

Range Extender

CoaXPress 2.0 over Fiber User Manual

User Manual



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KAYA
INSTRUMENTS

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2 Revision History

Ver	Date	Notes
1.0	10.2021	Initial release

Table 1 – Revision History

PRELIMINARY

3 Introduction

3.1 Safety Precautions

With your *CoaXPress 2.0 over Fiber* range extender in hand, please take the time to read through the precautions listed below to avoid preventable and unnecessary injuries and damage to you, other personnel, or property. Read these safety instructions carefully before your first use of the product, as these precautions contain safety instructions that must be observed. Be sure to follow this manual to prevent misuse of the product.



Caution! Read Carefully and do not disregard these instructions.

In the event of a failure, disconnect the power supply

Disconnect the power supply immediately and contact our sales personnel for repair. Continuing to use the product in this state may result in a fire or electric shock.

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

Disconnect the power supply immediately! Continuing to use the product in this state may result in a fire or electric shock. After verifying that no smoking is observed, contact our sales personnel for repair.

Do not disassemble, repair or modify the product.

Such actions may result in a fire or electric shock due to a circuit shortage or heat generation. Contact our sales personnel before inspection, modification, or repair.

Do not place the product on unstable surfaces.

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

Do not use the product if dropped or damaged.

Otherwise, a fire or electric shock may occur.

Do not touch the product with metallic objects.

Otherwise, a fire or electric shock may occur.

Do not place the product in dusty or humid environments, nor where water may splash.

Otherwise, a fire or electric shock may occur.

Do not wet the product or touch it with wet hands.

Otherwise, the product may fail or cause a fire, smoking, or electric shock.

Do not touch the gold-plated sections of the connectors on the product.

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

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

- Unventilated areas such as closets or bookshelves
- Near oils, smoke, or steam
- Next to heat sources
- A car with closed doors where the temperature can become hot
- Static electricity replete locations
- Near 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 objects on the product.

Otherwise, the product may be damaged.

Be sure to discharge static electricity from the body before touching any sensitive electronic components.

The electronic circuits in your computer and the circuits on the *Iron* camera and the *Predator II* board are sensitive to static electricity and surges. Improper handling may 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 only be used for image capturing and processing. **KAYA Instruments** assumes no responsibility for any damage that may ensue by using the camera for any purpose other than intended, as previously stated. Without detracting what was previously written, please be advised that the company takes no responsibility for any damages caused by:

- Earthquake, thunder strike, natural disasters, a fire caused by usage beyond our control, willful and/or accidental misuse and/or use under other abnormal and/or unreasonable conditions
- Secondary damages caused by the use of this product or its unusable state (business interruption or others)
- Use of this product in any manner that contradicts this manual or malfunctions due to connection to other devices.
- Damage to this product that is out of our control or failure due to modification.
- Accidents and/or third parties that may be involved.

Additionally, **KAYA Instruments** assumes no responsibility or liability for:

- Erasure or corruption of data caused by the use of this product
- Any consequences or other abnormalities following the use of this product

Repairs to this product are carried out by replacing it on a chargeable basis and not by repairing the faulty device. Non-chargeable replacement is offered for initial failure, as long as it is reported no later than two weeks post-delivery of the product.

4 Overview

KAYA Instruments' CoaXPress 2.0 over Fiber Range Extender provides a high resolution stream interface for large distances of up to 80km over single-mode fibers, and up to 300m over multi-mode optical fibers. Optical fibers are electrically isolated and do not radiate nor are susceptible to electromagnetic interference, also eliminating problems associated with grounding. Additionally, Fiber cable are not easily tapped, providing secure communication.

The system is constructed of two converters, one on the camera side and one on the frame grabber side. The camera side converter can provide power to the camera over a CoaXPress link, whilst the host side converter can sink power from a frame grabber. The converters use flexible SFP+ modules for optical connection that can be easily changed. The range extender is able to provide a downlink of up to 12.5Gbps (CXP-12) and uplink of up to 41.6 Mbps per link.

