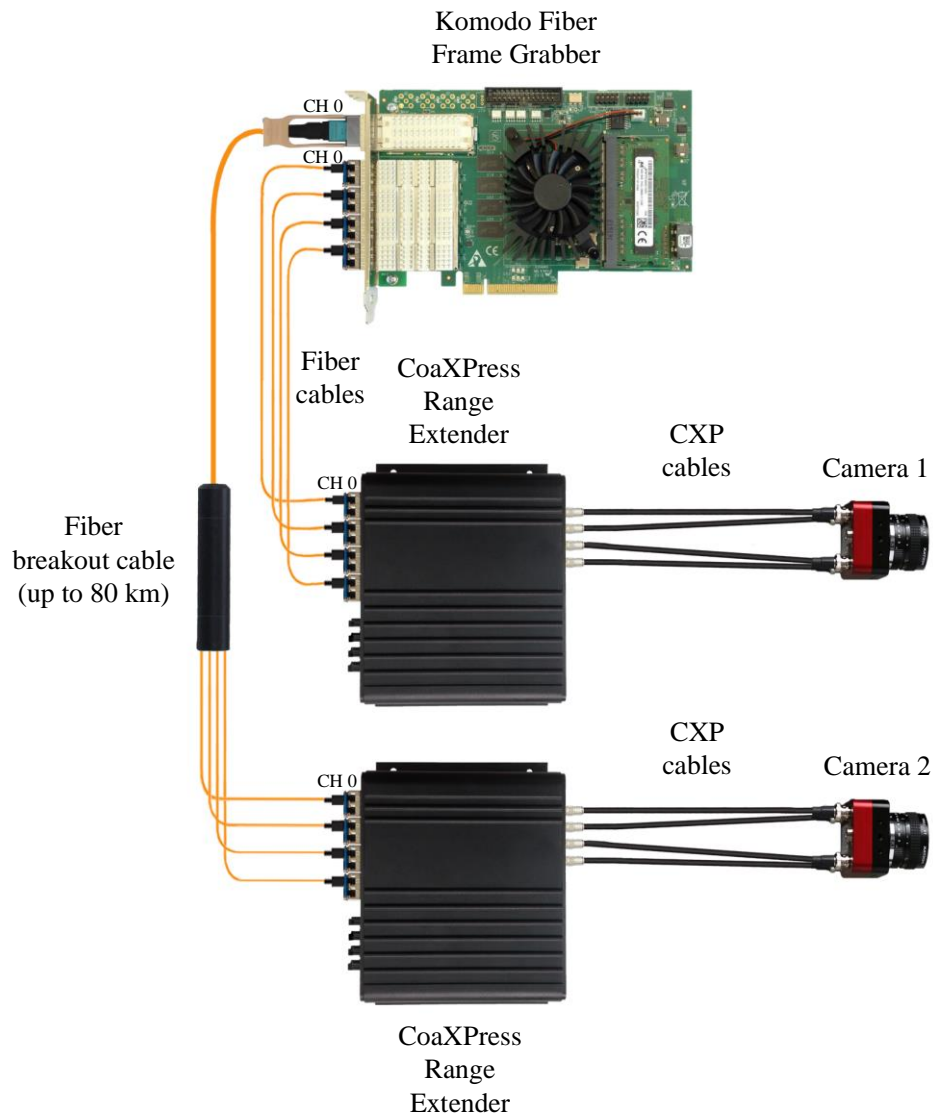
Figure 25: QSFP+ and SFP+ Quad connectivity order

3. Connect the Power Adaptor to the *KY-FEXT-D* unit.

4. The *KY-FEXT-D* requires 24V power supply for proper function and for PoCXP power for the camera. Please, refer to Electrical specification section of this document for exact Power Supply requirements.

5. The power supply connector of the *KY-FEXT-D* unit shown in the image below. Connect the positive wire from the power supply to the "+" connector, connect the GND pin of connector to the ground wire and the negative wire to the "-" connector.
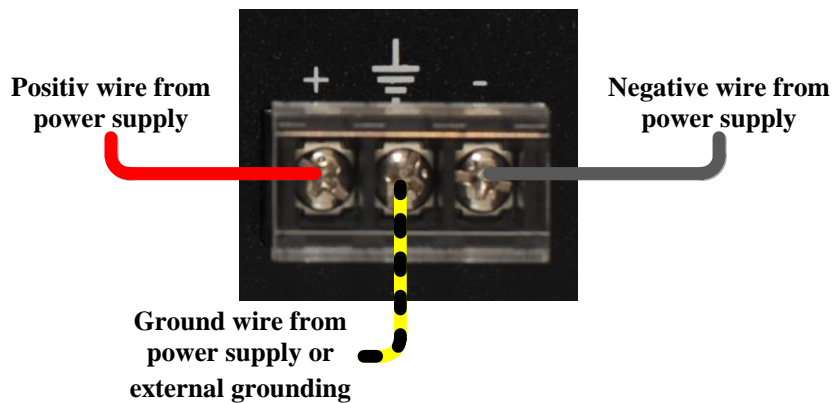
Figure 26: KY-FEXT-D power connector

6. Turn the *KY-FEXT-D* and the computer on and start your *Vision Point* software application

6.3 Reducing the fiber optic cable count

The system requires N+1 fiber optical cables in order to properly operate. The N is the number of CoaXPress links required for the camera. But sometimes it required transferring the data over smaller number of cables.

Several options listed in the sections below exist in order to reduce the number of required optical cables. Please note that these options are available for single mode fiber infrastructure only.

Please contact KAYA representative for details of those options.

