CameraLink™ Extender FXCL acquisition system Hardware Reference and Installation Guide

(Part-No. KY-FXCL)

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1 Contents

Revision History

Version	Date	Notes
1.0	02.02.16	Initial Release
1.1	05.01.17	Minor updates
1.2	11.04.18	Added SFP installation section

2 Figures and Tables

Figures

Tables

3.1 Safety Precautions

With your ***Komodo FXCL*** 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 converting CameraLink interface to fiber optic interface. 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

Komodo FXCL system is the industry most advanced Camera Link 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, while each Camera Link Full interface translated to single fiber cable. The Komodo FXCL system is capable of receiving video streams from Camera Link Full camera while such interface supports standard Camera Link bitrates up to 100MHz. This system is ideally suited for industrial, defense and aerospace Machine Vision Systems and applications. The system consists of Komodo Fiber frame grabber and CameraLink to Fiber device. The remote unit converts CameraLink interface to fiber optic interface. The Komodo Fiber FXCL 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 Camera Link
- Extention for distances up to 80km in single-mode and up to 300m in multi-mode
- Plug and Play , no need to configure
- Camera Link Full (Decca) support
- Link redundancy feature over separate fiber cable
- Up to 8 CL Full cameras with single Komodo Fiber Frame Grabber
- Camera Link Full (Decca) over single fiber cable
- PCIe Gen3 x8 Half-length card
- Up to 144 Gb image buffer
- 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
  - 2 RS232 interfaces (On remote unit)
  - One RS422/RS485 interface (On remote unit)
- Camera Link 2.0 compliant
- Power over Camera Link support
- Multiple Camera synchronization
- Multiple Frame Grabbers synchronization
- MDR connectors for camera interface
- GUI interface
- Supporting Windows and Linux OS
- API for developing custom applications
- Plug-ins modules for Matlab, HALCON and Labview
- GenTL support
- Data rates up to 10 Gbps per link
- Transfer Rate of up to 60 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_API_Data_Book
- Vision_Point_App_User_Guide

Accessories:

- CL cables
- Fiber cables (Multi or Single mode)
- GPIO Extension Panel

5.1 System Structure

The Komodo FXCL system consists of a CameraLink camera, an extender device unit (KY-CL2F-D) that translates the CameraLink interface to fiber optic interface and a Komodo Fiber Frame Grabber (FGF) that is able to acquire video directly from fiber optic cables.