PRELIMINARY

5 Hardware Reference

5.1 External View

Each unit is housed in a compact metal enclosure and has a power connector, 4 CoaXPress 2.0 (micro-BNC) connectors, 4 SFP+ cages and a Mini USB Terminal interface, as shown in Figure 1.



Figure 1 – External view

5.2 Power Supply

This device requires 24V power supply for proper function. The Host side of the extender is compatible with PoCXP standard and therefore doesn't require external power supply, once the Frame Grabber supports this feature too. At the Device side, external power supply must be used. Please, refer to Electrical specification section of this document for exact Power Supply requirements. An optional power supply or user selectable must be connected to this on the device side extender box.

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, as seen in Figure 2.

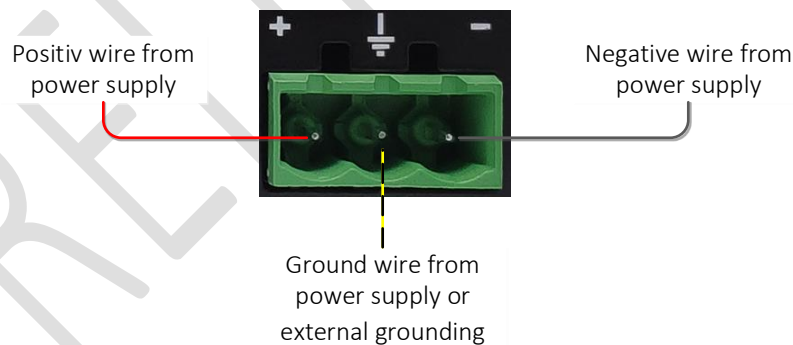


Figure 2 – Power connector

Table 2 includes part numbers for both female and male connector of the power supply:

Connector	Manufacturer	Part Number
Female Connector	Wurth Elektronik	691313510003
Male Connector	Wurth Elektronik	691351500003

Table 2 – Power connectors

5.3 LEDs



Figure 3 – LED locations

The system has three types of LEDs: a system status LED, CoaXPress LEDs and SFP+ LEDs. The system's status LEDs states are described in the following table:





LED state	Indication
	Device is not powered
	Device is on
	Firmware update is in progress
	System failure

Table 3 – System status LED

The CoaXPress LEDs conform to the CoaXPress 2.0 protocol, as described in Table 4 and Table 5:








LED state	Indication
	Camera is not powered
	Camera is booting
	Camera is powered but no active connection
	Fast flash alternate green / orange - Connection detection in progress
	Camera is connected, no data being transferred
	Camera is connected, data is being transferred
	Camera is connected. Waiting for trigger event

Table 4 – CoaXPress status LED colors




Indication	Timing
	12.5Hz (20ms on, 60ms off)
	0.5Hz (1s on, 1s off)
	1Hz (200ms on, 800ms off)

Table 5 – CoaXPress status LED timing

Finally, SFP+ status LEDs behavior is describes in Table 6:





LED state	Indication
	Device is not powered
	Normal operation
	SFP not detected
	No optical signal detected

Table 6 – SFP status LED

6 Installation & Configuration

6.1 Installation procedure

The KY-FEXT system, on the host side (KY-FEXTII- H unit), is connected to the Komodo Frame Grabber. On the device side (KY-FEXTII-D unit), the system is connected to 4 CoaXPress cameras, as described in Figure 4:

