Predator CoaXPress Frame Grabber Hardware Reference and Installation Guide

(Part-No. KY-FGP-200)

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International Distributors

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Contents

1 Figures and Tables

Figures

Tables

Revision History

Version	Date	Notes
1	16/6/2014	Initial Release
2	1/8/2016	Changed section 6.7

2.1 Safety Precautions

With your ***Predator CoaXPress Frame Grabber board*** 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 Predator 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.

2.2 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.

3 Key Features

3.1 Overview

Predator is low-cost ***Frame Grabber*** supporting CoaXPress standard. The ***Predator*** is capable of receiving video streams of up to 4 CoaXPress links in single, dual and quad modes, for simultaneous capture from up to two dual link or four single link cameras or single quad link camera. Each link supports standard CoaXPress bitrates up to 6.25 Gbps. This CoaXPress Frame Grabber is ideally suited for industrial, defense and aerospace Machine Vision Systems and applications. The ***Predator*** can easily receive video streams on the CoaXPress links and transmit them to computer memory through the PCIe interface using DMA mechanism and to one more Frame Grabber through 2 transmitter links. 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 streams receive.

The ***Predator*** uses standard DIN connectors as a CoaXPress interface to the camera and standard 100 mil headers for general purpose I/O. The Frame Grabber utilizes PCIe Gen2 x4 links for communication with Host PC for video uploading and configuration.

3.2 Features

- Up to 2 CoaXPress links
- Multi-stream support
- Camera controls and triggers
- Per-link LED indication on card bracket
- Power over CoaXPress with 13W per link
- Multiple Camera synchronization
- Multiple Frame Grabbers synchronization
- DIN 1.0/2.3 connectors for CoaXPress links
- CoaXPress compliant
- GUI interface

- Supporting Windows and Linux OS
- API for developing custom applications
- Plug-ins modules for Matlab
- Gen<i>Cam compliant
- GenTL support
- Full or Half-height bracket
- 8Gb image buffer
- PCIe Gen2 x4 Half-length PCIe card
- Data rates up to 6.25Gpbs per link
- PCI Express Transfer Rate of up to 12.5 Gbps
- 0°C to 55°C operating environment temperature
- Flexible machine I/O:
  - 4 TTL configurable I/Os
  - 4 LVTTL configurable I/Os
  - 2 LVDS inputs
  - 2 LVDS outputs
  - 4 opto - isolated outputs
  - 4 opto - isolated inputs
  - 4 quadrature rotary encoder
- 8 programmable timers (Strobe Controller , exposure , etc)

3.3 Product Applications

- CoaXPress vision systems testing and development
- AOI
- 3D
- Broadcasting and sports analytics
- High-speed DVR

3.4 Related documents and accessories

Documents:

- Vision Point App User Manual
- Vision Point API Reference Book
- CoaXPress standard 1.1
- KAYA Frame Grabbers Programming Guide

Accessories:

- CoaXPress cables (DIN to DIN)
- CoaXPress cables (DIN to BNC)

4.1 Example System Block Diagram

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

Single Camera Topology:
Single or Dual CoaXPress links with up to 6.25 Gb per link topology.
Maximum throughput to PCIe of 12.5 Gb/sec.

Dual Camera Topology:
Two Single CoaXPress links with up to 6.25 Gb per link topology.
Maximum throughput to PCIe of 12.5 Gb/sec.

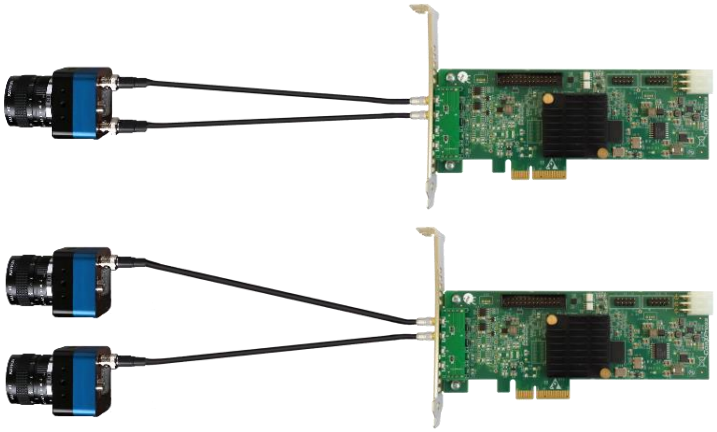

Figure 1: CoaXPress system block diagram

4.2 External View of the Board

Figure 2 shows the ***Predator Frame Grabber*** board specification.