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

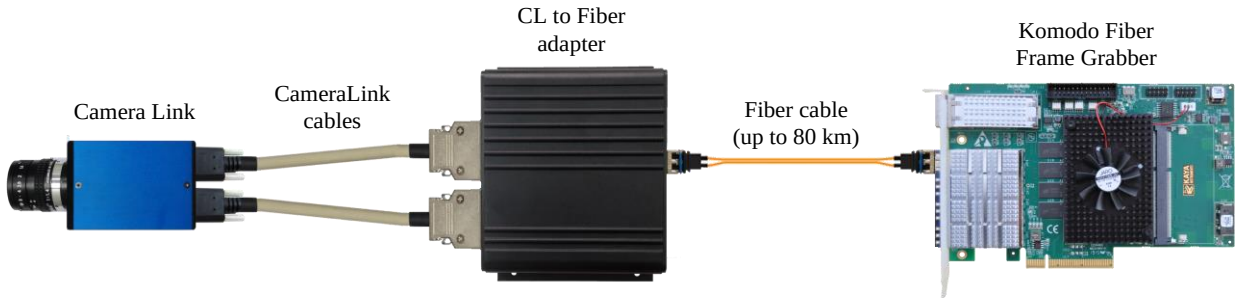

Figure 1 : KY-FXCL single camera topology block diagram

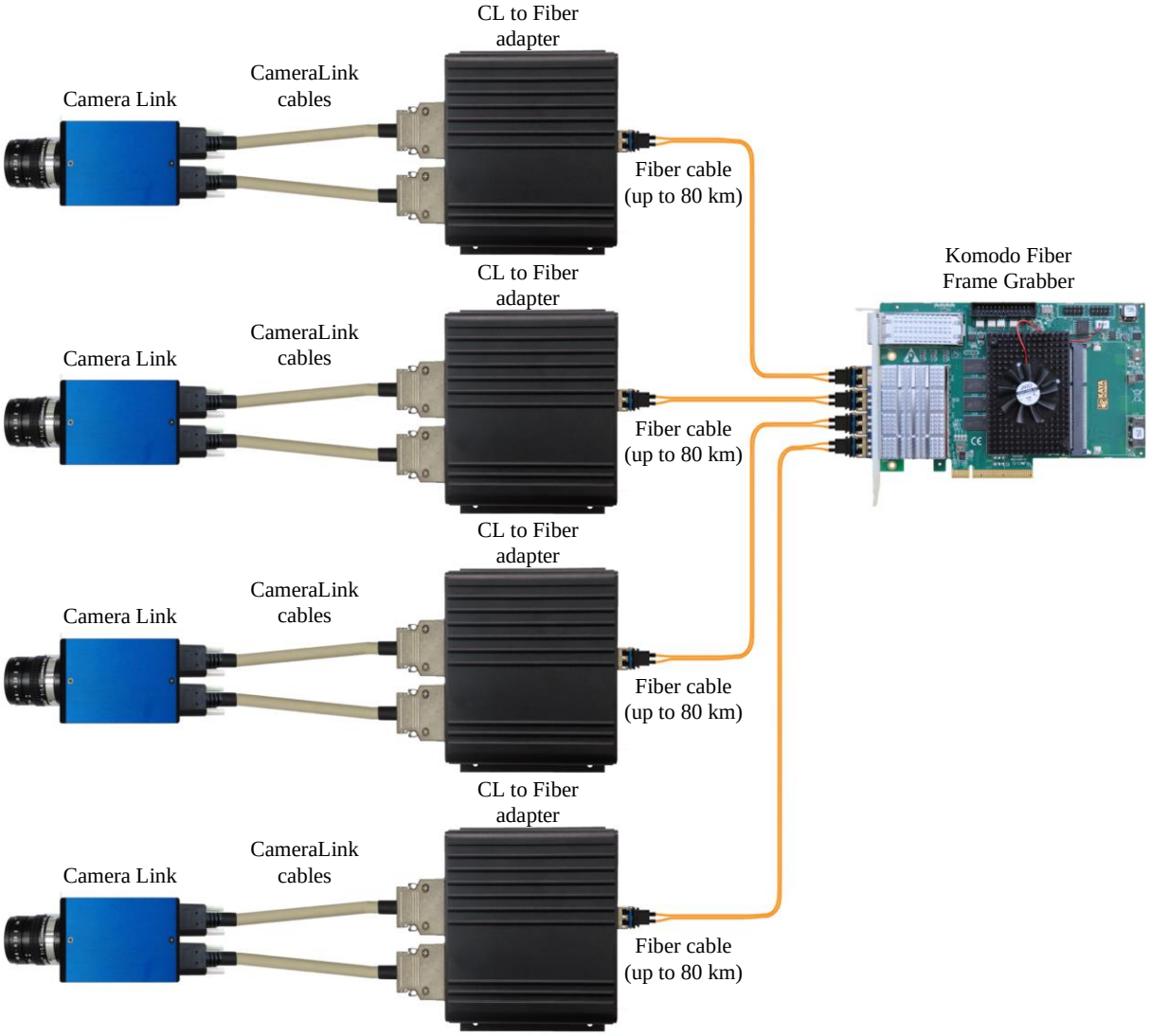

Figure 2 : KY-FXCL quad camera topology block diagram

5.2 External View of the Komodo Fiber frame grabber

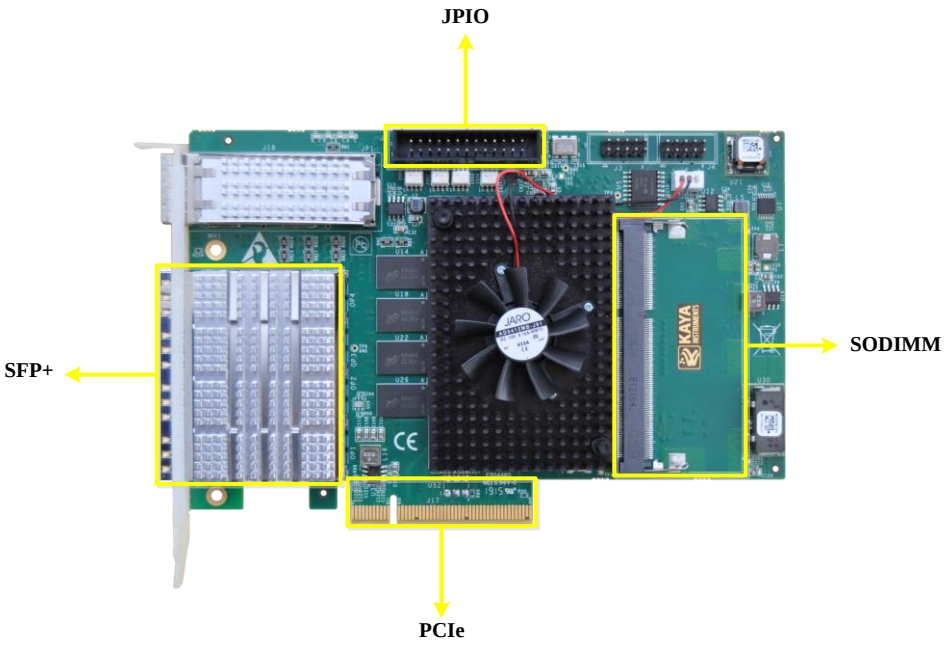

Figure 3 : Komodo board external view

5.3 External View of the KY-CL2F-D

Each ***KY-CL2F-D*** unit is housed in a compact, metal enclosure. Each unit has a power connector, 2 Camera Link connectors (MDR), SFP+ cage, 2 x RJ45 connectors for GPIO and a Mini USB Terminal interface, as shown in Figure 4.

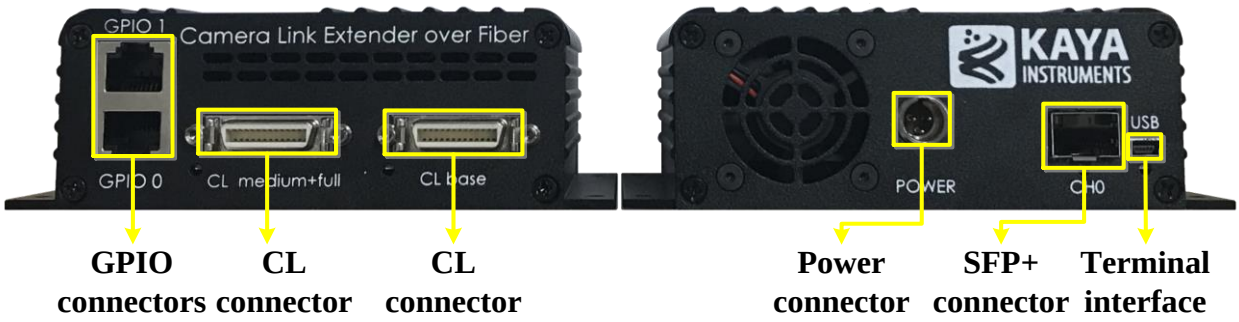

Figure 4 : KY-CL2F-D external view

Each of the CL and SFP+ connectors is paired with a status LED and there is a system status LED (see 7.2 section describing the LED status).

Each unit also has mount ears for an easy and secure installation on any flat surface.

6 Installation and Configuration

6.1 Essentials to get started

To begin using your ***Komodo FXCL*** 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
- ✓ Camera Link camera
- ✓ Camera Link 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 FXCL*** system is connected as described in Figure 5:

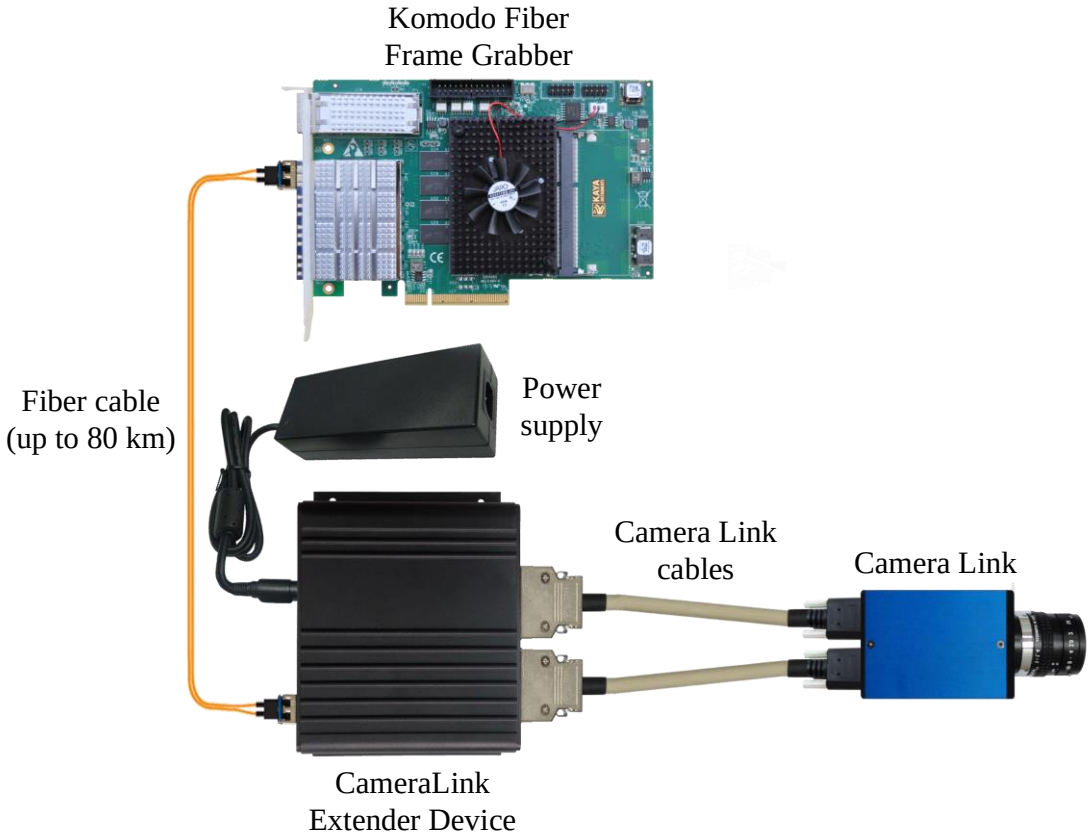

Figure 5 : Komodo FXCL system connection diagram

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+ modules and fiber cable allowing the connection between the ***Camera Link Extender Device (KY-CL2F-D)*** and the ***Komodo Fiber Frame Grabber***, described in section 6.2.2. The third stage is connection of ***KY-CL2F-D*** unit and ***Camera Link*** camera as described in section 6.2.7.

