Chameleon CoaXPress Camera Simulator Hardware Reference and Installation Guide

(Part-No. KY-Chameleon)

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International Distributors

Sky Blue Microsystems GmbH
Geisenhausenerstr. 18
81379 Munich, Germany
+49 89 780 2970, info@skyblue.de
www.skyblue.de

In Great Britain:
Zerif Technologies Ltd.
Winnington House, 2 Woodberry Grove
Finchley, London N12 0DR
+44 115 855 7883, info@zerif.co.uk
www.zerif.co.uk

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Revision History

Version	Date	Notes
0.1	16.4.14	Initial Release

2.1 Safety Precautions

With your ***Chameleon CoaXPress Camera Simulator 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 Chameleon 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 simulation 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

The ***Chameleon*** is the industry's first ***Camera Simulator*** supporting CoaXPress standard. This simulator is capable of generating video streams and test patterns of up to 4 CoaXPress links in single, dual and quad modes. Each link supports standard CoaXPress bitrates up to 6.25 Gbps. This product is ideally suited for development of industrial, defense and aerospace Machine Vision Systems and applications. The Chameleon can easily transmit generic test patterns, customer's specific pre-processed data or custom video streams on the CoaXPress links. It also provides GPIO for machine control signals, such as triggers, shaft encoders, exposure control and general I/O, which can be simulated together with the video streams. The simulator enables transmitting the video streams from onboard memory as well as run time uploading the streams from computer memory.

3.2 Features

- Video output modes:
  - Test patterns
  - BMP/RAW/TIFF/PNG image files
  - RAW video files
  - Streaming video (up to 12.5 Gbps)
  - Multiple pre-recorded video in sequential or loop modes
  - Fully programmable image timing
  - Fully programmable configuration parameters
  - Optional Multi-stream support
  - Emulation of Camera controls, triggers and light strobes
  - Up to 4 CoaXPress device links
  - Frame and line scan formats support

- Flexible machine I/O:
  - 8 TTL configurable I/Os
  - 4 LVTTL configurable I/Os
  - 4 LVDS inputs
  - 4 LVDS outputs
  - 4 opto - isolated outputs
  - 4 opto - isolated inputs
  - 4 quadrature rotary encoder simulators
- CoaXPress compliant
- GUI interface
- Supporting Windows and Linux OS
- API for developing custom applications
- Plug-ins modules for Matlab
- Gen<i>Cam compliant
- Up to 32Gb image buffer
- 4 DIN connectors for CoaXPress links
- PCIe Gen2 x4 Half-length PCIe card
- Data rates up to 6.25Gpbs per link
- 0°C to 55°C operating environment temperature

3.3 Product Applications

- CoaXPress vision systems testing and development
- Vision algorithm development
- CoaXPress systems integration
- CoaXPress systems reliability testing

3.4 Related documents and accessories

Documents:

- Chameleon Camera Simulator User Guide
- Chameleon App User Manual
- Chameleon API Reference Book
- CoaXPress standard 1.0

Accessories:

