

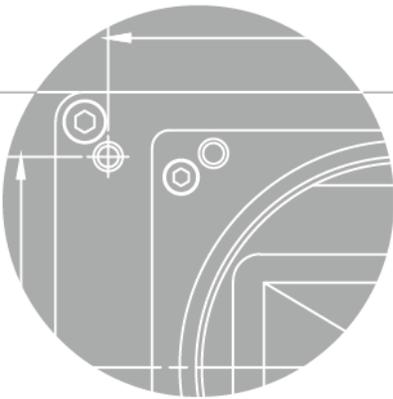
# VNP-190MX

## User Manual

English

VNP-190MX-10

**CoaxPress**<sup>®</sup>



**VIEWWORKS**  
Imaging Expert

**Revision History**

Version	Date	Description
1.0	2018-03-12	Initial Release

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# 1 Precautions

## General



- Do not drop, disassemble, repair or alter the device. Doing so may damage the camera electronics and cause an electric shock.
- Do not let children touch the device without supervision.
- Stop using the device and contact the nearest dealer or manufacturer for technical assistance if liquid such as water, drinks or chemicals gets into the device.
- Do not touch the device with wet hands. Doing so may cause an electric shock.
- Make sure that the temperature of the camera does not exceed the temperature range specified in [5.2 Specifications](#). Otherwise the device may be damaged by extreme temperatures.

## Installation and Maintenance



- Do not install in dusty or dirty areas - or near an air conditioner or heater to reduce the risk of damage to the device.
- Avoid installing and operating in an extreme environment where vibration, heat, humidity, dust, strong magnetic fields, explosive/corrosive mists or gases are present.
- Do not apply excessive vibration and shock to the device. This may damage the device.
- Avoid direct exposure to a high intensity light source. This may damage the image sensor.
- Do not install the device under unstable lighting conditions. Severe lighting change will affect the quality of the image produced by the device.
- Do not use solvents or thinners to clean the surface of the device. This can damage the surface finish.

## Power Supply



- Applying incorrect power can damage the camera. If the voltage applied to the camera is greater or less than the camera's nominal voltage, the camera may be damaged or operate erratically. Please refer to [5.2 Specifications](#) for the camera's nominal voltage.
  - ※ Vieworks Co., Ltd. does NOT provide power supplies with the devices.
- Make sure the power is turned off before connecting the power cord to the camera. Otherwise, damage to the camera may result.

## 2 Warranty

Do not open the housing of the camera. The warranty becomes void if the housing is opened.  
For information about the warranty, please contact your local dealer or factory representative.

## 3 Compliance & Certifications

### 3.1 FCC Compliance

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 expenses.

### 3.2 CE: DoC

EMC Directive 2014/30/EU  
EN 55032:2012 (Class A), EN 55024:2010  
Class A

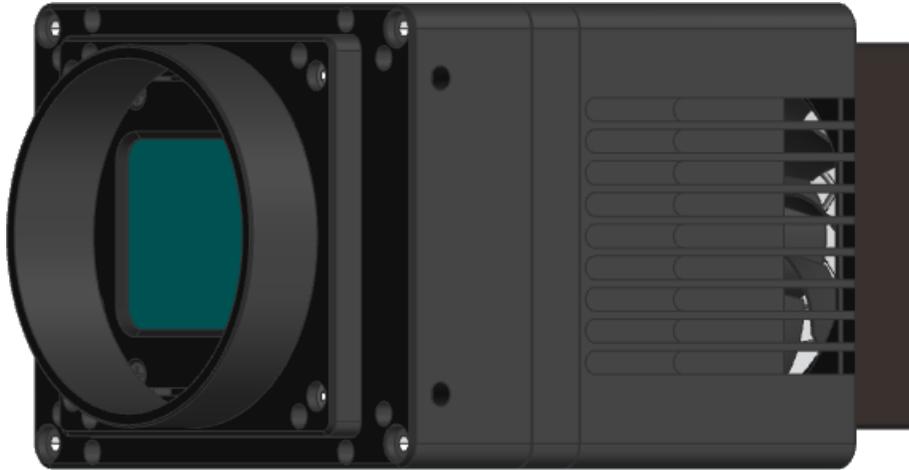
### 3.3 KC

#### KCC Statement

Type	Description
Class A (Broadcasting Communication Device for Office Use)	This device obtained EMC registration for office use (Class A), and may be used in places other than home. Sellers and/or users need to take note of this.

## 4 Package Components

Package Components



VNP-190MX Camera <M72-mount>



Mount Plate (Optional)

## 5 Product Specifications

### 5.1 Overview

The VNP-190MX, a pixel shifting camera equipped with thermo-electric Peltier (TEC) cooled, is designed not only for applications where extremely high resolution is required but also where high quality image is essential. The TEC maintains the operating temperature of the image sensor at up to 14 degrees below ambient temperature to reduce noise significantly. Pixel shifting technology based on a precise piezoelectric stage allows image captures as high as 420 million pixels using the VNP-190MX camera. Its CoaXPress interface supports transmitting image data at up to 12.5 Gbps using two coaxial cables. This camera is ideal for applications such as FPD inspection, document / film scanning, research and scientific imaging.

#### Main Features

- Nano Stage Pixel Shifting Mechanism
- Thermoelectric Peltier Cooled
- Extended Resolutions up to 420 Megapixels
- True Color Full Image Resolution
- Improved Fill Factor
- Area Of Interest (AOI)
- Binning Mode –  $2 \times 2 / 4 \times 4$
- Output Pixel Format – 8 / 10 / 12 bit
- Electronic Shutter – Global Shutter
- Advanced PRNU and DSNU Correction
- Tap Linearity Correction
- Defective Pixel Correction
- Flat Field Correction
- Horizontal Flip
- Temperature Monitor
- Field Upgrade
- GenICam Compatible – XML-based Control
- VNP-190MX Feature Bar



## 5.2 Specifications

Technical specifications for the VNP-190MX camera are as follows:

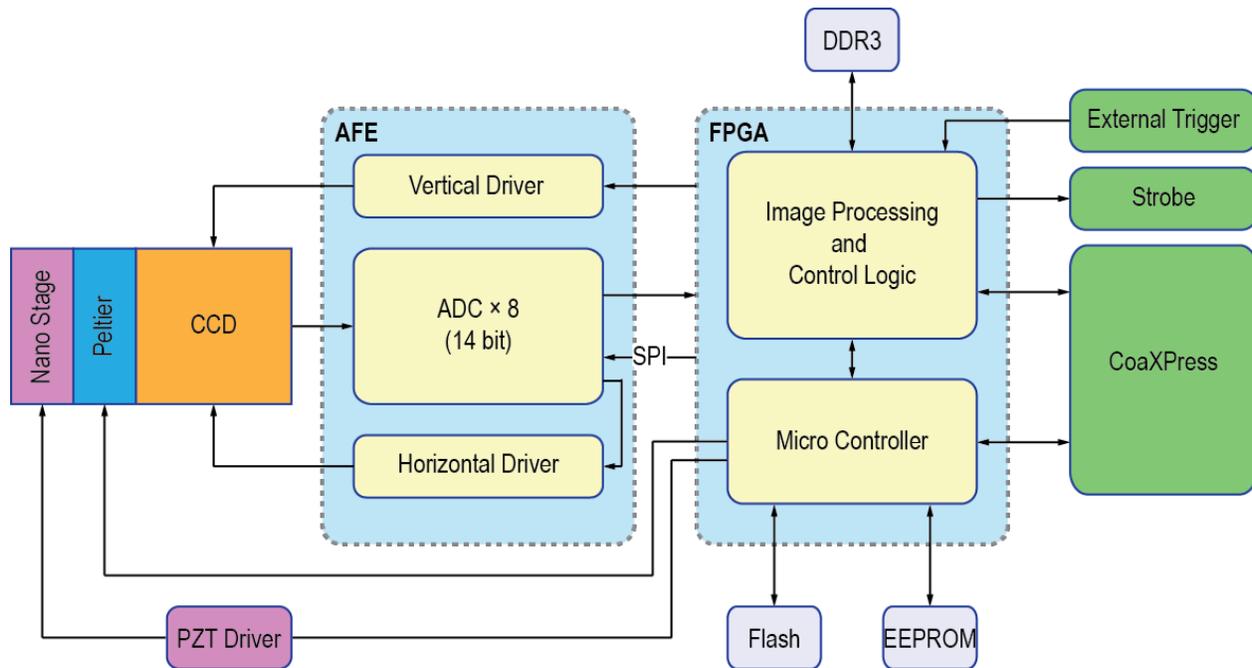
Specifications		VNP-190MX-10
Active Image (H × V)	1 × (1 Shot)	8856 × 5280
	4 × (4 Shot)	17712 × 10560
Sensor		On Semiconductor KAI-47051
Pixel Size		5.5 μm × 5.5 μm
Sensor Output		16 Tap Output
Dynamic Range		66 dB
Interface		CoaXPress 6 (2 CH)
Electronic Shutter		Global Shutter
Exposure Time		28 μs ~ 60 s
Max. Frame Rate at	1 × (1 Shot)	10 fps @ 46.8M (8856 × 5280)
	4 × (4 Shot)	2.5 fps @ 187 M (17712 × 10560)
Resolution		
Pixel Format		8/10/12 bits
Partial Scan (Max. Speed)		24 fps at 1056 Lines
Binning		2 ×, 4 ×
Black Level		Adjustable (0 ~ 127 LSB at 12 bit)
Video Gain		1 × ~ 4 ×
Exposure Mode		Free-Run, Timed, Trigger Width
Trigger Input		<ul style="list-style-type: none"> <li>External Port: 3.3 V ~ 24 V, 10 mA Optically Isolated</li> <li>CoaXPress Control Port</li> </ul>
Shift Range		0 ~ 15 μm, 1 nm step
Shift Resolution		0.001 μm
Shift Control		Manual Mode or Sequence Mode (4/9 Shot Mono, 4/16/36 Shot Color)
Shift Latency		< 5 ms
Features		<ul style="list-style-type: none"> <li>Defect Pixel Correction</li> <li>Non-uniformity Correction – DSNU, PRNU, Tap Linearity</li> <li>Flat Field Correction</li> <li>Defect Pixel Map and Flat Field Data Update</li> </ul>

**Table 5.1 Specifications of VNP-190MX (continuous)**

Specifications	VNP-190MX-10
Cooling Method	Thermoelectric Peltier Cooling
Cooling Performance	14°C below ambient temperature – Standard cooling with a fan
Lens Mount	M72 mount
Power	11 ~ 15V DC, Typ. 36 W / Max. 43 W
PoCXP (Power over CoaXPress)	Not supported
Environmental	Operating: 10°C~ 40°C, Storage: -40°C ~ 70°C
Dimension / Weight	120 mm × 94 mm × 171 mm / 2300 g
API SDK	Vieworks Imaging Solution 7.X