6.2.1 Komodo Fiber Frame Grabber installation instructions

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: The Komodo Fiber 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 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 board will be installed during installation of Vision Point software application.

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+ Module

The purpose of this section is to demonstrate how to install SFP+ transceiver module, attach an optical network cable and remove an SFP+ transceiver module. It is necessary to understand the correct way of installing and removing an SFP+ transceiver, as correct operation can protect the module from being damaged and ensure its stable performance.
Before removing or installing an SFP+ 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+ 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+ 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+ 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 FXCL*** 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 6.
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 7.
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-CL2F-D***.

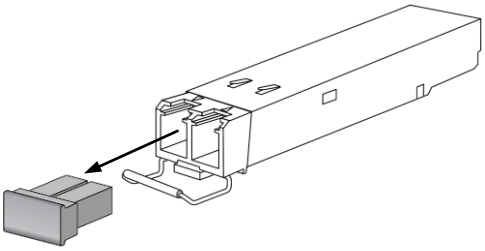

Figure 6 : SFP+ Module with bale clasp open and dust plug removed

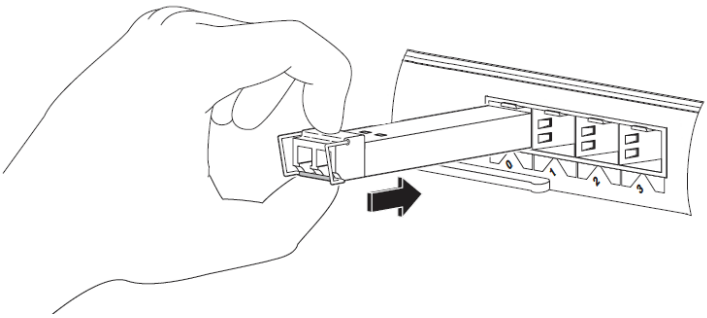

Figure 7 : Installing an SFP+ Module into a port

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 must be done to the same port number all over the way from ***KY-CL2F-D to 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-CL2F-D*** and RX input (Marked with RX or Arrow inwards the SFP+) on the ***Komodo Fiber Frame Grabber***, as shown in Figure 8.
3. Insert the fiber cable into the module, as shown in Figure 9.
4. Firmly push on each cable, until you will hear a click.

5. Connect the other side of the fiber cables to the ***KY-CL2F-D***.

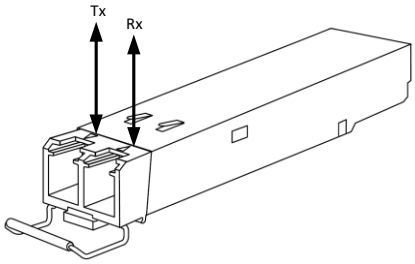

Figure 8 : SFP+ Module with TX output and RX input marked

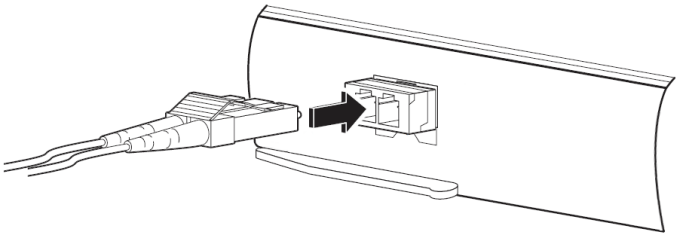

Figure 9 : Connecting the cable to SFP+ Module

6.2.6 Removing the SFP Module

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

1. Turn the ***KY-CL2F-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 10.
4. Grasp the module between your thumb and index finger and carefully remove it from the port, as shown in Figure 11.
5. Insert the clean dust covers into the module, as shown in Figure 12.

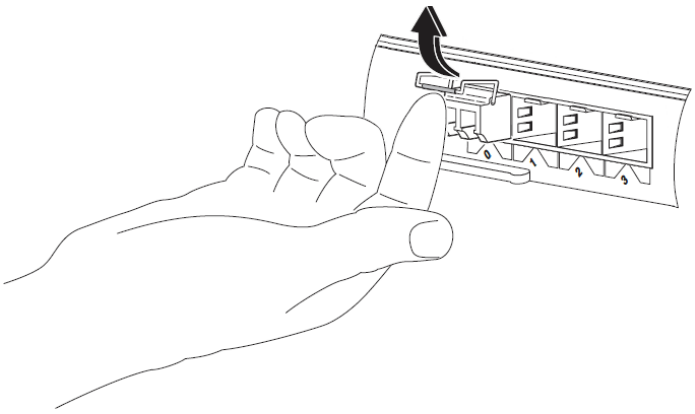

Figure 10 : Opening the bale clasp of an SFP+ Module

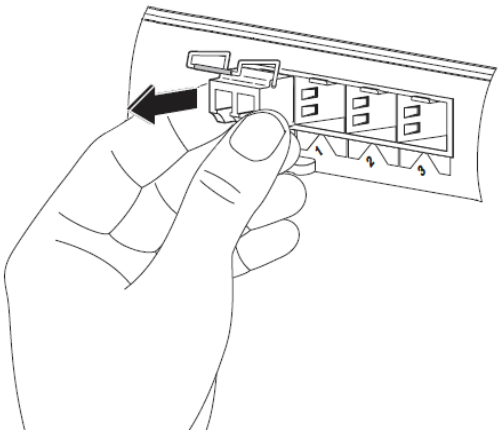

Figure 11 : Removing an SFP+ Module from the port

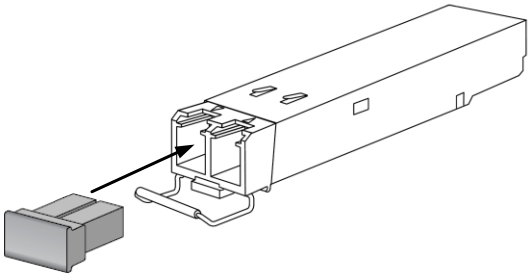

Figure 12 : SFP+ Module with bale clasp open

6.2.7 Completing the Komodo FXCL system installation

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

1. Connect the CameraLink cables between the camera and ***KY-CL2F-D*** unit.
2. Connect the Power Adaptor to the ***KY-CL2F-D*** unit.
   The ***KY-CL2F-D*** requires 12V power supply for proper function of the camera. Please, refer to Electrical specification section of this document for exact Power Supply requirements.
3. The power supply connector of the ***KY-CL2F-D*** unit shown in Figure 4.
4. Connect the camera to a power supply (Regardless of the cameras PoCL support).
5. Turn the ***KY-CL2F-D***, the CL camera and the computer on and start your Vision Point software application.

6.3 Reducing the fiber optic cable count

The system requires duplex fiber optical cable in order to properly operate, but sometimes it required transferring the data over simplex fiber cable or installing the system into existing CWDM infrastructure.

Several options listed in the sections below exist in order to achieve the above. 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 CWDM SFP option

In CWDM option the SFP is replaced by CWDM SFP that is able to transmit and receive the data on specific wavelength. By using these SFPs, the system can be integrated into existing CWDM infrastructure by usage of external CWDM MUX.
Please contact KAYA representative for details.

6.3.2 Bidirectional (BIDI) SFP option

This option allows using a simplex fiber cable in the system. In this option the SFP is replaced by bidirectional (BIDI) SFP that transmits and receives on the same fiber core. Example connection is described in Figure 13.