6.3.1 Bidirectional (BIDI) SFP option

This option allows reducing one fiber optic cable from the system. The total required number of cables will be as number of Coax cables. For example 4 link cameras will require 4 fiber cables. In this option the SFP in link 0 is replaced by bidirectional (BIDI) SFP that transmits and receives on the same fiber cable. Example connection for four link camera is described in Figure 27.
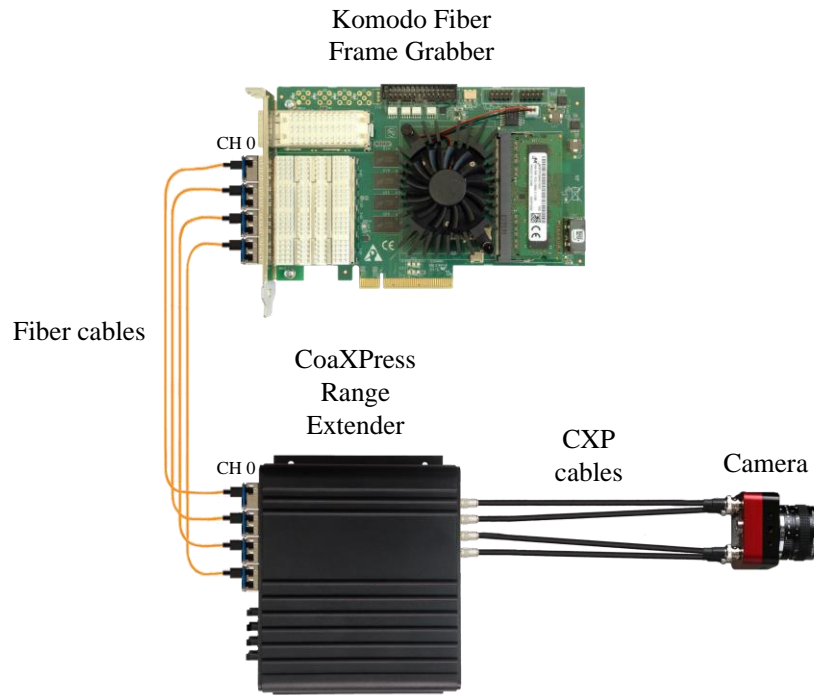
Figure 27: Bidirectional camera link connection

6.3.2   CWDM Option

In CWDM each optical SFP module operates at different wavelength and then an optical multiplexer is used to mix all the signals into a single fiber. In this mode the number of cables required in the infrastructure can be reduced from 5 down to two cables or even single cable. The CWDM also can be used to use the CoaXPress over existing infrastructure, sharing the same fiber cables with other applications.

Two available CWDM modes (for single or dual fibers) are described in Figure 28 and Figure 29. For assignment of CWDM wavelengths please contact KAYA Instruments representative.
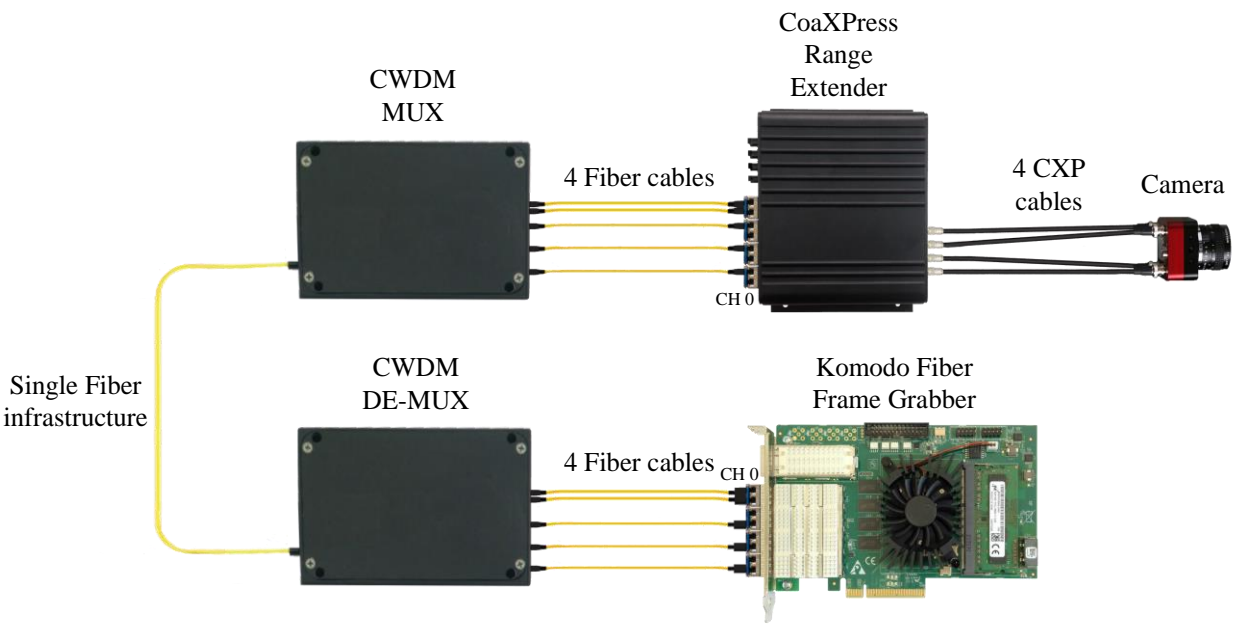
Figure 28: CWDM mode for single fiber
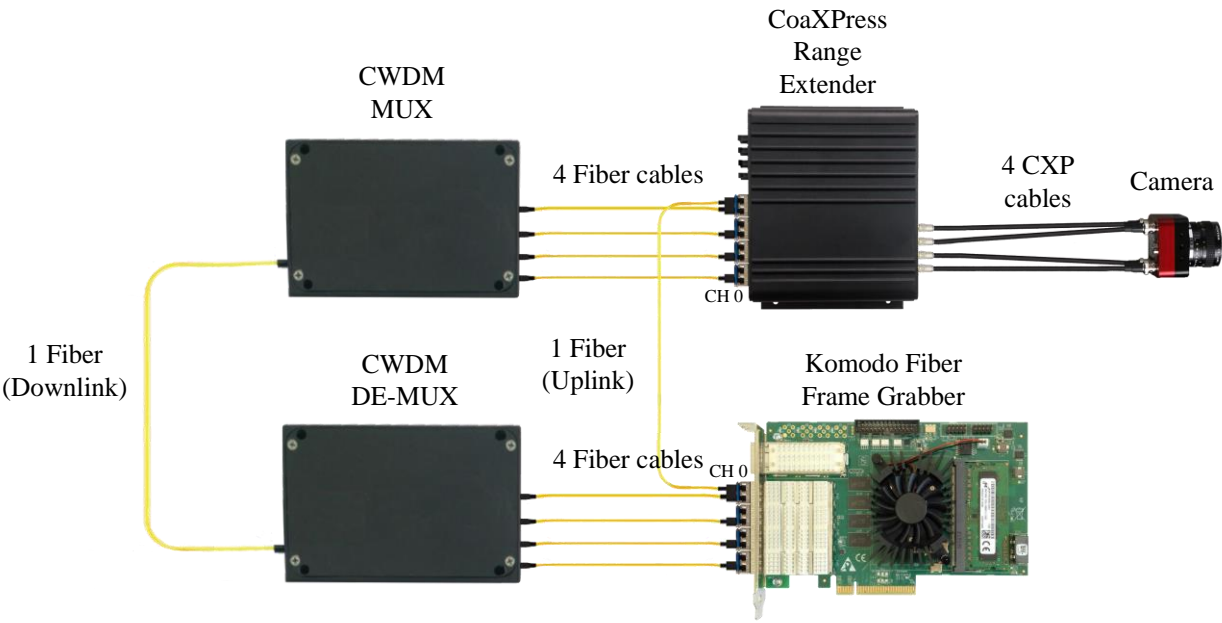
Figure 29: CWDM mode for dual fiber