**Table 5.2 Specifications of VNP-190MX**

## 5.3 Camera Block Diagram



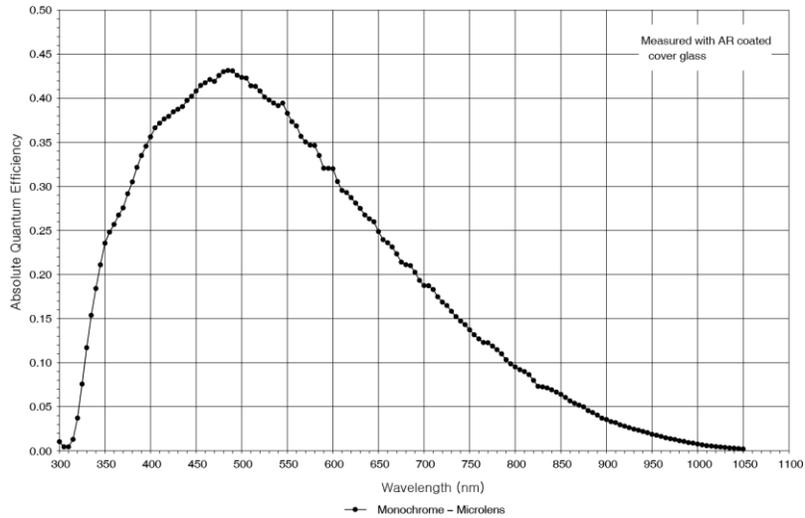
**Figure 5.1 Camera Block Diagram**

All controls and data processing of the VNP-190MX camera are carried out in one FPGA chip. The FPGA generally consists of a 32 bit RISC Micro-Controller and Processing & Control Logic. The Micro-Controller receives commands from the user through the CoaXPress interface and then processes them. The FPGA controls the Timing Generators (TGs) and the Analog Front End (AFE) chips where the TGs generate CCD control signals and AFE chips convert analog CCD output to digital values to be accepted by the Processing & Control Logic. The Processing & Control Logic processes the image data received from AFE and then transmits data through the CoaXPress interface. And also, the Processing & Control Logic controls the trigger inputs and strobe outputs which are sensitive to time. Furthermore, SDRAM and FLASH is installed outside FPGA. SDRAM is used for the frame buffer to process images and FLASH contains the firmware that operates the Micro-Controller. A PZT Driver is applied to control XY Stage with nanometers unit and a Peltier Driver is applied to control Thermoelectric Peltier Cooling unit.

## 5.4 Spectral Response

### 5.4.1 Mono Camera Spectral Response

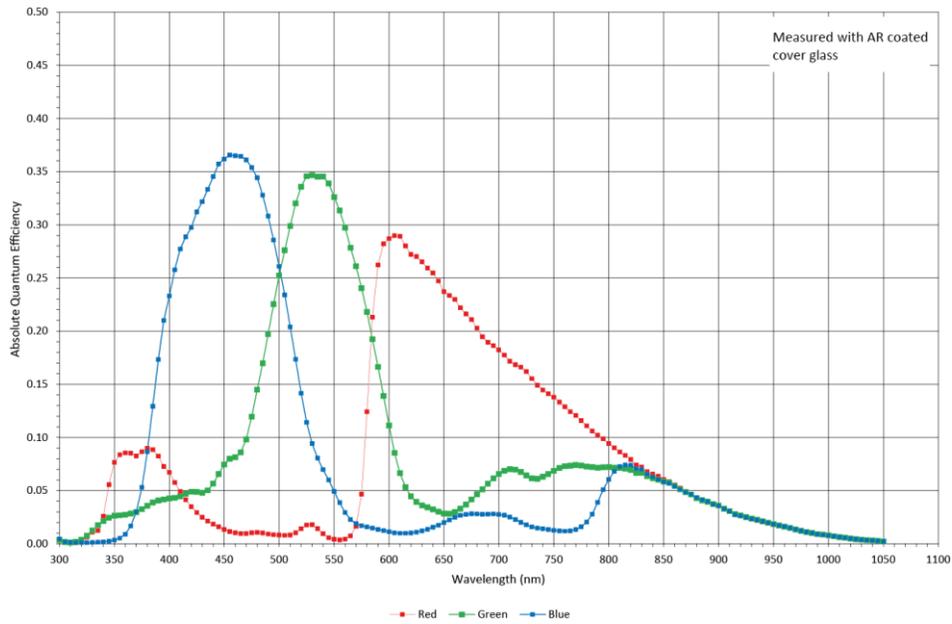
The following graph shows the spectral response for the VNP-190MX monochrome camera.



**Figure 5.2 VNP-190MX-M10 Spectral Response**

### 5.4.2 Color Camera Spectral Response

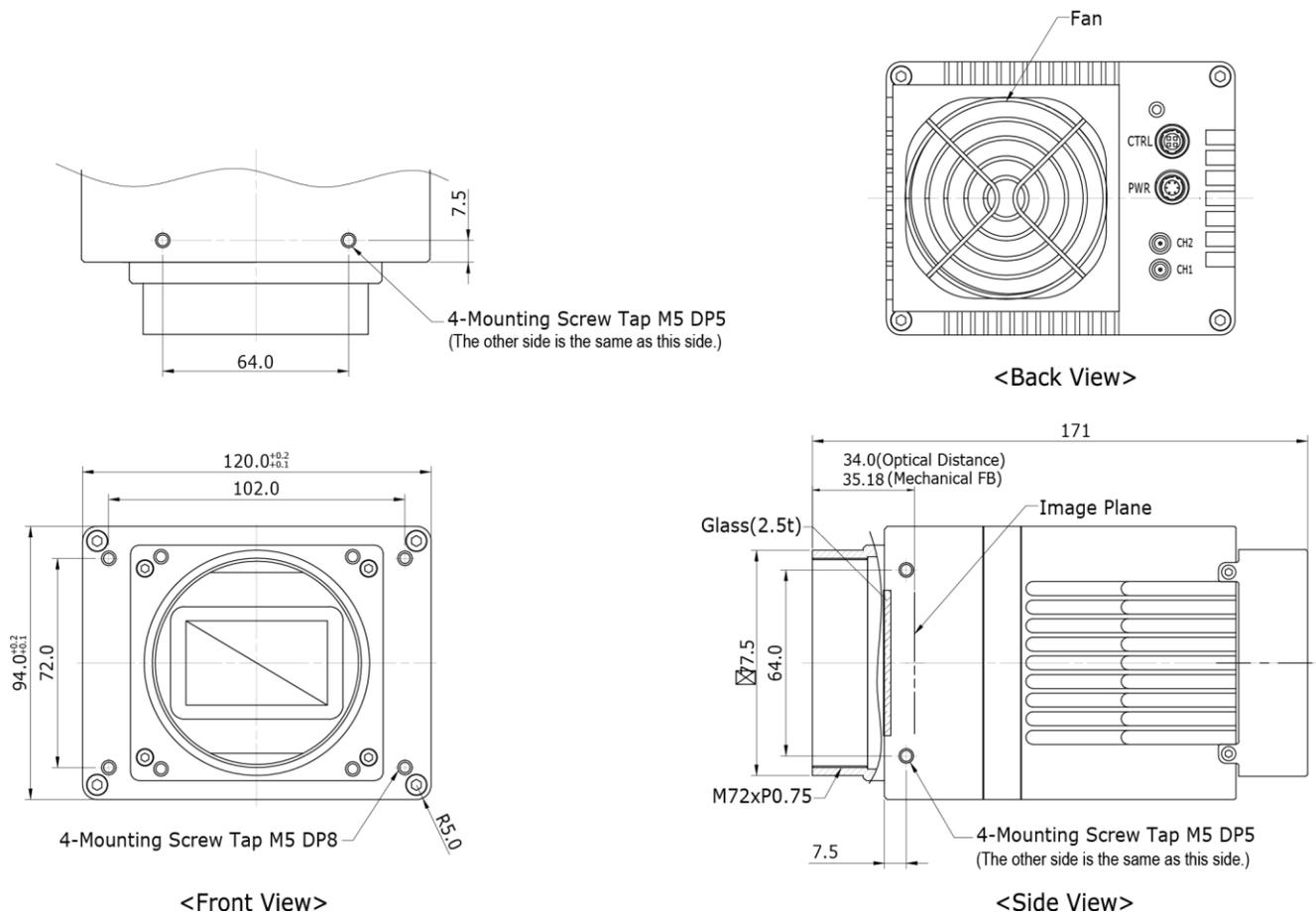
The following graph shows the spectral response for the VNP-190MX color camera.



**Figure 5.3 VNP-190MX-C10 Spectral Response**

## 5.5 Mechanical Specification

The camera dimensions in millimeters are shown in the following figure.



**Figure 5.4 VNP-190MX-10 M72-mount Mechanical Dimension**

## 6 Connecting the Camera

The following instructions assume that you have installed a CoaXPress Frame Grabber (hereinafter 'CXP Frame Grabber') in your computer including related software. Procedures below also assume that you may attempt to configure a link between a camera and CXP Frame Grabber by using two coax cables. For more detailed information, refer to your CXP Frame Grabber User Manual.

To connect the camera to your computer, follow the steps below:

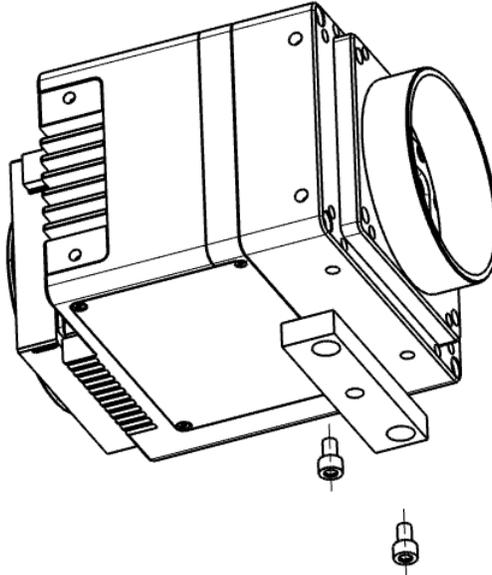
1. Make sure that the power supply is not connected to the camera and your computer is turned off.
2. Plug one end of a coax cable into the CH1 of the CXP connector on the camera and the other end of the coax cable into the CH1 of the CXP Frame Grabber in your computer. Then, plug one end of the other coax cable into CH2 of the CXP connector on the camera and the other ends of the coax cable into the CH2 of the CXP Frame Grabber respectively.
3. Connect the plug of the power adapter to the 6-pin power input receptacle on the camera.
4. Plug the power adapter into a working electrical outlet.
5. Verify all the cable connections are secure.



The VNP-190MX camera does not support Power over CoaXPress (PoCXP).

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## 6.1 Mount Plate



- The mount plate is provided as an optional item.
- The camera can be fixed without using this mount plate.

