

# User Manual

**CoaXPress**

**IC-X25CXP**

V2.1

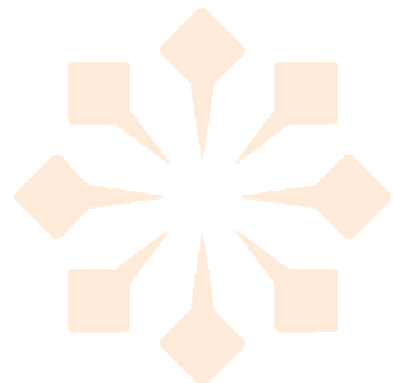
Digital Monochrome / Color

25Megapixel

Camera with CoaXPress Interface



**isvi**





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## 1. Precautions

### 1-1. General

- Do not drop or damage the device.
- Do not disassemble, repair or alter the device.
- Keep the machine not to be stained with the alien substances.
- Contact your nearest distributor in case of trouble or problem.

### 1-2. Precautions in Use

- Do not expose the camera's image-pickup-plane to sunlight or other intense light directly. Its inner CMOS sensor might be damaged.
- In clearing, do not splash water on the device but wipe it out with smooth cloth or towel.
- Do not place magnets near the product.
- Be careful not to let liquid like water, drinks or chemicals leak inside the device.
- Clean the device often to remove dust on it.
- If the camera is not in use, attach the lens cap to the camera to protect the image pickup surface.

### 1-3. Maintenance

Turn off power to the equipment and wipe it with a dry cloth.

If it becomes severely contaminated, gently wipe the affected areas with a soft cloth dampened with diluted neutral detergent. Never use alcohol, benzene, thinner, or other chemicals because such chemicals may damage or discolor the paint and indications.

If the image pickup surface becomes dusty, contaminated, or scratched, consult your sales representative.

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## 2. Overview

IC-M25CXP is a mono area scan CMOS camera and IC-C25CXP is a color area scan CMOS camera. IC-X25CXP has 25 million pixels resolution.

These Cameras are suitable for a wide range of application within factory, Automation, and also for application outside the factory floor, such as AOI(Automatic Optical Inspection), High-end surveillance and medical.

## 3. Specification

### 3.1 Electrical specification

- Sensor : 25 Mega Pixel Color & Mono CMOS image Sensor.
- Number of active pixels : 5120(H) x 5120(V)
- Full resolution in operation : 5120(H) x 5120(V)
- Max Frame rate 72 frames/sec(4ch\_6.25Gbps)
- Pixel size : 4.5 $\mu$ m (H)  $\times$  4.5 $\mu$ m (V)
- Optical size : 35mm
- Scanning system : Progressive scan camera
- Responsibility: 18.16 DN/nJ/cm<sup>2</sup>(550nm)
- ADC resolution : 8bit / 10bit Bayer Pattern Output
- Pre-select and pulse width trigger modes
- S/N Ratio : >42dB
- Dynamic range : > 53 dB
- Operating Temp: >0 $^{\circ}$ C ~ +40 $^{\circ}$ C
- Humidity : 20% ~ 90% RH(Condensing)
- CoaXPress Configuration : Up to 6.25GB per Channel, 4 Channels
- Gamma Correction :User defined LUT
- Defective Correction Circuit built in
- External Power supply voltage: DC24V(28W)  $\pm$  10%( Ripple 50 mV or less)
- PoCXP(Power over CoaXPress) : Available power per cable is 13W

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### 3.2 Electrical shutter specification

- Shutter Speed
  - Shutter speed from 13.9ms to 5s at 25M 72fps(8bit/10bit/4ch/6.25Gbps) mode.
  - Shutter OFF or 1/1,000,000 to 10 sec
  - The exposure time at shutter OFF is different depending..
  - On the reading mode(Factory default : Shutter OFF)
  
- Random Trigger Shutter ON / OFF switching (Factory default)
  - Fixed mode : The exposure time depends on the shutter speed setting
  - Pulse width mode: The exposure time depends on the pulse width.
  - Minimum pulse width: 2 $\mu$ s(Minimum exposure time: 2 $\mu$ s.

### 3.3 Mechanical spec

- Lens mount : F Mount (Option M42, M72 Mount)
- Dimensions : 131.9mm(L) \* 115mm(W) \* 109.9mm(H) – F Mount
- Weight : Approx 1900g
- Camera body grounding : Conductive between circuit GND and camera body

### 3.4 Input signal specification

- TRIG : Internal CoaXPress and External I/O connector input
- Signal level
  - Internal - CoaXPress packet data
  - External - TTL level
- Polarity : Positive/Negative switching

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### 3.5 Operating ambient conditions

- Performance assurance
  - Temperature : 0 to +40
  - Humidity : 20% ~ 90% RH(Non Condensing)
- Operation guaranteed
  - Temperature : -5 to +50
  - Humidity : 10% to 90 % (No dew formation)
- Storage Temperature
  - Temperature : -20 to +60
  - Humidity: 90 % or less (No dew formation)

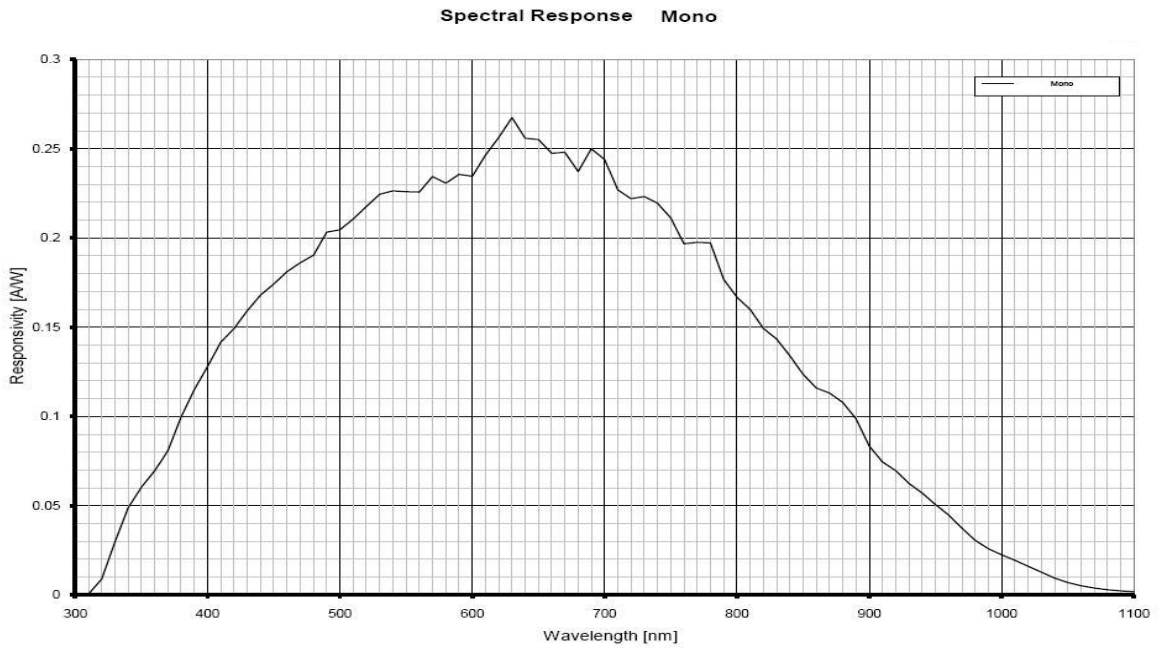
### 3.6 Various safety standards

- Performance assurance
  - CE(AoC)  
Test Standard (2004/108/EC): EN 55022: 2006 +A1:2007 [Class A Equipment]  
EN 55024: 1998 +A1:2001, +A2:2003
  - FCC(Verification)  
Test Standard: Section 15.107, Section 15.109 (Class A Equipment)

***NOTE 1 : 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 instruction 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.***