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

4.1 System Block Diagram

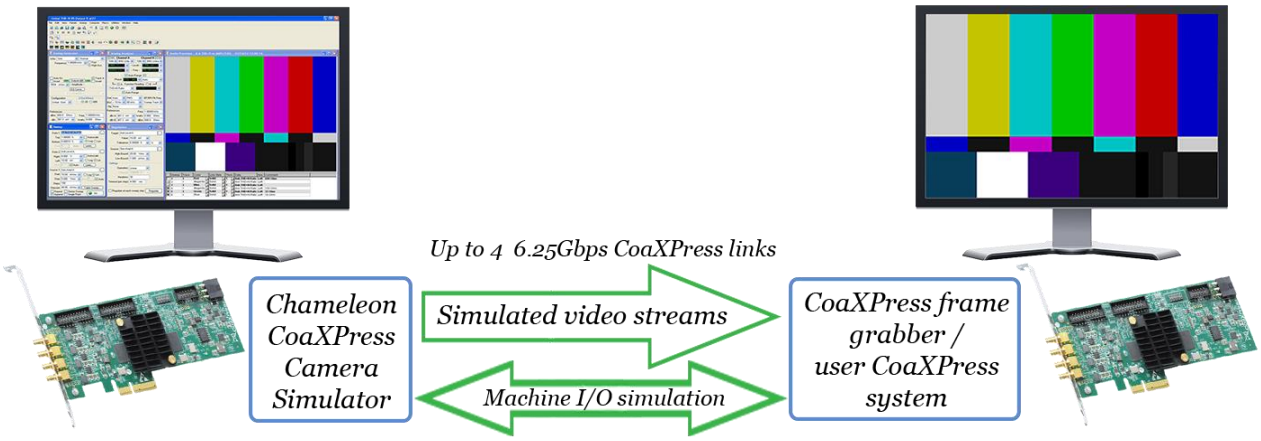
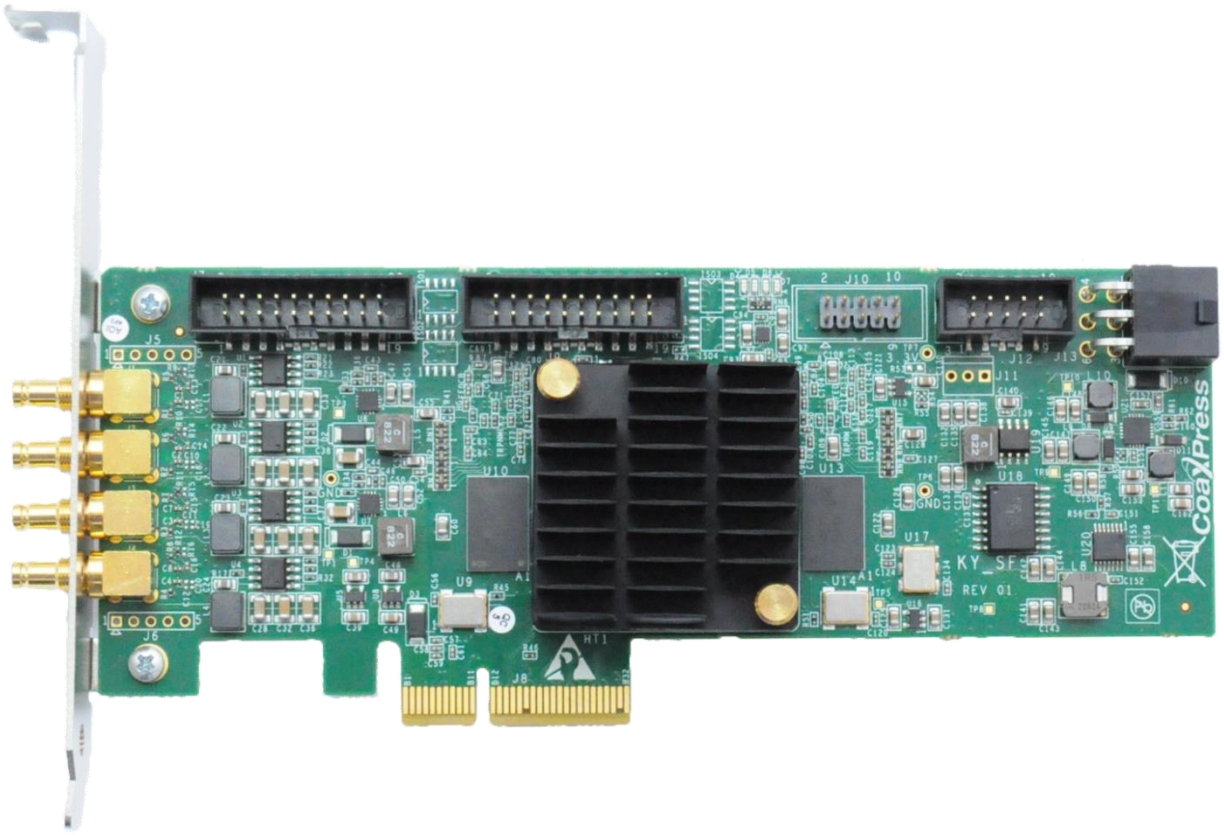


Figure 1: Chameleon CoaXPress simulator system block diagram

4.2 External View of the Board

Figure 2 shows the ***Chameleon Camera Simulator*** board specification.