## 6.2 Precaution to center the image sensor

- Users do not need to center the image sensor as it is adjusted as factory default settings.
- When you need to adjust the center of the image sensor, please contact your local dealer or the manufacturer for technical assistance.

## 6.3 Precaution about blurring compared to center

- Users do not need to adjust the tilt as it is adjusted as factory default settings.
- If the tilt settings need to be adjusted inevitably, please contact your local dealer or factory representative for technical support.

## 6.4 Installing Vieworks Imaging Solution

You can download the Vieworks Imaging Solution at <http://www.vieworks.com>. You should perform the software installation first and then the hardware installation.

## 7 Camera Interface

### 7.1 General Description

As shown in the figure below, three types of connectors and one status indicator LED are located on the back of the VNP-190MX camera and have the functions as follows:

- ① Status LED: displays power status and operation mode.
- ② 4-pin Control Receptacle: inputs external trigger signal and outputs strobe.
- ③ 6-pin Power Input Receptacle: supplies power to the camera.
- ④ CoaXPress Connector: controls video data transmission and the camera.

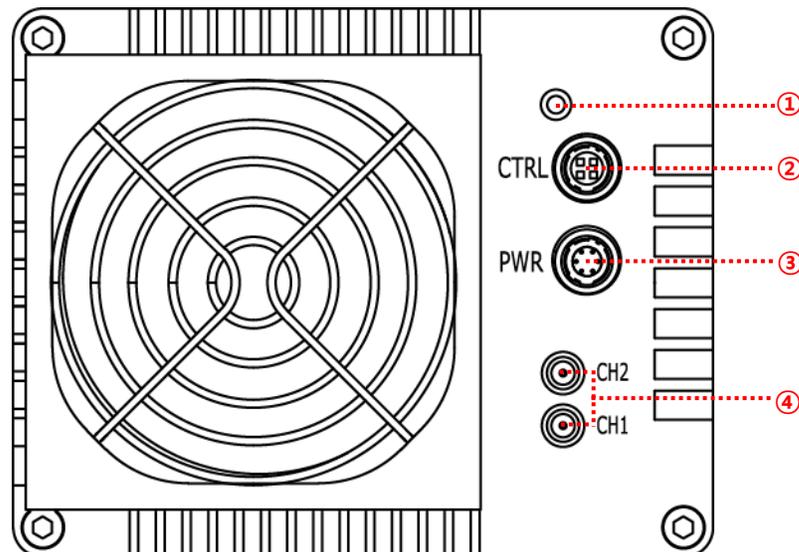


Figure 7.1 VNP-190MX Back Panel

## 7.2 CoaXPress Connector

CoaXPress protocol includes an automatic link detection mechanism (Plug and Play) to correctly detect the camera to the CXP Frame Grabber connection. The connection between the camera and CXP Frame Grabber uses a coax (also known as 'coaxial') cable and provides up to 6.25 Gbps bit rate per cable.

### 7.2.1 CoaXPress DIN Connector (75 $\Omega$ 1.0/2.3 DIN Receptacle)



**Figure 7.2 CoaXPress DIN 1.0/2.3-type Connectors**

The CoaXPress connector on the VNP-190MX camera complies with the CoaXPress standard and the following table shows the channel assignments.

Channel	Max. Bit Rate per Coax	Type	PoCXP Compliant
CH1	6.25 Gbps	Master Connection	No
CH2	6.25 Gbps	Extension Connection	No

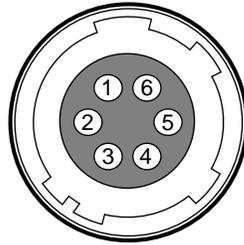
**Table 7.1 Channel Assignments for CoaXPress Connectors**



When you connect a camera to a CXP Frame Grabber using coax cables, make sure to connect the cables to their correct channels. If you connect the CH1 of the CXP connector on the camera to a channel other than CH1 of the CXP Frame Grabber, the camera may not transmit images properly or the serial communication between the computer and camera may fail.

## 7.3 Power Input Receptacle

The power input receptacle is a Hirose 6 pin connector (part # HR10A-7R-6PB). The pin assignments and configurations are as follows:



**Figure 7.3 Pin Assignments for Power Input Receptacle**

Pin Number	Signal	Type	Description
1, 2, 3	+ 12V DC	Input	DC Power Input
4, 5, 6	DC Ground	Input	DC Ground

**Table 7.2 Pin Arrangement for Power Input Receptacle**

Connecting the power cable to the camera can be made by using the Hirose 6-pin plug (part # HR10A-7P-6S) or the equivalent. The power adaptor is recommended to have at least 5 A current output at 12 V DC  $\pm 10\%$  voltage output (Users need to purchase the power adaptor separately).

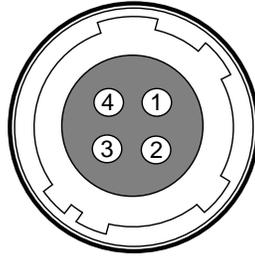
### Precaution for Power Input



- Make sure the power is turned off before connecting the power cord to the camera. Otherwise, damage to the camera may result.
- If voltage applied to the camera exceeds the camera's input voltage limit, damage to the camera may result.

## 7.4 Control I/O Receptacle

The control receptacle is a Hirose 4-pin connector (part # HR10A-7R-4S) and consists of an external trigger signal input and strobe output ports. The pin assignments and configurations are as follows:



**Figure 7.4 Pin Assignments for Control I/O Receptacle**

Pin Number	Signal	Type	Description
1	Trigger Input +	Input	-
2	Trigger Input -	Input	-
3	DC Ground	-	DC Ground
4	Strobe Out	Output	3.3 V TTL Output Output resistance: 47 $\Omega$

**Table 7.3 Pin Arrangements for Control I/O Receptacle**

The mating connector is a Hirose 4-pin plug (part # HR10A-7P-4P) or the equivalent connectors.

## 7.5 Trigger Input Circuit

The following figure shows trigger signal input circuit of the 4-pin connector. Transmitted trigger signal is applied to the internal circuit through a photo coupler. The minimum trigger width that can be recognized by the camera is 1  $\mu$ s. If transmitted trigger signal is less than 1  $\mu$ s, the camera will ignore the trigger signal. An example circuit of an external trigger input is shown below.

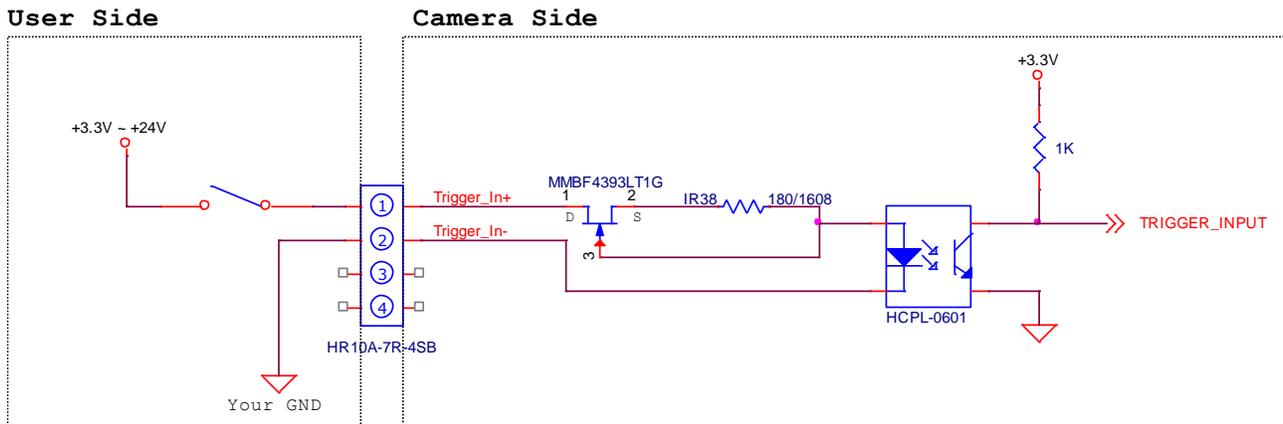


Figure 7.5 Trigger Input Schematic

## 7.6 Strobe Output Circuit

The strobe output signal comes out through a 3.3 V output level of TTL Driver IC. You can change the strobe output by setting the Digital IO Control (Refer to [9.19 Digital IO Control](#)).

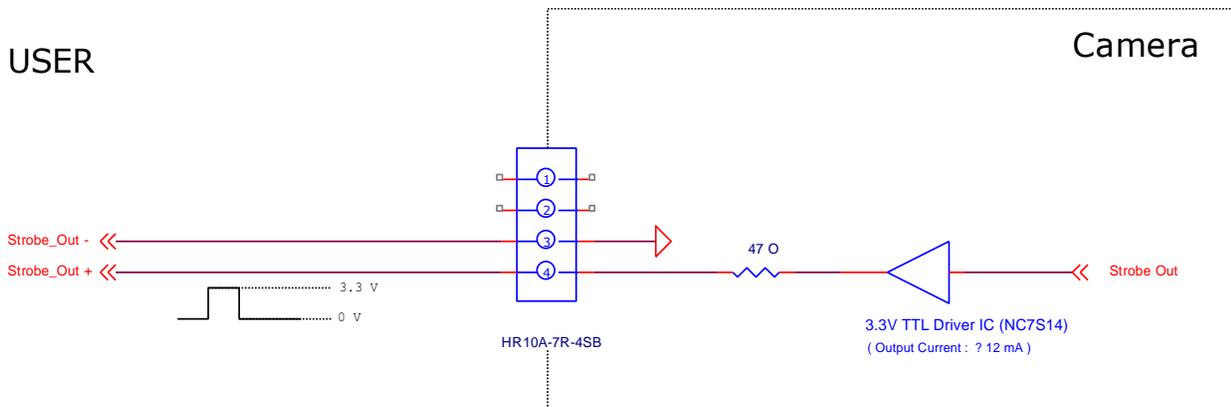


Figure 7.6 Strobe Output Schematic

## 8 Acquisition Control

This chapter provides detailed information about controlling image acquisition.

- Triggering image acquisition
- Setting the exposure time
- Controlling the camera's image acquisition rate
- Variation of the camera's maximum allowed image acquisition rate according to the camera settings

### 8.1 Overview

This section presents an overview of the elements involved with controlling the acquisition of images.

Three major elements are involved in controlling the acquisition of images:

- **Acquisition Start** and **Acquisition Stop** commands and the **Acquisition Mode** parameter
- Exposure Start trigger
- Exposure time control



When reading the explanations in the overview and in this entire chapter, keep in mind that the term **frame** is typically used to mean a single acquired image.

---

#### Acquisition Start and Stop Commands and the Acquisition Mode

The **Acquisition Start** command prepares the camera to acquire frames. The camera cannot acquire frames unless an **Acquisition Start** command has first been executed.

A parameter called the **Acquisition Mode** has a direct bearing on how the **Acquisition Start** command operates. The VNP-190MX camera only supports **Continuous** for the **Acquisition Mode** parameter.