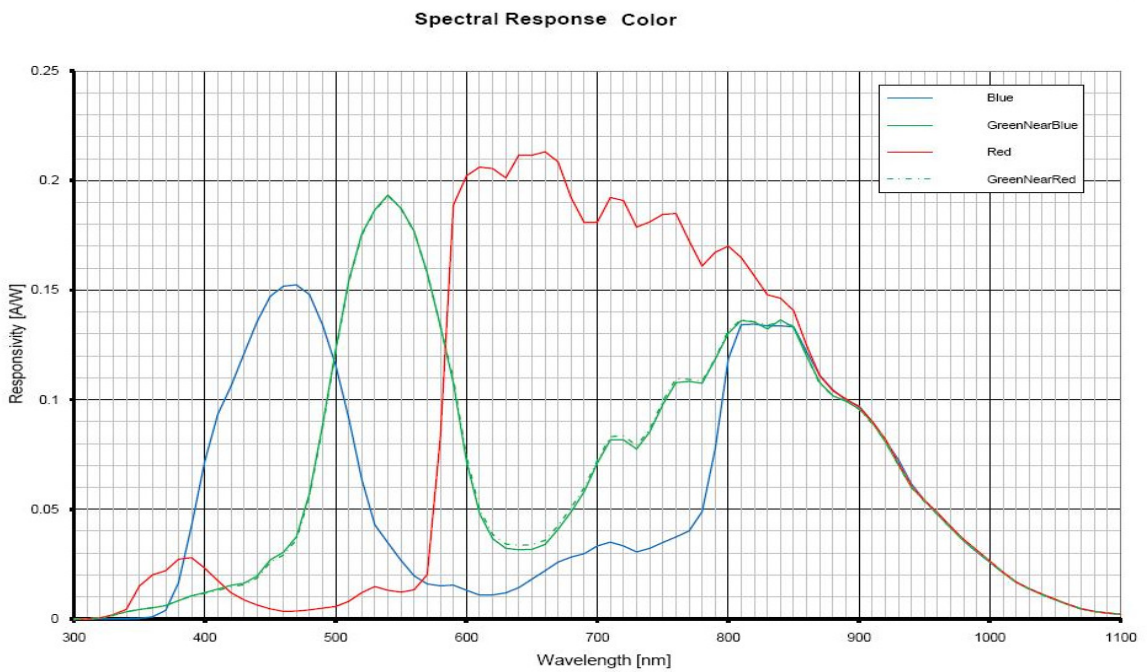
### 3.7 Sensor Information

#### 3.7.1 Spectral response Mono



<Fig 3-1 : Spectral response>

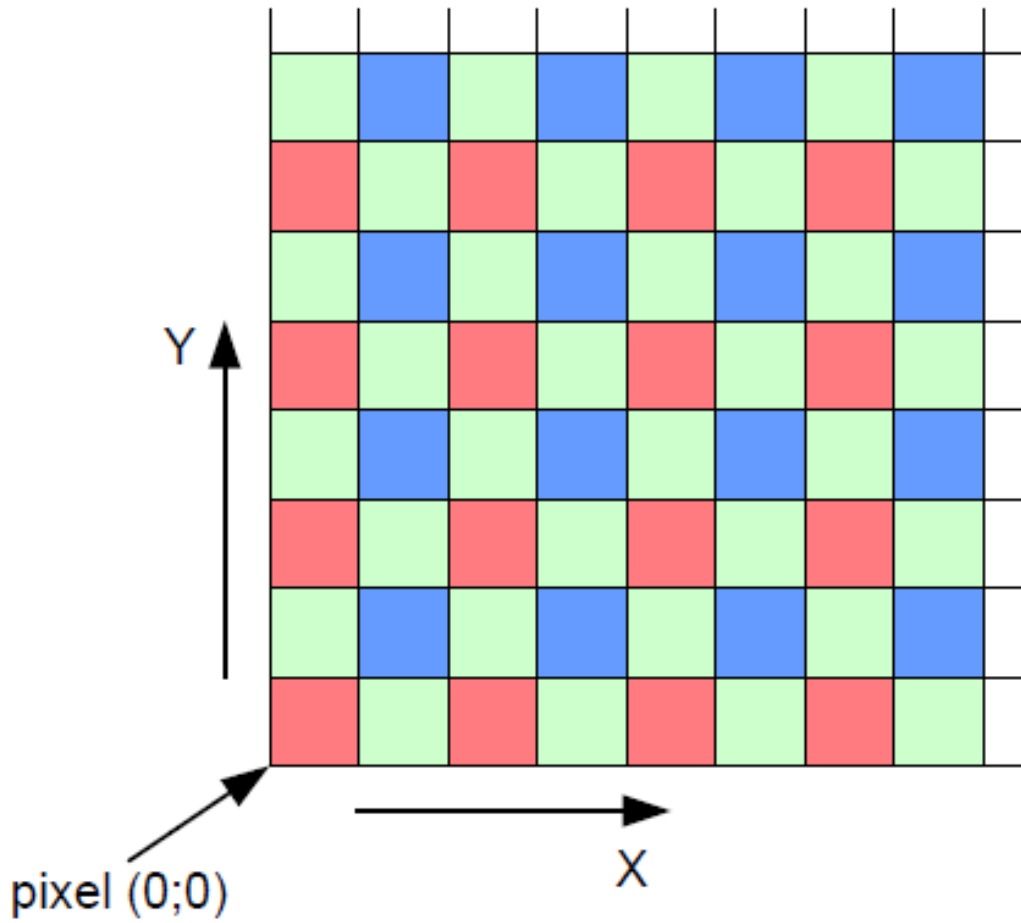
#### 3.7.2 Spectral response Color



<Fig 3-2 : Color Filters>



3.7.3 Color Filter Array

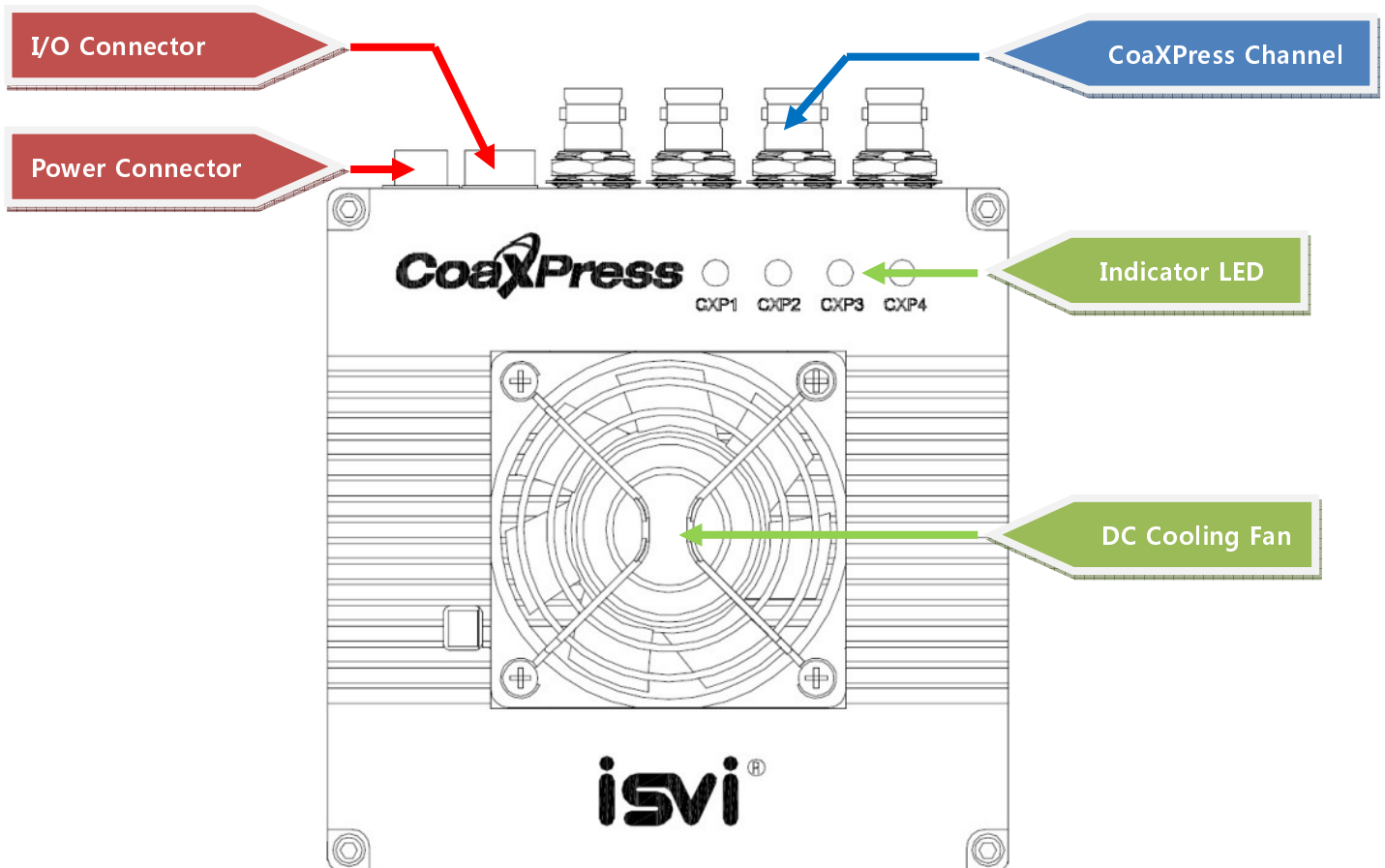


<Fig 3-3 : Color Filter Array>

## 4. Camera Interface

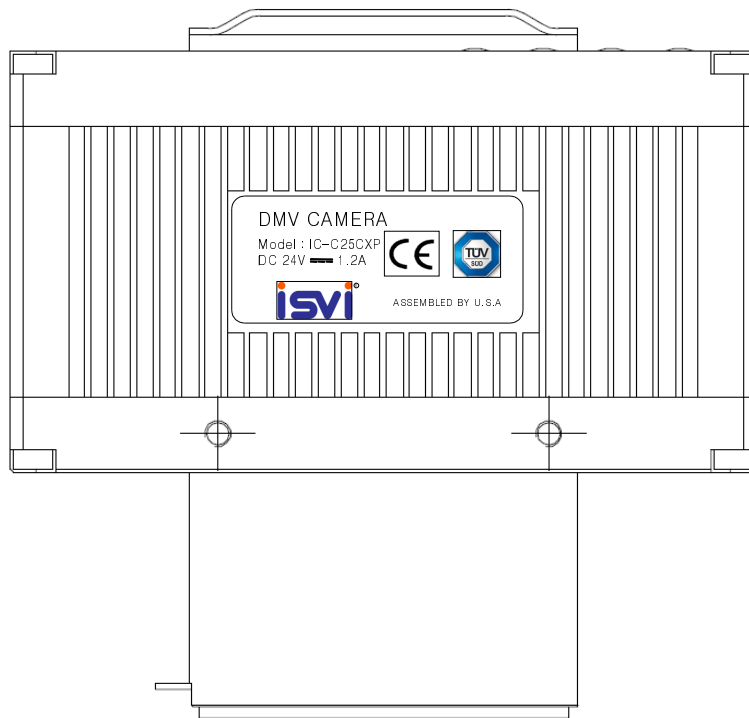
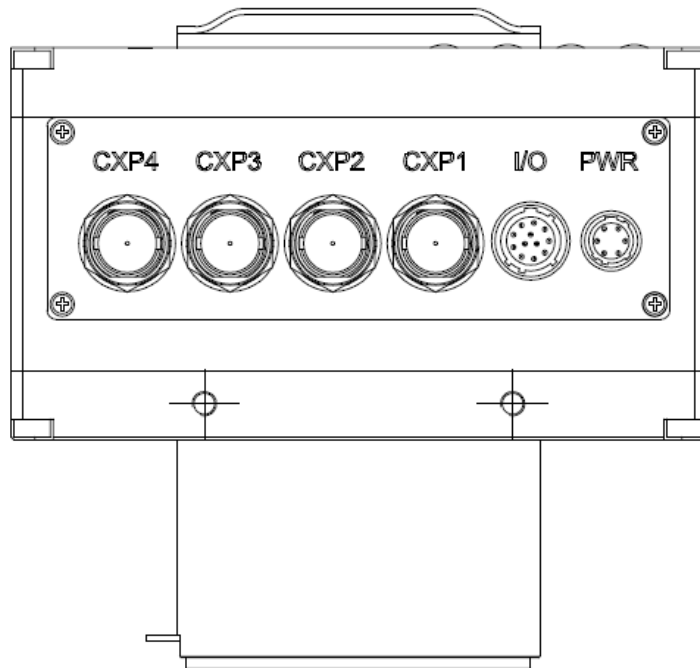
### 4.1 General Description

As shown in the following **Fig.4-1**, 3 types of connectors and status indicator LED, Cooling Fan are located on the top of the camera and have the functions as follows



<Fig 4-1 : IC-X25CXP Series Top Side Appearance>

- 6 pin Power Input
  - Camera Power Input(DC-24V/1.2A)
- 12 pin I/O Connector
  - External Trigger Signal Input(1ch) and Strobe Output(1ch)
  - Firmware update
- CoaXPress Channel(4ch)
  - Video Data Transmission, Camera Control
- 2pin Cooling Fan (DC12V/200mA)
  - Camera cooling fan.
- Indicator Lamp(LED)
  - Power and Operation state Display

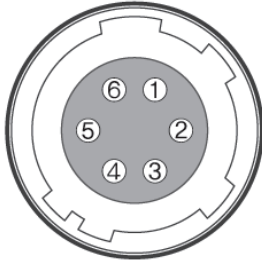


<Fig 4-2 : IC-X25CXP Series Connector Side Appearance>

## 4.2 Power Input Connector

Power input connector of camera is Hirose 6 pin connector(part # HR10A-7R-6S).