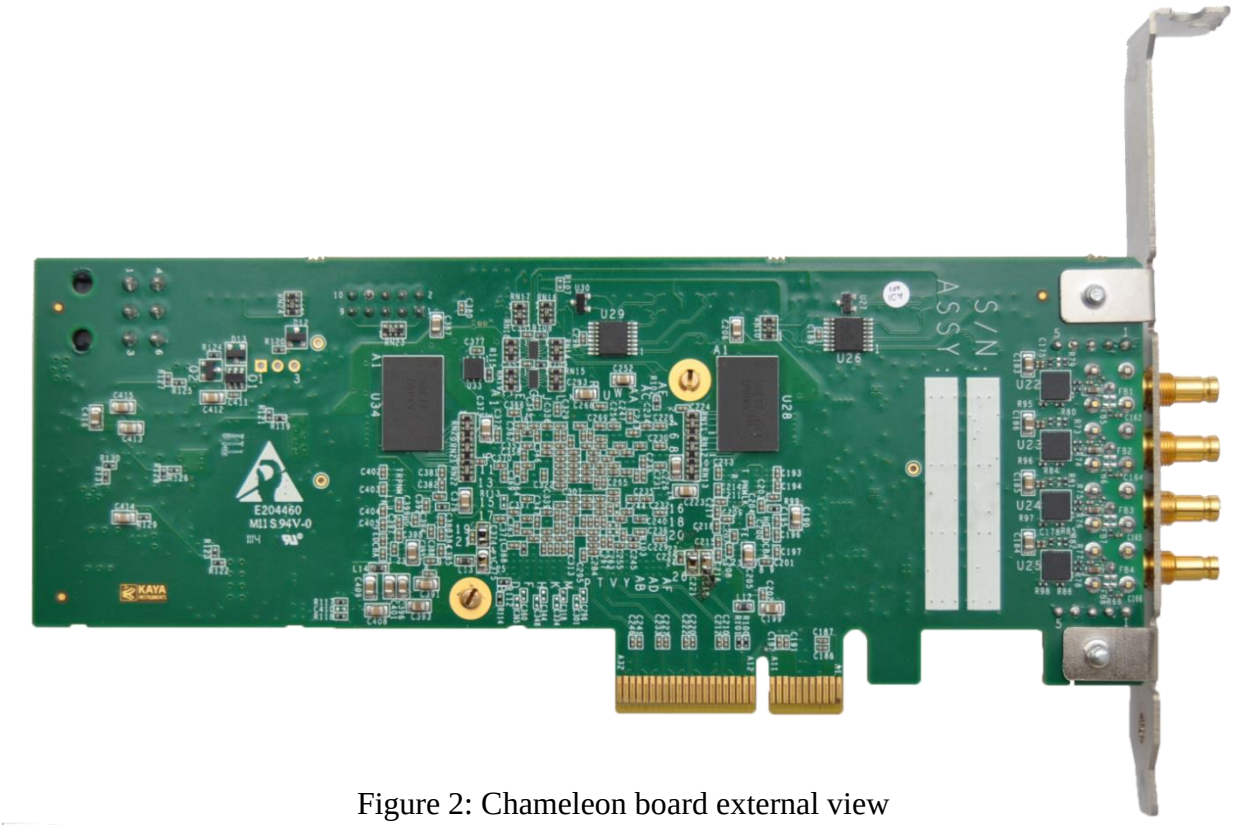


Figure 2: Chameleon board external view

5 Mechanical Specifications

5.1 Essentials to get started

To begin using your Chameleon Camera simulator, 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.
- ✓ Chameleon 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 Chameleon board receives it's power from PCIe connector 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.

5.3 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 1: Absolute maximum ratings

5.4 Mechanical dimensions

The Chameleon 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 3.

For more detailed information please, contact KAYA Instruments representative.