If the **Acquisition Mode** parameter is set to **Continuous**, an **Acquisition Start** command does not expire after a single frame is acquired. Once an **Acquisition Start** command has been executed, you can acquire as many frames as you like. The **Acquisition Start** command will remain in effect until you execute an **Acquisition Stop** command. Once an **Acquisition Stop** command has been executed, the camera will not be able to acquire frames until a new **Acquisition Start** command is executed.

## Exposure Start Trigger

Applying an exposure start trigger signal to the camera will exit the camera from the *waiting for exposure start trigger* acquisition status and will begin the process of exposing and reading out a frame (see Figure 8.1).

As soon as the camera is ready to accept another exposure start trigger signal, it will return to the *waiting for exposure start trigger* acquisition status. A new exposure start trigger signal can then be applied to the camera to begin another frame exposure.

The exposure start trigger has two modes: off and on.

If the **Trigger Mode** parameter is set to **Off**, the camera will generate all required exposure start trigger signals internally, and you do not need to apply exposure start trigger signals to the camera. The rate at which the camera will generate the signals and acquire frames will be determined by the way that you set several frame rate related parameters.

If the **Trigger Mode** parameter is set to **On**, you must trigger exposure start by applying exposure start trigger signals to the camera. Each time a trigger signal is applied, the camera will begin a frame exposure. When exposure start is being triggered in this manner, it is important that you do not attempt to trigger frames at a rate that is greater than the maximum allowed (There is a detailed explanation about the maximum allowed frame rate at the end of this chapter.). Exposure start trigger signals applied to the camera when it is not in a *waiting for exposure start trigger* acquisition status will be ignored.

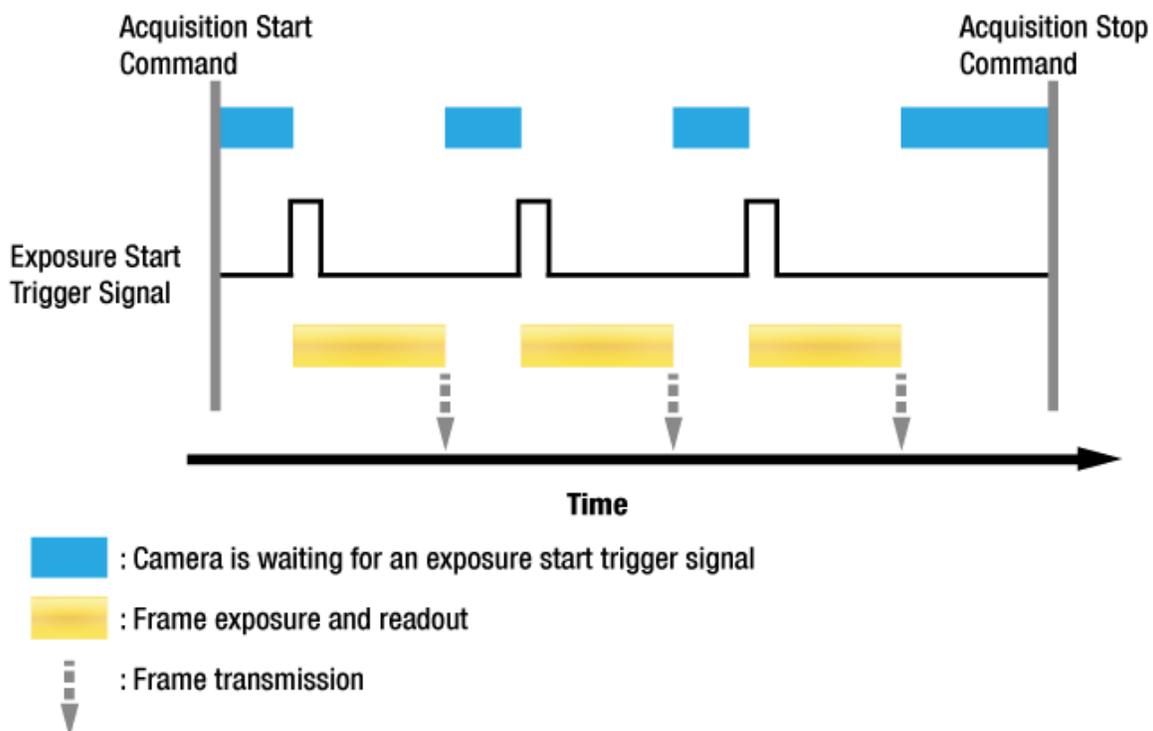


Figure 8.1 Exposure Start Triggering

## Applying Trigger Signals

The paragraphs above mention "applying a trigger signal". There are three ways to apply an exposure start trigger signal to the camera: via **Software**, via **CXPin** or via **Lineln0** (commonly referred to as hardware).

To apply trigger signals via **Software**, you must set the **Trigger Source** parameter to **Software**. At that point, each time a **Trigger Software** command is executed, the exposure start trigger signal will be applied to the camera.

To apply trigger signals via CH1 of the CXP Frame Grabber, you must set the **Trigger Source** parameter to **CXPin**. At that point, each time a proper CoaXPress trigger signal is applied to the camera by using the APIs provided by a CXP Frame Grabber manufacturer, the exposure start trigger signal will be applied to the camera. For more information, refer to your CXP Frame Grabber User Manual.

To apply trigger signals via hardware (external), you must set the **Trigger Source** parameter to **Lineln0**. At that point, each time a proper electrical signal is applied to the camera, an occurrence of the exposure start trigger signal will be recognized by the camera.

## Exposure Time Control

When an exposure start trigger signal is applied to the camera, the camera will begin to acquire a frame.

A critical aspect of frame acquisition is how long the pixels in the camera's sensor will be exposed to light during the frame acquisition.

If the **Trigger Source** parameter is set to **Software**, a parameter called the **Exposure Time** will determine the exposure time for each frame. At this point, you must set the **Exposure Mode** parameter to **Timed**.

If the **Trigger Source** parameter is set to **CXPin** or **Lineln0**, there are two modes of operation: **Timed** and **Trigger Width**.

With the **Timed** mode, the **Exposure Time** parameter will determine the exposure time for each frame.

With the **Trigger Width** mode, the way that you manipulate the rise and fall of the CoaXPress or external signal will determine the exposure time. The **Trigger Width** mode is especially useful if you want to change the exposure time from frame to frame.

## 8.2 Acquisition Start/Stop Commands and Acquisition Mode

Executing an **Acquisition Start** command prepares the camera to acquire frames. You must execute an **Acquisition Start** command before you can begin acquiring frames. Executing an **Acquisition Stop** command terminates the camera's ability to acquire frames. When the camera receives an **Acquisition Stop** command:

- If the camera is not in the process of acquiring a frame, its ability to acquire frames will be terminated immediately.
- If the camera is in the process of acquiring a frame, the frame acquisition process will be allowed to finish and the camera's ability to acquire new frames will be terminated.

The VNP-190MX camera only provides the '**Continuous**' mode of operation for the **Acquisition Mode**.

After an **Acquisition Start** command has been executed, exposure start can be triggered as desired. Each time an exposure start trigger is applied while the camera is in a *waiting for exposure start trigger* acquisition status, the camera will acquire and transmit a frame. The camera will retain the ability to acquire frames until an **Acquisition Stop** command is executed. Once the **Acquisition Stop** command is received, the camera will no longer be able to acquire frames.

## 8.3 Exposure Start Trigger

The **Trigger Selector** parameter is used to select a type of trigger and only the **Exposure Start** trigger is available on the VNP-190MX camera. The Exposure Start trigger is used to begin frame acquisition.

Exposure start trigger signals can be generated within the camera or may be applied externally by setting the **Trigger Source** parameter to **Software**, **CXPin** or **LineIn0**. If an exposure start trigger signal is applied to the camera, the camera will begin to expose a frame.

### 8.3.1 Trigger Mode

The main parameter associated with the exposure start trigger is the **Trigger Mode** parameter. The **Trigger Mode** parameter for the exposure start trigger has two available settings: **Off** and **On**.

#### 8.3.1.1 Trigger Mode = Off

When the **Trigger Mode** parameter is set to **Off**, the camera will generate all required exposure start trigger signals internally, and you do not need to apply exposure start trigger signals to the camera.

If the **Trigger Mode** parameter is set to **Off**, the camera will automatically begin generating exposure start trigger signals when it receives an **Acquisition Start** command. The camera will continue to generate exposure start trigger signals until it receives an **Acquisition Stop** command.



#### Free Run

When you set the **Trigger Mode** parameter to **Off**, the camera will generate all required trigger signals internally. When the camera is set this way, it will constantly acquire images without any need for triggering by the user. This use case commonly referred as “free run”.

The rate at which the exposure start trigger signals are generated may be determined by the camera's **Acquisition Frame Rate** parameter.

- If the parameter is set to a value less than the maximum allowed frame rate with the current camera settings, the camera will generate exposure start trigger signals at the rate specified by the parameter setting.
- If the parameter is set to a value greater than the maximum allowed frame rate with the current camera settings, the camera will generate exposure start trigger signals at the maximum allowed frame rate.

### Exposure Time Control with Trigger Mode = Off

When the **Trigger Mode** parameter is set to **Off**, the exposure time for each frame acquisition is determined by the value of the camera's **Exposure Time** parameter. For more information about the Exposure Time parameter, see [8.4 Setting the Exposure Time](#).

### 8.3.1.2 Trigger Mode = On

When the **Trigger Mode** parameter is set to **On**, you must apply an exposure start trigger signal to the camera each time you want to begin a frame acquisition. The **Trigger Source** parameter specifies the source signal that will act as the exposure start trigger signal.

The available settings for the **Trigger Source** parameter are:

- **Software:** You can apply an exposure start trigger signal to the camera by executing a **Trigger Software** command for the exposure start trigger on your computer.
- **CXPin:** You can apply an exposure start trigger signal via CH1 of the CXP Frame Grabber. For more information, refer to your CXP Frame Grabber User Manual.
- **LineIn0:** You can apply an exposure start trigger signal to the camera by injecting an externally generated electrical signal (commonly referred to as a hardware or external trigger signal) into the Control I/O receptacle on the camera. Refer to [7.5 Trigger Input Circuit](#) for more information.

You must also set the **Trigger Activation** parameter after setting the **Trigger Source** parameter.

The available settings for the **Trigger Activation** parameter are:

- **Rising Edge:** Specifies that a rising edge of the electrical signal will act as the exposure start trigger.
- **Falling Edge:** Specifies that a falling edge of the electrical signal will act as the exposure start trigger.

### Exposure Time Control with Trigger Mode = On

When the **Trigger Mode** parameter is set to **On** and the **Trigger Source** parameter is set to **Software**, the exposure time for each frame acquisition is determined by the value of the camera's **Exposure Time** parameter.