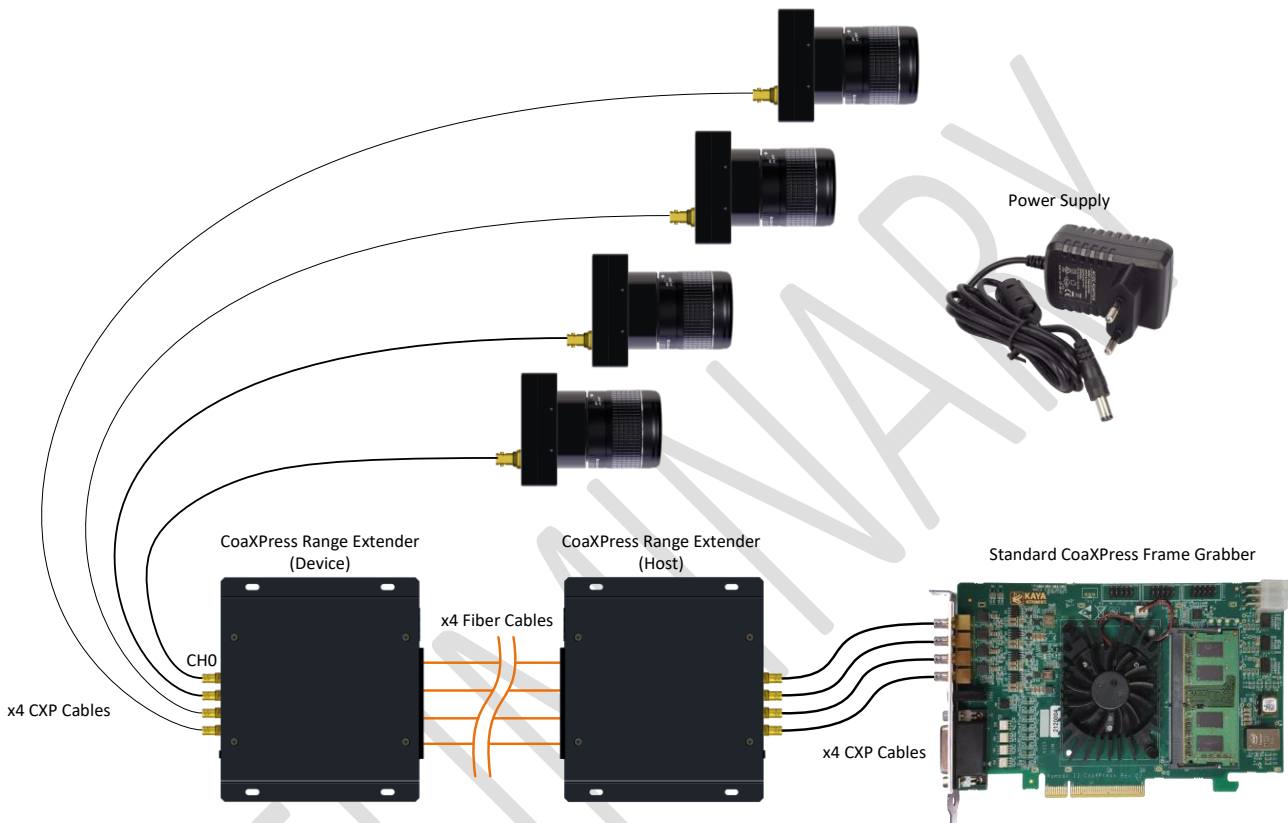


Figure 4 – KY-FEXTII connection diagram

6.2 SFP+ Modules

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.

6.2.1 Precautions

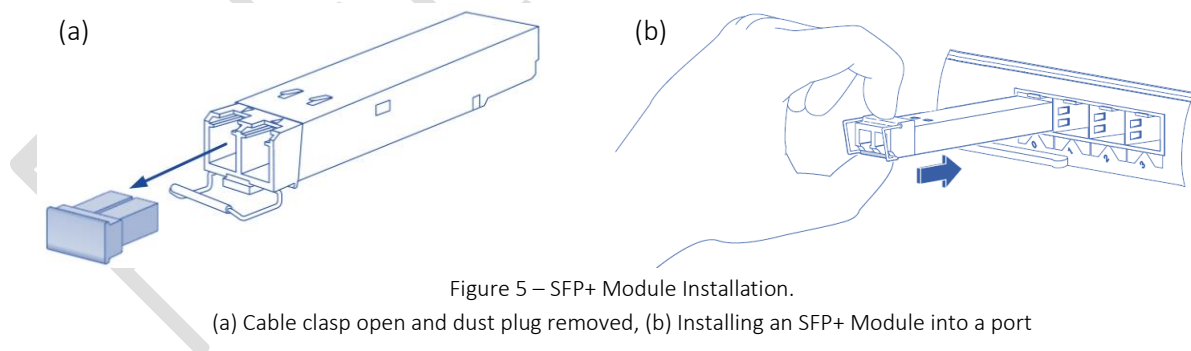
1. Use an ESD-preventive wrist or ankle strap and follow its instructions for use.
2. Make sure there is no dust or any other foreign matter inside the SFP+ module, or blocking any of the connectors.
3. Clean the optic surfaces of the fiber cables before plugging them into the optical ports of an SFP+ 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.