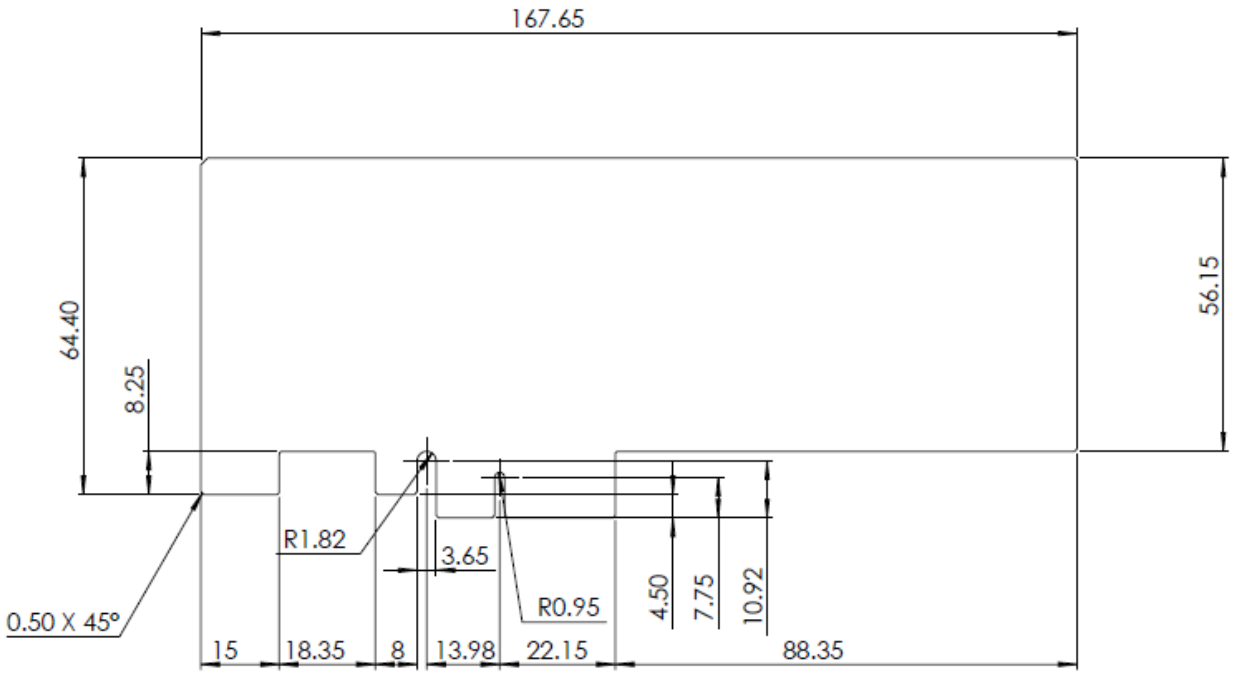


Figure 3: PCB Mechanical Dimensions

6 Installation and Configurations

6.1 Installation instructions

Chameleon 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 Chameleon board to PCIe connector of the motherboard.
3. Anchor the PCIe bracket to the computer chassis using M3 screw.
4. Verify the Chameleon board inserted correctly to the PCIe slot.
5. Power on the computer.
6. After OS is up, you will be asked to install a driver for new Multimedia Device. At this stage, you should Cancel the installation.

Under Windows and Linux the compatible drivers for Chameleon board will be installed during installation of Chameleon App software.

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

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

6.2 Connecting to CoaXPress output connectors

Chameleon board implements CoaXPress standard Din 1.0/2.3 connectors for CoaXPress interface. When attaching cables to your Chameleon Camera Simulator, 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.

