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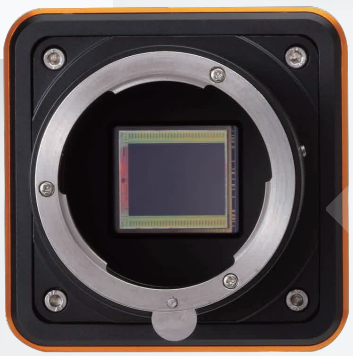
Operation Manual



CoaXPress

IC-X12S-CXP

High-Speed High-Resolution Camera Technology

Revision 1.1

Revision History

Revision	Date	Description
1.0	16.09.2015	Initial Release
1.1	13.01.2016	Modified CXP Connections

1. Introduction

Thank you and congratulations for purchasing the ISVI IC-X12S-CXP (hereafter referred to as "camera"). We have designed this camera to provide outstanding imaging performance and give you years of reliable service. As you become familiar with the camera, you will appreciate the high quality of its production and the excellence in its engineering design.

Please read and fully understand the entire manual before proceeding to operate your camera!

1.1. Statement of Intended Use and Liability

Intended Use Statement

This camera is a highly sophisticated electronic image capture device designed for use in industrial machine vision systems.

The intended use and safe operation of the camera shall not be interfered with, even by unforeseen external forces. Intended use and safe operation of the camera shall be carried out only by qualified technicians trained in the installation and operation of electronic image capturing devices, accident prevention and common safeguards for handling sensitive electronic devices. Operating the camera for any purpose other than the stated intended use or by unqualified personnel may result in personal injury or property damage for which the manufacturer assumes no liability.

Limitation of Liability and Indemnity Statement

This camera has been built to the high quality standards of ISVI Corp. and is delivered in full working order with factory default settings. Please read and understand this manual and follow all safeguards and cautions for your safety and to prevent damage to the camera. Please do not attempt to install this camera without adequate training and knowledge of this specific camera. Any use or operation, modification or repair in contravention of this document is at your own risk and will immediately void the user's warranty. By acceptance of this camera you hereby assume all liability consequent to your use or misuse of this camera.
To the maximum extent permitted by applicable law, ISVI Corp. shall not be liable for any damages suffered as a result of using, modifying, contributing, copying, distributing, or downloading the materials, use of the camera operation manual or use of any ISVI product and/or software. In no event shall ISVI be liable for any indirect, extraordinary, exemplary, punitive, special, incidental, or consequential damages (including, without limitation, loss of data, revenue, profits, use or other economic advantage) however arising, whether for breach or in tort, even if ISVI has been previously advised of the possibility of such damage. You agree that you have sole responsibility for adequate protection and backup of data and/or equipment used in connection with the product and software and will not make a claim of any nature against ISVI for lost data, inaccurate output, work delays or lost profits resulting from the use of any and all ISVI products and materials . You agree to indemnify, hold harmless and defend ISVI, together with its affiliates, parent and subsidiary entities, successors, assigns, partners, managers, members, employees, officers, directors and shareholders, from and against any and all damages, liens, liabilities, losses, demands, actions, causes of action, claims, costs and expenses (including, without limitation, reasonable attorneys' fees, charges and disbursements, as well as the cost of in-house counsel and appeals) arising from or related to ISVI, the use of this Operation Manual or any ISVI product and/or software.

Camera specifications, documentation, software applications and options are subject to change at any time and at the sole discretion of ISVI Corporation without notice.

1.2. Precautions

The following precautions must be heeded to avoid personal injury and damage to the camera and/or supporting equipment.
Failure to comply with any of the following precautions will void the user's warranty.

DO NOT attempt to disassemble, modify or repair the camera. Please contact your local ISVI Global Sales Partner if you require repair or modification.

DO NOT short circuit any output or input signals.

DO NOT allow high-voltage or electrostatic discharge to come into contact with the camera. The camera should be unpacked and handled in a clean, ESD protected workspace.

DO NOT operate the camera with any other voltage than is specified in this operation manual.

DO NOT expose the camera to electromagnetic fields. Image quality will degrade and, if strong enough, damage to the camera may occur.

DO NOT allow direct laser beams, direct sunlight or other high-intensity light to project directly onto the imaging sensor.

DO NOT expose the camera to temperatures and humidity levels outside of those specified in this operations manual.

DO NOT install the camera in a tightly enclosed space without ensuring proper heat dissipation and adequate ventilation.

DO NOT allow condensation to form on or in the camera and DO NOT allow the camera to come into contact with any liquids, cleaning agents or solvents. Should the camera require cleaning, then only with a clean, lint-free cloth.

DO NOT expose the camera to shock and vibration levels outside of those specified in this operations manual.

DO NOT allow foreign objects or particles to enter the camera. Immediately install the camera lens mount cover when lens is not mounted. When installing lenses, ensure that they are clean and they are not cross-threaded, tilted or otherwise damaged. Contamination of the optical path/sensor may occur and/or removal of the lens may become impossible. Installation of a lens should take place in a clean environment to avoid airborne contamination of the optical path.

DO NOT attempt to clean the camera's optical path yourself. Any damage to the optical path occurring from the user's attempt at cleaning it will void the warranty. If the optical path becomes contaminated, then please contact your local ISVI Global Sales Partner for assistance.

DO NOT apply unnecessary pressure or stress on the camera's cable connectors or pull or damage the camera cables.

DO NOT use mounting screws longer or with different thread pitch than specified in the operation manual.

1.3. Standards Conformity

CE marking and certification

(as per EN 50022-Class A Device)

The CE mark is a declaration by a manufacturer that European Union directives and regulations controlling a specific product have been certifiably met.

This camera fulfills the requirements of current EU regulations relating to EN 50022. A corresponding declaration of conformity and documentation are available upon request.

Federal Communications Commission (FCC / USA and Canada)

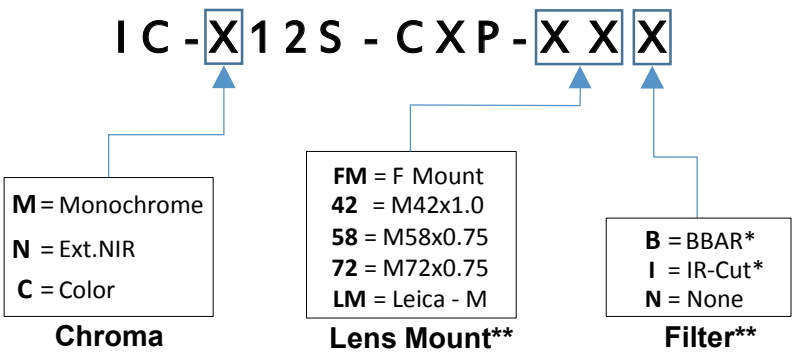
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the Operation Manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Camera complies with FCC Form 47 Rules.

Changes or modifications to this unit not expressly approved by the part responsible for FCC compliance could void the user's authority to operate the equipment.

Restriction of Hazardous Substances (RoHS).

The EU Directive 2002/95/EC Restriction of Hazardous Substances (RoHS) has been in effect since July 1, 2006 and has been revised in 2011. The changes to Directive 2011/65/EU, also known as "RoHS II" will slowly take effect over 6 years. This directive restricts the use of six hazardous materials in EEE products. This camera meets the current requirement for RoHS compliancy.

1.4. Ordering Information



* Monochrome standard with BBAR filter, Color standard with IR-Cut.

** Custom OEM available

Contents

2. Overview

The ISVI IC-X12S-CXP cameras are industrial area scan cameras utilizing the latest CMOSIS CMV12000 global shutter CMOS sensors and the highly successful CoaXPress high-bandwidth digital interface. The camera is available in 8-bit monochrome or 8-bit raw Bayer color versions which deliver high-sensitivity and high-dynamic images at very high frame rates. Its flexible acquisition modes include Continuous, Trigger Timed and Trigger Width. It also has a rich feature set making the camera adaptable to any application environment.

The IC-X12S-CXP cameras combine high dynamic range, high frame rate, high-resolution and a compact, robust form factor to provide the highest possible performance for the most demanding applications. The IC-X12S-CXP is suitable for a wide range of application areas including Factory Automation, Bio-Mechanics, Automated Digital Pathology, High-Speed Event Recording, Metrology, Large-Scale 3D Imaging, AOI, Flat Panel Inspection, LED Inspection, Print Inspection, Intelligent Transportation Systems, Aerial Mapping, Aeronautics, Defense and more.

2.1. Main features

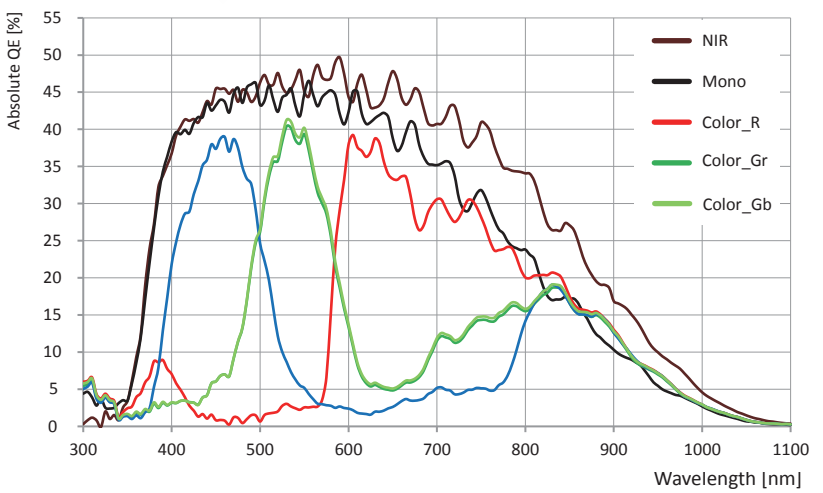
- 12 MP High-Performance CMOS
- 4096 x 3072 Pixels
- 5.5 μm^2 pixel size
- 181 fps
- Global Shutter
- 8-bit Output
- CXP-6 DIN-4 CoaXPress 1.1 std. certification
- GenICam XML SFNC conform
- Monochrome. Ext. NIR or Bayer Color
- DSNU and PRNU Correction
- Defect Pixel Correction
- 2 User Areas for Calibration Storage
- Exposure Delay
- Strobe Out Delay
- Programmable ROI
- Compact Size - 80 x 80 x 36.55 mm
- F-Mount, M58, M42, M72, LM Lens Mount
- High-Precision Mounted Sensor