Pin arrangement and configuration are as follows:



Pin No	I/O	Signal Name
1	VCC	+24V
2	VCC	+24V
3	VCC	+24V
4	GND	GROUND
5	GND	GROUND
6	GND	GROUND

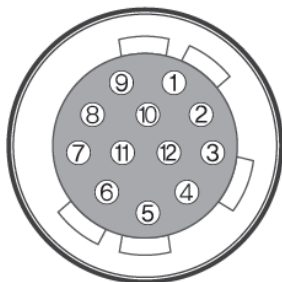
<Fig 4-3 : Power Input Connector>

<Table 4-1 : Power Input Connector Pin map>

Power plug can be configured using the Hirose 6 pin plug (part # HR10A-7R-6P) or compatible parts enclosed in the camera box. For power supply, it is recommended to use the power adapter with over 1.2A current output at 24VDC  $\pm$ 10% voltage output.

## 4.3 I/O control connector

The control connector used is Hirose 12 pin connector(part # HR10A-10R-12S) and Consists of external trigger signal input and strobe output port, Camera firmware update port. Pin arrangement and configuration are as follow



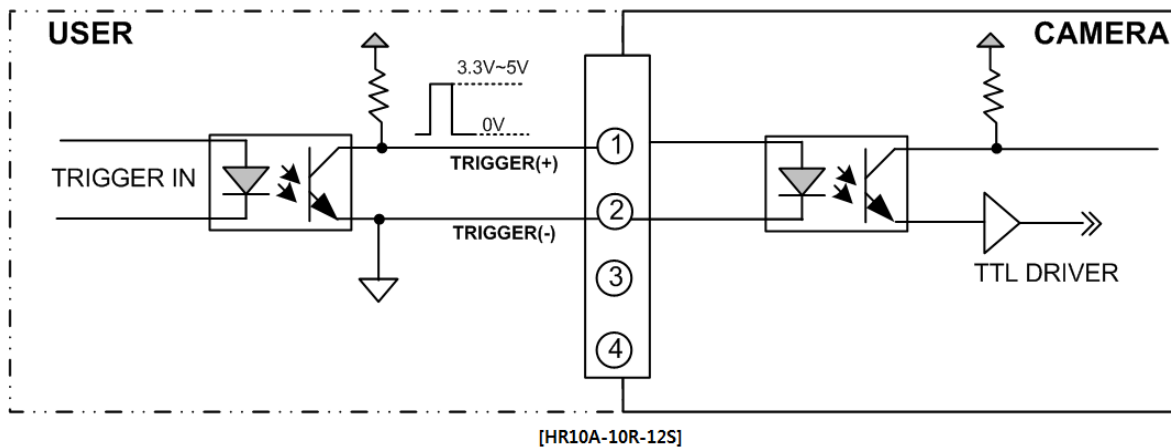
Pin No	I/O	Signal Name	Pin No	I/O	Signal Name
1	INPUT	Trigger +	7	OUTPUT	Reserved
2	INPUT	GROUND	8	INPUT	Reserved
3	OUTPUT	Strobe Output	9	INPUT	Reserved
4	INPUT	Reserved	10	OUTPUT	Reserved
5	GND	GROUND	11	INPUT	Reserved
6	INPUT	Reserved	12	INPUT	Reserved

<Fig 4-4 : I/O Control Connector>

<Table 4-2 : I/O Control Connector Pin Map>

### 4.3.1 Trigger Input Circuit

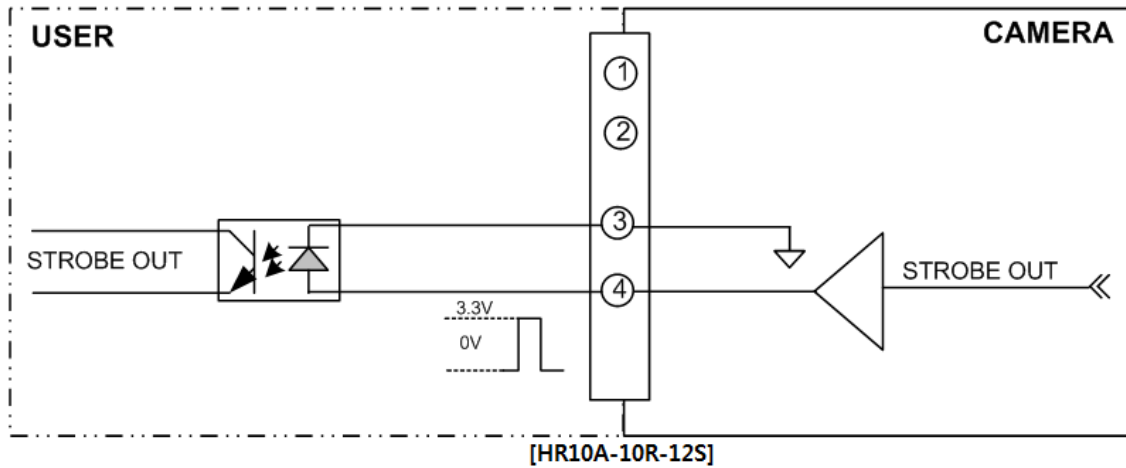
Following **Fig 4-5** shows trigger signal input circuit of 12 pin connector. Trigger signal entered is delivered to internal circuit through photo coupler. Minimum trigger width that can be recognized at camera is 5us. If trigger signal entered is less than 5us, trigger signal is ignored in camera. External trigger signal can approve signals to the circuits in the 2 methods shown below.



<Fig 4-5 : Trigger Input Schematic>

### 4.3.2 Strobe Output Circuit

Strobe output signal is output through TTL Driver IC of 3.3 V output level and pulse width of signal is output in synchronization with exposure of camera.



<Fig 4-6 : Strobe Output Schematic>

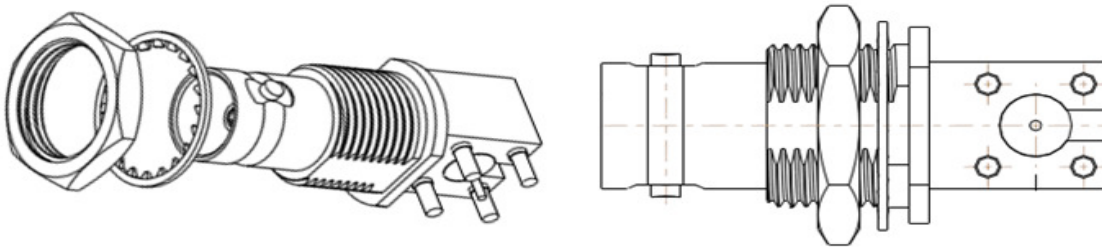
### 4.3.3 Firmware Update

Camera firmware update is available through the ISVI firmware cable.

(For more details, see [오류! 참조 원본을 찾을 수 없습니다.](#))

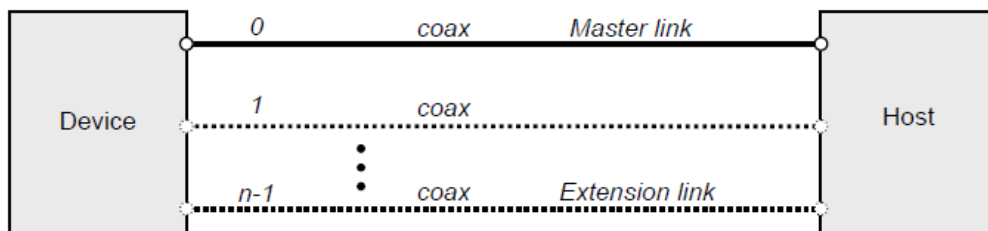
#### 4.4 CoaXPress Channel

- BNC Connector  
 Impedance :  $75\Omega$   
 Gender : Socket  
 Body Plating : Nickel  
 Contact Plating : Gold  
 Frequency Range : DC-3GHz  
 Dielectric withstanding Voltage : 1500VRMS, min



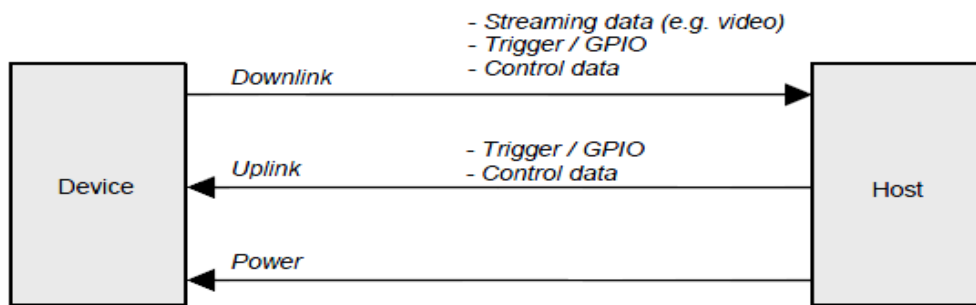
<Fig 4-7 : CoaXPress BNC Connector>

- The link protocol defines the transfer of triggers, general purpose I/O, control data and high speed streaming data over a link.