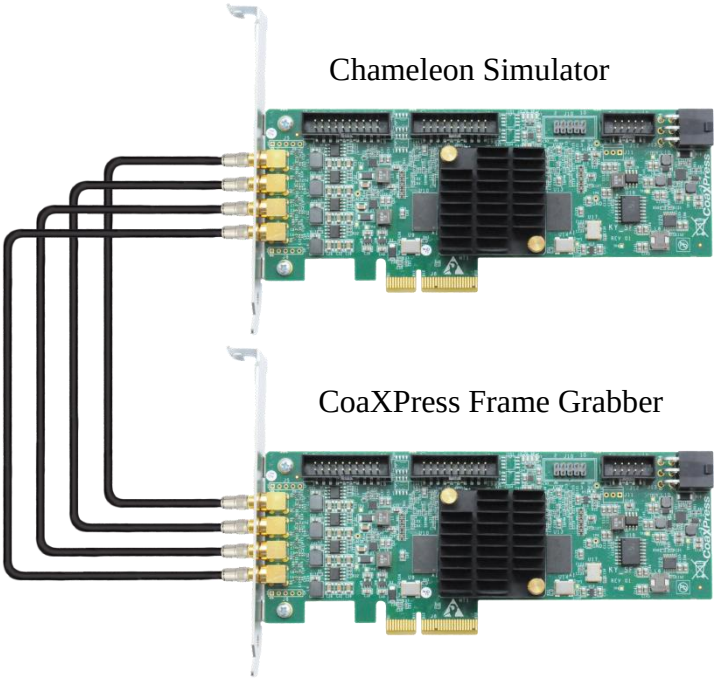


Figure 4: CoaXPress system connection

6.3 Chameleon LEDs

Each CoaXPress link of the Camera Simulator equipment with indication bi-color LED. The LEDs behaves according to the defined in section 5.4 of the CXP standard. The possible LED's states described in Table 2.

LED state	Description
Solid orange	System is not initialized
Slow pulse red	No frame grabber is connected to the system
Solid green	Frame grabber is connected, no data being transferred
Slow pulse orange	Frame grabber connected. Waiting for trigger event
Fast flash green	Frame grabber connected , data is being transferred
Slow flash alternate green / orange	Connection test packets being sent

Table 2: CoaXPress links status LED's

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

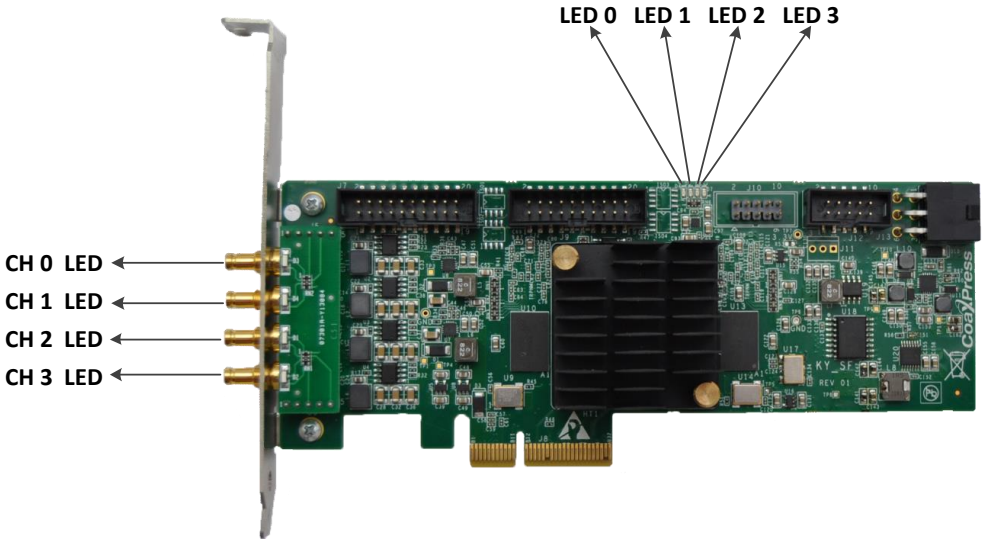


Figure 5: Chameleon Board LED's locations

Board Status LEDs functionality is described in Table 3:

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 3: Board status LED's

6.4 Chameleon Hardware Reference

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

6.5 Chameleon Board Block Diagram

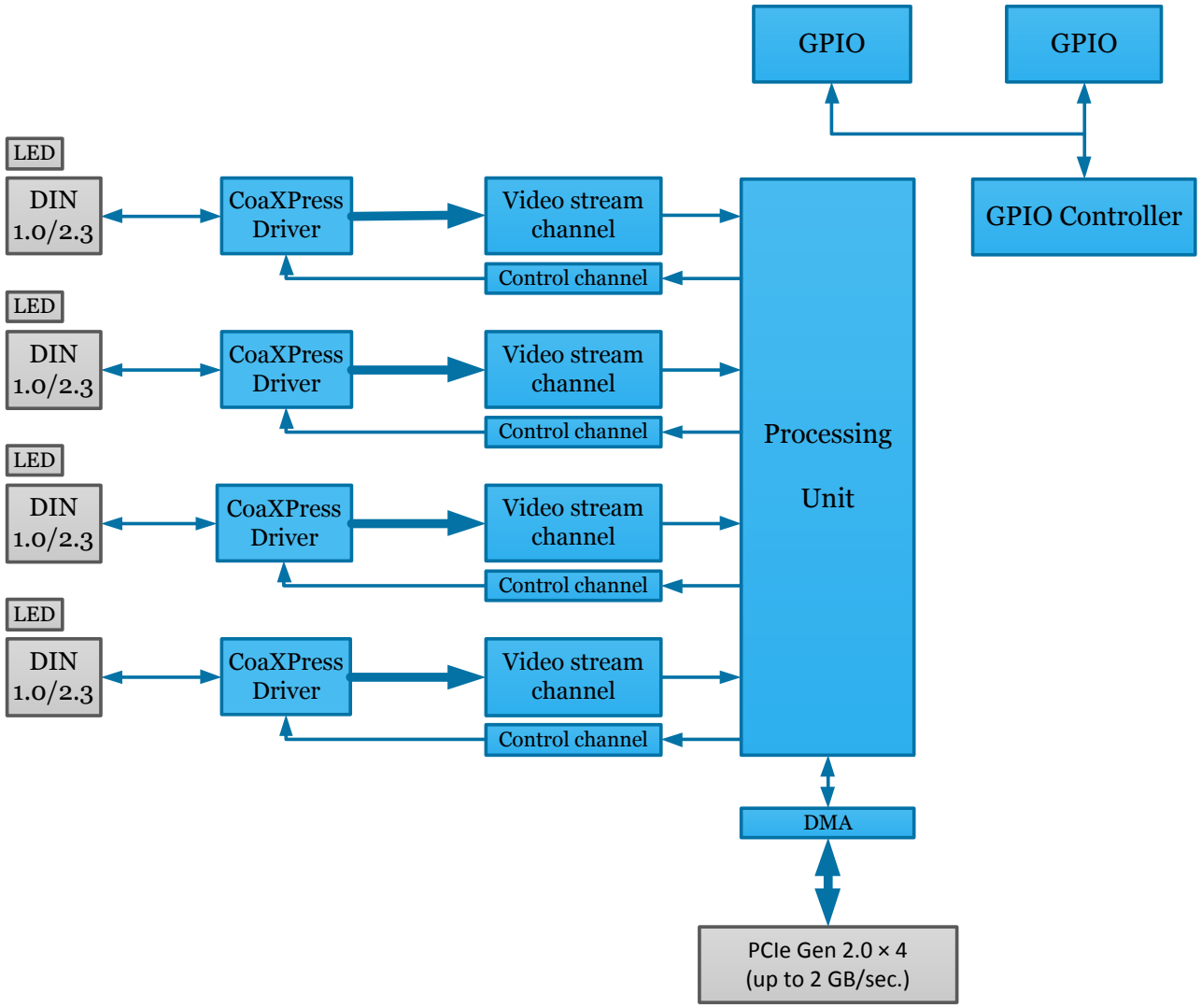


Figure 6: Chameleon Board Block Diagram

6.6 Video stream generation

Chameleon is designed to generate different video streams compliant with CoaXPress standard 1.0 over 4 CoaXPress links.

When connected to acquisition device, the board communicates with Frame Grabber device to determine link parameters, such as data rate.

For different video generation options please refer to Chameleon Application User Manual.

6.7 Auxiliary Input/Output signals

The auxiliary signal of Chameleon 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 emulate complex devices, such as encoders and drive controls.

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

The Chameleon's GPIO structure consists of 2 corresponding IO headers with 2.54 mm (100 th) pitch.