2.2. Specifications

Sensor	High Speed CMOS Image Sensor - CMOSIS CMV12000
Resolution	4096(H) x 3072(V) Active Pixels
Pixel Size	5.5µm(H) x 5.5µm(V)
Frame Rate	181Hz @ 8bit CXP-6 4CH (5464 µsec)
Active Area Size	Diameter 28.14mm, 22.52mm(H) x 16.9mm(V)
Output Format	8 bit Monochrome, Ext. NIR and Raw Bayer GBRG
CoaXPress Interface	CXP-3, CXP-6 : 1, 2 and 4 Links, GenICam XML
Dynamic Range	60dB
Full Well Capacity	13500 e^-
SNR	> 50dB
Sensitivity	4.64 V/lux.s (with microlenses)
Exposure Mode	Freerun - Trigger Master - Trigger Width
Exposure Control	Programmable from 1 µsec to 10 sec in 1 µsec steps
Trigger Control	Programmable Period in 1 µsec steps, External PWC
Analog Control	Gain, Black Offset
Digital Control	Digital Gain, Gamma
Image Control	DSNU & PRNU Correction, Defect Pixel Correction
Special Functions	Programmable Exposure Start Delay Programmable Strobe Pulse Start Delay Programmable Region of Interest
Lens Mounts	F-Mount, M42, M58, M72, LM(Leica M), Custom OEM
Operating Temperature	0℃ to +40℃, ext. temp. possible with reduced performance
Storage Temperature	-10℃ to +70℃
Relative Humidity	20% - 90% non-condensing
Shock / Vibration	25G (Half sine 6-10ms XYZ) / 10G (5-150Hz, 1min, XYZ)
MTBF	> 78,000 hrs
Power Requirements	24VDC ± 10%, 18W, ≤ 50mV Ripple
Power over CXP	PoCXP: 24VDC @ 18W, min. required CXP Links = 2 ch (CXP1,2)
Dimensions (H x W x L)	80mm x 80mm x 36.55mm without lens mount and connectors
Weight	400g (without lens mount), 540g (including F-Mount)
Compliancy	CoaXPress 1.1, GenICam SFNC, RoHS, CE, FCC

All specifications subject to change without notice. Please visit our website for the latest documentation.

2.3. Sensor spectral response (Quantum efficiency)



2.4. Mechanical dimension

- F Mount

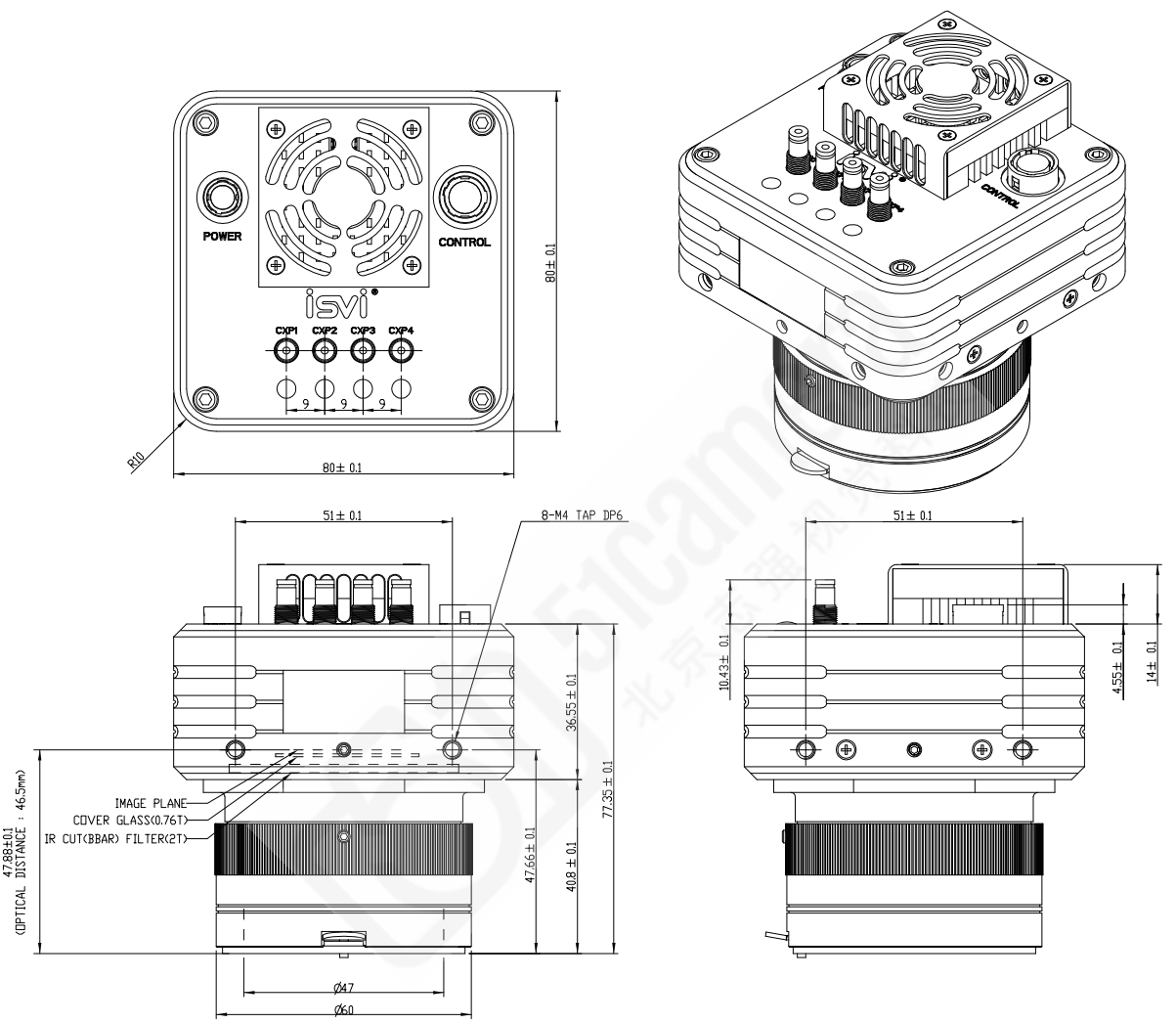


Figure 2.1 Mechanical dimensions (F Mount)

- M42 Mount

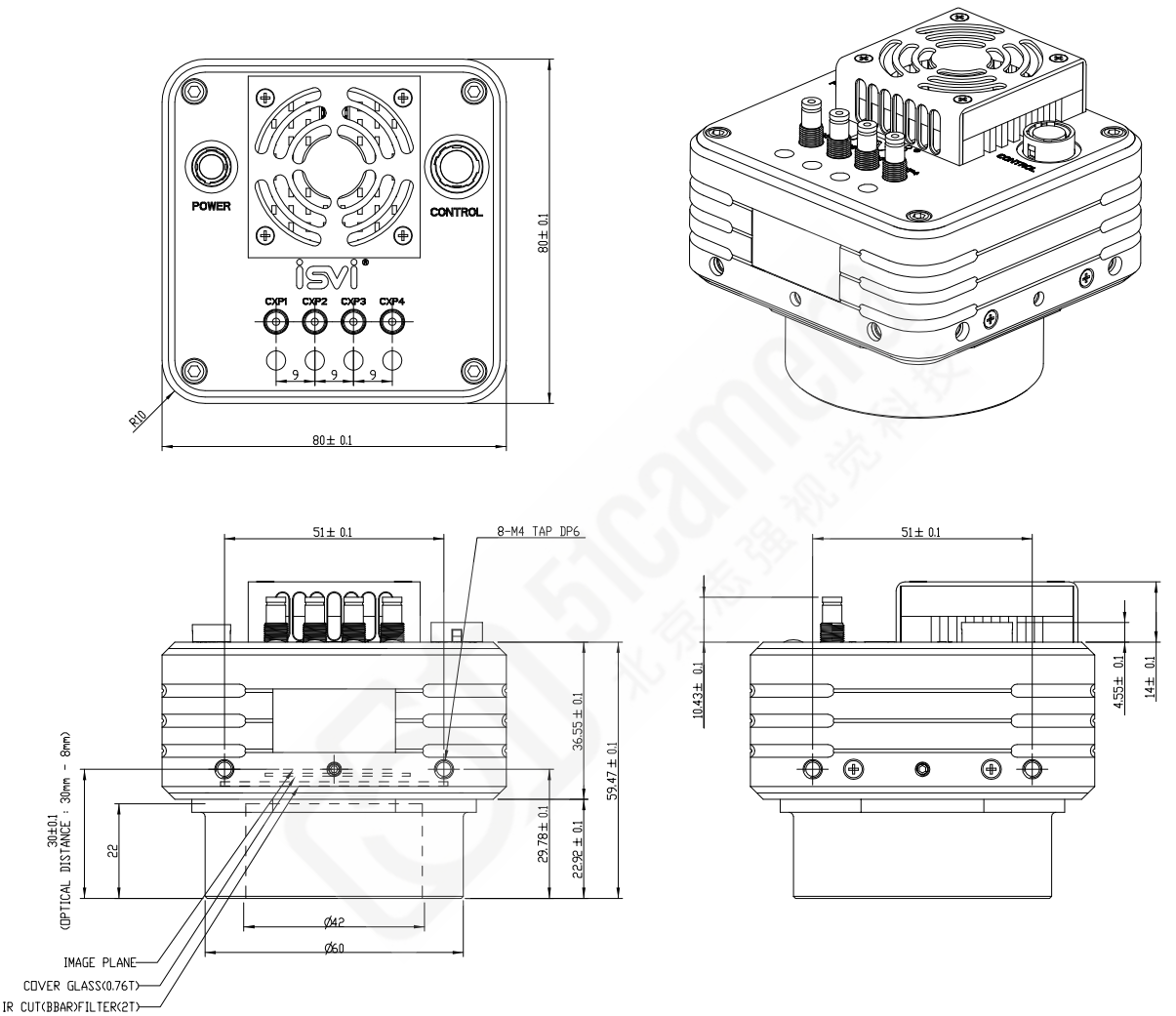


Figure 2.2 Mechanical dimensions (M42 Mount)