<Fig 4-8 CoaXPress physical topology>

- Each link provides the following signaling connections:
  - A high speed serial link at up to 6.25 Gbps.
  - A low speed serial link at 20.83 Mbps
  - A power connection (Host to Device), up to 13W.

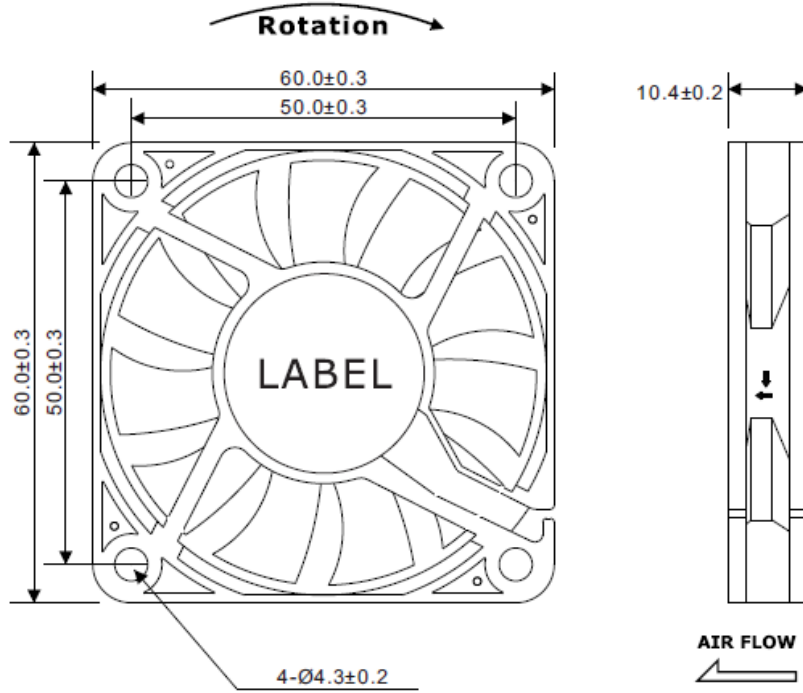


<Fig 4-9 Link signaling connections and data flow>

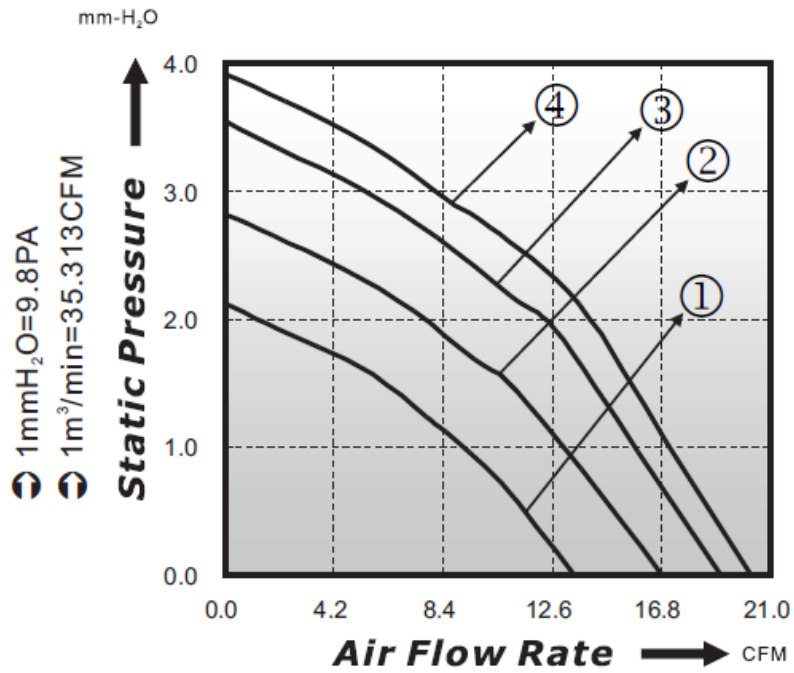
For more details, see [5. Introduction to CoaXPress](#)



4.5 DC Cooling Fan



<Fig 4-10 Cooling Fan Dimension>



<Fig 4-11 Cooling Fan P-Q Curve>

**4.6 State Indication LED**

State	Indication
No power	Off
System booting	Solid orange
Powered, but nothing connected(not applicable to a Device reliant on PoCXP power)	Slow pulse red
Link detection in progress, PoCXP active	Fast flash green Shown for a minimum of 1s even if the link detection is faster
Link detection in progress, PoCXP not in use	Fast flash orange Shown for a minimum of 1s even if the link detection is faster
Device / Host incompatible, PoCXP active	Slow flash alternate red / green
Device / Host incompatible, PoCXP not in use	Slow flash alternate red / orange
Device / Host connected, but no data being transferred	Slow pulse green
Device / Host connected, waiting for event (e.g. trigger, exposure pulse)	Slow pulse orange
Device / Host connected, data being transferred	Solid green whenever data transferred (i.e. blinks synchronously with data)

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

< Table 4-3 : CoaXPress LED Indicate >

## 5. Introduction to CoaXPress

CoaXPress is an interface to connect to Hosts.

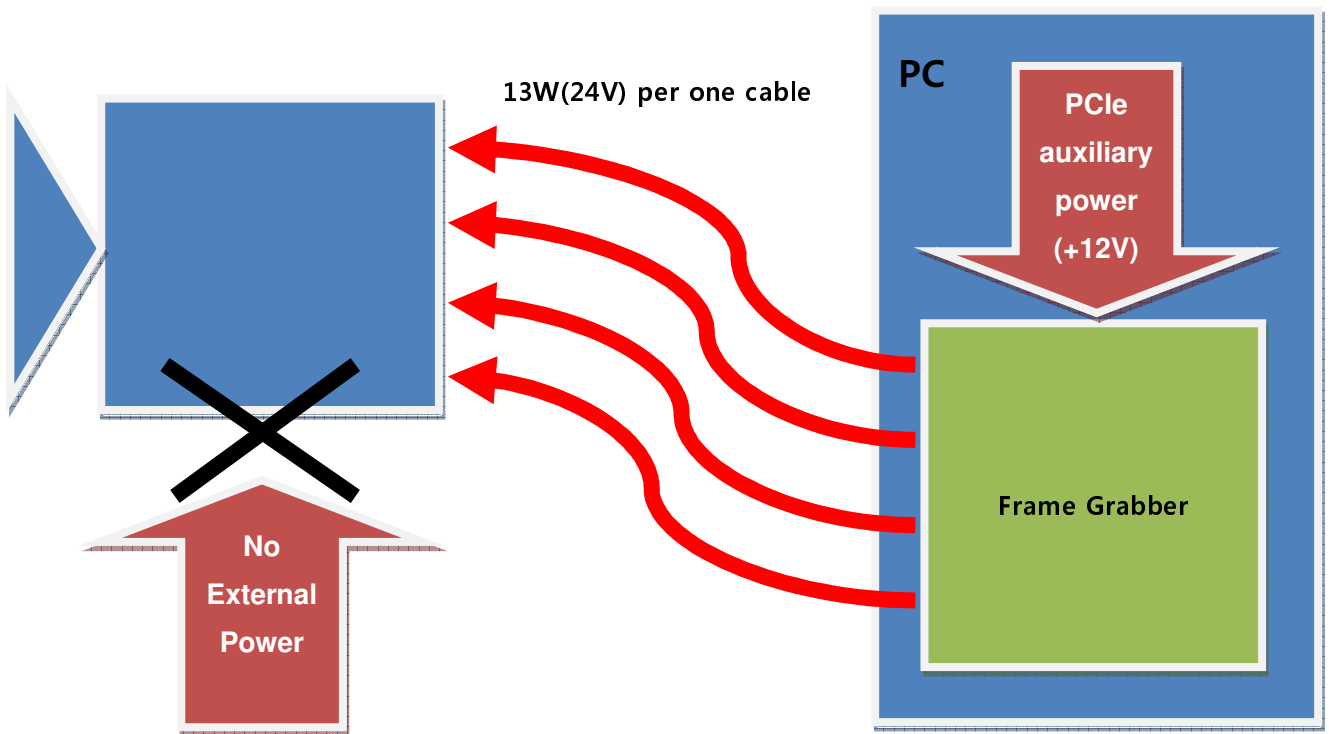
It combines the simplicity of coaxial cable with state of the art high speed serial data technology, allowing up to 6.25Gbps data rate per cable, plus device control and power in the same cable. For more details, visit next below web site.

JIIA(Japan Industrial Imaging Association) : <http://jiaa.org/>

CoaXPress : <http://www.coaxpress.com/coaxpress.php>

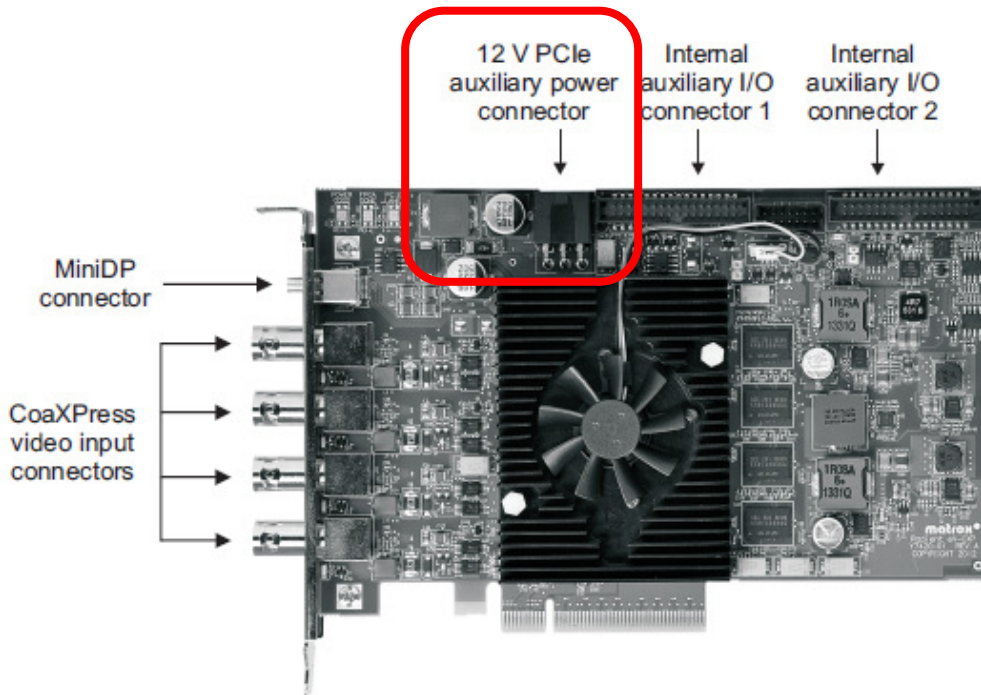
### 5.1 Power over CoaXPress

The available power per cable is 13W at the Camera, at a nominal 24V.