When the **Trigger Mode** parameter is set to **On** and the **Trigger Source** parameter is set to **CXPin** or **LineIn0**, the exposure time for each frame acquisition can be controlled with the **Exposure Time** parameter or it can be controlled by manipulating the external trigger signal.

### 8.3.2 Using a Software Trigger Signal

If the **Trigger Mode** parameter is set to **On** and the **Trigger Source** parameter is set to **Software**, you must apply a software trigger signal (exposure start) to the camera to begin each frame acquisition. Assuming that the camera is in a *waiting for exposure start trigger* acquisition status, frame exposure will start when the software trigger signal is received by the camera. Figure 8.2 illustrates frame acquisition with a software trigger signal.

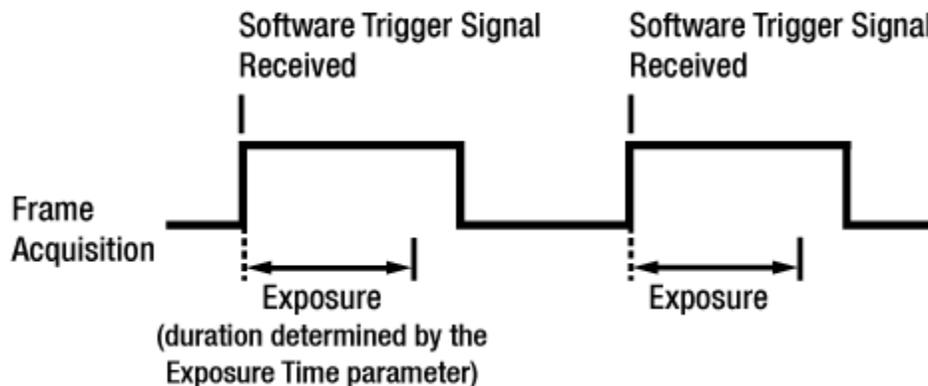
When the camera receives a software trigger signal and begins exposure, it will exit the *waiting for exposure start trigger* acquisition status because at that point, it cannot react to a new exposure start trigger signal.

As soon as the camera is capable of reacting to a new exposure start trigger signal, it will automatically return to the *waiting for exposure start trigger* acquisition status.

When you are using a software trigger signal to start each frame acquisition, the camera's **Exposure Mode** parameter must be set to **Timed**. The exposure time for each acquired frame will be determined by the value of the camera's **Exposure Time** parameter.



When you use a software trigger signal to acquire frames, be aware that there is a Trigger Latency due to the characteristics of the CoaXPress. Use an external trigger signal to precisely synchronize the trigger signal with the exposure timing.



**Figure 8.2 Frame Acquisition with Software Trigger Signal**

When you are using a software trigger signal to start each frame acquisition, the frame rate will be determined by how often you apply a software trigger signal to the camera, and you should not attempt to trigger frame acquisition at a rate that exceeds the maximum allowed for the current camera settings (There is a detailed explanation about the maximum allowed frame rate at the end of this chapter.). Software trigger signals that are applied to the camera when it is not ready to receive them will be ignored.

### 8.3.3 Using a CoaXPress Trigger Signal

If the **Trigger Mode** parameter is set to **On** and the **Trigger Source** parameter is set to **CXPin**, you must apply a CoaXPress trigger signal to the camera to begin each frame acquisition. A CoaXPress trigger signal will act as the exposure start trigger signal for the camera. For more information, refer to your CXP Frame Grabber User Manual.

A rising edge or a falling edge of the CoaXPress signal can be used to trigger frame acquisition. The **Trigger Activation** parameter is used to select rising edge or falling edge triggering.

Assuming that the camera is in a *waiting for exposure start trigger* acquisition status, frame acquisition will start whenever the appropriate edge transition is received by the camera.

When the camera receives a CoaXPress trigger signal and begins exposure, it will exit the waiting for exposure start trigger acquisition status because at that point, it cannot react to a new exposure start trigger signal.

As soon as the camera is capable of reacting to a new exposure start trigger signal, it will automatically return to the *waiting for exposure start trigger* acquisition status.

When the camera is operating under control of a CoaXPress signal, the period of the CoaXPress trigger signal will determine the rate at which the camera is acquiring frames:

$$\frac{1}{\text{CoaXPress signal period in seconds}} = \text{Frame Rate}$$

For example, if you are operating a camera with a CoaXPress trigger signal period of 500 ms (0.5 s):

So in this case, the frame rate is 2 fps.

### 8.3.4 Using an External Trigger Signal

If the **Trigger Mode** parameter is set to **On** and the **Trigger Source** parameter is set to **LineIn0**, an externally generated electrical signal injected into the Control I/O Receptacle pin 1 will act as the exposure start trigger signal for the camera. This type of trigger signal is generally referred to as a hardware trigger signal.

A rising edge or a falling edge of the external signal can be used to trigger frame acquisition. The **Trigger Activation** parameter is used to select rising edge or falling edge triggering.

Assuming that the camera is in a *waiting for exposure start trigger* acquisition status, frame acquisition will start whenever the appropriate edge transition is received by the camera.

When the camera receives an external trigger signal and begins exposure, it will exit the *waiting for exposure start trigger* acquisition status because at that point, it cannot react to a new exposure start trigger signal.

As soon as the camera is capable of reacting to a new exposure start trigger signal, it will automatically return to the *waiting for exposure start trigger* acquisition status.

When the camera is operating under control of an external signal, the period of the external trigger signal will determine the rate at which the camera is acquiring frames:

$$\frac{1}{\text{External signal period in seconds}} = \text{Frame Rate}$$

For example, if you are operating a camera with an External trigger signal period of 500 ms (5 s):

So in this case, the frame rate is 2 fps.

### 8.3.4.1 Exposure Mode

If you are triggering the start of frame acquisition with an externally (CoaXPress or External) generated trigger signal, two exposure modes are available: **Timed** and **Trigger Width**.

#### Timed Exposure Mode

When the **Timed** mode is selected, the exposure time for each frame acquisition is determined by the value of the camera's **Exposure Time** parameter. If the camera is set for rising edge triggering, the exposure time starts when the external trigger signal rises. If the camera is set for falling edge triggering, the exposure time starts when the external trigger signal falls. Figure 8.3 illustrates **Timed** exposure with the camera set for rising edge triggering.

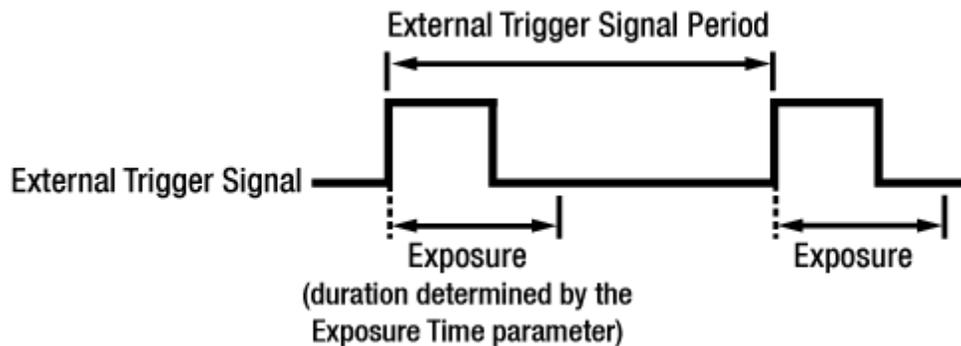


Figure 8.3 Timed Exposure Mode

Note that if you attempt to trigger a new exposure start while the previous exposure is still in progress, the trigger signal will be ignored.

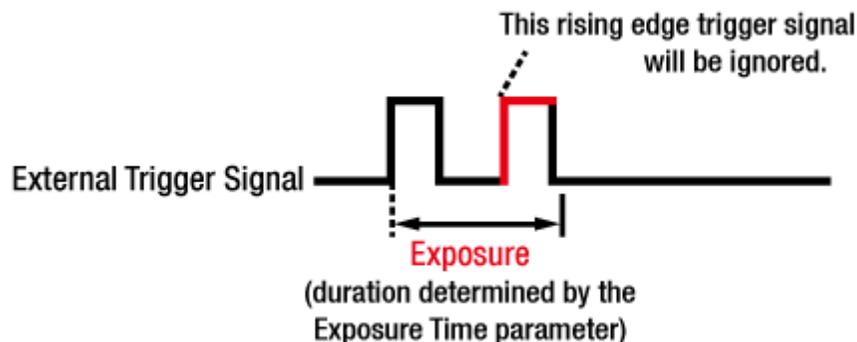


Figure 8.4 Trigger Overlapped with Timed Exposure Mode

### Trigger Width Exposure Mode

When the **Trigger Width** exposure mode is selected, the length of the exposure for each frame acquisition will be directly controlled by the external trigger signal (CoaXPress or External). If the camera is set for rising edge triggering, the exposure time begins when the external trigger signal rises and continues until the external trigger signal falls. If the camera is set for falling edge triggering, the exposure time begins when the external trigger signal falls and continues until the external trigger signal rises. Figure 8.5 illustrates **Trigger Width** exposure with the camera set for rising edge triggering.

**Trigger Width** exposure is especially useful if you intend to vary the length of the exposure time for each frame.

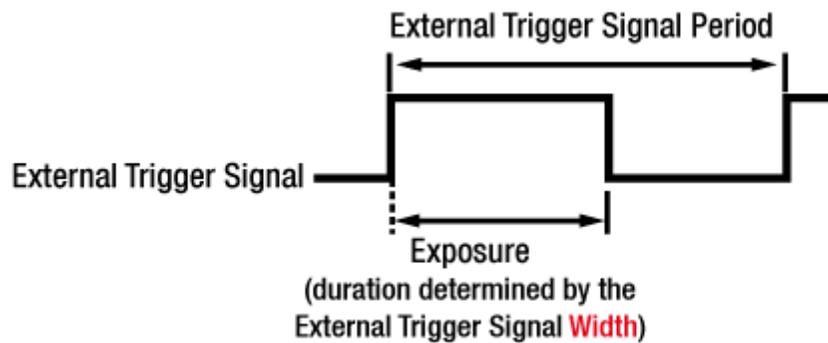


Figure 8.5 Trigger Width Exposure Mode

## 8.4 Setting the Exposure Time

This section describes how the exposure time can be adjusted manually by setting the value of the **Exposure Time** parameter. If you are operating the camera in any one of the following ways, you must specify an exposure time by setting the camera's **Exposure Time** parameter.

- the **Trigger Mode** is set to **Off**
- the **Trigger Mode** is set to **On** and the **Trigger Source** is set to **Software** (In this case, you must set the **Exposure Mode** parameter to **Timed**.)
- the **Trigger Mode** is set to **On**, the **Trigger Source** is set to **CXPin** or **LineIn0**, and the **Exposure Mode** is set to **Timed**.

The **Exposure Time** parameter must not be set below a minimum specified value. The **Exposure Time** parameter sets the exposure time in microseconds ( $\mu s$ ). The minimum and maximum exposure time settings for the VNP-190MX camera are shown in the following table.