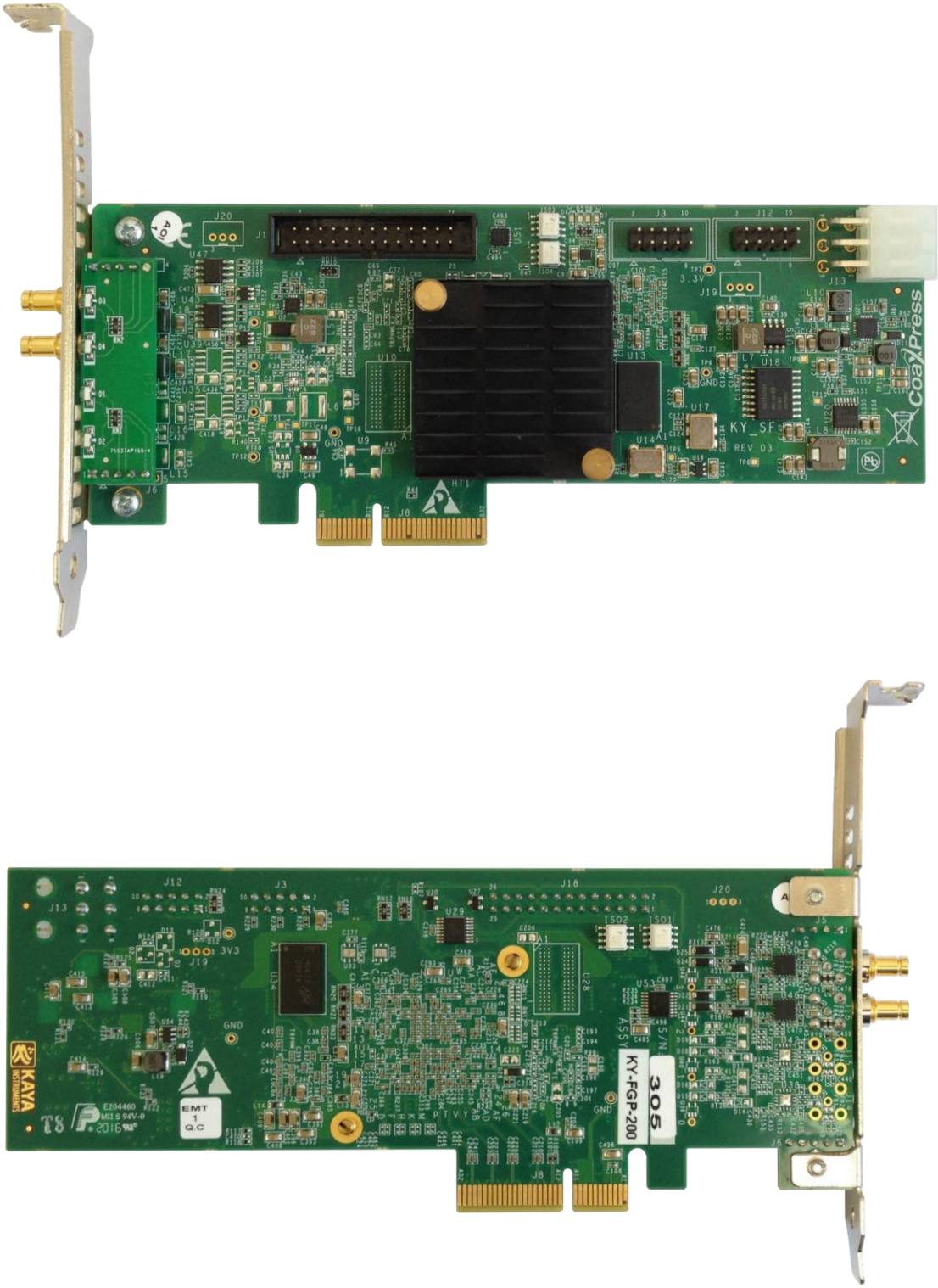

Figure 2: Predator board external view

5 Mechanical Specifications

5.1 Essentials to get started

To begin using your Predator Frame Grabber, you must have a computer with the following:

- ✓ Processor with an Intel 64-bit architecture, or equivalent.
- ✓ An availably x4 (or x8 or x16) PCIe slot. Gen 2 support is recommended to faster data transfer.
- ✓ Vision Point Application installation

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

5.2 Power supplies

The Predator board receives its power directly from PCIe slot of the motherboard.