7.1   Komodo Fiber Hardware Reference

This chapter provides information on Komodo board hardware. It covers architecture, features and pin assignments for various connectors.

7.1.1   Komodo Board Block Diagram
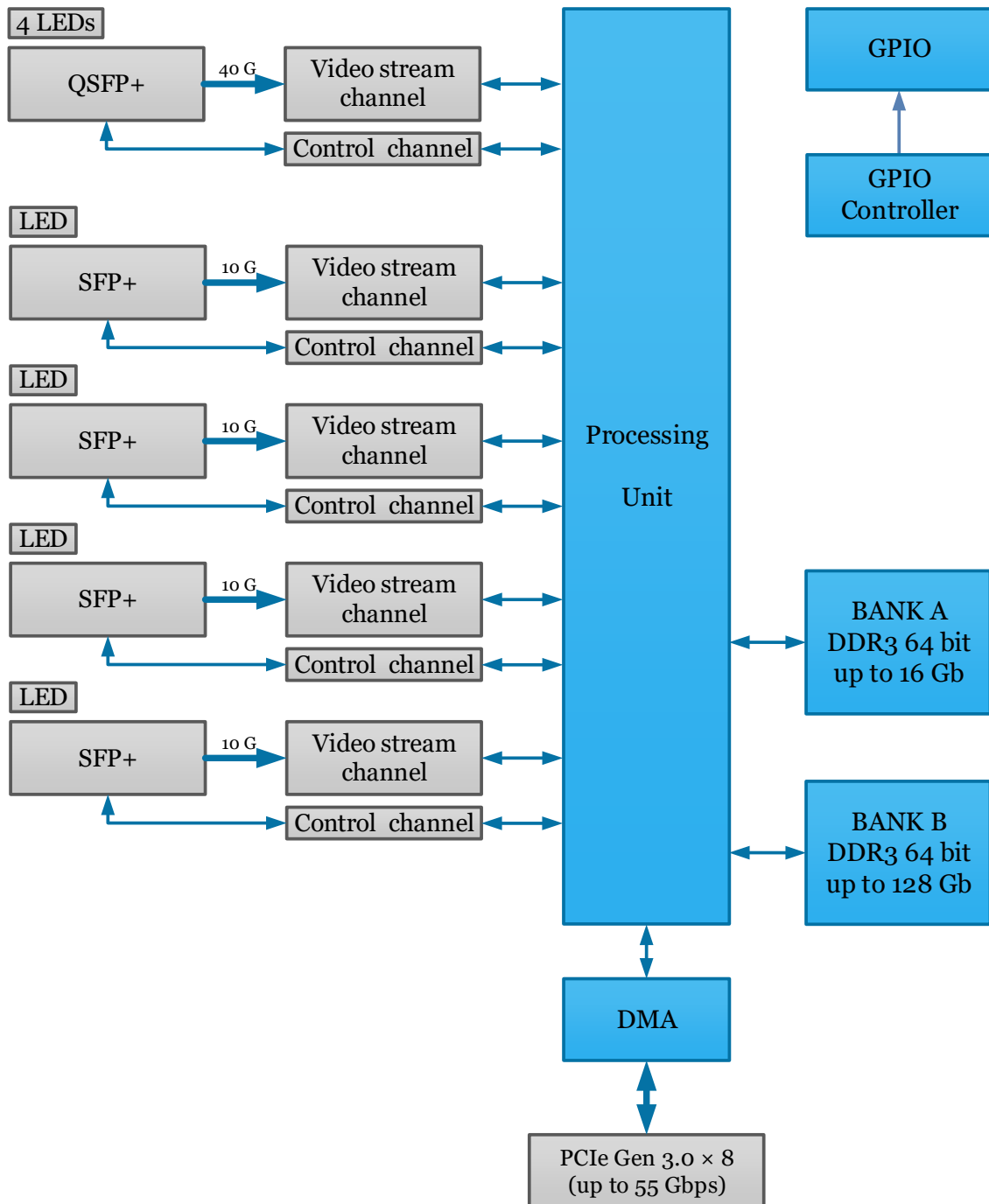
Figure 30: Komodo Board Block Diagram

7.1.2   Komodo Fiber LEDs

Komodo Fiber is equipped with indication bi-color LED for each SFP+ and QSFP+ connector.
The LEDs behave according to definition in section 5.4 of the CXP standard. The LEDs' different
states are described in Table 1.
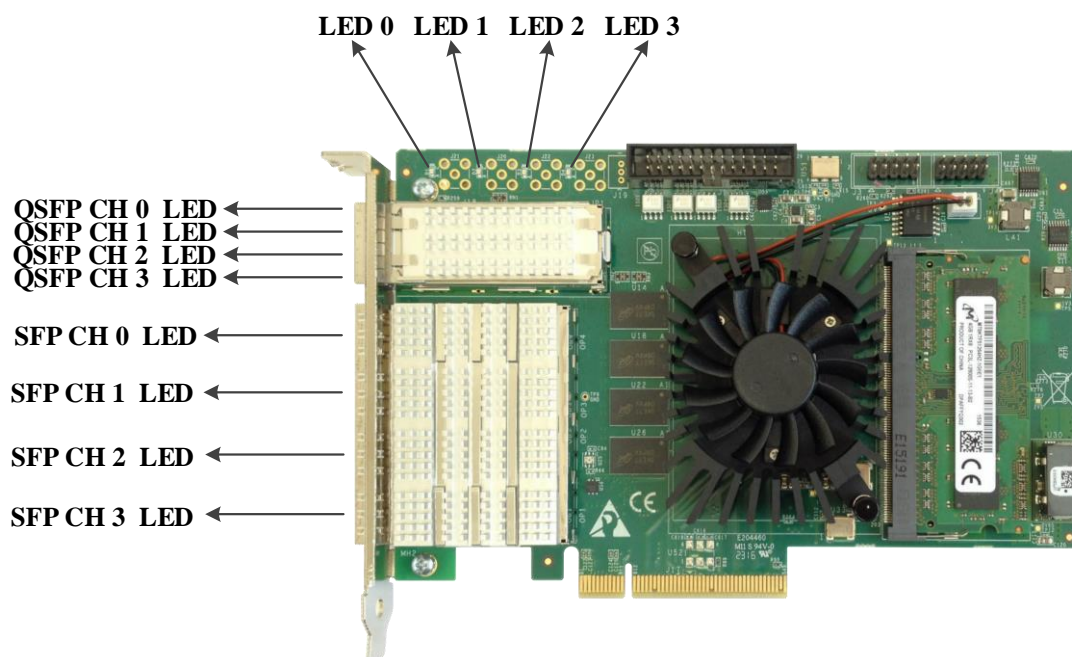
Figure 31: Komodo Board LED's locations

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, PoCXP active
Fast flash orange	Connection detection in progress, PoCXP not in use
Solid red	PoCXP over-current
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 1: Komodo Fiber links status LED's

In additional to SFP+ and QSFP+ links LEDs, the Komodo Board is equipped with status LEDs.