6.2.2 Installing the SFP+ Module

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

1. Remove the dust plugs from the module as shown in Figure 5(a).
2. The SFP+ module has a bale clasp that used to remove or install the SFP+ module.
3. Close the bale clasp before inserting the SFP+ module.
4. Line up the module with the port and slide it into the port as shown in Figure 5 (b).
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 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.
7. Follow the exact steps to insert additional module into the camera's fiber interface.



6.2.3 Connecting the Interface Cable to the 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. Perform 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 camera to 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 camera and RX input (Marked with RX or Arrow inwards the SFP+) on the Frame Grabber, as shown in Figure 6(a).
 - 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.
3. Insert the fiber cable into the module, as shown in Figure 6 (b).
 4. Firmly push on each cable, until you will hear a click.
 5. Connect the other side of the fiber cables to the cameras SFP+ module.
 6. Turn the camera and the computer on and start your Vision Point software application.

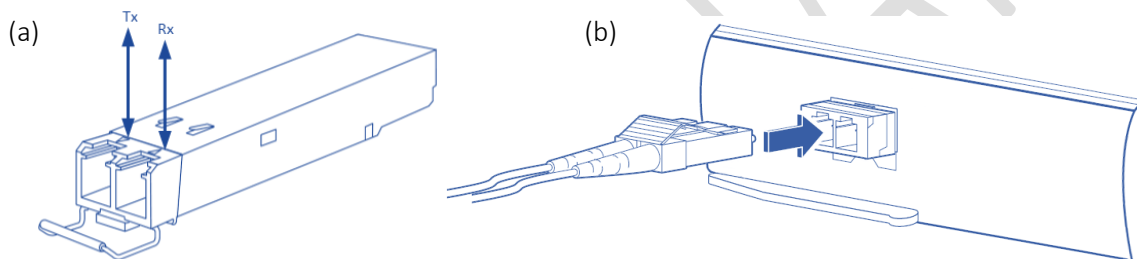


Figure 6 – Interface connecting to the SFP+ Module
 (a) SFP+ module with TX output and RX input marked, (b) Connecting the cable to SFP+ Module

6.2.4 Removing the SFP+ Module

1. Turn the camera 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 7(a).
4. Grasp the module between your thumb and index finger and carefully remove it from the port, as shown in Figure 7(b).
5. Insert the clean dust covers into the module, as shown in Figure 7(c).

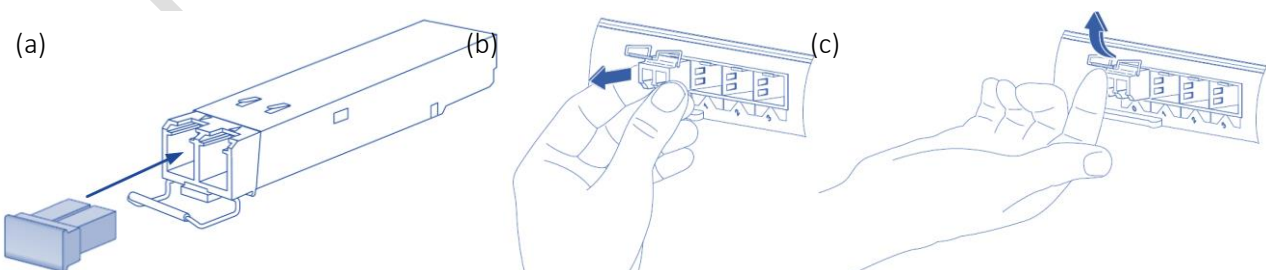


Figure 7 – Removing the SFP+ Module
 (a) Opening the bale clasp of an SFP+ Module, (b) Removing an SFP+ Module from the port, (c) SFP+ Module dust plug placement

6.3 Micro BNC Cables

To connect the Micro-BNC cable, first need to align the pin on the male end with the “L” shaped track on the female-connector of the Coaxial cable. Once aligned, the connector should be pushed in place (see Figure 8). Only mild pressure should be applied to achieve this operation, otherwise it may cause unnecessary damage to the cable or the card.