According to PCIe standard 2.0, the board might consume up to 10W of power, while actual power consumption depends on usage mode and interfaces.

In order to support PoCXP feature the boards is capable of supplying up to 13W of power per each CoaXPress link.

The PSU connector (standard PCI power connector), located on the top right side of the board. It may be used to supply PoCXP power for connected cameras.

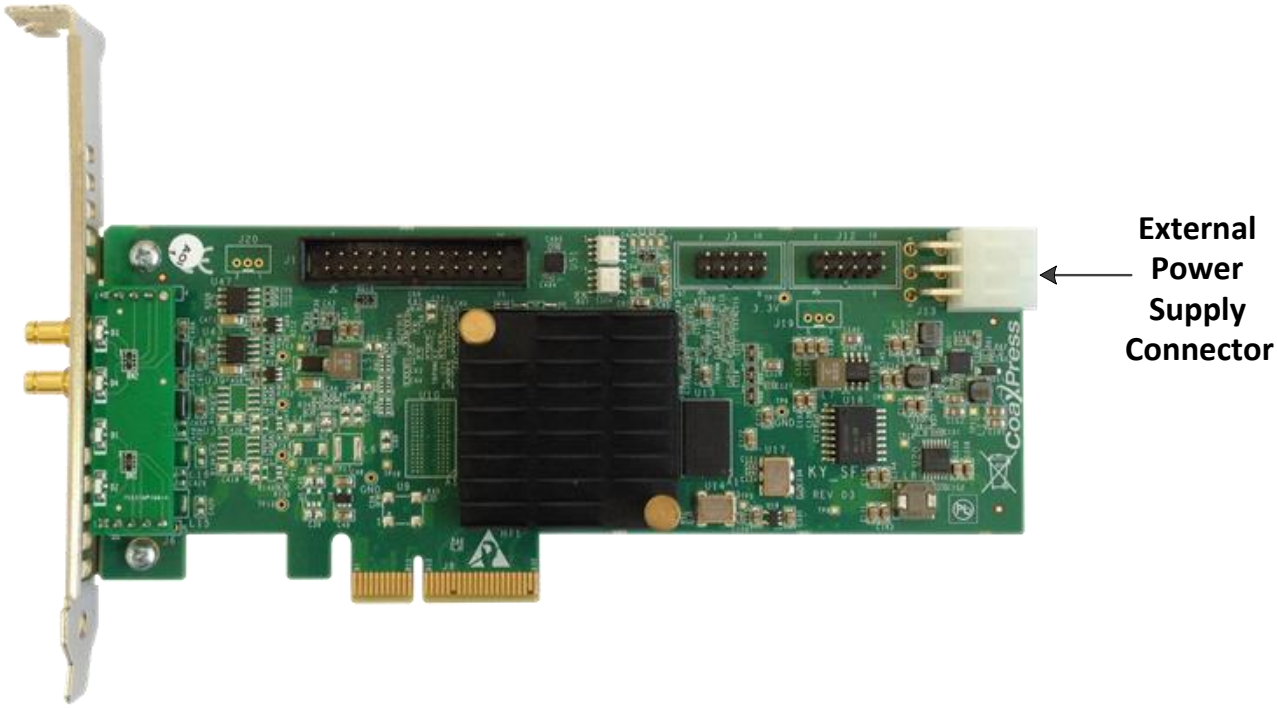

Figure 3: External Power supply connector

5.3 Mechanical dimensions

The Predator board is a Low profile PCIe card according to PCI Express Card Electromechanical Specification.

This card can be installed in both Standard Height and Low profile computers, simply by replacing the bracket.

The exact board mechanical dimensions are as defined in Figure 4.

For more detailed information please, contact KAYA Instruments representative.