Board Status LEDs functionality is described in Table 2:

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 2: Komodo Fiber board status LED's

7.1.3   Auxiliary Input/Output signals

The auxiliary signal of Komodo Fiber board can be used to initiate on-board events, transmitted to other devices or rerouted from other signals, such as CoaXPress triggers and GPIO's.

Additionally, these auxiliary signals can be used to communicate with complex devices, such as encoders, strobe controls and drive controls.

The GPIOs can be controlled from the Vision Point API and be set as a trigger sources. The API enables routing of any input to any output as well as to the CXP IO and Trigger lines. Please see the API documentation for more information regarding the GPIO configuration.

The GPIOs of Komodo Fiber are routed to single IO header with 2.54 mm (100 th) pitch.
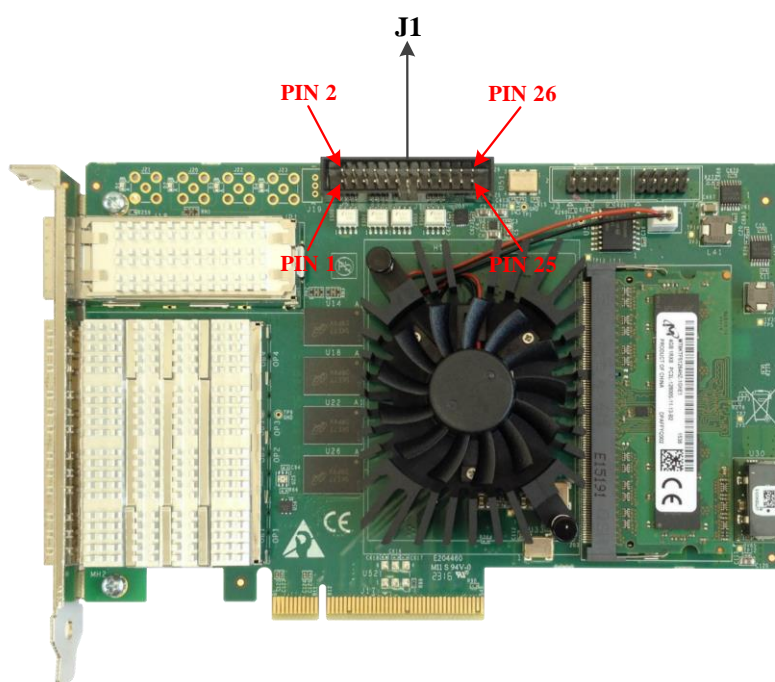
Figure 32: GPIO connectors location

The pinout of IO connector is as described in Table 3.