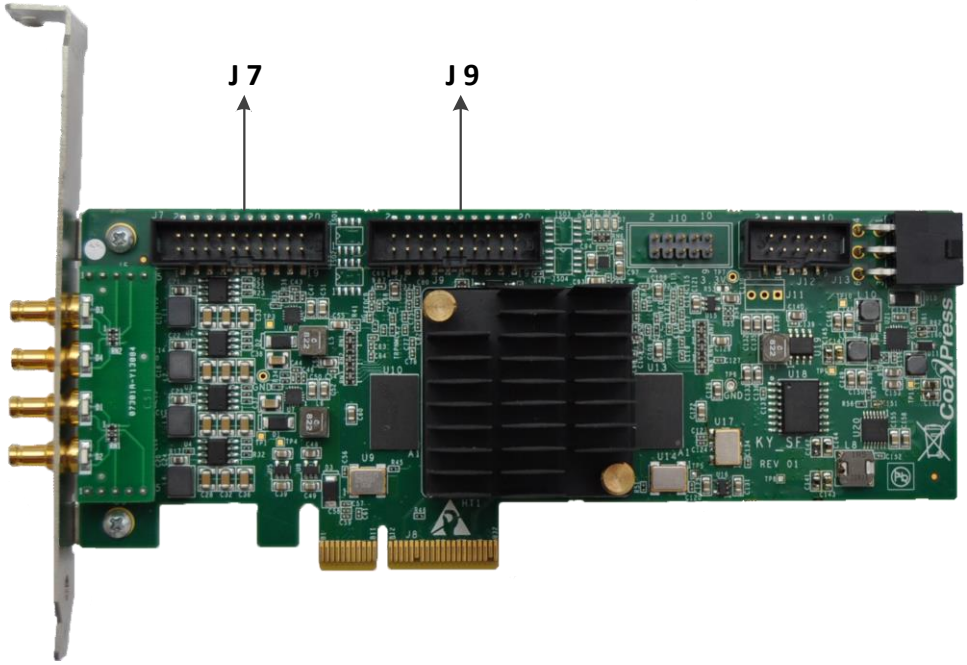


Figure 7: GPIO connectors location

The pinout of each of these connectors is as described in Table 4 and Table 5.

Pin Number	Signal Name	Function	Electrical Standard	Description
1	IO_OUT_EXT0	Opto-Isolated output	Up to 70V	Optically isolated outputs
2	IO_OUT_EXT0	Opto-Isolated output	Up to 70V	Optically isolated outputs
3	IO_IN_EXT0	Opto-Isolated input	Up to 70V	Optically isolated inputs
4	IO_IN_EXT0	Opto-Isolated input	Up to 70V	Optically isolated inputs
5	RIN1p	LVDS input		Positive signal of LVDS pair
6	RIN2p	LVDS input		Positive signal of LVDS pair
7	RIN1n	LVDS input		Negative signal of LVDS pair
8	RIN2p	LVDS input		Negative signal of LVDS pair
9		External GND		Ground signal for opto-isolated signals
10		Board GND		Reference ground signal
11	DOUT1p	LVDS output		Positive signal of LVDS pair
12	DOUT2p	LVDS output		Positive signal of LVDS pair
13	DOUT1n	LVDS output		Negative signal of LVDS pair
14	DOUT2n	LVDS output		Negative signal of LVDS pair
15	GPIO_5V_0	GPIO	TTL (Open-drain)	General Purpose IO
16	GPIO_5V_2	GPIO	TTL (Open-drain)	General Purpose IO
17	GPIO_5V_1	GPIO	TTL (Open-drain)	General Purpose IO
18	GPIO_5V_3	GPIO	TTL (Open-drain)	General Purpose IO
19	GPIO0	GPIO	LVTTL	General Purpose IO
20	GPIO1	GPIO	LVTTL	General Purpose IO