Figure 8 – Pushing the Micro-BNC connector into place

Once pushed all the way through, twist the connector clock-wise. The pin will move in the track locking the connector in position:



Figure 9 – Twisting the connector and securing it in position

The cable can be removed by reversing the steps: twisting the connector counter-clock-wise and pulling it out. Do not force the cable out! In case of resistance check for the pin location in relation to the track. Adjust as needed and only then pull the cable out.

7 Configuration Interface

7.1 Device Control

In order to properly complete the system installation, the following steps must be taken:

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 in the right order, using one of the configurations available:

7.1.1 Single connectivity

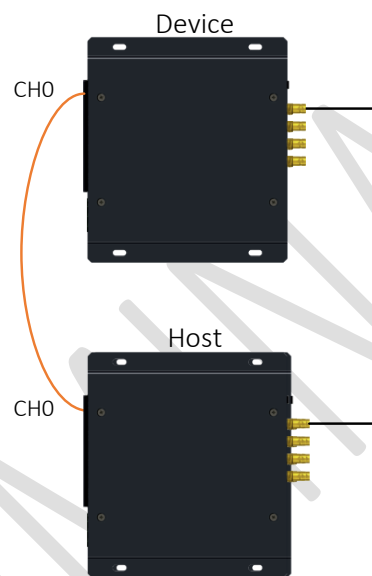


Figure 10 – Single connectivity order

7.1.2 Dual connectivity

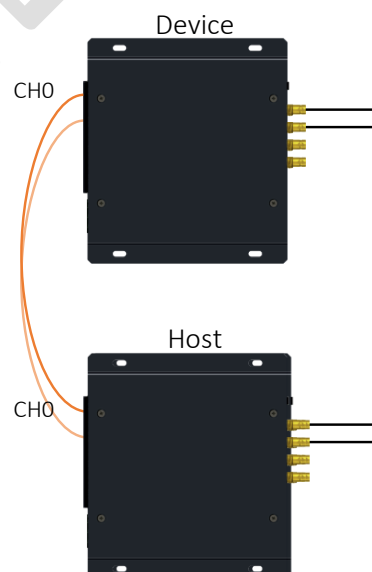


Figure 11 – Dual connectivity order

7.1.3 Quad connectivity

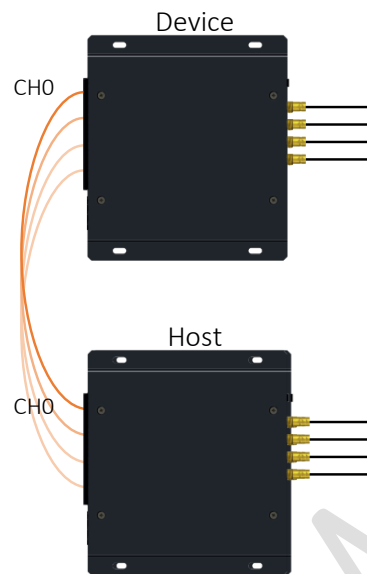


Figure 12 – Quad connectivity order

3. Connect the Power Adaptors to the 2 extenders (connecting the power supply is optional; alternatively, the unit can be powered via a frame grabber supporting PoCXP.).

7.2 Bidirectional (BIDI) SFP option

This option allows reducing one fiber optic cable from the system. The total required number is identical to number of CoaXPress cables: for example 4 link cameras will require 4 fiber cables.

The bidirectional system supports up to 10Km bidirectional connection over single fiber cable. 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 13.