<Fig 5-1 : PoCXP Block Diagram>

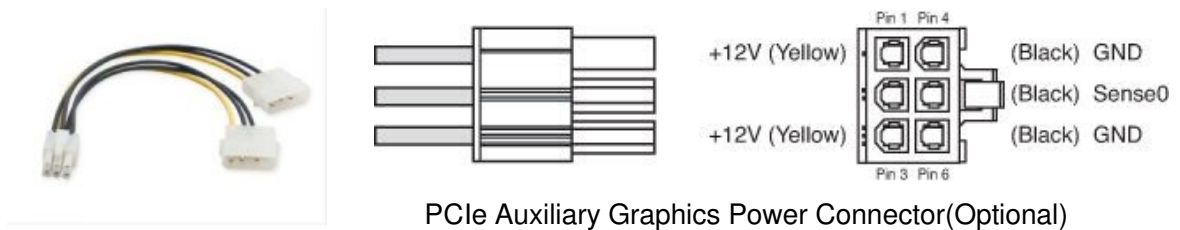
If you will use PoCXP, first check whether support to your frame grabber.  
Next is example with matrox Radient eV-CXP.



<Fig 5-2 : Radient eV-CXP PCIe Auxiliary Power Connector>

Connect the PCIe power cable from your computer's 12V power supply to the PCIe auxiliary power connector on Matrox Radient eV-CXP.

***This power is only need if you are using PoCXP-compliant video sources.***



<Fig 5-3 : PCIe Auxiliary Power Connector Pin Map>

## 5.2 Plug-and-Play

CoaXPress is designed to be plug-and-play.

CoaXPress contains mechanisms for automatic link setup (bit rate, link configuration scheme) and Camera and Grabber setup (image format, bit depth, data packing format, etc).The link is designed to automatically recover after a loss of connection.

**Note 2 : These mechanisms make CoaXPress hot-pluggable, and the protocol supports it. However this does not imply that an application will recover if a camera is unplugged and then reconnected. Also there is the potential for damage if a long cable with stored charge is connected**

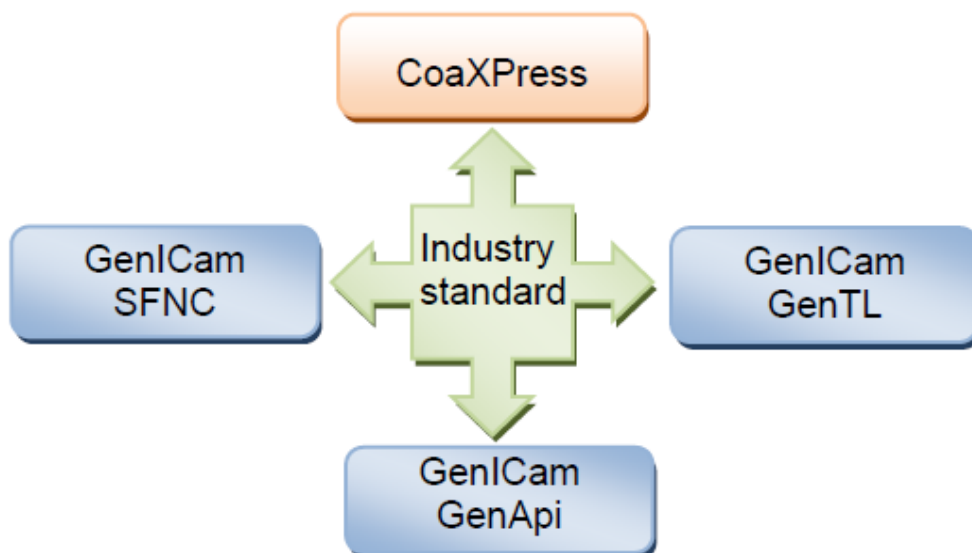
## 5.3 GenICam and XML Files

This camera support the GenApi and the SFNC(Standard Feature Naming Convention) module of the GenICam standard v2.0 or higher.

XML file provided with the camera description compatible with the GenApi module of GenICam. The bootstrap registers in the camera provide a means to access the XML file.

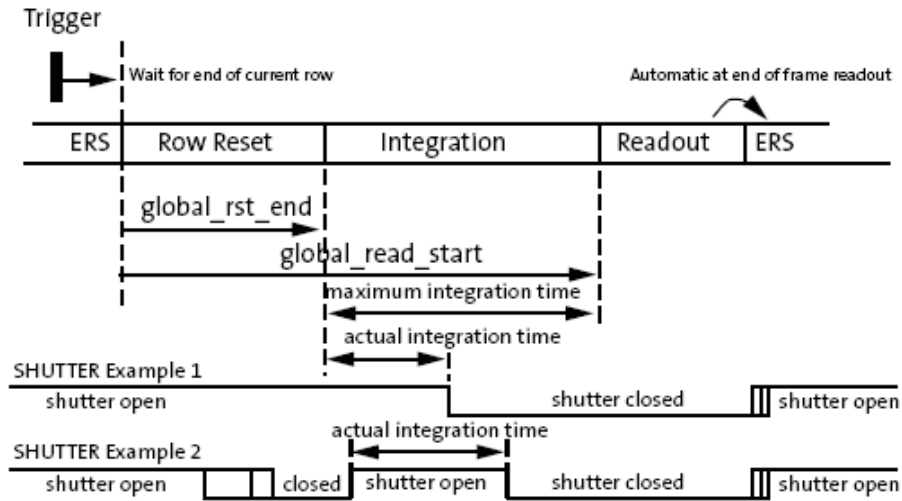
The feature of the camera follow GenICam's SFNC. For more detail, visit next website.

**GenICam standard :** <http://www.emva.org/cms/index.php?idcat=27>



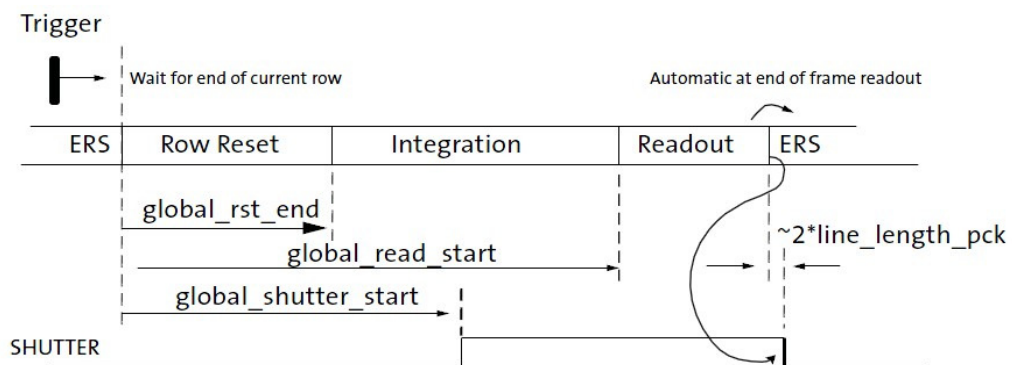
<Fig 5-4 : Industrial standard GenICam>

## 6. Functions and Operations



<Fig. 6-1 : Control of the Electromechanical Shutter>

It is essential that the shutter remains closed during the entire row readout phase (that is, until FV has de-asserted for the frame readout); otherwise, some rows of data will be corrupted (over-integrated). It is essential that the shutter closes before the end of the integration phase. If the row readout phase is allowed to start before the shutter closes, each row in turn will be integrated for one row-time longer than the previous row. After FV de-asserts to signal the completion of the readout phase, there is a time delay of approximately  $10 * line\_length\_pck$  before the sensor starts to integrate light-sensitive rows for the next ERS frame. It is essential that the shutter be opened at some point in this time window; otherwise, the first ERS frame will not be uniformly integrated.



<Fig. 6-2 : Controlling the SHUTTER Output>

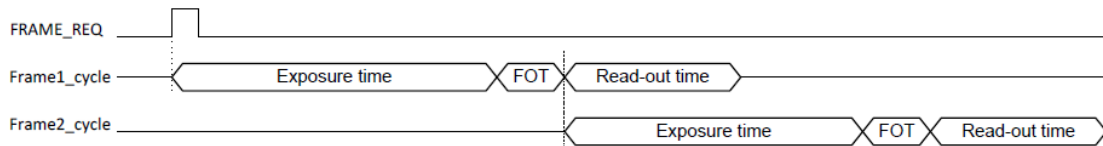
## 6.1 Trigger operation

Trigger mode of camera is divided into Free-Run mode where image is synchronized to Internal Trigger signal created inside camera, and External Sync mode where image is synchronized to the trigger signal entered in external port.