Camera Model	Minimum Exposure Time	Maximum Exposure Time †
VNP-190MX	28 $\mu s$	60,000,000 $\mu s$

†: When the Exposure Mode is set to **Trigger Width**, the exposure time is controlled by the external trigger signal and has no maximum limit.

**Table 8.1 Minimum and Maximum Exposure Time Setting**

## 8.5 Overlapping Exposure with Sensor Readout

The frame acquisition process on the camera includes two distinct parts. The first part is the exposure of the pixels in the imaging sensor. Once exposure is complete, the second part of the process – readout of the pixel values from the sensor – takes place. In regard to this frame acquisition process, the VNP-190MX camera basically operates with ‘overlapped’ exposure so that the exposure for a new frame can be overlapped with the sensor readout for the previous frame.

When the **Trigger Mode** parameter is set to **On**, the exposure of a new frame begins while the camera is still reading out the sensor data for the previously acquired frame. This situation is illustrated in Figure 8.6 with the **Trigger Source** parameter set to **LineIn0** and the **Exposure Mode** parameter set to **Trigger Width**.

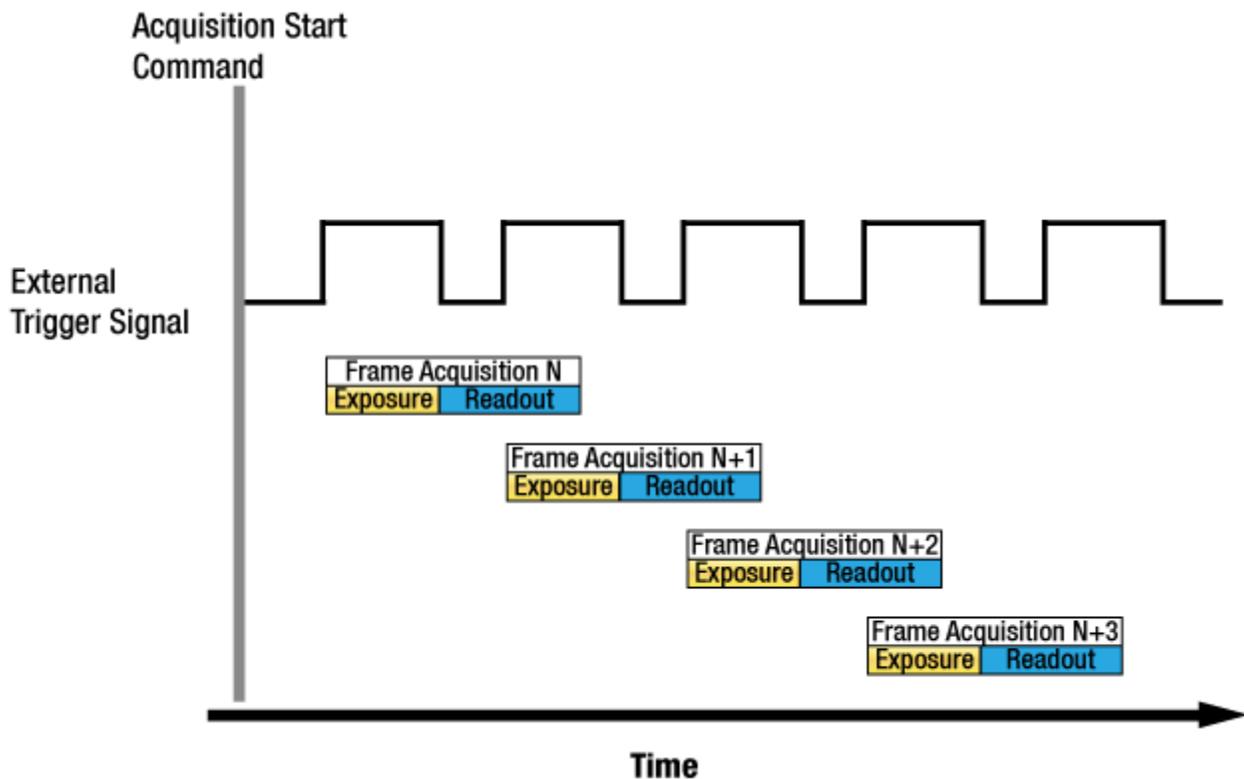


Figure 8.6 Overlapped Exposure and Readout

Determining whether your camera is operating with overlapped exposure and readout is not a matter of issuing a command or changing a setting. Rather a way that you operate the camera will determine whether the exposures and readouts are overlapped or not. If we define the “Frame Period” as the time from the start of exposure for one frame acquisition to the start of exposure for the next frame acquisition, then:

- Overlapped:  $\text{Frame Period} \leq \text{Exposure Time} + \text{Readout Time}$

### **Guidelines for Overlapped Exposure**

Since the VNP-190MX camera operates with overlapped exposure, there are two important guidelines to keep in mind:

- You must not begin the exposure time for a new image acquisition while the exposure time of the previous acquisition is in progress.
- You must not end the exposure time of the current image acquisition until readout of the previously acquired image is complete.

When you are operating a camera with overlapped exposure and using an external trigger signal to trigger image acquisition, you could use the camera's Exposure Time parameter settings and timing formula to calculate when it is safe to begin each new acquisition.

## 8.6 Real Exposure

### 8.6.1 Timed Exposure Mode

When the Timed mode is selected, the exposure time is determined by the time interval between the point where an external trigger signal is applied and the point where the  $t_{pd}$  (Photodiode Transfer) signal falls.

The camera generates a shutter signal to clear pixels when an external trigger signal is applied. The exposure time begins when the shutter signal falls and continues until the  $t_{pd}$  (Photodiode Transfer) signal falls. As Figure 8.7 shows, there is an Exposure Start Delay (refer to [Table 8.2](#)) between the rise of the external trigger signal and the point where exposure actually begins. The setting value on the Exposure Time parameter is equal to the exposure time, because the  $t_{sub}$  value of the shutter signal and Transfer Pulse Offset value ( $t_{pd}$ ,  $t_{3p}$ ) are compensated on the exposure time by the camera's logic internally. Therefore, there is no difference between the setting value on the Exposure Time parameter and the exposure time. The  $t_{sub}$  value and Transfer Pulse Offset value are determined by the CCD sensor used in the camera.

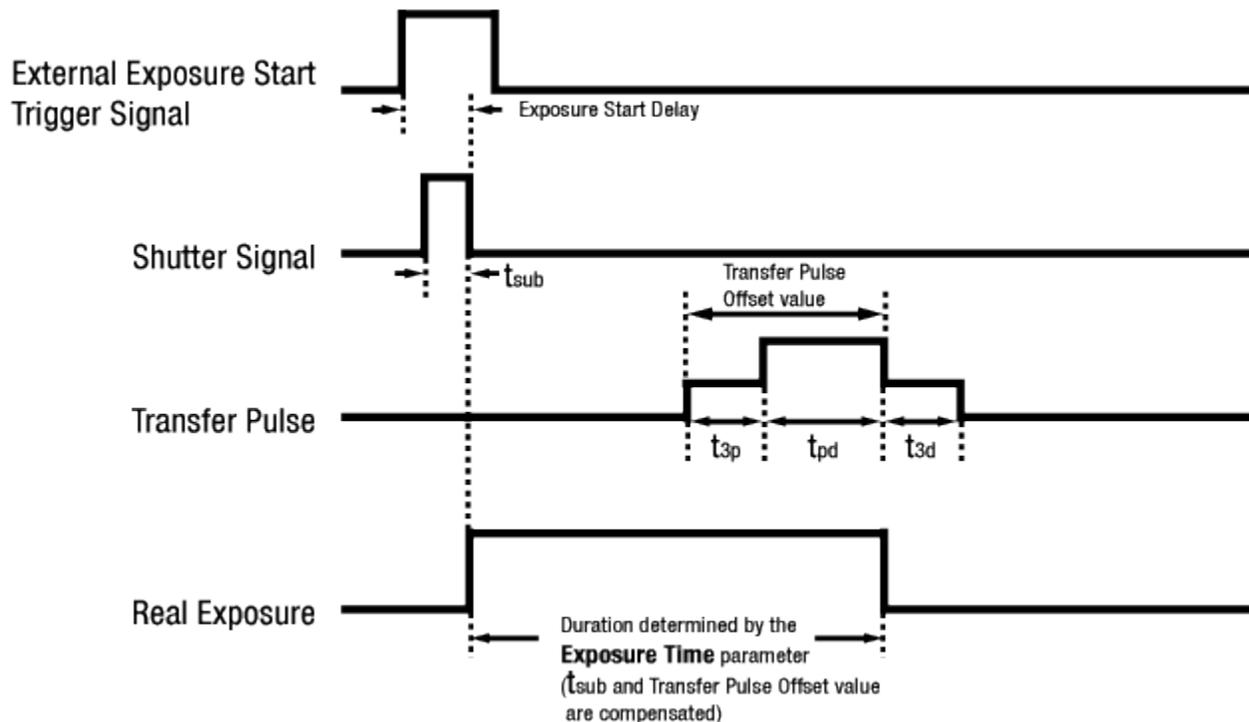


Figure 8.7 Real Exposure with Timed Exposure Mode

## 8.6.2 Trigger Width Exposure Mode

When the Trigger Width mode is selected, the exposure time is controlled by the external trigger signal.

The camera generates a shutter signal to clear pixels when an external trigger signal is applied. The exposure time begins when the shutter signal falls and continues until the  $t_{pd}$  (Photodiode Transfer) signal falls. As Figure 8.8 shows, there is an Exposure Start Delay (refer to [Table 8.2](#)) between the rise of the external trigger signal and the rise of the shutter signal. There is difference between the width of the external trigger signal and the exposure time as much as the  $t_{sub}$  value of the shutter signal and Transfer Pulse Offset value ( $t_{pd}$ ,  $t_{3p}$ ).