Pin Number	Signal Name	Function	Electrical Standard	Description
1	LVDS Input 0p	LVDS input	LVDS	Positive signal of LVDS pair
2	LVDS Input 0n	LVDS input	LVDS	Negative signal of LVDS pair
3	LVDS Input 1p	LVDS input	LVDS	Positive signal of LVDS pair
4	LVDS Input 1n	LVDS input	LVDS	Negative signal of LVDS pair
5	LVDS Output 0p	LVDS output	LVDS	Positive signal of LVDS pair
6	LVDS Output 0n	LVDS output	LVDS	Negative signal of LVDS pair
7	LVDS Output 1p	LVDS output	LVDS	Positive signal of LVDS pair
8	LVDS Output 1n	LVDS output	LVDS	Negative signal of LVDS pair
9	OptoCoupled Output 0	Opto-Isolated output	Up to 70V	Optically isolated outputs
10	OptoCoupled Output 1	Opto-Isolated output	Up to 70V	Optically isolated outputs
11	OptoCoupled Output 2	Opto-Isolated output	Up to 70V	Optically isolated outputs
12	OptoCoupled Output 3	Opto-Isolated output	Up to 70V	Optically isolated outputs
13	OptoCoupled Input 0	Opto-Isolated input	Up to 70V	Optically isolated inputs
14	OptoCoupled Input 1	Opto-Isolated input	Up to 70V	Optically isolated inputs
15	OptoCoupled Input 2	Opto-Isolated input	Up to 70V	Optically isolated inputs
16	OptoCoupled Input 3	Opto-Isolated input	Up to 70V	Optically isolated inputs
17	OptoCoupled GND	External GND		Ground signal for opto-isolated signals on this connector.
18	GND	Board GND		Reference ground signal
19	TTL 0	GPIO	TTL (Open-drain)	General Purpose IO
20	TTL 1	GPIO	TTL (Open-drain)	General Purpose IO
21	TTL 2	GPIO	TTL (Open-drain)	General Purpose IO
22	TTL 3	GPIO	TTL (Open-drain)	General Purpose IO
23	LVTTL 0	GPIO	LVTTL	General Purpose IO
24	LVTTL 1	GPIO	LVTTL	General Purpose IO
25	LVTTL 2	GPIO	LVTTL	General Purpose IO
26	LVTTL 3	GPIO	LVTTL	General Purpose IO

Table 3: J1 connector pinout

The electrical connection of the GPIO connector is described following principal schematic diagram:
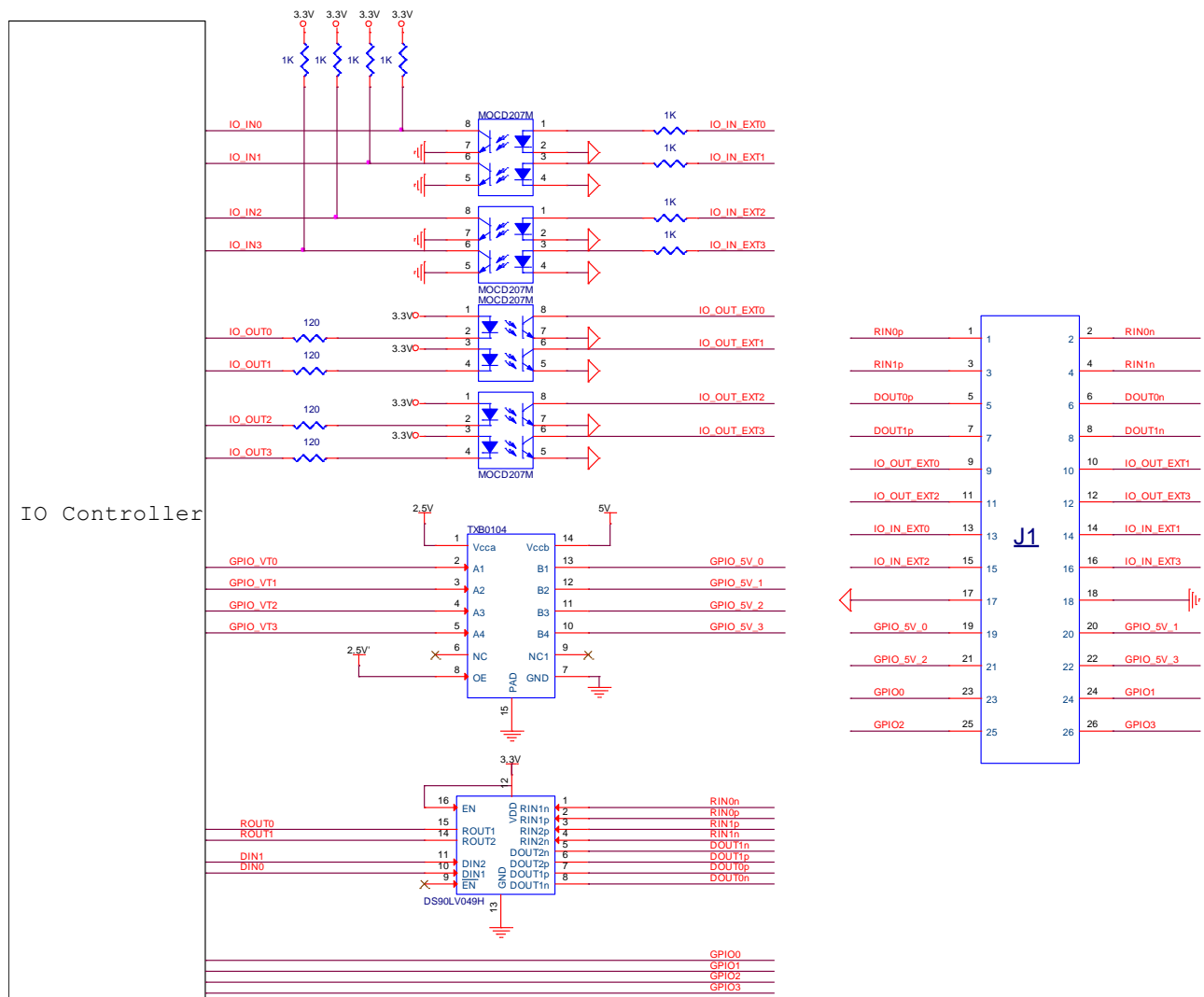
Figure 33: GPIO Connector schematic

7.2 KY-FEXT-D unit Hardware Reference

This chapter provides information on KY-FEXT-D unit hardware.