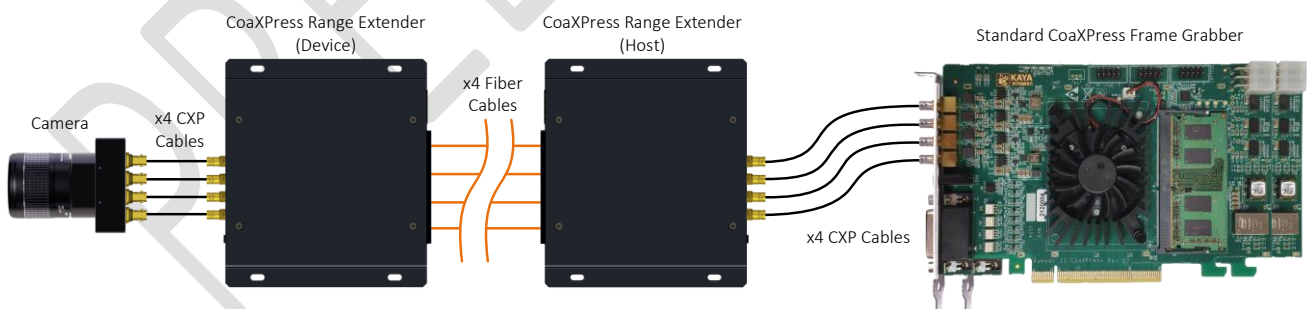


Figure 13 – Bidirectional camera link connection

7.3 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. For assignment of CWDM wavelengths please contact KAYA Instruments representative.

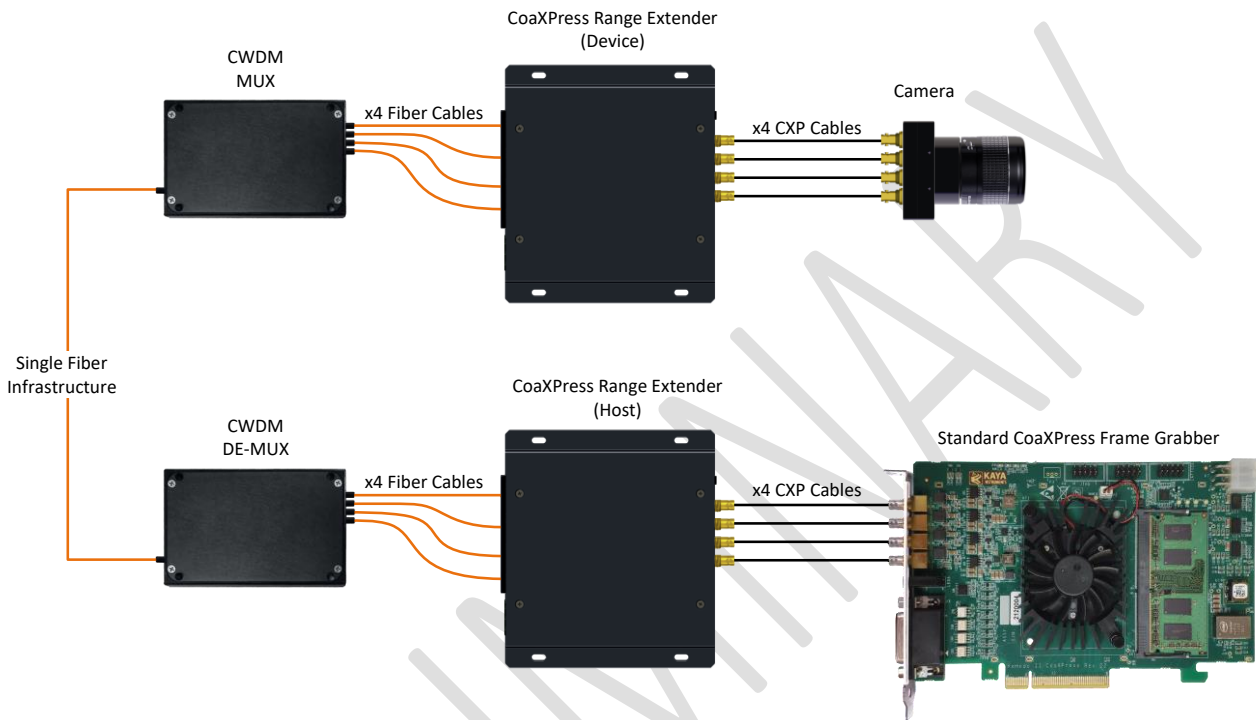


Figure 14 – CWDM mode for single fiber

8 Firmware

8.1 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/usbtouartbridgevcpcdrivers.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 7:

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

Table 7 – Serial emulated terminal configurations

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

Command	Description
firmware	Sets the system to firmware update mode. See 8.2 chapter for firmware update information
status	Prints the system and individual link status and general information
pwr <x>	Sets the PoCXP state of the device unit according to <x>: <ul style="list-style-type: none"> 0. Off - No power is provided to CoaXPress 1. Auto – Connection of PoCXP compatible device is automatically detected 2. On – power is always provided to CoaXPress
save	Saves the configured parameters to unit nonvolatile memory
default	Resets the unit to default configuration

Table 8 – Terminal commands

NOTE: *The commands are not case sensitive.*

8.2 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
4. Table 7.
5. In the terminal window type "status" followed by carriage return and checks the current firmware version.
6. 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:"
7. 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_EXTII_x_xx.rbf, when x_xx is the version number.
8. 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.
9. A successful update will result in appropriate message and a reboot of the extender to new firmware.
10. 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.

9 Cables

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 12.5 Gbps data rates, along with device power up to 13W and device control at up to 30 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 30 meters at 12.5Gbps and over 100 meters at 3.125 Gbps.

Table 9 gives an overview of typical link performance at room temperature for the link between two FMX II CoaXPress boards, using the downlink channel, uplink channel and power transmission simultaneously.



	BELDEN					
	Name	Belden 7731A	Belden 1694A	Belden 1505A	Belden 1505F	Belden 1855A
	Type	Long Distance	Industry Standard	Compromise	Flexible	Thinnest cable
Diameter	(mm)	10.3	6.99	5.94	6.15	4.03
1.25 Gbps	(m)	194	130	107	80	55
2.5 Gbps	(m)	162	110	94	66	55
3.125 Gbps	(m)	147	100	86	60	55
5.0 Gbps	(m)	87	60	52	35	38
6.25 Gbps	(m)	58	40	35	23	25
10 Gbps	(m)	TBD	40	TBD	TBD	TBD
12 Gbps	(m)	TBD	30	TBD	TBD	TBD
	Length					

	GEPKO					
	Name	Gepco VHD1100	Gepco VSD2001	Gepco VPM2000	Gepco VHD2000M	Gepco VDM230
	Type	Long Distance	Industry Standard	Compromise Coax	Flexible	Thinnest cable
Diameter	(mm)	10.3	6.91	6.15	6.15	4.16
1.25 Gbps	(m)	212	140	109	81	66
2.5 Gbps	(m)	185	120	94	67	66
3.125 Gbps	(m)	169	110	86	61	62
5.0 Gbps	(m)	102	66	53	36	38
6.25 Gbps	(m)	68	44	35	24	25
10 Gbps	(m)	TBD	TBD	TBD	TBD	TBD
12 Gbps	(m)	TBD	TBD	TBD	TBD	TBD
	Length					

Table 9 – Typical link performance

9.2 Fiber cables

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

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

PRELIMINARY

10 Ordering Information

Parameter	Value
CoaXPress Range Extender over Fiber – Host and Device units	KY-FEXTII
CoaXPress Range Extender over Fiber – Host unit only	KY-FEXTII-H
CoaXPress Range Extender over Fiber – device unit only	KY-FEXTII-D
SFP+ single-mode module	KY-SFP-12G31-10
SFP+ multi-mode module	KY-SFP-12G85-3M
SFP+ bidirectional connection module	KY-BSFP-12G33-10
SFP+ bidirectional connection module	KY-BSFP-12G23-10
Fiber cable - single-mode x meter	KY-FCA-S-SM-LC-LC-XXX.X
Fiber cable - multi-mode x meter	KY-FCA-S-MM-LC-LC-XXX.X
Coaxial cable x meter	KY-CCA-000-XXX.X
Power supply 24V , 72W	KY-PWR-24

Table 10 – 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.

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