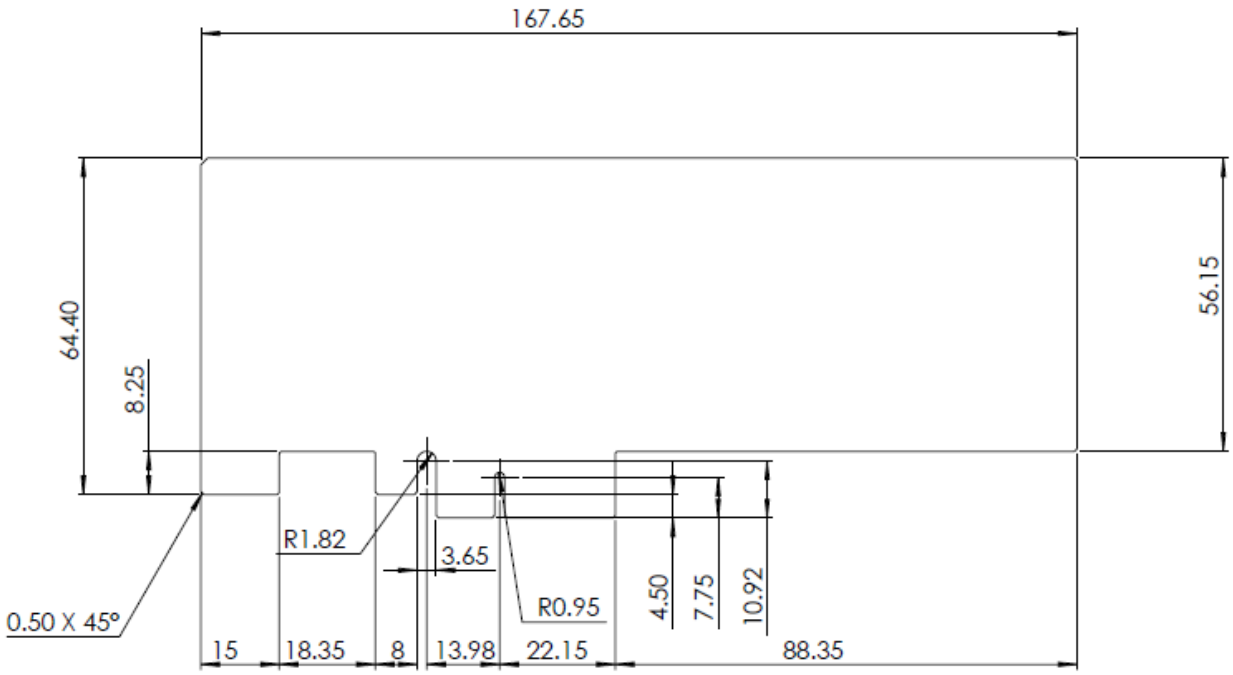

Figure 4: PCB Mechanical Dimensions

6 Installation and Configurations

6.1 Installation instructions

Predator board is standard PCIe card with 4 lanes connector.

It can be installed in any PCIe Gen2 connector of the motherboard with 4 lanes and up.

Note: Board should be installed before you install your software.

1. Before installing, turn off the power of the computer and its peripherals.
2. Firmly insert the Predator board to PCIe connector of the motherboard.
3. Anchor the PCIe bracket to the computer chassis using M3 screw.
4. Verify the Predator board inserted correctly to the PCIe slot.
5. Connect external power supply to dedicated connector (J13).
6. Power on the computer.
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 the compatible drivers for Predator board will be installed during installation of Vision Point App software.

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

The number of Predator boards that can be installed in a computer depends on the number of available PCIe slots.

6.2 Connecting to CoaXPress output connectors

Predator board implements CoaXPress standard Din 1.0/2.3 connectors for CoaXPress interface. When attaching cables to your Predator Frame Grabber, you must use 75 Ω coaxial cables. For best performance, it's recommended to use high quality cables, such as Belden 1694A.

Note: If you are using more than single cable to connect to the same frame grabber, the cables you use must be of the same type and length.

6.3 Predator LEDs

Each CoaXPress link of the Frame Grabber equipped with indication bi-color LED.

The LEDs behaves according to the defined in section 5.3 of the CXP standard. The possible LED's states described in Table 1.