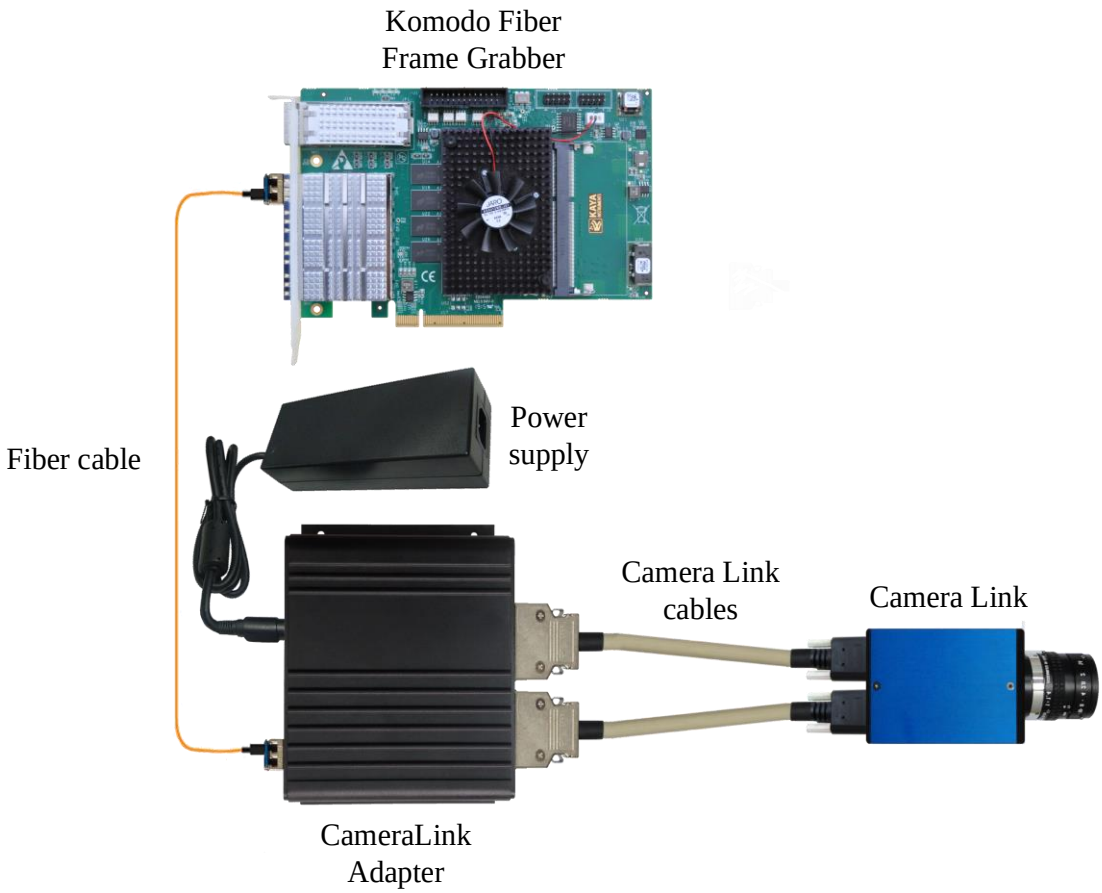

Figure 13 : Bidirectional camera link connection

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 Fiber Board Block Diagram

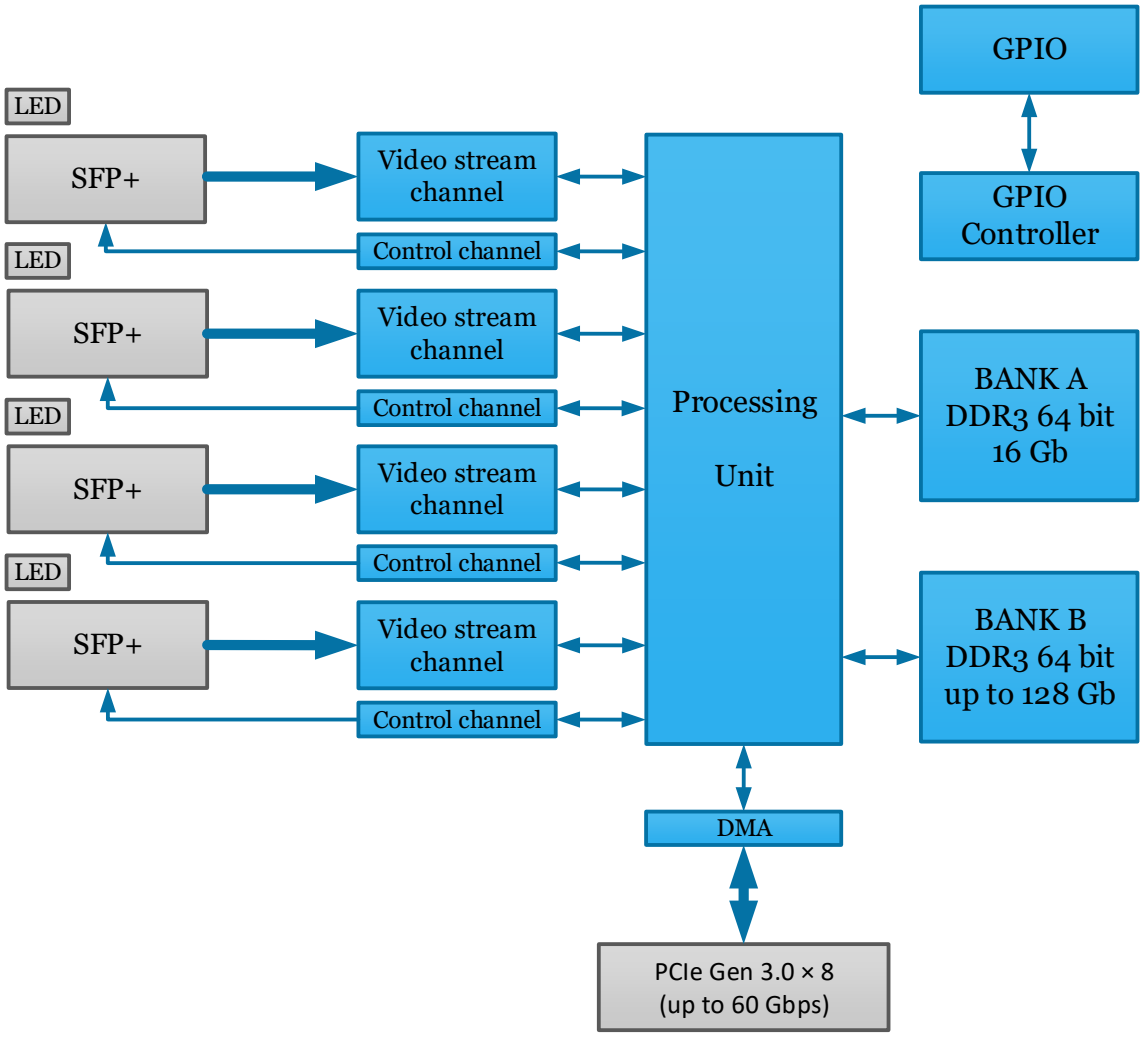

Figure 14 : Komodo Fiber Board Block Diagram

7.1.2 Komodo Fiber LEDs

Komodo Fiber is equipped with indication bi-color LED for each SFP connector.

The LEDs' different states are described in Table **1**.