You can calculate an actual exposure time by using the following formula:

- Exposure Time = Trigger Width +  $t_{3p}$  +  $t_{pd}$  -  $t_{sub}$

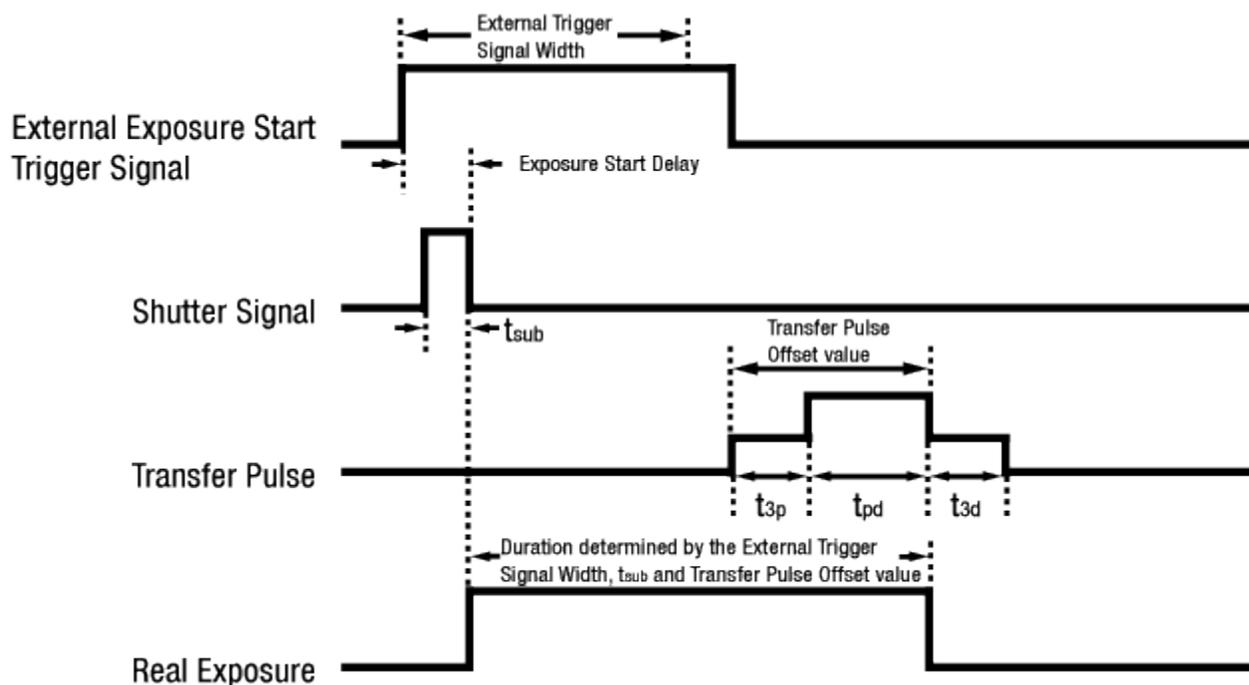


Figure 8.8 Real Exposure with Trigger Width Exposure Mode

The  $t_{sub}$  and Transfer Pulse Offset value are determined by the CCD sensor used in the camera. The following table shows the  $t_{sub}$  and Transfer Pulse Offset values for the VNP-190MX camera.

Model	Real Exposure Parameters					Remarks
	$t_{sub}$	$t_{3p}$	$t_{pd}$	$t_{3d}$	Exposure Start Delay	
VNP-190MX	$2 \mu s$	$16 \mu s$	$6 \mu s$	–	–	<ul style="list-style-type: none"> <li><math>t_{sub}</math>: Shutter Transfer</li> <li><math>t_{3p}</math>: VCCD leading pedestal signal</li> <li><math>t_{pd}</math>: Photodiode transfer signal</li> <li><math>t_{3d}</math>: VCCD trailing pedestal signal</li> <li>Exposure Start Delay: Trigger Latency + Trigger Jitter</li> </ul>

**Table 8.2 Real Exposure Parameters**

## 8.7 Maximum Allowed Frame Rate

In general, the maximum allowed acquisition frame rate on the camera may be limited by several factors:

- The amount of time that it takes to transmit an acquired frame from the camera to your computer.  
The amount of time needed to transmit a frame depends on the bandwidth assigned to the camera.
- The amount of time it takes to read an acquired frame out of the imaging sensor and into the camera's frame buffer. This time varies depending on the setting for the **Height** parameter. Frames with a smaller height take less time to read out of the sensor. The frame height is determined by the camera's **Height** settings (**Image Format Control**).
- The exposure time for acquired frames. If you use very long exposure times, you can acquire fewer frames per second.

### 8.7.1 Increasing the Maximum Allowed Frame Rate

You may find that you would like to acquire frames at a rate higher than the maximum allowed with the camera's current settings. In this case, you must adjust one or more of the factors that can influence the maximum allowed frame rate and then check to see if the maximum allowed frame rate has increased:

- The time that it takes to transmit a frame out of the camera is the main limiting factor on the frame rate. You can decrease the frame transmission time (and thus increase the maximum allowed frame rate) by using the ROI feature.
  - Use a smaller ROI. Decreasing the ROI means that the camera has less data to transmit and therefore the transmission time will decrease.
- If you are using normal exposure times and you are using the camera at its maximum resolution, your exposure time will not normally restrict the frame rate. However, if you are using long exposure times or small region of interest, it is possible that your exposure time is limiting the maximum allowed frame rate. If you are using a long exposure time or a small ROI, try using a shorter exposure time and see if the maximum allowed frame rate increases (You may need to compensate for a lower exposure time by using a brighter light source or increasing the opening of your lens aperture.).



A very long exposure time severely limits the camera's maximum allowed frame rate.

As an example, assume that your camera is set to use a 1 second exposure time. In this case, because each frame acquisition will take at least 1 second to be completed, the camera will only be able to acquire a maximum of one frame per second.

## 9 Camera Features

### 9.1 Region of Interest

The Image Region of Interest (ROI) feature allows you to specify a portion of the sensor array. You can acquire only the frame data from the specified portion of the sensor array while preserving the same quality as you acquire a frame from the entire sensor array.

With the ROI feature, you can achieve increased frame rates by decreasing the **Height** of the ROI; however, decreasing the **Width** of the ROI does not affect the frame rate.

The ROI is referenced to the top left corner [origin (0, 0)] of the sensor array as follows.

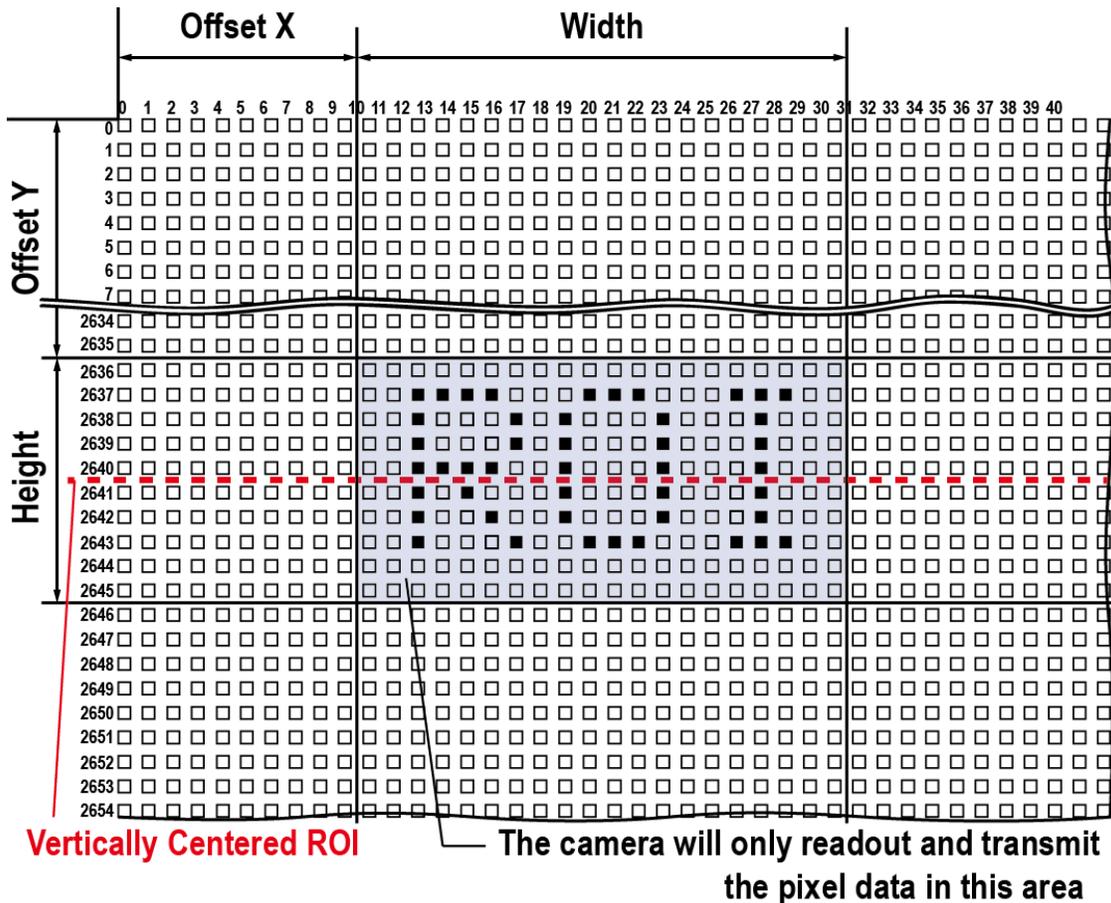


Figure 9.1 Region of Interest

The XML parameters related to ROI settings are as follows.

XML Parameters		Value	Description
ImageFormatControl	SensorWidth <sup>a</sup>	-	Effective width of the sensor
	SensorHeight <sup>a</sup>	-	Effective height of the sensor
	WidthMax	-	Maximum allowed width of the image with the current camera settings
	HeightMax	-	Maximum allowed height of the image with the current camera settings
	Width <sup>b</sup>	-	Current width of the image
	Height <sup>b</sup>	-	Current height of the image
	OffsetX <sup>c</sup>	-	Horizontal offset from the origin to the Image ROI
	OffsetY <sup>a</sup>	-	Vertical offset from the origin to the Image ROI

The unit for all parameters in this table is pixel

a: Read only. User cannot change the value

b: User configurable parameters for setting ROI

c: User configurable parameters for setting the origin of the ROI

**Table 9.1 XML parameters related to ROI**

The VNP-190MX camera automatically centers the ROI along the sensor's Y axis. You can change the size of ROI by setting the **Width** and **Height** parameters. And also, you can change the position of the ROI origin by setting the **Offset X** parameter. When you adjust the **Height** parameter, the **Offset Y** parameter is adjusted accordingly and read only. You must set the size of the ROI first, and then the **Offset X** value since the **Width** and **Height** parameters are set to its maximum value by default.

The **Width** parameter must be set to a multiple of 8, and the **Height** parameter must be set to a value greater than the minimum Vertical ROI size shown in the table below. The **Width**, **Height**, **Offset X** and **Offset Y** parameters will be updated respectively according to the **Horizontal** and **Vertical** parameter settings in the **Binning** category.

The minimum allowed setting values for the ROI Width and Height are shown below.

Camera Model	Minimum Width Settings	Minimum Height Settings
VNP-190MX	512	1056

**Table 9.2 Minimum ROI Width and Height Settings**

The following figure shows the maximum frame rates depending on Vertical ROI changes.