- M58 Mount

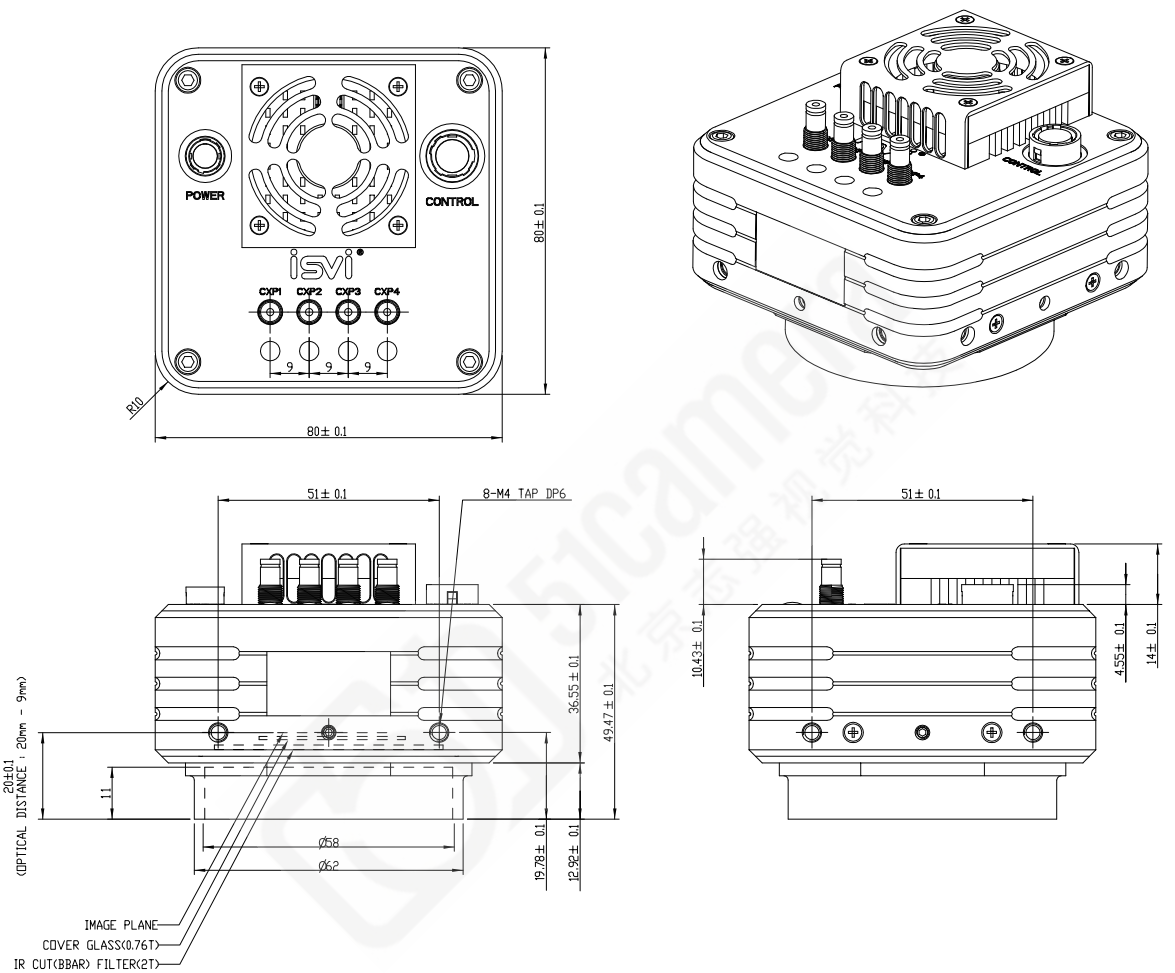


Figure 2.3 Mechanical dimensions (M58 Mount)

- M72 Mount

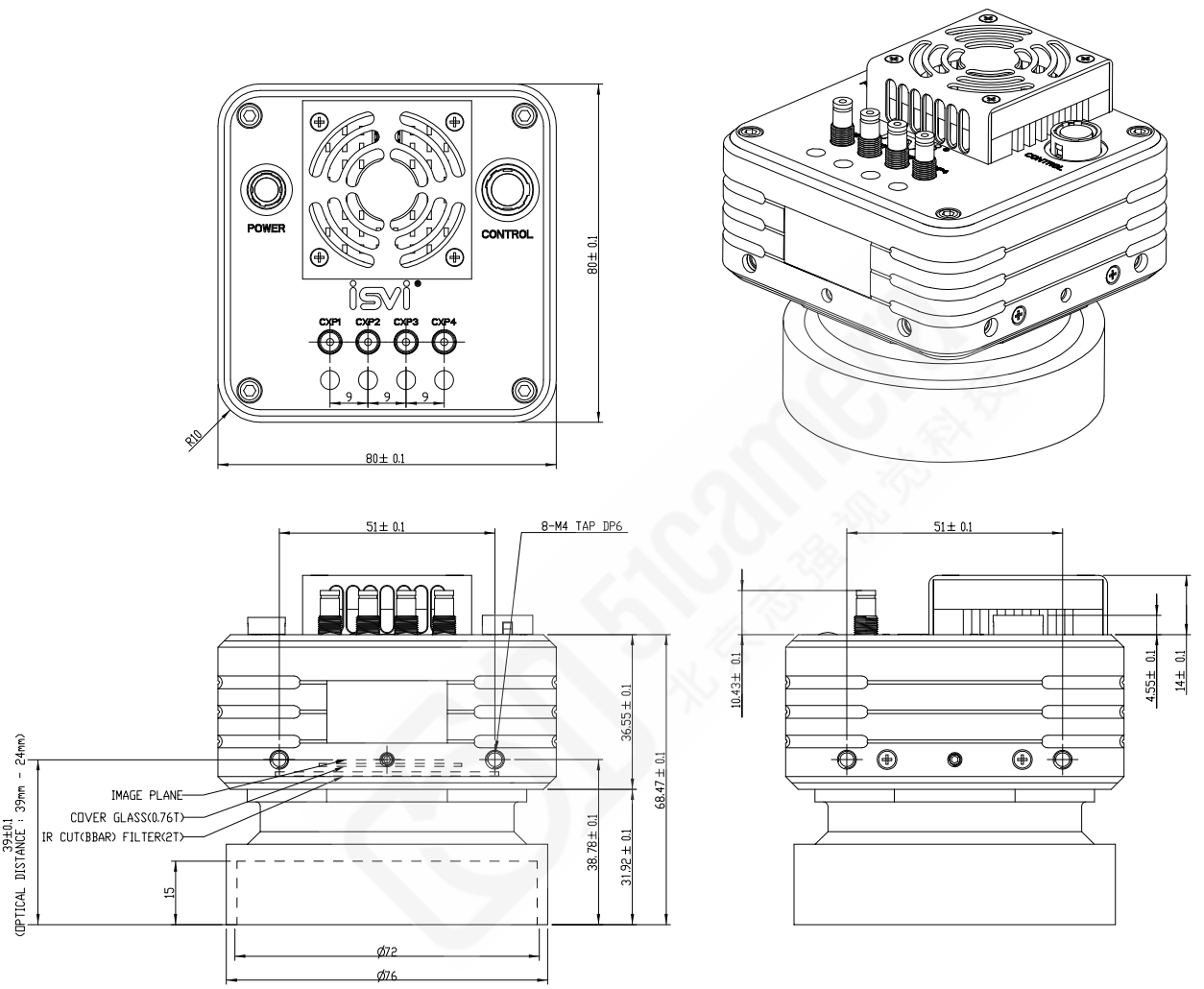


Figure 2.4 Mechanical dimensions (M72 Mount)

- LM Mount (Leica M Mount)

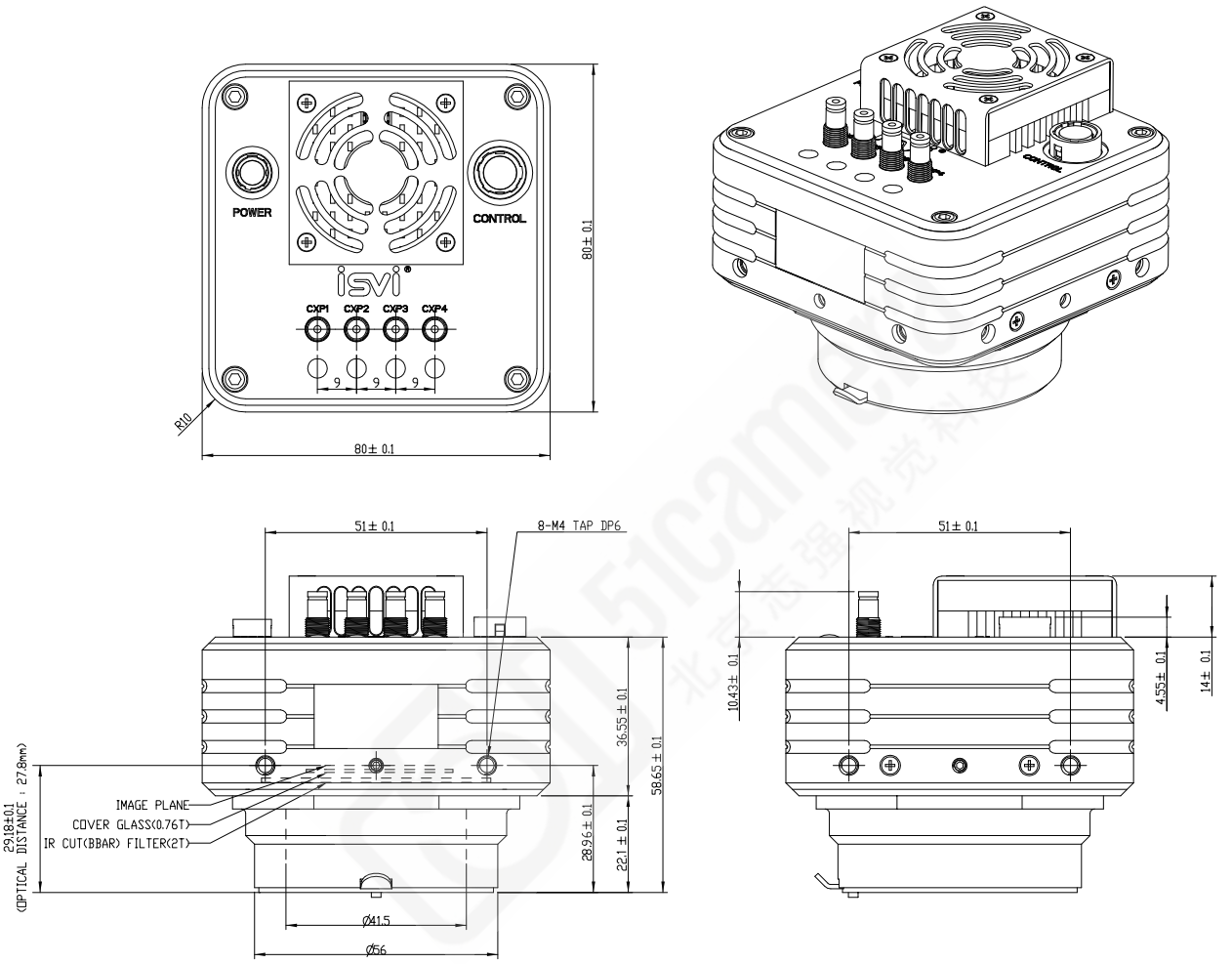


Figure 2.5 Mechanical dimensions (LM Mount)

3. Installation

In this section you will find information on the proper means of mounting your camera in your system, connecting the camera to a frame grabber and power supply, as well as ensuring proper electrical connections to the camera's I/O signals.