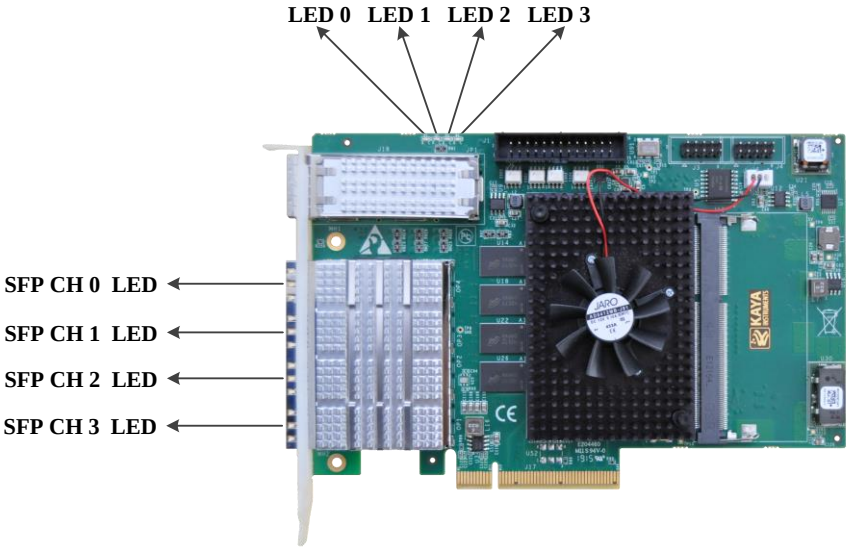

Figure 15 : Komodo Board LED's locations

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
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

Table 1: Komodo Fiber links status LED's

In additional to SFP 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 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 API and be set as a trigger sources. The API enables routing of any input to any output as well as to the remote 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.

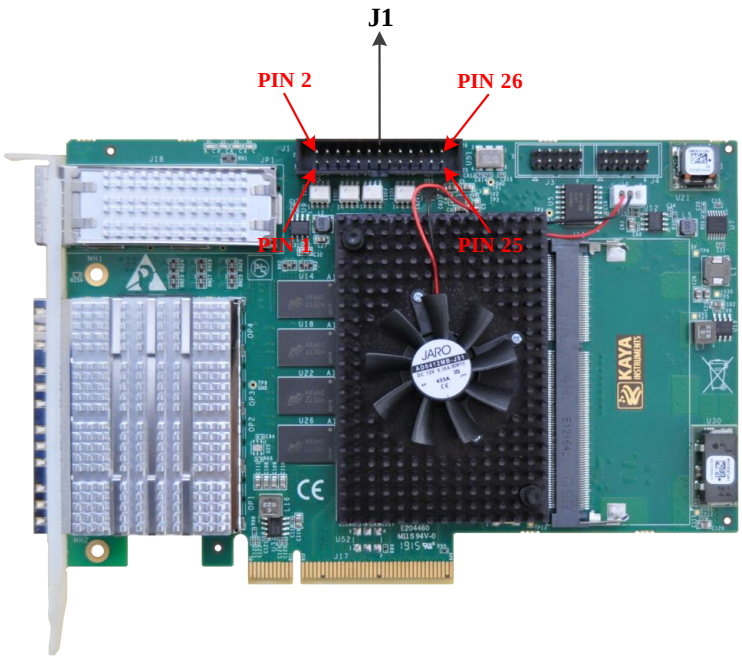

Figure 16 : GPIO connectors location

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	Negative 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	Positive signal of LVDS pair
7	LVDS Output 1p	LVDS output	LVDS	Negative 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:

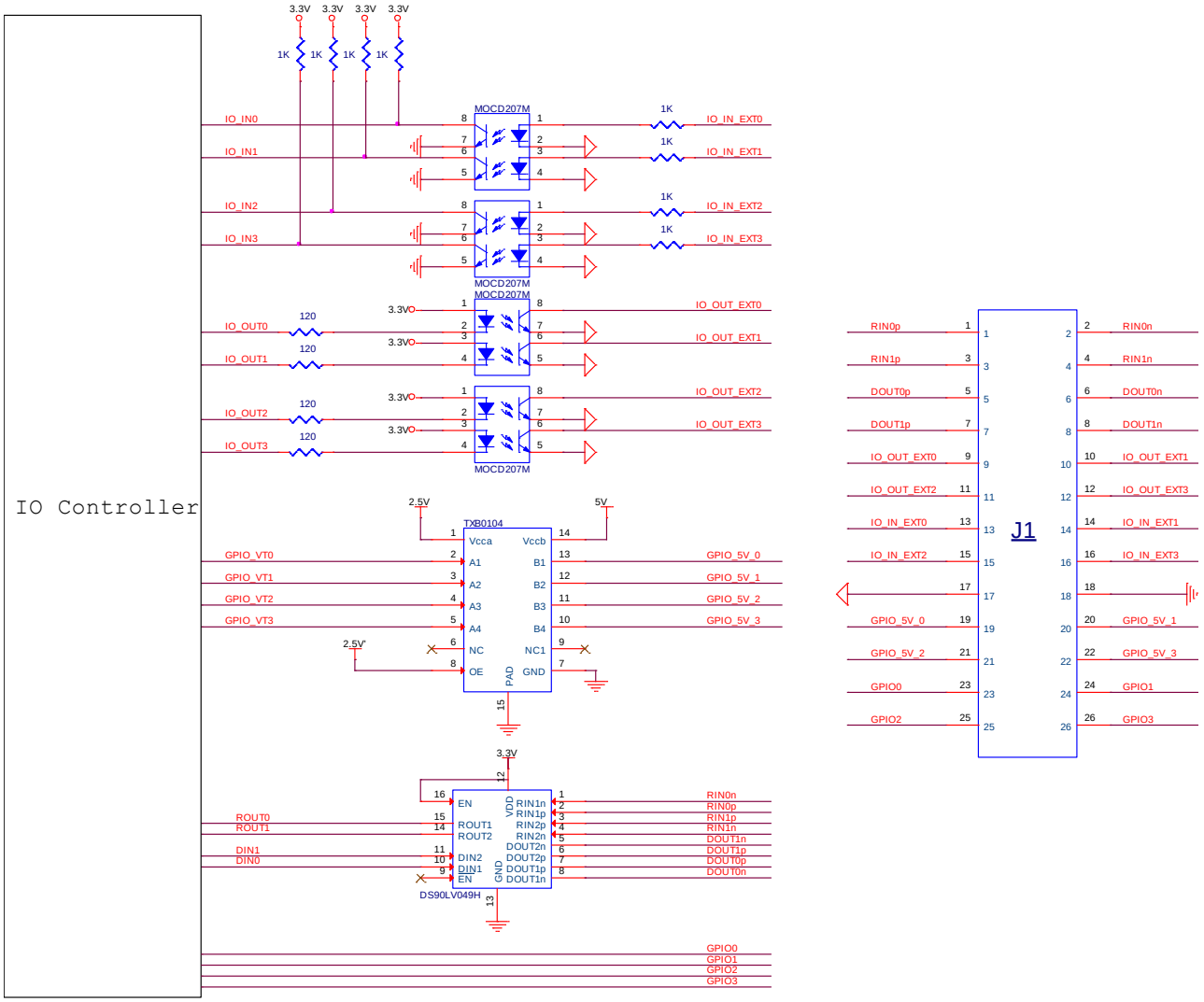

Figure 17 : GPIO Connector schematic

7.2 KY-CL2F-D unit Hardware Reference

This chapter provides information on KY-CL2F unit hardware.

7.2.1 KY-CL2F-D unit LEDs description

Each unit has several status LEDs, as seen in Figure 18 and Figure 19.