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: CoaXPress links status LED's

In additional to CoaXPress links LEDs, the Predator Board is equipped with status LEDs.

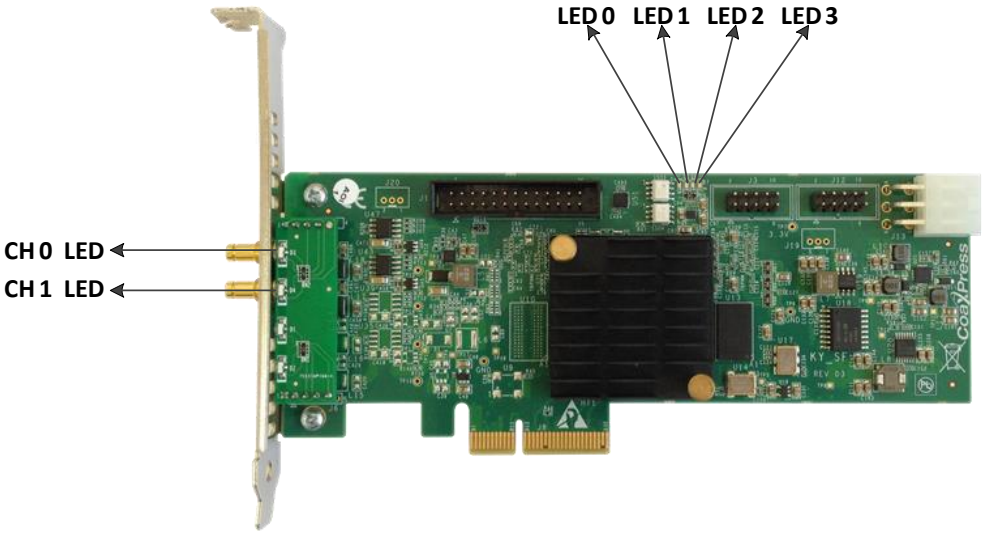

Figure 5: Predator Board LED's locations

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	Gen2 PCIe indicator. When lit indicates that PCIe is working as Gen2. When not lit the boards works as PCIe Gen1
LED 3	Lane's indicator. When lit, indicates that all 4 PCIe lanes are up. If not lit, only one lane is up.