7.2.1 KY-FEXT-D unit LEDs

Each unit has several status LEDs, as seen in Figure 34 and Figure 35.
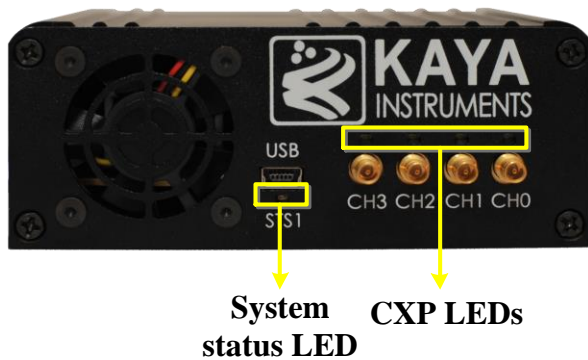
| Figure 34: KY-FEXT-D coax side LEDs | Figure 35: KY-FEXT-D fiber side LEDs |
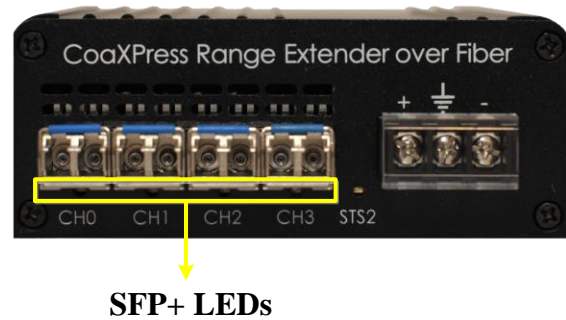
The System status LED, located on the coax side, always slow pulses in green while the system is ON. While in firmware update mode, this LED slow pulses orange. In any case of system failure, the LED will constantly light orange.

The CXP LED's behavior is described in Table 4:

LED state	Condition
Slow pulse red	No valid CoaXPress low speed link detected
Solid red	PoCXP failure (Overcurrent/Under voltage/Overvoltage)
Fast flash green	CoaXPress link speed is being negotiated
Solid green	CoaXPress link is active

Table 4: KY-FEXT-D status LEDs behavior

The SFP+ LED's behavior is described in Table 5:

LED state	Condition
Fast flash red or orange	SFP+ is unplugged
Solid red or orange	SFP is not compatible
Slow pulse red or orange	No signal detected on optic fiber
Fast flash green	CoaXPress link speed is being negotiated
Solid green	CoaXPress link is active

Table 5: SFP+ status LEDs behavior

7.2.2 KY-FEXT-D 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 6:

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

Table 6: 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 7.2.3 chapter for firmware update information
status	Prints the system and individual link status and general information

Table 7: Terminal commands

NOTE: The commands are not case sensitive.

7.2.3 KY-FEXT-D Firmware update

1. The extender supports firmware update via USB using a serial emulated terminal. To initiate firmware update the following steps should be taken:

2. Connect the USB cable to the extender and acquire connection using Silabs drivers (drivers need to be downloaded manually if an automatic download isn't initiated).

3. Open serial emulated terminal (usage of Tera Term terminal is recommended) and set serial communication protocol as described in Table 6.

4. In the terminal window type "status" followed by carriage return and checks the current firmware version.

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

6. At this point all the LEDs will turn off and the "System status LED" will slow pulse orange indicating the extender is ready to receive the firmware binary file. Under "File" tab use the terminal "transfer" capability using the XMODEM protocol to initiate the firmware update. Choose "Send" and the firmware version: CXP_EXT_x_xx.rbf, when x_xx is the version number.

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

8. A successful update will result in appropriate message and a reboot of the extender to new firmware.

9. Check the firmware version by typing "status" followed by carriage return. Make sure that the firmware version matches the version on the firmware update package supplied; that would insure the success of the firmware update operation.

7.3 Absolute maximum ratings

Specification	Values
3.3V power supply	-1.0V to +7.0V
12V power supply	-0.3V to 14V
Storage temperature	-40°C to 85°C
Operating ambient temperature	0°C to 50°C

Table 8: Komodo Fiber absolute maximum ratings

Specification	Values
Power supply voltage	0V to 30V
Storage Temperature	-40°C to 85°C
Operating Temperature	0°C to 50°C -40°C to 70°C (industrial grade, optional)

Table 9: KY-FEXT-D absolute maximum ratings

7.4 Operating conditions

Parameter	Description	Minimum	Typical	Maximum
V_{cc}	Supply voltage	20.3V	24V	26 V
I_{cc} (Host)	Supply Current from PoCXP or external power supply (4 active channels)	-	0.25A	0.33A
I_{cc} (Device)	Supply Current from external power supply (4 active channels)	-	0.25A	2.61A [1]
I_{PoCXP}	PoCXP Output current per link	0A	-	0.57A

Table 10: KY-FEXT-D operating conditions

(1) In case all the 4 CXP channels supply 13.5W of power to connected camera

Parameter	Description	Minimum	Typical	Maximum
3.3 V_{cc}	3.3V Supply voltage from PCIe	3.04V	3.3V	3.56V
12V V_{cc}	12V Supply voltage from PCIe	11.04V	12V	12.96V
3.3 I_{cc} (Host)	Supply Current from 3.3V PCIe power rail	-	2.1A	-
12 I_{cc}	Supply Current from 12V PCIe power rail	-	2A	-

Table 11: Komodo Fiber operating conditions

Electrical characteristics for Komodo Fiber board IO's:

Symbol	Parameter	Condition	Pin	MIN	Typ	MAX	Units
$|V_{OD}|$	Differential Output Voltage			250	350	450	mV
ΔV_{OD}	Change in Magnitude of V_{OD} for Complementary Output States	$R_L = 100\ \Omega$			1	35	$|$ mV $|$
V_{OS}	Offset Voltage			1.125	1.23	1.375	V
ΔV_{OS}	Change in Magnitude of V_{OS} for Complementary Output States		D_{OUT-} D_{OUT+}		1	25	$|$ mV $|$
I_{OS}	Output Short Circuit Current[4]	ENABLED, $D_{IN} = V_{DD}$, $D_{OUT+} = 0$ V or $D_{IN} = $ GND, $D_{OUT-} = 0$ V			-5.8	-9.0	mA
I_{OSD}	Differential Output Short Circuit Current[4]	ENABLED, $V_{OD} = 0$ V			-5.8	-9.0	mA
I_{OFF}	Power-off Leakage	$V_{OUT} = 0$ V or 3.6 V $V_{DD} = 0$ V or Open		-20	±1	+20	µA
I_{OZ}	Output TRI-STATE Current	EN = 0 V and EN = V_{DD} $V_{OUT} = 0$ V or V_{DD}		-10	±1	+10	µA

Table 12: Komodo Fiber LVDS Output DC specifications (Driver Outputs)