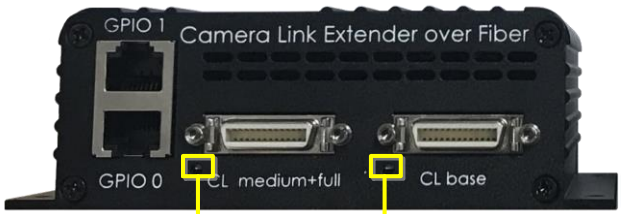

Figure 18 : KY-CL2F-D Fiber side LEDs

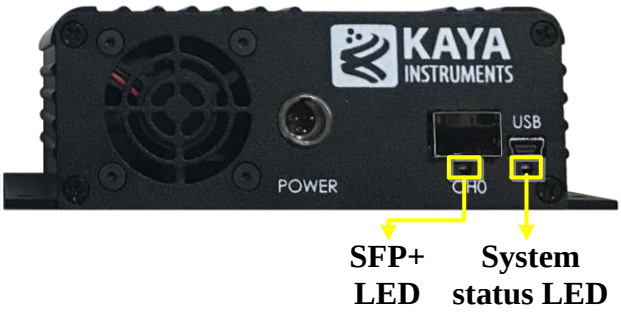

Figure 19 : KY-CL2F-D CL side LEDs

The System status LED, located on the Camera link 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 KY-CL2F-D LED's behavior is described in Table 4:

LED state	Condition
Slow pulse red	No valid CL link detected
Solid red	PoCL failure (Overcurrent/Under voltage/Overvoltage)
Solid green	Camera link is active

Table 4 : KY-CL2F-D status LEDs behavior

The SFP+ LED behavior is described in Table 5:

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

Table 5 : SFP+ status LEDs behavior

7.3 Power supply

This device requires 12V power supply for proper function. External power supply or user provided 12V must be connected to unit.

Please, refer to Electrical specification section of this document for exact Power Supply requirements.

8.1 KY-CL2F-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

8.2 KY-CL2F-D Terminal commands

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 link status and general information
pwr	Power over CL configuration
default	Reset user settings
save	Save user settings to flash

Table 7 : Terminal commands for Device unit

NOTE: The commands are not case sensitive.

8.3 KY-CL2F-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 chapter 8.1.
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: cl_ext_device, 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.

8.4 IO Connector

The extender incorporates two RJ45 connectors to provide GPIO functionality such as TTL, Opto Coupled, RS232 and RS422. The pin-out of the connectors can be found in the tables below.

Pin number	Name	Description
1	TTL0	Bidirectional TTL signal
2	OptoCoupled Output	Opto Isolated output
3	RS232 RX 0	RS232 Receive
4	OptoCoupled GND	Opto Isolated Ground
5	GND	Signal ground
6	RS232 TX 0	RS232 Transmit
7	TTL1	Bidirectional TTL signal
8	OptoCoupled Input	Opto Isolated input

Table 8 : Top I/O connector pinout

Pin number	Name	Description
1	RS422 RXp	RS422 positive receive
2	RS422 RXn	RS422 negative receive
3	GND	Signal ground
4	RS422 TXp	RS422 positive transmit
5	RS422 TXn	RS422 negative transmit
6	GND	Signal ground
7	RS232 TX 1	RS232 transmit
8	RS232 RX 1	RS232 receive

Table 9 : Bottom I/O connector pinout

9 User Interface

The extender supports configurations of several components using standard Gen<i>Cam interface described in extracted xml file. The xml file, which is embedded in the extender unit, is complaint with Gen<i>Cam standard 2.0. This provides an interactive interface for controlling extender features and setting and controlling the video stream parameters for the Frame Grabber.

9.1 Stream provided features and controls

1. Width – width of the image provided by the device (in pixels).
2. Height - height of the image provided by the device (in pixels).
3. CL Mode – the CameraLink mode of the connected camera.
4. Pixel Format – format of the pixels provided by the device.
5. Pixel Format is subordinate to the chosen CL Mode. Not all provided Pixel Formats are available for all CL modes. The complete list can be found in Table 10.
6. Taps - Number of taps of the camera sensor. Not all provided Taps are available for all CL modes. The complete list can be found in Table 10.
7. Scan Type – Scan type of the sensor of the device. AreaScan (for area cameras) or LineScan (for line scan cameras) can be chosen to define the mode of the scan type.

CL Mode	Supported Pixel Format	Supported Taps configuration
Lite	Mono8 Mono10	1 tap
Base	Mono8 Mono10 Mono12 Mono14 Mono16 RGB8	1 tap 2 taps 3 taps
Medium	Mono8 Mono10 Mono12 RGB10 RGB12	1 tap 3 taps 4 taps
Full	Mono8 RGB8	8 taps
Deca8taps	Mono10 RGB8	8 taps
Deca10taps	Mono8	10 taps

	RGB8	

Table 10 : Supported Pixel Formats and Taps for different CL modes

9.2 Extender Device provided features and controls

1. Device Firmware Version – Current Extender firmware version.
2. Connection Reset – This will issue reset signal for the device video stream in order to reset stream feed connection with the camera.
3. Acquisition Start – Enables the transmission of the video stream from the extender.
4. Acquisition Stop – Disables the transmission of the video stream from the extender.
5. Uart Baud Rate – configure the serial baud rate for serial communication with the connected camera.
6. PoCL Control – Enables or disables the PoCL on the extender for both channels
7. Test Pattern – Outputs test pattern instead of camera image
8. Save user configurations – saves stream and extender configuration to extender's non-volatile memory.