Table 2: Board status LED's

6.4 Predator Hardware Reference

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

6.5 Predator Board Block Diagram

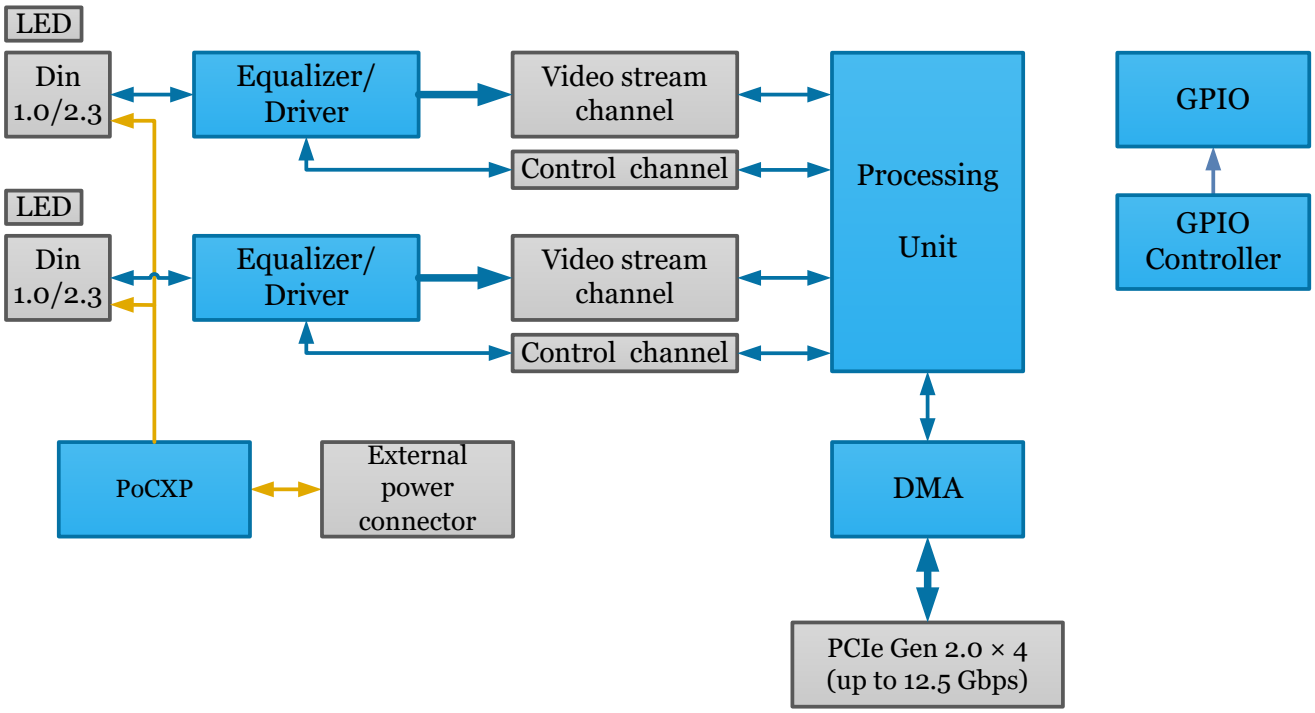

Figure 6: Predator Board Block Diagram

6.6 Video stream acquisition

Predator is designed to acquire different video streams compliant with CoaXPress standard 1.0 over up to 4 CoaXPress links.

When connected to transmitting device, the frame grabber communicates with Camera device to determine link parameters, such as data rate.

For different options please refer to Vision Point Application User Manual.

6.7 Auxiliary Input/Output signals

The auxiliary signal of Predator 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 a KAYA Frame Grabbers Programming Guide for more information regarding the GPIO configuration.

The Predator's GPIO is routed to single IO header with 2.54 mm (100 th) pitch.