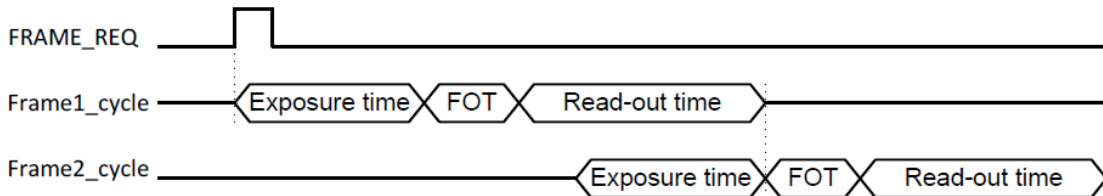
**Note 3 : exposure time must use greater than or equal to frame transfer time**

### 6.1.1 Free Run Mode

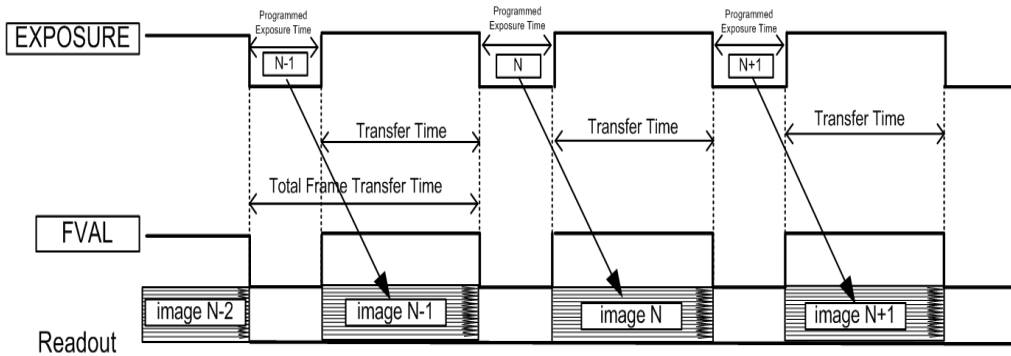
In FreeRun mode, the cycle of internal trigger signal is determined by Transfer Time (1 Frame data transmission time) and Exposure setting value, and image is obtained with such periodic signal. Cycle of internal signal, that is, Frame Rate, is determined with the following 2 conditions



<Fig. 6-3 : Internal Exposure Time Mode>



<Fig. 6-4 : Internal Exposure Time Mode with Exposure Time < Read out Time>>

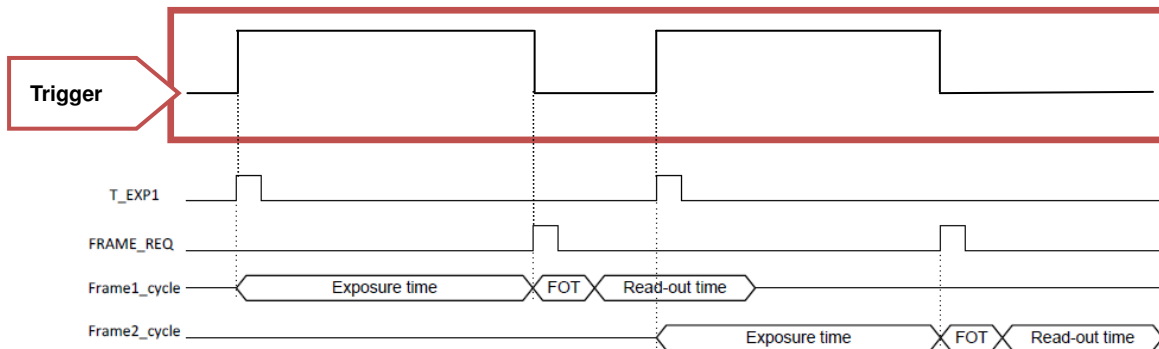


$$\text{Total Frame Transfer Time} = \text{Exposure Time} + \text{Transfer Time}$$

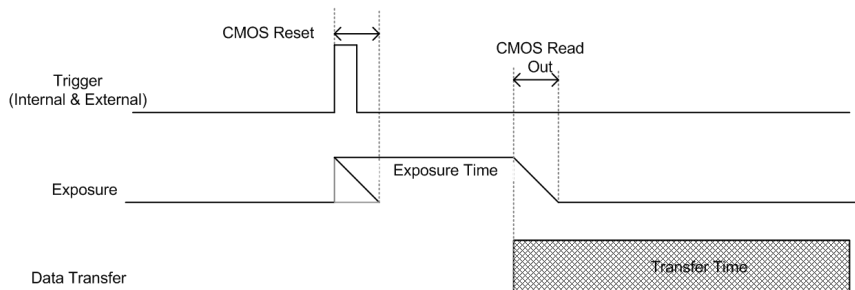
<Fig. 6-5 : Free Run Mode Readout Time>

### 6.1.2 External Sync Mode

In External Sync Mode, camera keeps standby status until trigger signal is entered and performs image transmission (Frame Transfer) after exposure process if trigger input occurs as shown in below figure to operate camera in External Sync mode, it is required to set Trigger Source regarding which input, CoaXPress port or External Trigger port, will be used for trigger signal, as well as Polarity and Exposure Time of signal entered.



**<Fig. 6-6 : External Exposure Time Mode>**



**<Fig. 6-7 : External Sync Mode>**

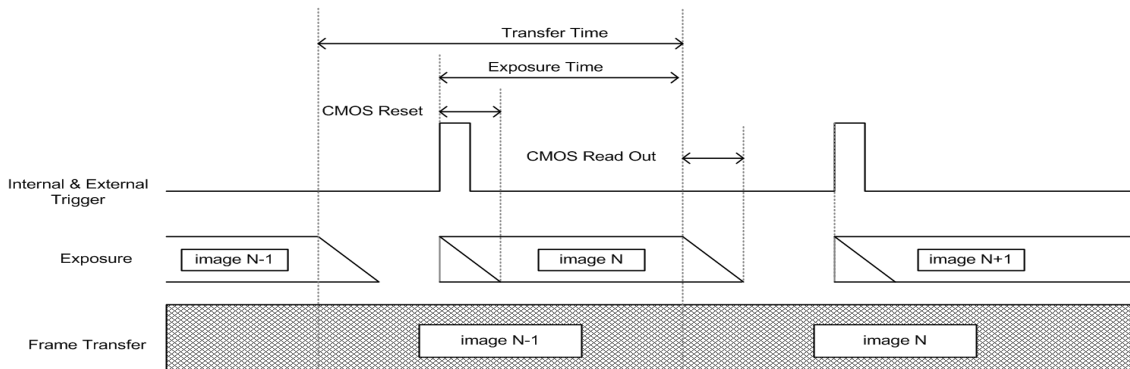
- **Trigger Source**  
: Select either of Internal CoaXPress or External I/O Connector as source of external trigger input signals.
- **Trigger Polarity**  
: Set whether polarity of Trigger signal entered is Active High or Active Low.
- **Exposure Source**  
: select to synchronize exposure time with pulse width of trigger input signal or with exposure time programmed inside the camera.



### 6.1.3 Overlap trigger input

When trigger input occurs in the course of Frame Transfer and **Fig. 6-8**, it simultaneously performs exposure of next image for new trigger input. In this case, image shooting is possible up to the speed of  $1/\text{Transfer Time}(\text{sec})$ , the maximum Frame Rate conditions regardless of exposure time.

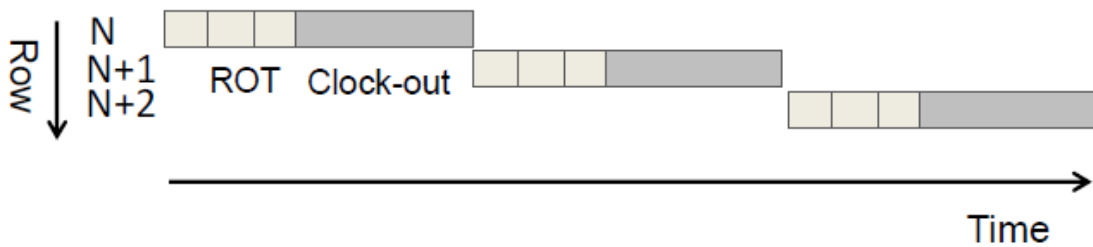
- When the trigger signal with cycle faster than maximum Frame Rate conditions, next Frame Transfer is performed while one Frame Transfer is not completed, failing to obtain overall image.
- When new trigger input occurs in Exposure section while Exposure Source is set in Program, the signal is ignored. It is the case that exposure setting value is set longer than trigger input cycle, and since it is not synchronized for all trigger signal entered in camera, Frame Rate gets slower than Trigger input cycle.



<Fig. 6-8 : Overlap Trigger>

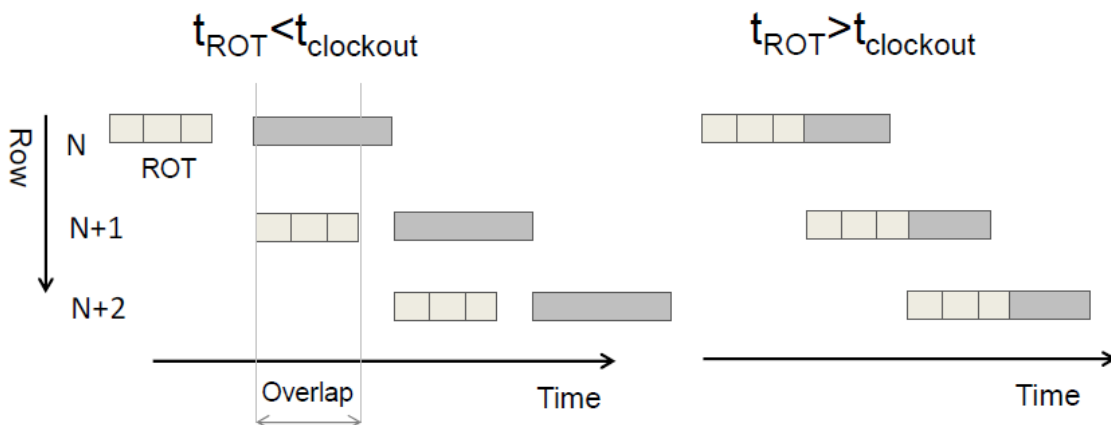
### 6.2 Reduced/Zero ROT

In pipelined global shutter mode, the integration and readout are done in parallel. Images are continuously read out and integration of frame N is ongoing during readout of the previous frame N-1. The readout of every frame starts with a Frame Overhead Time (FOT), during which the analog value of the pixel diode is transferred to the pixel memory element. After the FOT, the sensor is read out line by line and the readout of each line is preceded by a Row Overhead Time (ROT) as shown in **<Fig. 6-9>**.



<Fig. 6-9 : Normal ROT function>

In Reduced/Zero ROT operation mode (refer to **<Fig. 6-10>**), the row blanking and kernel readout are performed (partially) in parallel. This mode is called reduced ROT as a part of the ROT is done while the image row is readout. The actual ROT can thus be longer, however the perceived ROT will be shorter ('overhead' spent per line is reduced).