Table 4: J7 connector pinout

Pin Number	Signal Name	Function	Electrical Standard	Description
1	IO_OUT_EXT0	Opto-Isolated output	Up to 70V	Optically isolated outputs
2	IO_OUT_EXT0	Opto-Isolated output	Up to 70V	Optically isolated outputs
3	IO_IN_EXT0	Opto-Isolated input	Up to 70V	Optically isolated inputs
4	IO_IN_EXT0	Opto-Isolated input	Up to 70V	Optically isolated inputs
5	RIN1p	LVDS input		Positive signal of LVDS pair
6	RIN2p	LVDS input		Positive signal of LVDS pair
7	RIN1n	LVDS input		Negative signal of LVDS pair
8	RIN2p	LVDS input		Negative signal of LVDS pair
9		External GND		Ground signal for opto-isolated signals
10		Board GND		Reference ground signal
11	DOUT1p	LVDS output		Positive signal of LVDS pair
12	DOUT2p	LVDS output		Positive signal of LVDS pair
13	DOUT1n	LVDS output		Negative signal of LVDS pair
14	DOUT2n	LVDS output		Negative signal of LVDS pair
15	GPIO_5V_0	GPIO	TTL (Open-drain)	General Purpose IO
16	GPIO_5V_2	GPIO	TTL (Open-drain)	General Purpose IO
17	GPIO_5V_1	GPIO	TTL (Open-drain)	General Purpose IO
18	GPIO_5V_3	GPIO	TTL (Open-drain)	General Purpose IO
19	GPIO0	GPIO	LVTTL	General Purpose IO
20	GPIO1	GPIO	LVTTL	General Purpose IO

Table 5: J9 connector pinout

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	| mV |
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	| 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 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	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 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

The electrical connection of the Opto-isolated signals is designed as on following principal schematic diagram:

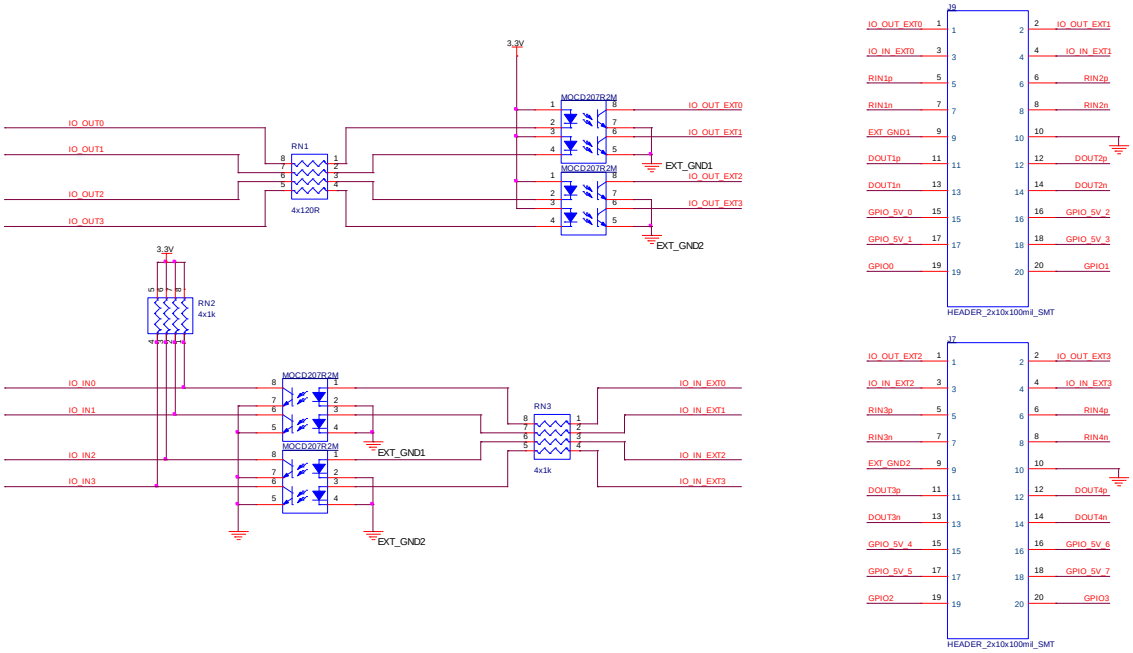


Figure 8: Opto-isolated IO's schematic