3.1. Mounting the camera

The camera has 8 mounting holes, 2 each top, bottom and sides. See the mounting hole specifications in Section 2.4 for their location and specifications.

Ensure that the maximum internal thread depth indicated in Section 2.4 is not exceeded. The maximum torque which can be applied to the mounting screws is 1.7Nm.
Using screws which are too long or are over-tightened may damage the camera!

3.2. Thermal management

Mounting the camera properly and adequately is required to ensure proper thermal management, which ensures the best possible image quality. Thermal management means conducting heat away from the sensor in order to keep it as cool as possible. Heat is one of the primary causes of dark current noise on the sensor which increases photo response non-uniformity, dark signal non-uniformity, fixed-pattern noise and other image degrading effects.

The optimal conduction of heat from the sensor to the front and side surfaces is ensured by the design of this camera. In addition to its internal thermal management design, this camera comes with an active cooling fan to help maintain a constant operating temperature at any given ambient temperature. However, it is still necessary to transfer heat away from the camera surfaces by mounting the camera to a solid metal surface of adequate mass using the mounting holes found on the camera. The attachment of heat sinks to the camera sides can also aid in the transference of heat.

This camera is designed to operate at an ambient temperature between 0°C and +40°C. Operating the camera between 40°C and maximum 70°C will result in reduced image performance and camera lifetime. Do not operate the camera at temperatures above 70°C!

3.3. Mounting a Lens

This camera is equipped with a lens mount designed for use with high-precision industrial lenses. All lens mounts available for this camera are engineered with specific dimensions and very tight tolerances.
When mounting a lens to the camera, ensure that the lens is held parallel with the lens mount and never forcibly assert pressure to attach the lens. Ensure that the lens is not cross-threaded to the mount. Damage to the camera, lens mount and lens may occur!

When mounting an F-mount or L-mount lens (Leica M or equivalent), ensure that the lens is inserted properly before turning counter-clockwise until the locking tab clicks into place.
When removing an F-mount or L-mount lens, push the locking tab towards the camera body and turn the lens clockwise.

3.4. Camera connections

The camera connections are laid out on the back panel of the camera as follows:

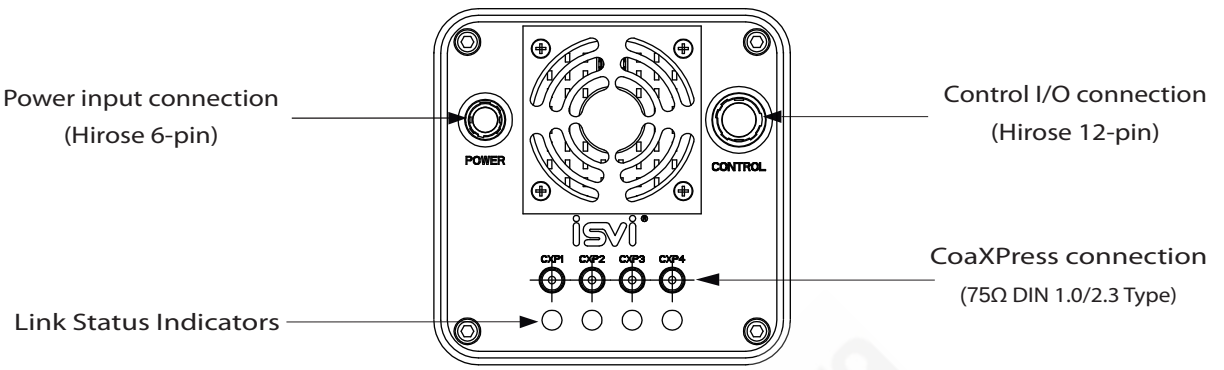


Figure 3.1 Camera connectors

3.4.1 CXP Connections and interface standard

CoaXPress (CXP) is a state-of-the-art high-speed serial data interface developed for machine vision devices (typically cameras) and hosts (typically frame grabbers) which defines the plug-and-play detection, device/host setup, transfer of image data, device control and device power using a single 75 Ohm coaxial cable. The interface between device and host is scalable and consists of one master connection and optional extension connections to form a complete link.

The CXP connectors on the camera are of type 75 Ohm DIN 1.0/2.3 and conform to the latest CXP standard specifications. The connections transfer image data, provide for camera control and power when connected to a CoaXPress 4-port (DIN-4 or BNC-4) framegrabber. Because CXP is a scalable interface, the user has the possibility to connect 4, 2 or 1 cables.

Fig. 3.2 shows the link configurations supported by the camera's CXP interface.

IC-M12S-CXP (Monochrome) & IC-C12S-CXP (Color)				
Pixel Format	**Link Configuration**	**Total bit rate**	**No. of Cables**	**Max. Framerate (Hz)**
Mono8/Bayer RG8	CXP6_X4	25 Gbps	4	181.66
Mono8/Bayer RG8	CXP6_X2	12.5 Gbps	2	91.19
Mono8/Bayer RG8	CXP6_X1	6.25 Gbps	1	45.71
Mono8/Bayer RG8	CXP3_X4	12.5 Gbps	4	91.19
Mono8/Bayer RG8	CXP3_X2	6.25 Gbps	2	45.71
Mono8/Bayer RG8	CXP3_X1	3.125 Gbps	1	22.89

Figure 3.2 Supported CoaXPress Link Configuration

Only high quality 75 Ohm coaxial cables should be used without adapters or other couplings as these deteriorate the high-frequency data signals and may lead to loss of data or a reduction in the maximum usable cable length. When using multiple cables, all cables should have the same length to within less than 1 meter tolerance. Please contact your local ISVI Partner for recommendations on proper cabling.

The CXP connection is designed to be plug-and-play. It has mechanisms for automatic camera detection, link setup and camera/host setup. The order in which multiple cables are connected is not important and there is no need to connect any particular connection when using fewer than 4 cables. Therefore, the camera is hot-pluggable and the link will be recovered if there is a loss of connectivity.

Caution: Although the link to the host (frame grabber) will recover, this does not mean that an application will recover after a loss of connectivity.

Caution: Although it has over-voltage protection, connecting long cables with stored charge may damage the camera.

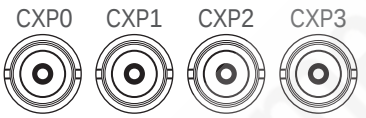
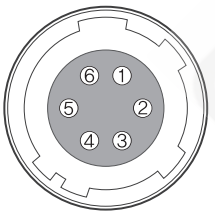


Figure 3.3 CXP Connector

3.4.2 Power input connection

The camera power input connector is a Hirose 6 pin connector (part # HR10A-7R-6S) and is used exclusively to power the camera. Pin layout and configuration are shown in Figure 3.4.



Power Connector

Pin Number	Signal
1, 2, 3	VCC, +24VDC
4, 5, 6	GND Ground

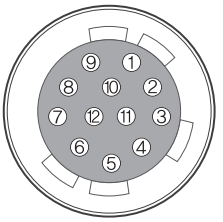
Mating connector: Hirose HR10(A)-7P-6P

Figure 3.4 Power input connector

It is recommended to use a direct current (DC) regulated power supply rated to at least 2 Amps current with output voltage of 24VDC ±10%. The camera employs a self-recovery fuse for protecting against reverse voltage and overvoltage. However, applying reverse voltage or overvoltage may damage the camera and void the warranty.

3.4.3 Control I/O connection

The Control I/O Connection is used for supplying the camera with an external TTL trigger input as an alternative to inputing a trigger signal over the CXP connection. It is also used for supplying an external strobe output trigger.



Control Connector

Pin Number	Signal
1	+ Trigger Input
2	- Trigger Input
3	Strobe Output
5	GND, Ground
4, 6-12	Reserved - Do not connect

Mating connector: Hirose HR10(A)-10P-12P

Figure 3.5: Power input connector

The reserved pins are used by the ISVI Camera Firmware Upgrade Cable for field firmware upgrading. Do not connect these pins – damage to the camera may occur! See seperate manual provided for more detailed information about firmware upgrading.

Do not apply voltage to the Strobe Output or GND pins. Damage to the camera may occur!

3.5 Trigger input circuit

Figure 3.5 shows the trigger signal input circuit of the 12-pin Control I/O connection. The trigger signal entered is delivered to the internal circuit through a photo coupler.

Trigger pulse width must be a minimum of 1µsec. If trigger pulse width supplied to the camera is less than the minimum allowed, the trigger signal will be the camera and an image will not be taken.

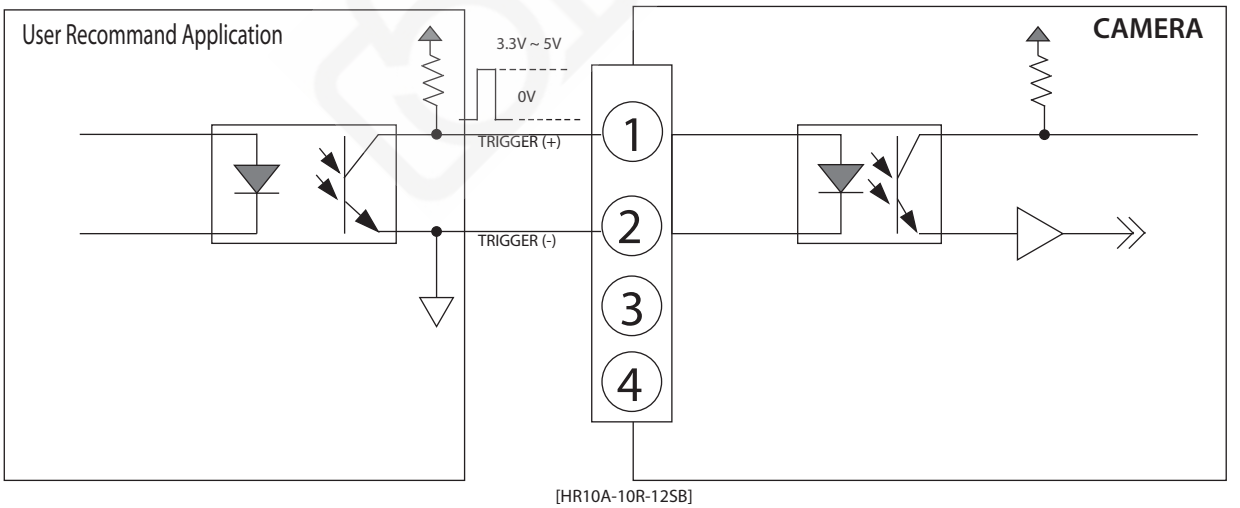


Figure 3.5: Trigger Input Circuit

3.6 Strobe output circuit

The strobe output signal is output through a TTL Driver IC with a 3.3 V / Max 50mA output level. The start of the strobe pulse can be programmed by the user and the pulse width of the output signal is the same as the exposure time setting.