<Fig. 6-10 : Reduced/Zero ROT function>

Operation Mode	8-bit	10-bit
Normal ROT	248 MHz	310 MHz
Zero ROT	184 MHz	230 MHz

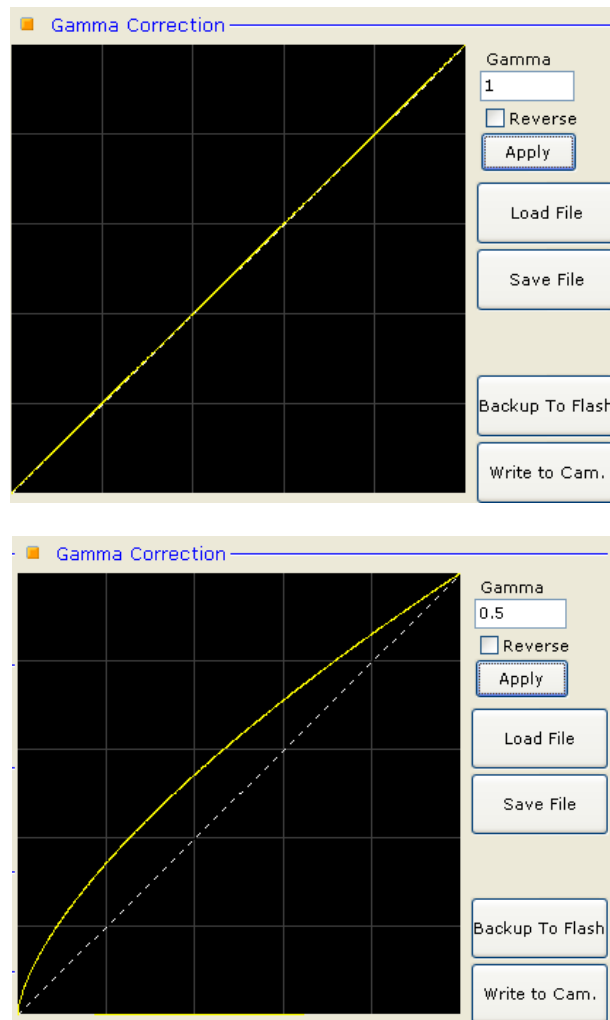
Operation Mode	8-bit	10-bit
Normal ROT	53	53
Zero ROT	72	72

<Table. 6-1 : Normal ROT vs. Reduced/Zero ROT function>

### 6.3 Gamma Correction

LUT (Lookup Table) enables the conversion of the original image value into an ad-hoc level value. Since one-on-one mapping is performed for each level value, you can connect the ad-hoc 8/10-bit input to the ad-hoc 8/10-bit output.

LUT has a programmable look-up table (LUT) that lets the user adjust the transfer function of the video output. Selectable settings include multiple-point LUT and Gamma 0.5. The look up table has 1024 setting points by which the full range of input signal is divided. On each of the point, the gain can be set to get a required transfer function. Gamma 0.45 or programmable LUT can be selected by software control. If the LUT is not configured, Gamma is set at 1.0(off)



<Fig. 6-9 : Gamma Correction>

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## 6.4 Defective Correction Circuits

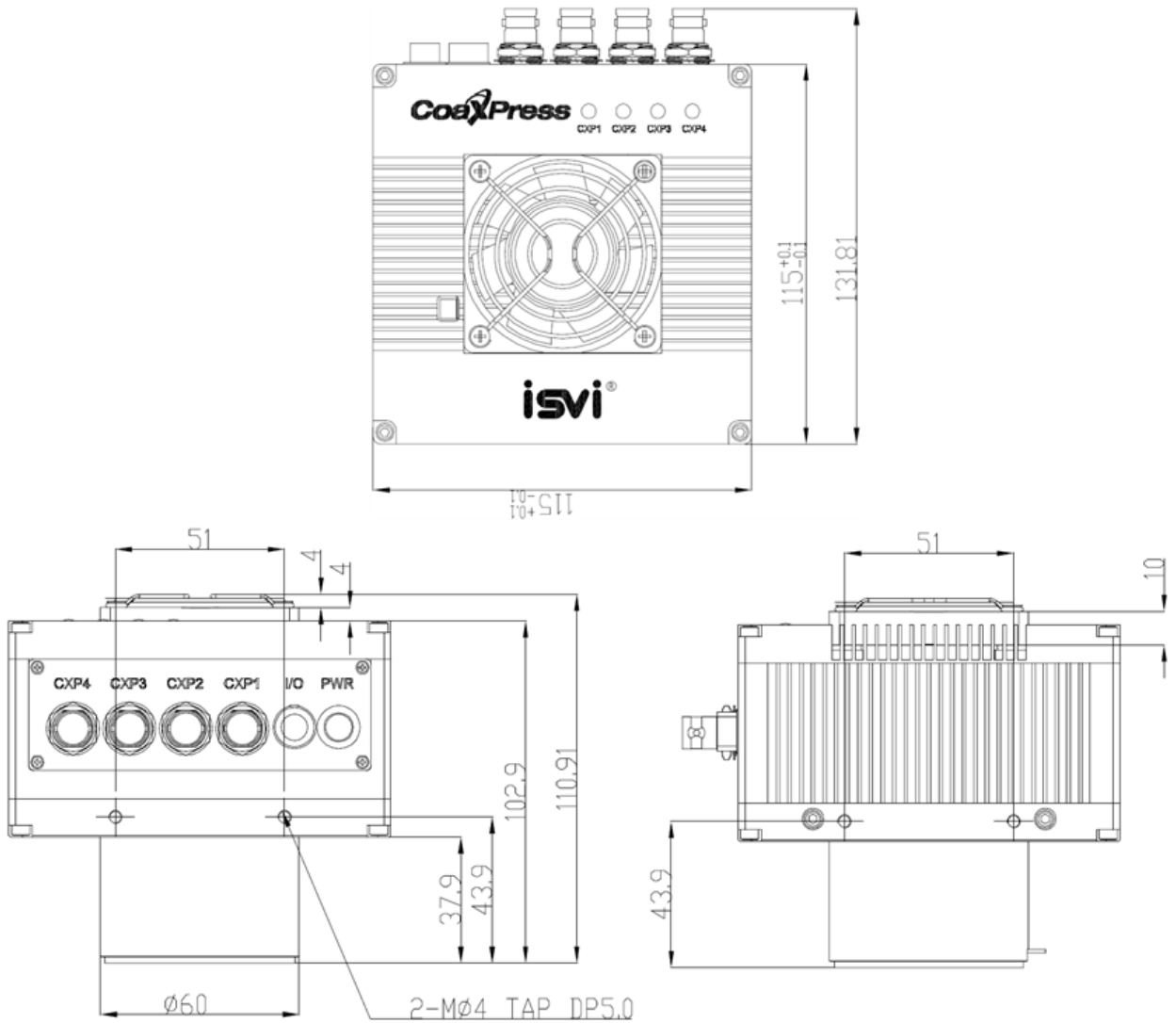
There could be incidence of light-malfunctioning defective pixel in the CMOS. In this case, additional correction is required to enhance the degraded quality of output images. For each camera, defective pixel information of CMOS is encoded during the shipping process. If a user demands an addition of defective pixel information, a new coordinate of defective pixel must be entered into the camera.

## 6.5 Test Pattern Image

It can be set to output test image created inside instead of image data output from image sensor, in order to check normal operation of camera. 3 types of test image are available (For more details, see [오류! 참조 원본을 찾을 수 없습니다.](#))

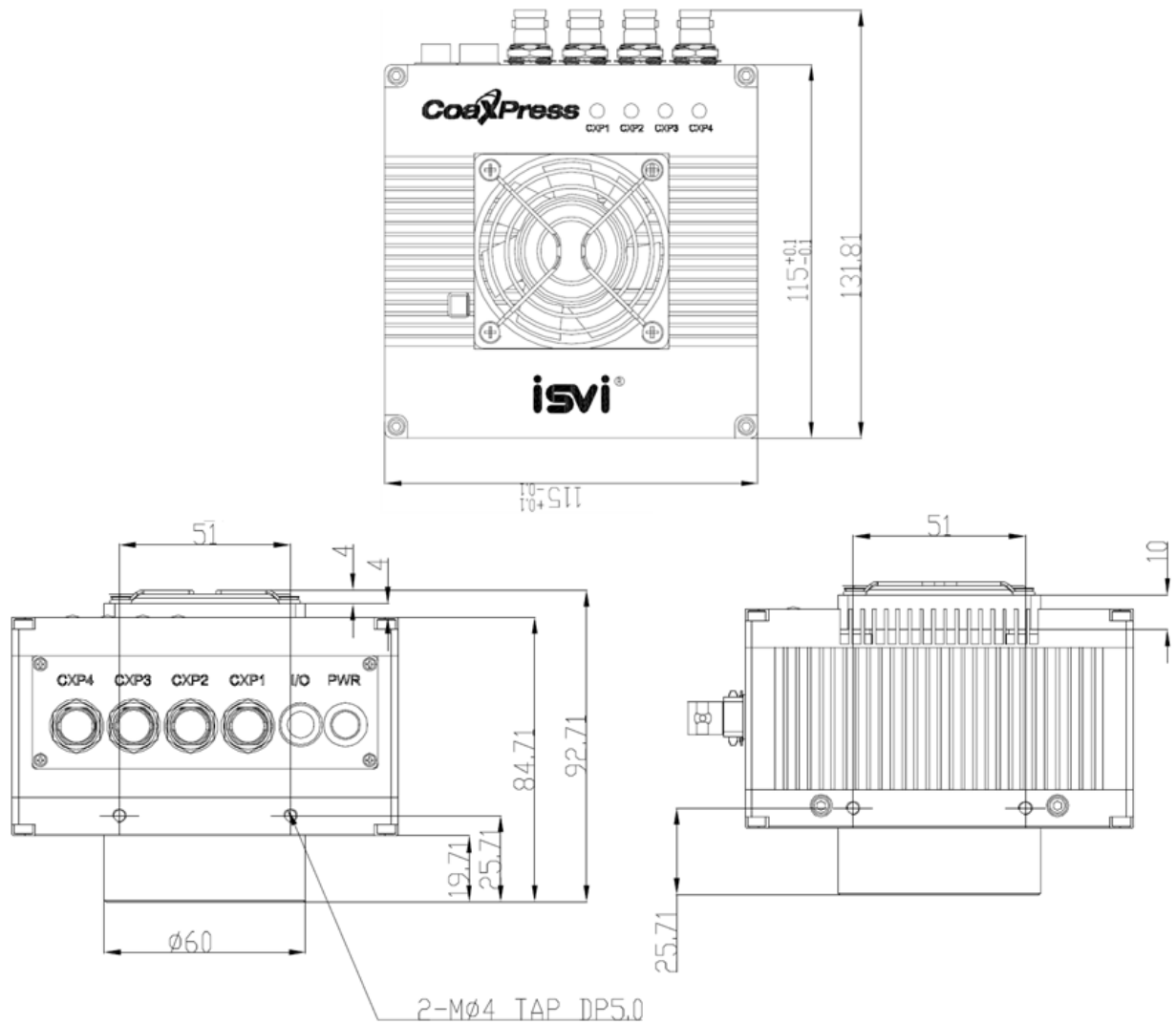
## 7. External Appearance and Dimensions