Symbol	Parameter	Condition	Pin	MIN	Typ	MAX	Units
V_{TH}	Differential Input High Threshold	$V_{CM} = 1.2$ V, 0.05 V, 2.35 V			-15	35	mV
V_{TL}	Differential Input Low Threshold		R_{IN+} R_{IN-}	-100	-15		mV
V_{CMR}	Common-Mode Voltage Range	$V_{ID} = 100$ mV, $V_{DD} = 3.3$ V		0.05		3	V
I_{IN}	Input Current	$V_{DD} = 3.6$ V $V_{IN} = 0$ V or 2.8 V		-12	±4	+12	µA
		$V_{DD} = 0$ V $V_{IN} = 0$ V or 2.8 V or 3.6 V		-10	±1	+10	µA

Table 13: Komodo Fiber LVDS Input DC specifications (Receiver Inputs)

Symbol	Parameter	Test condition (note 1)	MIN	MAX	Units
V_{IH}	Input High Voltage	$V_{OUT} \geq V_{OH\ (min)}$ or	2	$V_{DD}+0.3$	V
V_{IL}	Input Low Voltage	$V_{OUT} \leq V_{OL\ (max)}$	-0.3	0.8	V
I_{IN}	Input Current	$V_{IN} = 0$ V or $V_{IN} = V_{DD}$		±5	µA

Note: Vdd = 3.3V, unless specified otherwise

Table 14: Komodo Fiber LVTTL input 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

Note: Vdd = 3.3V, unless specified otherwise

Table 15: Komodo Fiber LVTTL output specifications

Symbol	Parameter	Test condition (note 1)	MIN	MAX	Units
V_{IH}	Input High Voltage	$V_{OUT} \geq V_{OH\ (min)}$ or	2	5	V
V_{IL}	Input Low Voltage	$V_{OUT} \leq V_{OL\ (max)}0$	-0.3	0.8	V
I_{IN}	Input Current	$V_{IN} = 0$ V or $V_{IN} = V_{DD}$		±5	µA

Note: Vdd = 5V, unless specified otherwise

Table 16: Komodo Fiber TTL input specifications

Symbol	Parameter	Test condition	MIN	MAX	Units
V_{OH}	Output High Voltage	$V_{DD} = $ min, $I_{OH} = -2$ mA	4		V
V_{OL}	Output Low Voltage	$V_{DD} = $ min, $I_{OL} = 2$ mA		0.4	V

Note: Vdd = 5V, unless specified otherwise

Table 17: Komodo Fiber TTL output specifications

7.5 Absolute maximum ratings for GPIO

Specification	Minimum voltage [V]	Maximum voltage [V]
LVDS	-0.3	3.6
Opto-isolated (in)	-6	60
Opto-isolated (out)	-7	70
TTL	-0.5	6
LVTTL	-0.5	3.9

Note: The maximum current that the Opto-isolated (out) IOs can support is 150mA

Table 18: Absolute maximum ratings for GPIO

7.6 Mechanical dimensions

The Komodo Fiber board is a half-length PCIe card according to PCI Express Card Electromechanical Specification.

The exact board mechanical dimensions are as defined in Figure 36.

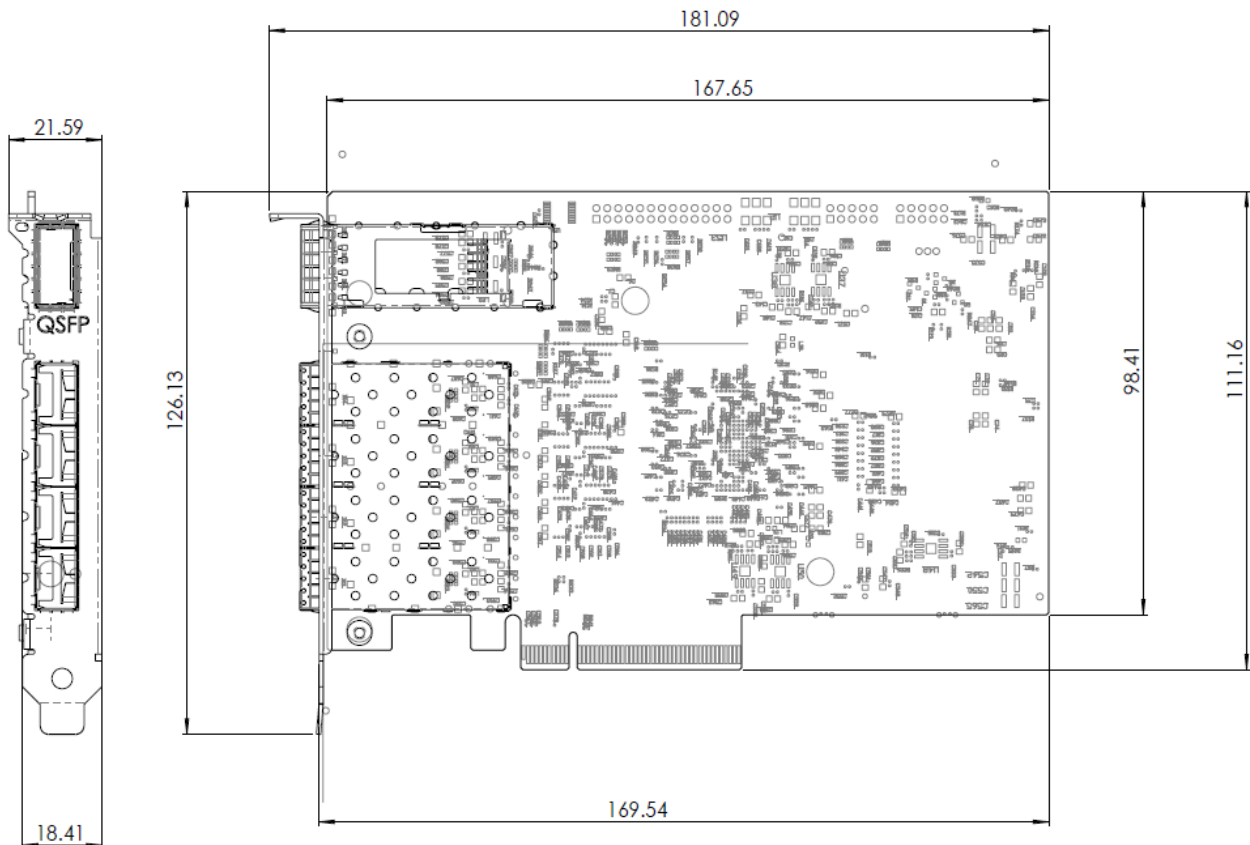For more detailed information please, contact KAYA Instruments representative.