Do not apply any voltage to the Strobe Output pins – damage to the camera will occur and the warranty will be voided!

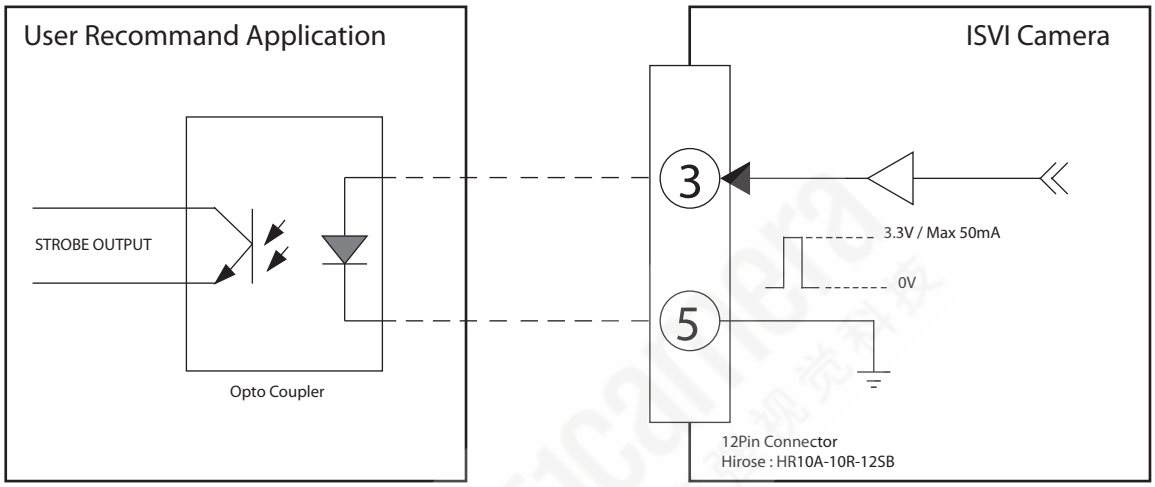


Figure 3.6: Trigger Output Schemetic

4. Image Acquistion

4.1 Overview

This section describes the different modes of acquiring images with the Camera. Setting the Camera to use these acquisition modes is described in Section 5.

The Camera has 3 acquisition modes which can be selected for a high degree of flexibility in any application environment:

- Continuous
- Trigger Timed
- Trigger Width

4.2 Continuous

The Continuous mode is a self-triggering acquisition mode which requires the user to preset the exposure time and frame rate. Once started the camera will continuously acquire images at the specified rate. Fig. 4.1 shows the relational timing of this mode.

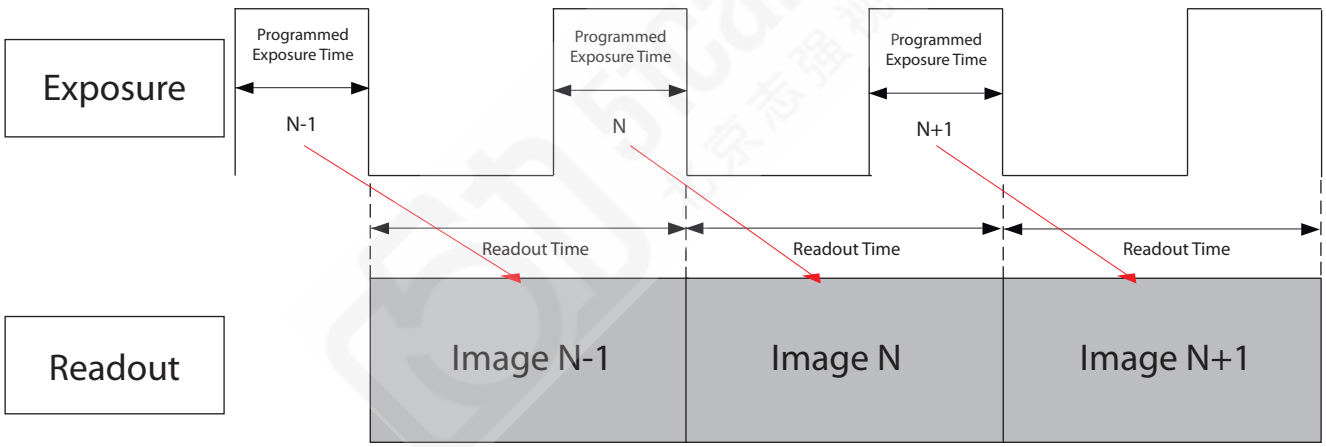


Figure 4.1: Continuos Mode

4.3 Trigger Timed

In Trigger Timed mode the camera controls the Exposure period which is programmed in the camera by the user. The camera waits for an external trigger to be applied to the CXP connection or to the External Trigger pin of the I/O connection. Once a trigger is detected by the camera, then the programmed Exposure begins.

Readout of the image occurs at the end of the programmed Exposure period.

The overlapping function of the Trigger Timed mode allows a new trigger and programmed Exposure period to be applied for the next frame during the readout of the current frame. Fig. 4.2 shows the overlapping relationship of Trigger, Exposure and Readout.

Applying a trigger during the previous frame's exposure period or at an interval shorter than the total readout period of 5.464msec will result in the trigger being ignored.

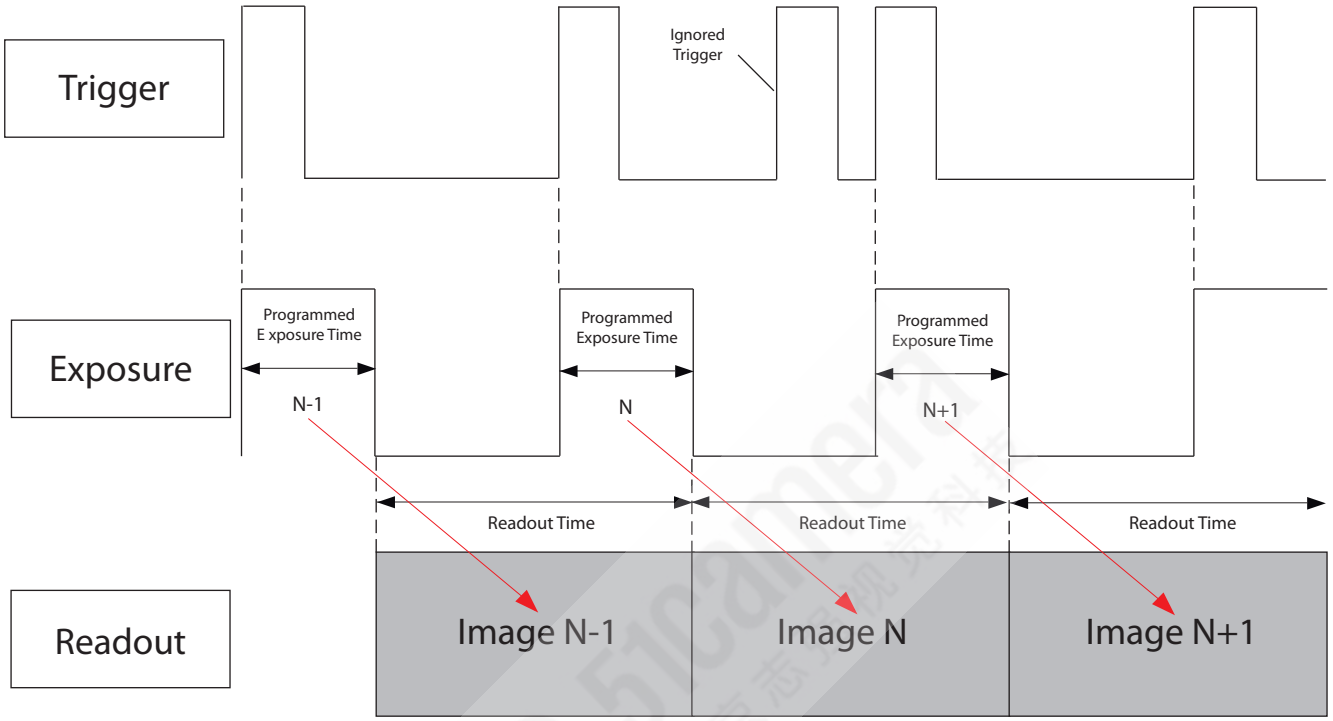


Figure 4.3: Trigger Timed Mode

4.4 Trigger Width

In Trigger Width Mode the Exposure period is is controlled by the pulse width (PWC) of the applied trigger signal. The camera waits for an external trigger to be applied to CXP connection or to the External Trigger pin of the I/O connection. Once a trigger is detected by the camera, then the Exposure begins and ends when the state of the trigger changes (high to low or low to high).

Readout of the image occurs at the end of the Exposure period.

A trigger can be applied and a new Exposure period started for the next frame during the readout of the current frame. Fig. 4.4 shows the overlapping relationship of Trigger, Exposure and Readout.

Applying a trigger during the previous frame's exposure period or allowing the pulse width and therefore exposure to end before the readout of the previous frame is completed will result in an ignored trigger or a corrupted image.

Trigger pulse width must be a minimum of 1µsec. If the trigger pulse width supplied to the camera is less than the minimum allowed, the trigger signal will be ignored by the camera and an image will not be taken.