### 7.1 F-Mount IC-X25CXP



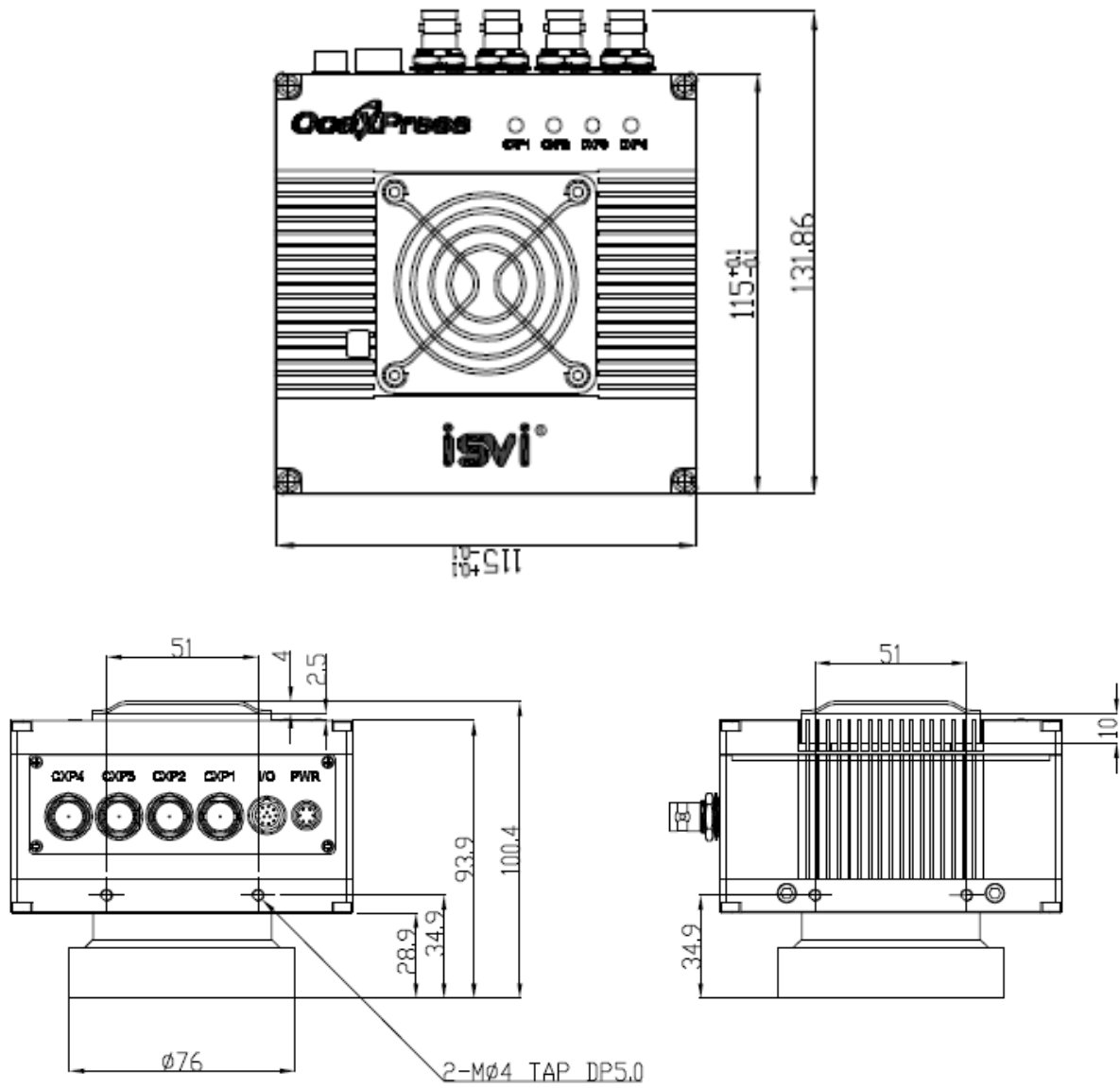
<Fig. 7-1 : F-Mount Dimension>

7.2 M42-Mount IC-X25CXP



<Fig. 7-2 : M42 Mount Dimension>

7.3 M72-Mount IC-X25XP



<Fig. 7-3 : M72 Mount Dimension>



## 8. Communication specification

### 8.1 Bootstrap registers

Address	Name	Access	Length	Default Value	Description
0x2000	DeviceVendorName	RO	32	"ISVI"	
0x2020	DeviceModelName	RO	32	"IC-X25CXP"	
0x4000	LinkReset	RW	4	0	0 : - 1 : Link_Reset
0x4014	LinkConfig	RW	4	0x40038	0x10038 : CXP 1ch, Link Speed 3.125Gbps 0x10040 : CXP 1ch, Link Speed 5Gbps 0x10048 : CXP 1ch, Link Speed 6.25Gbps 0x20038 : CXP 2ch, Link Speed 3.125Gbps 0x20040 : CXP 2ch, Link Speed 5Gbps 0x20048 : CXP 2ch, Link Speed 6.25Gbps 0x40038 : CXP 4ch, Link Speed 3.125Gbps 0x40040 : CXP 4ch, Link Speed 5Gbps 0x40048 : CXP 4ch, Link Speed 6.25Gbps
0x6000	OffsetX	RW	4	0	Set ROI X Offset 0~5119 (128 unit)
0x6004	OffsetY	RW	4	0	Set ROI Y Offset 0~5119 (1 unit)
0x6008	WidthMax	RO	4[15:0]	5120	
	Width	RW	4[31:16]	5120	Set ROI Width : 64~5120(64 unit)
0x600C	HeightMax	RO	4[15:0]	5120	
	Height	RW	4[31:16]	5120	Set ROI Height : 4~5120(1 unit)
0x6010	PixelFormat	RW	4	0x0101	0x0101 : Mono 8 Bit 0x0102 : Mono 10 Bit 0x0321 : BayerRG 8 Bit 0x0322 : BayerRG 10 Bit
0x7048	ReverseX	RW	4	0	0 : OFF 1 : On
0x7014	Binning	RW	4	0	0 : OFF 1 : On(2X2_Binning - Mono Camera Only)
0x7014	SubSampling	RW	4	0	0 : OFF 2 : On(2X2_Subsampling - Mono Camera Only) 6 : On(2X2_Subsampling - Color Camera Only)

0x6020	AcquisitionMode	RW	4	1	1 : FreeRun Mode 2 : TriggerMaster Mode 3 : TriggerSlave Mode
0x6024	TriggerSource	RW	4	0	0 : Internal 1 : External
0x6028	TriggerEdge	RW	4	0	0 : RisingEdge 1 : FallingEdge
0x602C	TriggerPolarity	RW	4	0	0 : ActiveHigh 1 : ActiveLow
0x6030	StrobePolarity	RW	4	0	0 : ActiveLow 1 : ActiveHigh
0x6034	AcquisitionTime	RW	4	20000	1us ~10,000,000us (Unit : 1 us)
0x603C	ExposureTime	RW	4	10000	1us ~10,000,000us (Unit : 1 us)
0x6044	StrobeOutControl	RW	4	0	0 : Enable 1 : Disable
0x6048	StrobeTime	RW	4	10000	1us ~10,000,000us (1 us)
0x6050	AcquisitionStart / Stop	RW	4[31]	0	0 : AcquisitionStart 1 : AcquisitionStop
0x8010	TemperatureRead	RW	4[31]	0	0 : - 1 : Temperature Read
0x8014	TemperatureValueCelsius	RO	4	-	Read the Celsius temperature. Formula : Read Temp * 1.06685 = Camera Temp
0x8018	SensorOperation	RW	4	0	0 : Running 1 : Stop
0x7000	UD_TestPattern	RW	4	0	0 : OFF 4 : GreyVerticalRamp Test Pattern On 5 : GreyHorizontalRamp Test Pattern On 6 : ColorBar - Color Camera Only Test Pattern On
0x7030	WB_Enable	RW	4	0	0 : White Balance Disable 1 : White Balance Enable
0x7034	WB_GreenGain	RW	4	0	Set Green Gain - 0~1023 (1 unit)
0x7038	WB_BlueGain	RW	4	0	Set Blue Gain -0~1023 (1 unit)
0x703C	WB_RedGain	RW	4	0	Set Red Gain -0~1023 (1 unit)

0x7040	WbAuto	RW	4	0	0 : Off 1 : Auto White Balance Enable
0x8000	UserSetSelector	RW	4	0	0 : Select Current Page 1 : Select Factory Page 2 : Select UserSet1 Page
0x8004	UserSetLoad UserSetSave	RW	4	-	1 : UserSet Load 2 : UserSet Save
0x8008	UD_SensorGain	RW	4	0	Set Sensor Gain : 0~4000 (1 Unit)
0x800C	UD_SensorBlack	RW	4	0	Set BlackOffset : 0~255 (1 Unit)
0x7044	UD_Gamma	RW	4	0	0 : Gamma Disable 1 : Gamma Enable 0.5 3 : Gamma Enable 1.5

<Table. 8-1 : Bootstrap Resister Map>

# CE

EN 55024 : 1998+A1:2001, +A2:2003

EN 55022 : 2006+A1:2007 [Class A Equipment]

# FCC

Section 15.107, Section 15.109 (Class A Equipment)

**NOTICE!** : 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 instruction 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.



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