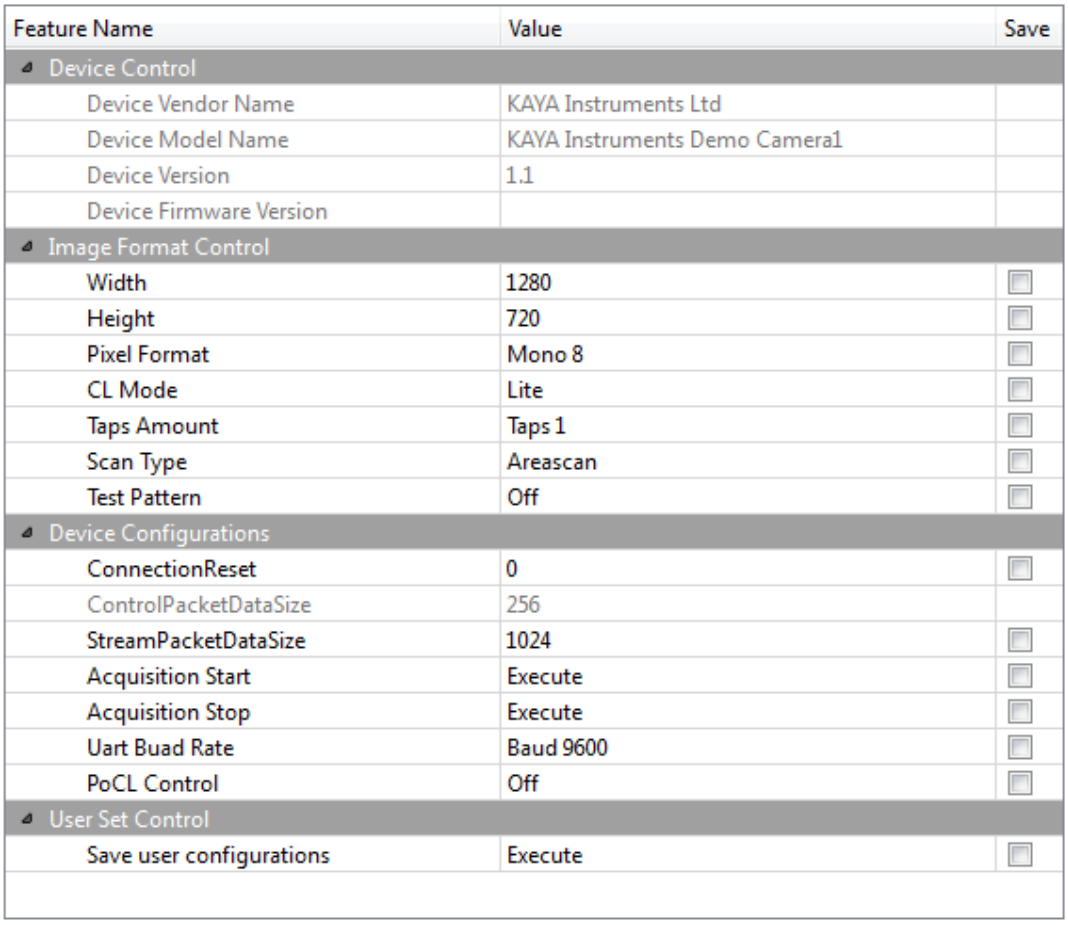

Figure 20 : User Configurations

9.3 Setting the extender parameters to work with CameraLink camera

1. Make sure the Extender has been detected and xml file was fully extracted.
2. Set the Width, Height and Scan Type parameters according to current camera stream.
3. Set the CL Mode of the camera before setting the Pixel Format and Taps. This is because not all Pixel Format and Taps are supported for all CL Modes.
4. In order to save current configurations issue the “Save user configurations” command and this will save current configurations to the extender’s non-volatile memory.

10.1 Absolute maximum ratings

Specification	Minimum rate	Maximum rate
3.3V power supply	-1.0V	+7.0V
12V power supply	-0.3V	+14V
Storage temperature	-40°C	+85°C
Operating ambient temperature	0°C	+50°C
LVDS	-0.3V	+3.6V
Opto-isolated (in)	-6V	+60V
Opto-isolated (out)	-7V	+70V
TTL	-0.5V	+6V
LVTTL	-0.5V	+3.9V

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

Table 11 : Komodo Fiber Absolute maximum ratings

Specification	Values
Power supply voltage	10V to 14V
Storage Temperature	-40°C to 85°C
Operating Temperature	0°C to 50°C (Commercial) -40°C to 70°C (Industrial)
Opto Isolated input voltage	-6V to 60V
Opto Isolated output voltage	-7V to 70V
Opto isolated output current	150mA max
TTL I/O input voltage	-0.2V to 6V
RS422 input voltage	-6V to 12V
RS232 input voltage	-20V to 20V

Table 12 : KY-CL2F-D Absolute maximum ratings

10.2 Operating conditions

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 13 : Komodo Fiber operating conditions

Electrical characteristics for Komodo Fiber board IO's:

Symbol	Parameter	Condition	Pin	MIN	Typ	MAX	Units
$\lvert V_{OD} \rvert$	Differential Output Voltage	R_L = 100 Ω	D_{OUT-} D_{OUT+}	250	350	450	mV
ΔV_{OD}	Change in Magnitude of V_{OD} for Complementary Output States				1	35	$\lvert$ mV $\rvert$
V_{OS}	Offset Voltage			1.125	1.23	1.375	V
ΔV_{OS}	Change in Magnitude of V_{OS} for Complementary Output States				1	25	$\lvert$ mV $\rvert$
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 14 : 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	R_{IN+} R_{IN-}		-15	35	mV
V_{TL}	Differential Input Low Threshold			-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 15 : 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 $V_{OUT} \leq V_{OL\ (max)}$	2	V_{DD}+0.3	V
V_{IL}	Input Low Voltage		-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 16 : 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 17 : 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 18 : 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 19 : Komodo Fiber TTL output specifications

Parameter	Description	Minimum	Typical	Maximum
V_{cc}	Supply voltage	11 V	12V	13 V
I_{cc} (Host)	Supply Current from PoCL or external power supply	-	0.9 A	1.2 A
I_{cc} (Device)	Supply Current from external power supply	-	0.5 A	1 A
I_{PoCL}	PoCL Output current per link	0 A	-	0.4 A

Table 20 : KY-CL2F-D Operating conditions

Electrical characteristics for ***KY-CL2F-D*** board IO's:

Symbol	Parameter	Test condition (note 1)	MIN	MAX	Units
V_{IH}	Input High Voltage	$V_{OUT} \geq V_{OH\ (min)}$ or	3.5	5	V
V_{IL}	Input Low Voltage	$V_{OUT} \leq V_{OL\ (max)}$0	0	1.5	V
I_{IN}	Input Current	V_{IN} = 0 V or V_{IN} = V_{DD}		±2	µA

Note: Vdd = 5V, unless specified otherwise

Table 21 : KY-CL2F-D TTL input specifications

Symbol	Parameter	Test condition	MIN	MAX	Units
V_{OH}	Output High Voltage		4		V
V_{OL}	Output Low Voltage			0.6	V

Note: Vdd = 5V, unless specified otherwise

Table 22 : KY-CL2F-D TTL output specifications

Symbol	Parameter	Condition		MIN	Typ	MAX	Units
V_{OD}	Differential Output Voltage	R_L = 100 Ω (RS422)		2	2.7		V
		R_L = 54 Ω (RS485)		1.5	2.3	3.3	V
ΔV_{OD}	Change in Magnitude of V_{OD} for Complementary Output States	R_L = 100 Ω / 54 Ω			0.01	0.2	V
ΔV_{OS}	Change in Magnitude of V_{OS} for Complementary Output States						
I_{OS}	Output Short Circuit Current					250	mA
I_{OFF}	Power-off Leakage	Out enabled	V_{IN} = 12V		14	20	µA
			V_{IN} = -7V	-20	-11		
		Out disabled	V_{IN} = 12V		0.03	1	
			V_{IN} = -7V	-1	-0.01		
I_{OZ}	Output TRI-STATE Current			-1		1	µA
V_{OH}	Output High Voltage			2.9			V
V_{OL}	Output Low Voltage					0.4	V

Table 23 : KY-CL2F-D RS422 / RS485 Output DC specifications (Driver Outputs)

Symbol	Parameter	Condition	MIN	Typ	MAX	Units
V_{TH}	Differential Input High Threshold		-0.2		0.2	V
I_{IN}	Input Current	V_{IN} = 12 V		0.6	1	µA
		V_{IN} = -7 V		-0.3	-0.8	µA
V_{IH}	Input High Voltage		2			V
V_{IL}	Input Low Voltage				0.8	V

Table 24 : KY-CL2F-D RS422 / RS485 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	5		V
V_{IL}	Input Low Voltage	$V_{OUT} \leq V_{OL\ (max)}$0	-5		V
I_{IN}	Input Current	V_{IN} = 0 V or V_{IN} = V_{DD}		1	µA

Table 25 : KY-CL2F-D RS232 input specifications

Symbol	Parameter	Test condition	MIN	MAX	Units
V_{OH}	Output High Voltage		2.7		V
V_{OL}	Output Low Voltage			0.4	V

Table 26 : KY-CL2F-D RS232 output specifications

11.1 Komodo Fiber 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 21.

For more detailed information please, contact KAYA Instruments representative.