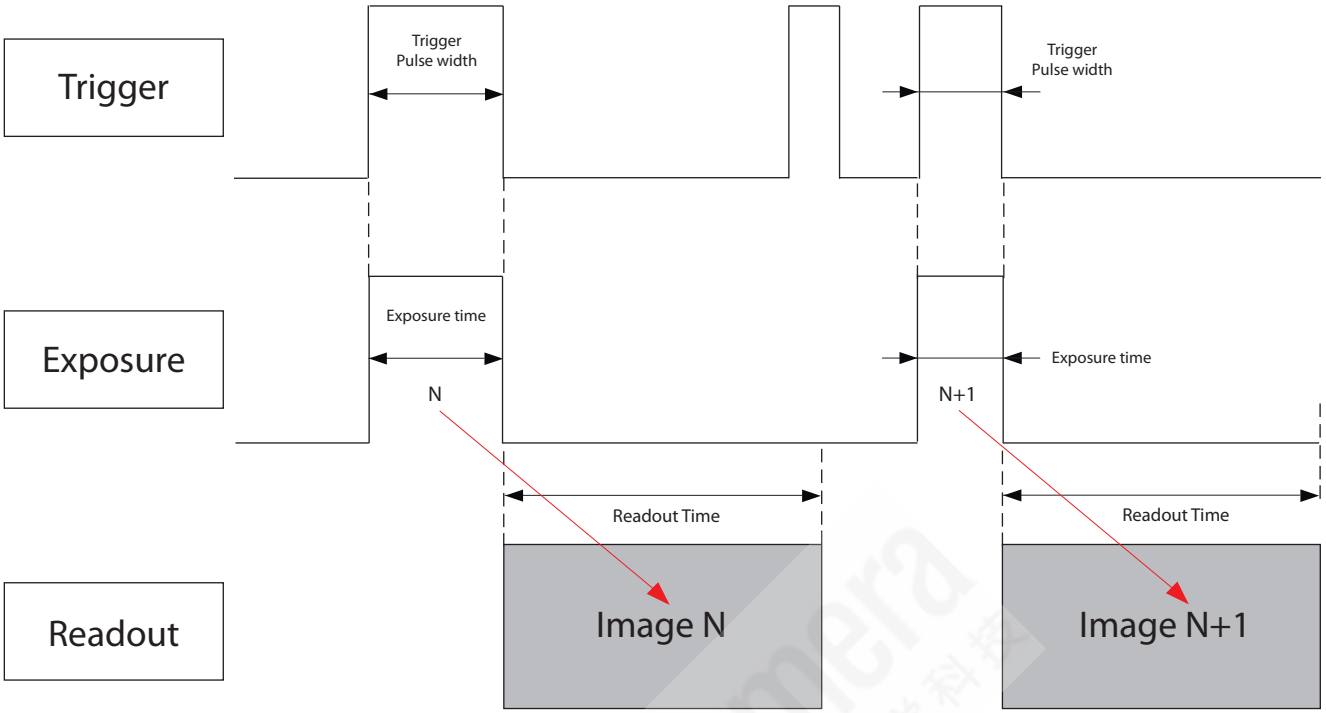


Figure 4.4: Trigger Width Mode

5. Camera Features

5.1 Overview

This section provides a description of each Camera feature and how to control it.

This section assumes that the user has a suitable CoaXPress (CXP) framegrabber (FG) installed in a PC of sufficient specification for his application environment and all supporting software drivers and interfacing API have been correctly installed. For advice on how to install the FG hardware and software and suitable PC specifications, please consult with your FG vendor.

After connection of the Camera to the FG and power up, the Camera sends its GenICam compliant XML file to the framegrabber once an automatic detection has been established. The FG reads the XML file delivered from the Camera and creates from it a Graphical User Interface (GUI) called a Camera Feature window. In this window, the user is able to control all the features of the camera and save the configuration to user setting areas.

Screen shots of a typical Camera Feature window are used in this section as an aid to understanding and using the features of the camera. The GUI Camera Feature window from the user's FG may be slightly different in appearance than the one portrayed in this section, but the basic function will be the same.

Figure 5.1 is an overview of a typical FG-GUI showing the Feature Sections described here.

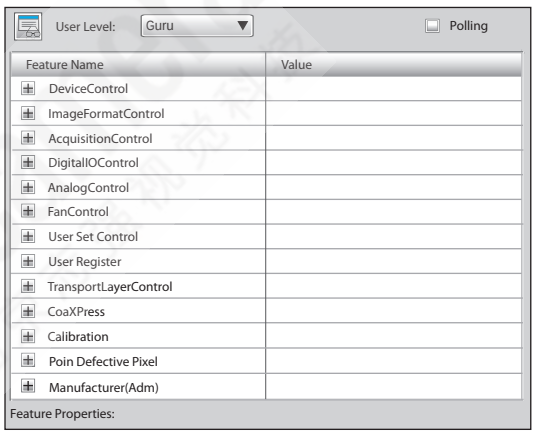


Figure 5.1 Feature Browser Window

5.2 User Level

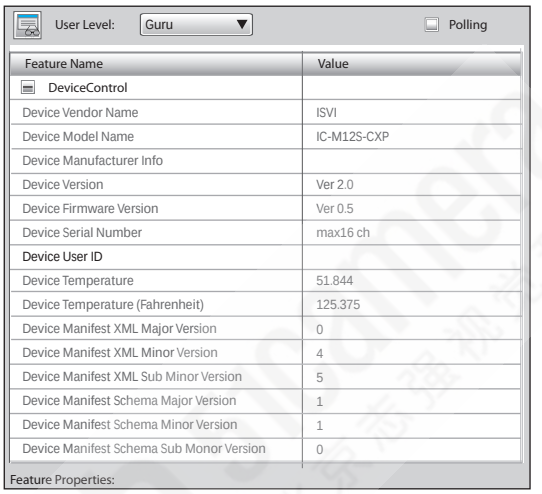
The User Level setting is used to activate the visibility of features of different levels of complexity. The User Levels are

- **Beginner** - Features visible to all users via the GUI and API. These are all basic features used to control the camera and which do not require specialized knowledge to use them.
- **Expert** - Features that require a more in-depth knowledge of the camera functionality.
- **Guru** - Advanced features that might bring the camera into a state where it will not work properly anymore if it is set incorrectly for the camera's current mode of operation. These features should be set only by qualified users.

5.3 Feature Description Table

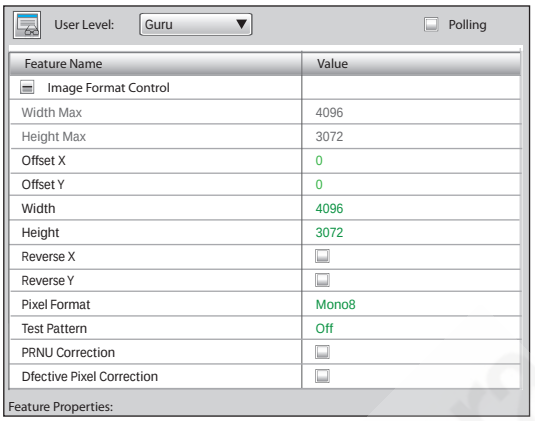
'In this section the feature description tables show all of the user accessible features of the camera, their interface type, visibility level, their accessibility level (Access) and a description of their function.
In the following section, Communication/Command Code, the user modifiable features are listed with their possible settings and/or ranges and their factory default values, in addition to information required to address the registers directly to control the features.'

5.3.1 Device Control



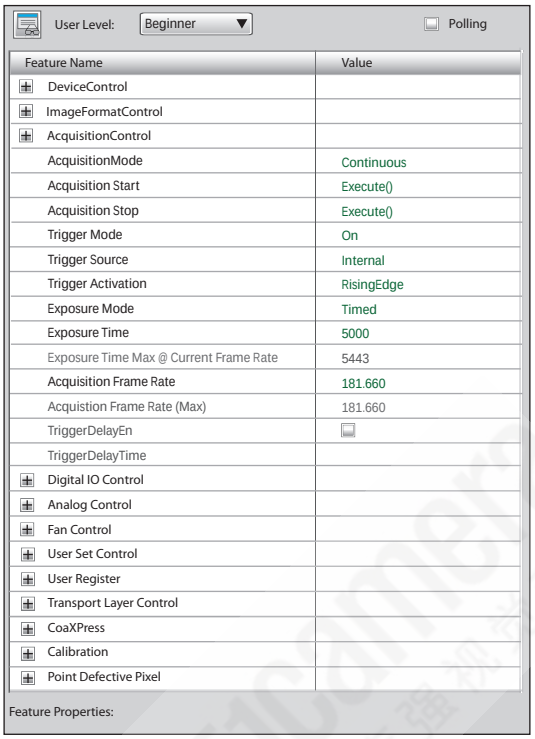
Feature Name	Access Mode	Interface	Visibility	Access	Description
Device Control	User	Category	Beginner	RO	Category for device information and control.
Device Vendor Name	User	String	Beginner	RO	Name of the manufacturer of the device.
Device Model Name	User	String	Beginner	RO	Model of the device.
Device Manufacturer Info	User	String	Beginner	RO	Manufacturer information about the device.
Device Version	User	String	Beginner	RO	Version of the device.
Device Firmware Version	User	String	Beginner	RO	Version of the firmware in the device.
Device Serial Number	User	String	Expert	RO	Device's serial number. This string is a unique identifier of the device.
Device User ID	User	String	Beginner	RW	User-programmable device identifier.
Device Temperature	User	Float	Expert	RO	Device temperature in degrees Celsius (C).
Device Temperature (Fahrenheit)	User	Float	Expert	RO	Device temperature in degrees Fahrenheit (F).
Device Manifest XML Major Version	User	Integer	Guru	RO	Indicates the major version number of the GenICam XML file of the selected manifest entry.
Device Manifest XML Minor Version	User	Integer	Guru	RO	Indicates the minor version number of the GenICam XML file of the selected manifest entry.
Device Manifest XML SubMinor Version	User	Integer	Guru	RO	Indicates the subminor version number of the GenICam XML file of the selected manifest entry.
Device Manifest Schema Major Version	User	Integer	Guru	RO	Indicates the major version number of the schema file of the selected manifest entry.
Device Manifest Schema Minor Version	User	Integer	Guru	RO	Indicates the minor version number of the schema file of the selected manifest entry.
Device Manifest Schema SubMinor Version	User	Integer	Guru	RO	Indicates the subminor version number of the GenICam XML file of the selected manifest entry.