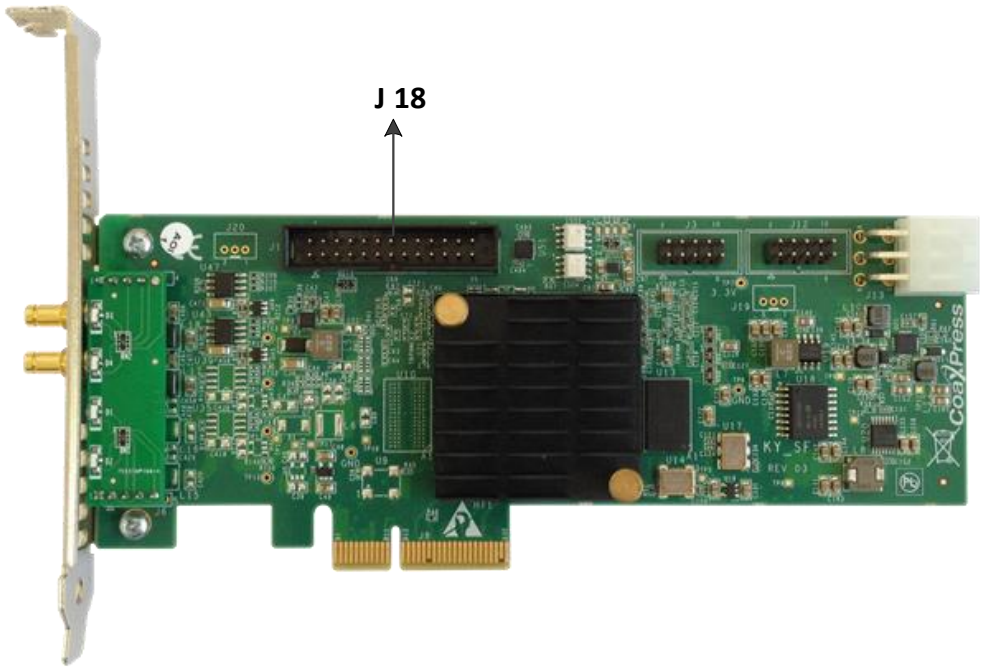

Figure 7: GPIO connectors location

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

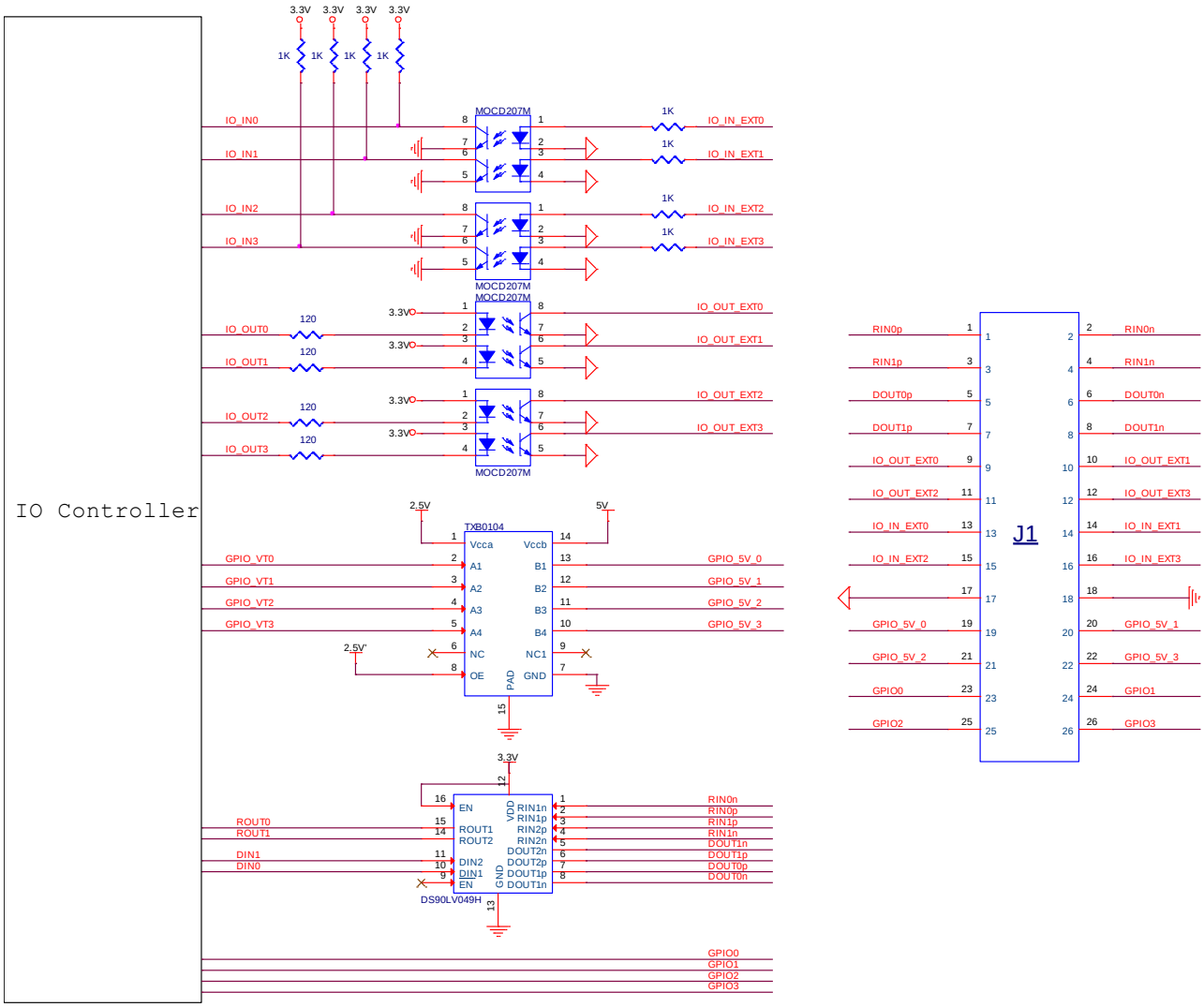

Figure 8: GPIO Connector schematic

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	Positive 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: GPIO connector pinout

6.8 Absolute maximum ratings

Specification	Values
3.3V power supply	-1.0V to +7.0V
12V power supply	-0.3V to 14V
Storage temperature	-55°C to 125°C
Operating ambient temperature	0°C to 50°C

Table 4: Absolute maximum ratings

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 5: Absolute maximum ratings for GPIO

6.9 Electrical characteristics for 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 6: 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 7: 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 8: 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 9: 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 10: 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 11: TTL output specifications