Figure 36: PCB Mechanical Dimensions

8.1   Dimensions

Each *KY_FEXT-D* unit is housed in a metal enclosure as shown in Figure 37:
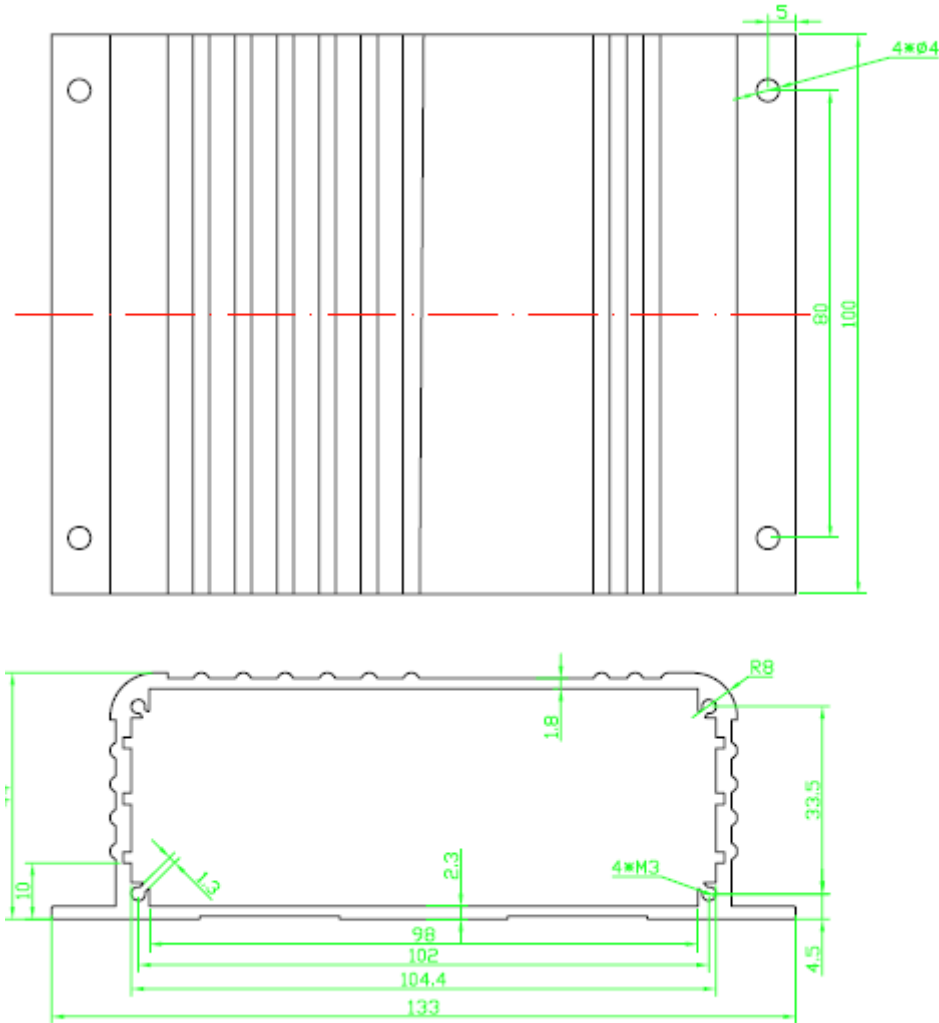

Figure 37: External dimensions of the KY-FEXT-D enclosure box

8.2   Weight

Each *KY-FEXT-D* unit weights 356g. (the metal enclosure weights 235g.)

9.1 CoaXPress cables

CoaXPress is a new digital transmission standard that allows high speed data from a device, such as a camera, to be transferred to a host, such as a frame grabber. Each CoaXPress link supports up to 6.25 Gbps data rates, along with device power up to 13W and device control at 20 Mbps – all on a single coax cable. For very fast devices, the links can be aggregated to provide multiples of the single coax bandwidth. Long cable lengths are supported – up to 40 meters at 6.25 Gbps and over 100 meters at 3.125 Gbps.
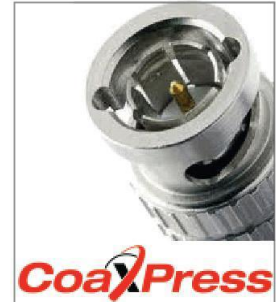
9.2 Fiber cables

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.).

Item name	Item part number
CoaXPress Range Extender over Fiber – device unit	KY-FEXT-D
Komodo Fiber Frame Grabber	KY-FGF
SFP+ single-mode module	KY-SFP-10GLR-31
SFP+ multi-mode module	KY-SFP-10G85-3M
SFP+ bidirectional connection module (pair)	KY-BSFP-10G
QSFP+ CWDM module (LC termination)	KY-QSFP-CWDM
QSFP+ - single-mode module	KY- QSFP-40G85
QSFP+ - multi-mode module	KY- QSFP-SR4-40G
Fiber cable - single-mode x meter	KY-FCA-S-SM-XX.X
Fiber cable - multi-mode x meter	KY-FCA-S-MM-XX.X
Fiber breakout cable	KY-QSFP-BRKT-MM/SM
Coaxial cable x meter	KY-XX-XX.X
Power supply 24V , 72W	KY-PWR24

Table 19: Ordering Information

We are offering variety of modules and customized cable assembly, to fit your application exact needs.

Please, Contact KAYA Instruments' representative for any question and services.

We have the expertise and experiences to develop a suitable solution dedicated to customer's application, prototypes or production.