5.3.2 Image Format Control



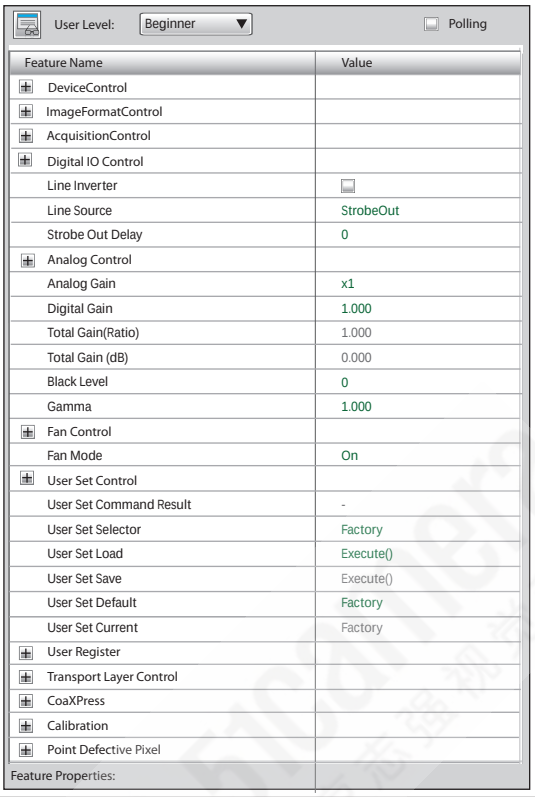
Feature Name	Access Mode	Interface	Visibility	Access	Description
Image Format Control	User	Category	Beginner	RO	Category for Image Format Control Features.
Width Max	User	Integer	Expert	RO	Maximum width of the image (in pixels). The dimension is calculated after horizontal binning, decimation or any other function changing the horizontal dimension of the image.
Height Max	User	Integer	Expert	RO	Maximum height of the image (in pixels). This dimension is calculated after vertical binning, decimation or any other function changing the vertical dimension of the image.
Offset X	User	Integer	Beginner	RW	Horizontal offset from the origin to the region of interest (in pixels).
Offset Y	User	Integer	Beginner	RW	Vertical offset from the origin to the region of interest (in pixels).
Width	User	Integer	Beginner	RW	Width of the image provided by the device (in pixels).
Height	User	Integer	Beginner	RW	Height of the image provided by the device (in pixels).
Reverse X	User	Boolean	Expert	RW	Flip horizontally the image sent by the device. The Region of interest is applied after the flipping.
Reverse Y	User	Boolean	Expert	RW	Flip vertically the image sent by the device. The Region of interest is applied after the flipping.
Pixel Format	User	Enumeration	Beginner	RO	Format of the pixels provided by the device.
Test Pattern	User	Enumeration	Beginner	RW	Selects the type of test pattern that is generated by the device as image source.
PRNU Correction	User	Boolean	Beginner	RW	PRNU Correction On or Off
Defective Pixel Correction	User	Boolean	Beginner	RW	Defective Pixel Correction On or Off

5.3.3 Acquisition Control



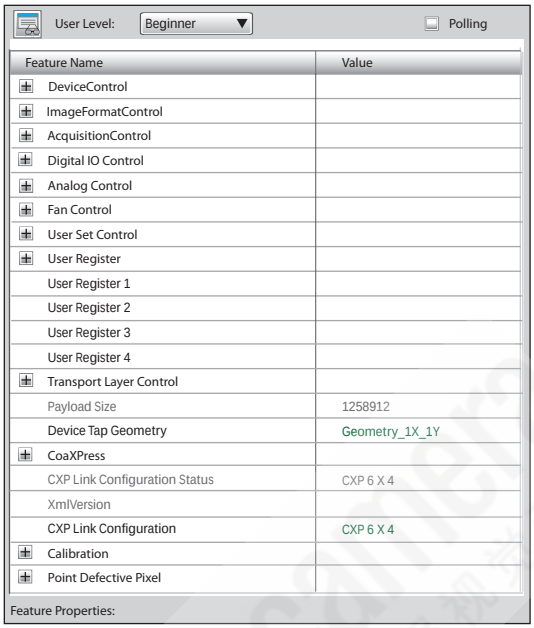
Feature Name	Access Mode	Interface	Visibility	Access	Description
Acquisition Control	User	Category	Beginner	RO	Category for the acquisition and trigger control features.
Acquisition Mode	User	Enumeration	Beginner	RW	This feature controls the acquisition mode of the device.
Acquisition Start	User	Command	Beginner	RW	Starts the Acquisition of the device. The number of frames captured is specified by AcquisitionMode.
Acquisition Stop	User	Command	Beginner	RW	Stops the Acquisition of the device at the end of the current Frame. It is mainly used when AcquisitionMode is Continuous but can be used in any acquisition mode.
Trigger Mode	User	Enumeration	Beginner	RW	Controls if the selected trigger is active.
Trigger Source	User	Enumeration	Beginner	RW	Specifies the internal signal or physical input Line to use as the trigger source. The selected trigger must have its TriggerMode set to On.
Trigger Activation	User	Enumeration	Beginner	RW	Specifies the activation mode of the trigger.
Exposure Mode	User	Enumeration	Beginner	RW	Sets the operation mode of the Exposure.
Exposure Time	User	Integer	Beginner	RW	Sets the Exposure time when ExposureMode is Timed and TriggerMode is Off. This controls the duration where the photosensitive cells are exposed to light.
Exposure Time Max @ Current Frame Rate	User	Integer	Beginner	RO	Possible Maximum Exposure time of current Acquisition Frame Rate.
Acquisition Frame Rate	User	Float	Beginner	RW	Controls the acquisition rate (in Hertz) at which the frames are captured.
Acquisition Frame Rate(Max)	User	Float	Beginner	RO	Maximum frame rate of Sensor(decided by ROI & CXP Speed, Connections).
TriggerDelayEn	User	Integer	Beginner	RW	Enable/Disable internal trigger generation delay. This will create a corresponding delay in the start of Exposure.
TriggerDelayTime	User	Integer	Beginner	RW	Specifies the delay in microseconds (us) to apply after the trigger reception before activating it.

5.3.4 Digital IO Control / Analog Control / Fan Control / User Set Control



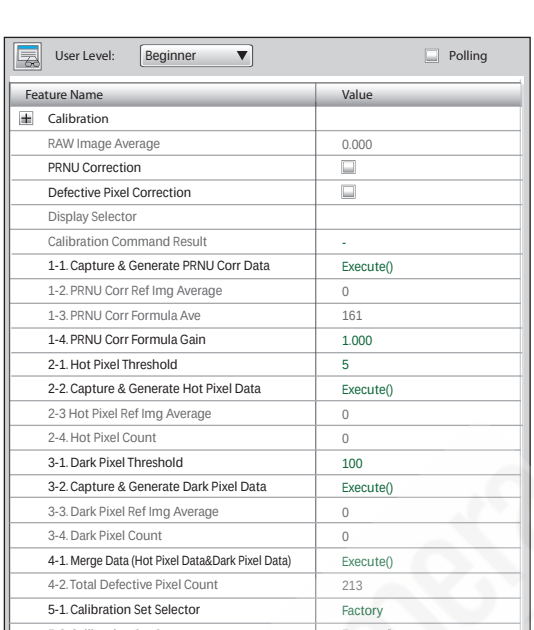
Feature Name	Access Mode	Interface	Visibility	Access	Description
Digital IO Control	User	Category	Beginner	RO	Category that contains the digital input and output control features.
Line Inverter	User	Boolean	Beginner	RW	Controls the inversion of the signal of the selected input or output Line.
Line Source	User	Enumeration	Beginner	RW	Selects which internal acquisition or I/O source signal to output on the selected Line.
Strobe Out Delay	User	Integer	Beginner	RW	This Feature is StrobeOutDelay Time Setting Feature(in us).
Analog Control	User	Category	Beginner	RO	Category that contains the Analog control features.
Analog Gain	User	Enumeration	Beginner	RW	Analog Gain
Digital Gain	User	Float	Beginner	RW	Digital Gain
Total Gain(Ratio)	User	Float	Beginner	RO	Total Gain(Ratio)
Total Gain(dB)	User	Float	Beginner	RO	Total Gain(dB)
Black Level	User	Integer	Beginner	RW	Controls the analog black level as an absolute physical value. This represents a DC offset applied to the video signal.
Gamma	User	Float	Beginner	RW	Controls the gamma correction of pixel intensity. This is typically used to compensate for non-linearity of the display system (such as CRT).
Fan Control	User	Category	Beginner	RO	Category that contains the Fan control feature.
Fan Mode	User	Enumeration	Beginner	RW	Controls if the fan is active.
User Set Control	User	Catergory	Beginner	RO	Category that contains the User Set control features.
User Set Command Result	User	String	Beginner	RO	User Set Control Command Result
User Set Selector	User	Enumeration	Beginner	RW	Selects the feature User Set to load, save or configure.
User Set Load	User	Command	Beginner	RW	Loads the User Set specified by UserSetSelector to the device and makes it active.
User Set Save	User	Command	Beginner	RW	Save the User Set specified by UserSetSelector to the non-volatile memory of the device.
User Set Default	User	Enumeration	Beginner	RW	Selects the feature User Set to load and make active by default when the device is reset.
User Set Current	User	Enumeration	Beginner	RO	Shows current User Set being used by the device. May be different than 'User Set Selector'

5.3.5 User Set Register / Transport Layer Control / CoaXPress



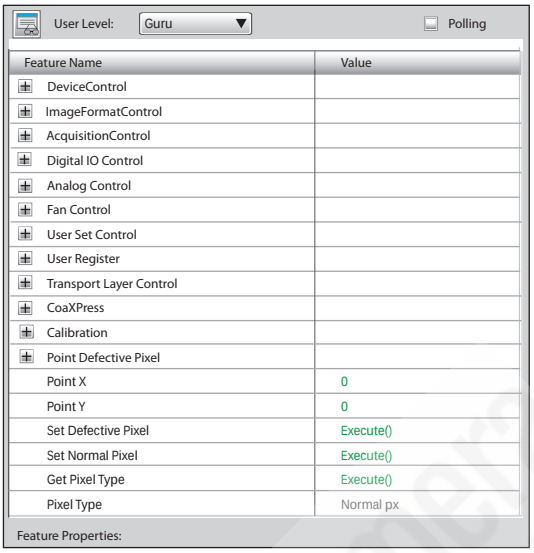
Feature Name	Access Mode	Interface	Visibility	Access	Description
User Register	User	Category	Guru	RO	Category that contains the User Register.
User Register 1	User	String	Guru	RW	Allows user to store a desired value (8byte) in Register 1
User Register 2	User	String	Guru	RW	Allows user to store a desired value (8byte) in Register 2
User Register 3	User	String	Guru	RW	Allows user to store a desired value (8byte) in Register 3
User Register 4	User	String	Guru	RW	Allows user to store a desired value (8byte) in Register 4
Transport Layer Control	User	Category	Expert	RO	Category that contains the transport Layer control features.
Payload Size	User	Interger	Expert	RO	Provides the number of bytes transferred for each image or chunk on the stream channel. This includes any end-of-line, end-of-frame statistics or other stamp data. This is the total size of data payload for a data block.
Device Tap Geometry	User	Enumeration	Expert	RW	This device tap geometry feature describes the geometrical properties characterizing the taps of a camera as presented at the output of the device.
CoaXPress	User	Category	Beginner	RO	Category that contains the features pertaining to the CoaXPress transport layer of the device.
CXP Link Configuration Status	User	Enumeration	Beginner	RO	This feature indicates the current and active Link configuration used by the Device.
Xml Version	User	Enumeration	Beginner	RO	Provides the Link configuration that allows the Transmitter Device to operate in its default mode.
CXP Link Configuration	User	Enumeration	Beginner	RW	This feature allows specifying the Link configuration for the communication between the Receiver and Transmitter Device. In most cases this feature does not need to be written because automatic discovery will set configuration correctly to the value returned by CxpLinkConfigurationPreferred. Note that the currently active configuration of the Link can be read using CxpLinkConfigurationStatus.