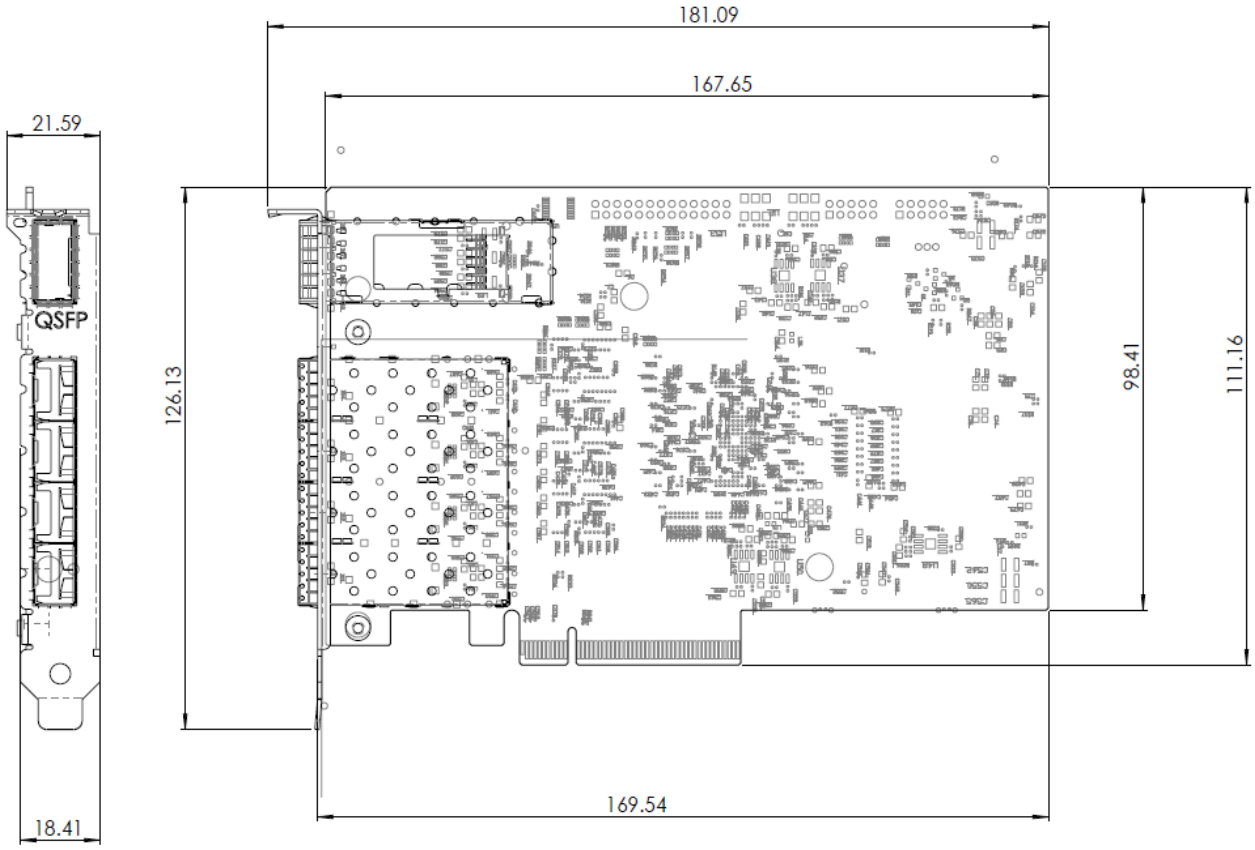

Figure 21 : PCB Mechanical Dimensions

11.2 KY-CL2F-D Dimensions

Each ***KY-CL2F-D*** unit is housed in a metal enclosure as shown in Figure 22.

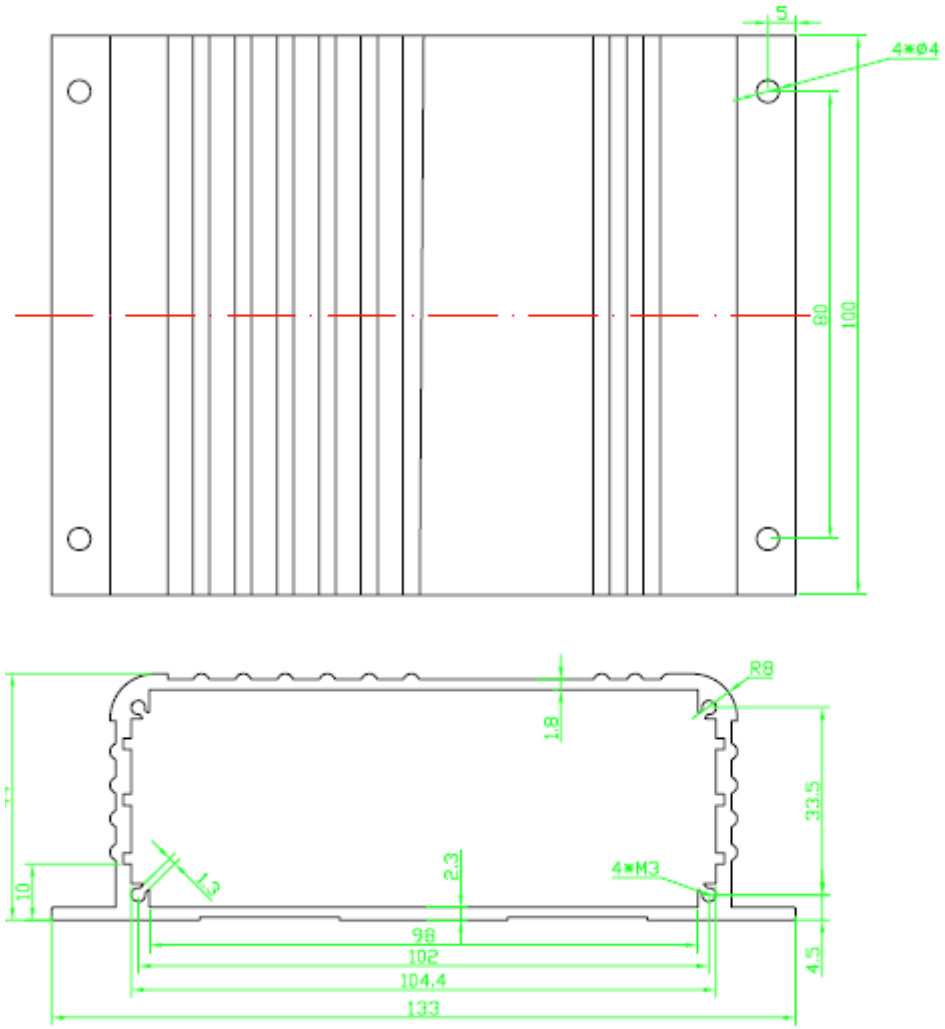

Figure 22 : External dimensions of the KY-CL2F-D enclosure box

11.3 Weight

Each ***KY-CL2F-D*** unit weights 356g. (the metal enclosure weights 235g.)

11.4 Camera Link cables

Camera Link® is a robust communications link using a dedicated cable connection and a standardized communications protocol. Camera Link is a hardware specification that standardizes the connection between cameras and frame grabbers. It defines a complete interface which includes provisions for data transfer, camera timing, serial communications, and real time signaling to the camera. Camera Link was built for real time, high bandwidth (maximum 850 MB/s) parallel communication. It is a well-established and distributed industry standard, and there are many Camera Link products on the market today.

11.5 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.).

12 Ordering information

Item name	Item part number
Camera Link FXCL system	KY-FXCL
Camera Link Range Extender over Fiber –Device unit	KY-CL2F-D
Komodo Fiber Frame Grabber	KY-FGF
SFP+ single-mode module	KY-SFP-10G31-10
SFP+ multi-mode module	KY-SFP-10G85-3M
SFP+ single-mode bidirectional module	KY-SFP-BD-10G-10
Fiber cable (*)	KY-FCA-X-XX
Camera Link Cable (*)	KY-CCL-X-XX
Power supply 12V , 26W	KY_PWR12_26

Table 27 : Ordering Information

(*) Please contact KAYA Instruments for exact Part Number or refer to our website at: www.kayainstruments.com/category/products/cables-assembly/

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.