5.3.6 Calibration



Feature Name	Access Mode	Interface	Visibility	Access	Description
Calibration	User	Category	Guru	RO	Category for the Calibration Control features.
RAW Image Average	User	Float	Guru	RO	RAW image Average
PRNU Correction	User	Boolean	Guru	RW	PRNU Correction On or Off
Defective Pixel Correction	User	Boolean	Guru	RW	Defective Pixel Correction On or Off
Display Selector	User	Enumeration	Guru	RW	Select type of display image (PRNU Correction or Defective Pixel Correction on)
Calibration Command Result	User	String	Guru	RO	Calibration Command Result
1.1. Capture&Generate PRNU Corr Data	User	Command	Guru	RW	Capture Gray image and generate PRNU Corr data
1.2. PRNU Corr Ref Img Average	User	Integer	Guru	RO	Image Average of '1-1'
1.3. PRNU Corr Formula Avg	User	Integer	Guru	RO	Auto PRNU Corr Formula update
1.4. PRNU Corr Formula Gain	User	Float	Guru	RW	Sets a gain value to allow a corrected image to achieve saturation when 'PRNU Correction' is on.
2.1. Hot Pixel Threshold		Integer	Guru	RW	Set range to detect Hot pixel. Higher values than set value will be defective pixel.
2.2. Capture&Generate Hot Pixel Data	User	Command	Guru	RW	Capture Ref image and generate Hot Pixel Corr data.
2.3. Hot Pixel Ref Img Average		Integer	Guru	RO	Image Average of '2-2'
2.4 Hot Pixel Count	User	Integer	Guru	RO	Hot Pixel numbers from '2-3'
3.1 Dark Pixel Threshold	User	Integer	Guru	RW	Set range to detect Dark pixel. Lower values than set value will be defective pixel.
3.2. Capture&Generate Dark Pixel Data	User	Command	Guru	RW	Capture Ref image and generate Dark Pixel Corr data.
3.3. Dark Pixel Ref Img Average	User	Integer	Guru	RO	Image Average of '3-2'
3.4. Dark Pixel Count	User	Integer	Guru	RO	Dark Pixel numbers from '3-3'
4.1. Merge Data(Hot Pixel Data&DarkPixel Data)	User	Command	Guru	RW	Merge data between Hotpixel and Dark Pixels
4.2. Total Defective Set Selector	User	Integer	Guru	RO	Total Defective Pixel numbers from '4-1'.
5.1 Calibration Set Selector	User	Enumeration	Guru	RW	Set area to save or to read either PRNU Correction data or Defective Pixel Correction data
5.2. Calibration Set Save	User	Command	Guru	RW	Save Calibration data to the area that was set in '5-1'.
5.3. Calibration Set Load	User	Command	Guru	RW	Load Calobration data from the area that was set in '5-1'.

5.3.7 Point Defective Pixel



Feature Name	Access Mode	Interface	Visibility	Access	Description
Point DP	User	Category	Guru	RO	Category for the Point Defective Pixel Control Features
Point X	User	Integer	Guru	RW	X Axis of the pixel
Pint Y	User	Integer	Guru	RW	Y Axis of the pixel
Set Defective Pixel	User	Command	Guru	WO	Set defective pixel that was designated from 'Point X' & 'Point Y'
Set Normal Pixel	User	Command	Guru	WO	Set normal pixel that was designated from 'Point X' & 'Point Y'
Get Pixel Type	User	Command	Guru	WO	Read type of pixel that was designated from 'Point X' & 'Point Y'
Pixel Type	User	Enumeration	Guru	RO	This displays type of pixel from 'Get Pixel Type'

6. Communication / Command Code

Bootstrap

0x0000 - 0x5FFF: Please refer to 'CoaXPress Standard'.

Address	Name	Access	Length (Bytes)	Default Value	Access
0x6000	Offset X	RW	4	0	Set ROI X Offset 0 - 3584 (step: 32)
0x6004	Offset Y	RW	4	0	Set ROI Y Offset 0 - 3070 (step: 2)
0x6008	Width	RW	4	4096	Set ROI Width: 512 - 4096 (step: 32)
0x600C	Height	RW	4	3072	Set ROI Height: 2 - 3072 (step: 2)
0x6010	Pixel Format	RW	4	0x0101	0x0101: Mono 8Bit
0x6018	Height Max	RO	4[15:0]	3072	
	Width Max	RO	4[31:16]	4096	
0x7048	Reverse X	RW	4[31]	0	0: OFF 1: On
	Reverse Y	RW	4[30]	0	0: OFF 1: On
0x7000	Test Pattern	RW	4	0	0: OFF 1: Gray Horizontal Ramp 2: Gray Vertical Ramp 3: Gray Diagonal Ramp 4: Gray Diagonal Ramp Moving 16: Sensor Test Pattern
0x8864	PRNU Correction	RW	4	0	0: OFF 1: On
0x8880	Defective Pixel Correction	RW	4	0	0: OFF 1: On
0x6020	Acquisition Mode	RW	4	0	0: Continuous
0x6024	Trigger Source	RW	4	0	0: Internal 1: External
0x6028	Trigger Activation	RW	4	0	0: Rising Edge 1: Falling Edge
0x6040	Exposure Mode	RW	4	0	0: Timed 1: Trigger Width
0x6058	Trigger Mode	RW	4	0	0: OFF 1: On

Address	Name	Access	Length (Bytes)	Default Value	Access
0x6050	Acquisition Start	RW	4	0	1: Acquisition Start
0x6054	Acquisition Stop	RW	4	0	1: Acuisition Stop
0x6034	Exposure Time Max	RO	4	5443	Possible Maximum Exposure time of current Acquisition Frame Rate. (unit: µs)
0x603C	Exposure Time	RW	4	5000	1 - 10000000 (unit: µs)
0x6038	Acquisition Frame Rate	RW	4	181.660	0.1 - Acquisition Frame Rate Max (unit: Hz)
0x6030	Acquistion Fram Rate Max	RO	4		Maximum Frame Rate of Sensor (decided by ROI & amp: CXP Speed, Connections) (unit: HZ)
0x6044	Trigger Delay Time	RW	4	0	0 - 1000000 (unit: µs)
0x6048	Trigger Delay En	RW	4	0	0 : OFF 1 : On
0x6060	Line Inverter	RW	4[31]	0	0 : OFF 1 : On
	Line Source	RW	4[30]	0	0 : StrobeOut
0x6064	Strobe Out Delay	RW	4	0	0 - 10000000 (unit: µs)
0x8212	Analog Gain	RW	4	0	0 : x1 1 : x1.5 2 : x2.25 3 : x3
0x8210	Digital Gain	RW	4	0	1.0 - 3.0 (step: 0.001)
0x821C	Total Gain(Ratio)	RO	4	0	Analog Gain x Digital Gain
0x8214	Black Level	RW	4	0	0 - 1023
0x7044	Gamma	RW	4	1.0	0.1 - 3.0 (step: 0.001)
0x7100	Fan Mode	RW	4	1	0 : OFF 1 : On
0x8700	User Set Command Result	RO	64	-	User Set Command Result
0x8020	User Set Selector	RW	4	0	0 : Factory 1 : User Set 1 2 : User Set 2
0x8004	User Set Load User Set Save	RW	4	0	1 : User Set Load 2 : User Set Save
0x8008	User Set Default	RW	4	0	0 : Factory 1 : User Set 1 2 : User Set 2

Address	Name	Access	Length (Bytes)	Default Value	Access
0x800C	User Set Current	RO	4	0	0 : Factory 1 : User Set 1 2 : User Set 2
0x8060	User Register 1	RW	8		
0x8068	User Register 2	RW	8		
0x8070	User Register 3	RW	8		
0x8078	User Register 4	RW	8		
0x8100	Device Temperature	RO	4		Device Temperature (unit: ℃)
0x88B0	RAW Image Average	RO	4	0	
0x7018	Display Selector	RW	4	0	0 : Correction Img 1 : RAW Img 2 : PRNU Ref Img 4 : RAW/DP (White) 5 : RAW/DP (Black) 6 : RAW(black)/DP(white) 7 : RAW(shite)/DP(black)
0x8700	Calibration Command Result	RO	48	-	Calibration Command Result
0x8740	Capture & Generate	RW	4	0	1 : 1.1 Capture & Generate PRNU Corr Data 2 : 2.2. Capture & Generate Hot Pixel Data 3 : 3.2. Capture & Generate Dark Pixel Data
0x88A0	1.2. PRNU Corr Ref Ima Average	RO	4	0	1-2. PRNU Corr Ref Img Average
0x887C	1.3. PRNU Corr Firmula Average	RO	4	0	1-3. PRNU Corr Formula Average
0x8870	1.4. PRNU Corr Formula Gain	RW	4	1.0	1.0 - 1.999 (step: 0.001)
0x8748	2.1. Hot Pixel Threshold	RW	4	5	1 - 254 (step: 1)
0x88A8	2.3. Hot Pixel Ref Img Average	RO	4	0	0 - 255
0x8750	2.4. Hot Pixel Count	RO	4	0	
0x874C	3.1. Dark Pixel Threshold	RW	4	100	1 - 254 (step: 1)
0x88AC	3.3. Dark Pixel Ref Img Average	RO	4	0	0 - 255
0x8754	3.4. Dark Pixel Count	RO	4	0	
0x8744	4.1. Merge Data (Hot Pixel Data & Dark Pixel Data	WO	4		1 : 4-1. Merge Data (Hot Pixel Data & Dark Pixel Data)
0x8758	4.2 Total Defective Pixel Count	RO	4	0	

Address	Name	Access	Length (Bytes)	Default Value	Access
0x88F0	5.2. Calibration Set Save	RW	4[31]	0	1 : Calibration Set Save
	5.2. Calibration Set Load	RW	4[30]	0	1 : Calibration Set Load
	-	RW	4[27:24]	0	Always 0
	5.1. Calibration Set Selector	RW	4[23:20)	0	0 : Factory 1 : User 1 2 : User 2
0x88E0	Point X	RW	4[31:16]	0	0 - 4095
	Point Y	RW	4[15:0]	0	0 - 3071
0x88E4	Pixel Type Command	RW	4	0	0 : Set Defective Pixel 1 : Set Normal Pixel 2 : Get Pixel Type
0x88E8	Pixel Type	RW	4	0	0 : defective Pixel 1 : Normal Pixel

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