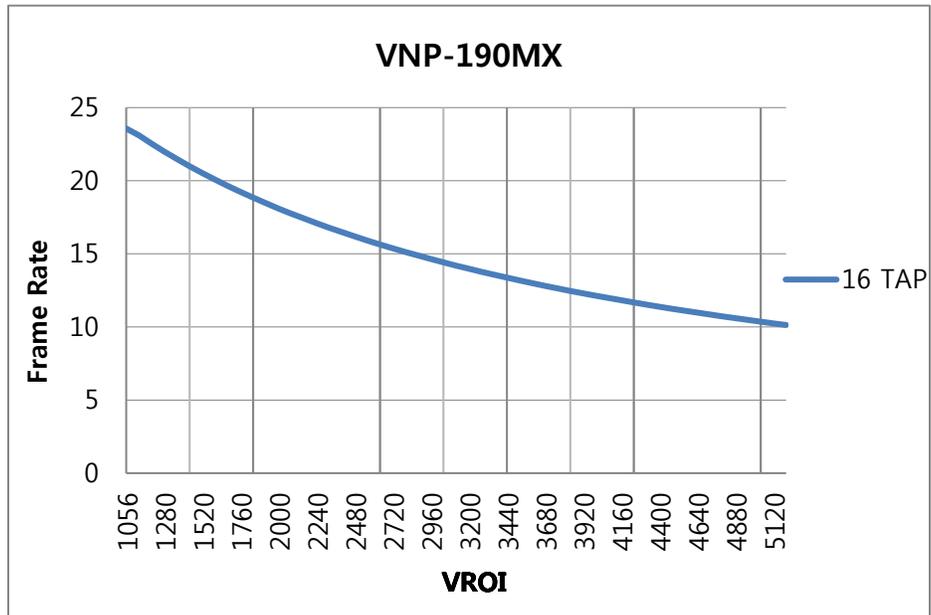


Figure 9.2 Maximum Frame Rates by Vertical ROI Changes

## 9.2 Binning

Binning has the effects of increasing the level value and decreasing resolution by summing the values of the adjacent pixels and sending them as one pixel.

The XML parameters related to Binning are as follows.

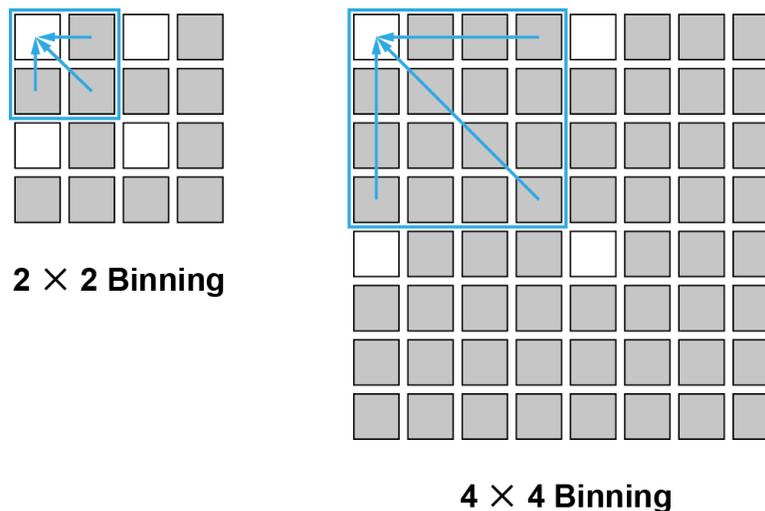
XML Parameters		Value	Description
ImageFormatControl	BinningHorizontal	×1, ×2, ×4	Number of horizontal pixels to combine together
	BinningVertical	×1, ×2, ×4	Number of vertical pixels to combine together

**Table 9.3 XML Parameters related to Binning**

For example, if you set  $2 \times 2$  binning, the camera's resolution is reduced to  $1/2$  and the camera's maximum allowed frame rate is increased. The **Width Max** and **Height Max** parameters, indicating the maximum allowed resolution of the image with the current camera settings, will be updated depending on the binning settings. And also, the **Width**, **Height**, **Offset X** and **Offset Y** parameters will be updated depending on the binning settings.

You can verify the current resolution through the **Width** and **Height** parameters.

The available settings on the VNP-190MX camera for the binning feature are as follows.



**Figure 9.3 2 × 2 and 4 × 4 Binning**



When you enable the binning feature on a color camera, the camera produces monochrome images.

### 9.3 CXP Link Configuration

The VNP-190MX camera must be connected to a CXP Frame Grabber installed in your computer via CoaXPress interface. CoaXPress interface allows you to connect a camera to a CXP Frame Grabber by using simple coax cabling and allows up to 6.25 Gbps data rate per cable. The VNP-190MX camera supports one master connection and one extension connection to configure a link. In compliance with the CoaXPress standard, the VNP-190MX camera includes an automatic link detection mechanism (Plug and Play) to correctly detect the camera to CXP Frame Grabber connections.

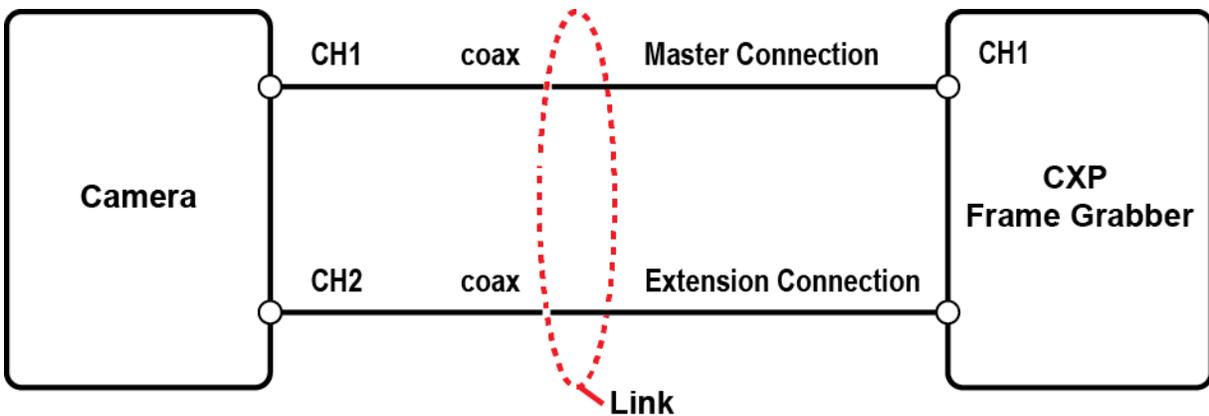


Figure 9.4 CXP Link Configuration

The XML parameters related to the link configuration between the camera and CXP Frame Grabber are located in the CoaXPress category under the Transport Layer Control as shown below.

	XML Parameters	Value	Description
CoaXPress	CxpLinkConfigurationPreferredSwitch	CXP6_X2	Sets the <b>A</b> parameter value to CXP6_X2
	CxpLinkConfigurationPreferred <sup>A</sup>	Read Only	Displays bit rate and the number of connections to be set for the link configuration between the camera and Host (Frame Grabber) while discovering devices.
	CXPLinkConfiguration	CXP6_X2	Forcefully sets bit rate and the number of connections for the link configuration. ex) CXP6_X2: Two connections running at a maximum of CXP6 speed(6.25Gbps)

Table 9.4 XML Parameter related to CXP Link Configuration

## 9.4 Channel Mode

The VNP-190MX camera is equipped with a 16 Taps imaging sensor. From VOUTa to VOUTp, all 16 channels will be used to read out image data from the CCD.

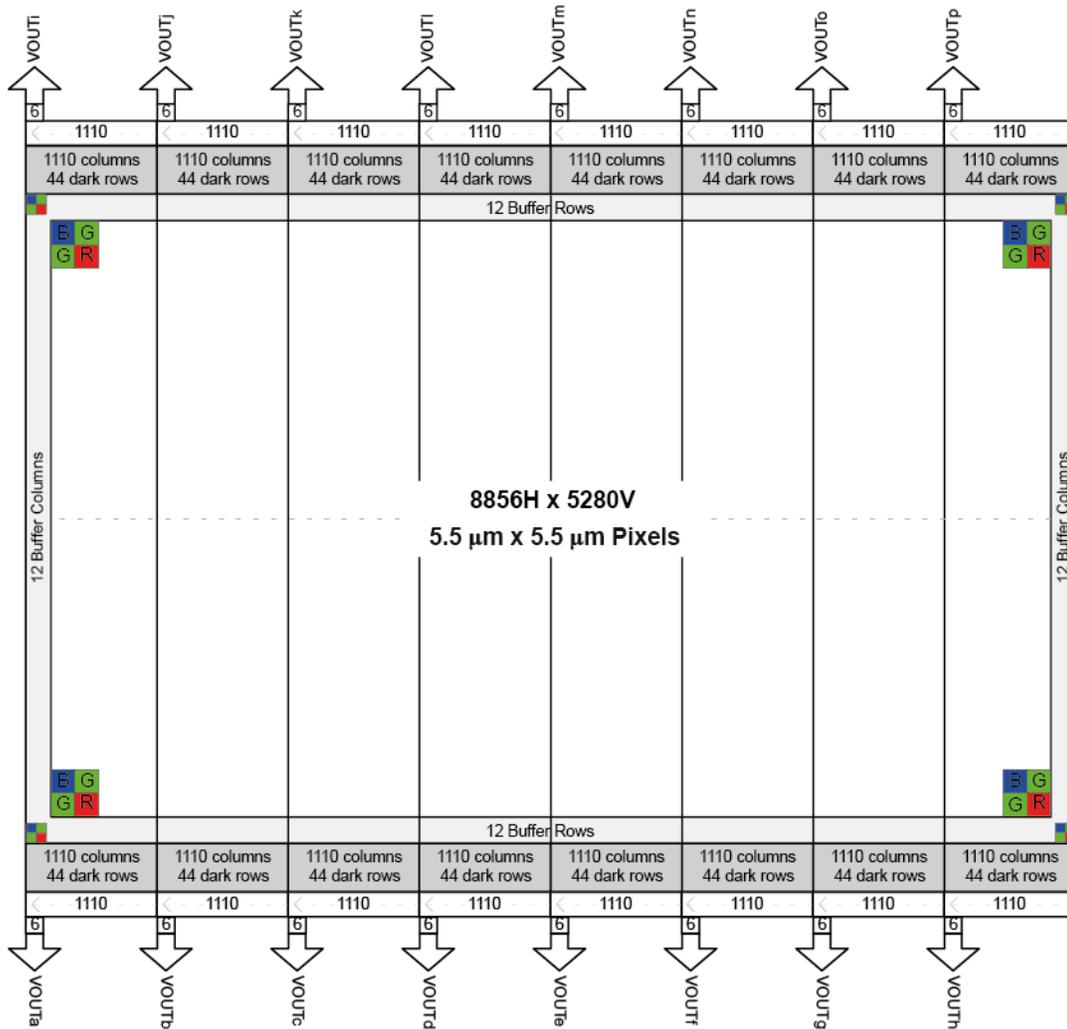


Figure 9.5 Channel Mode

The image data read out from the CCD goes through image processing and it is reordered to be compliant with the CoaXPress interface. The image data read out from 16 channels will be transmitted in a CoaXPress – 1X-1Y fashion.

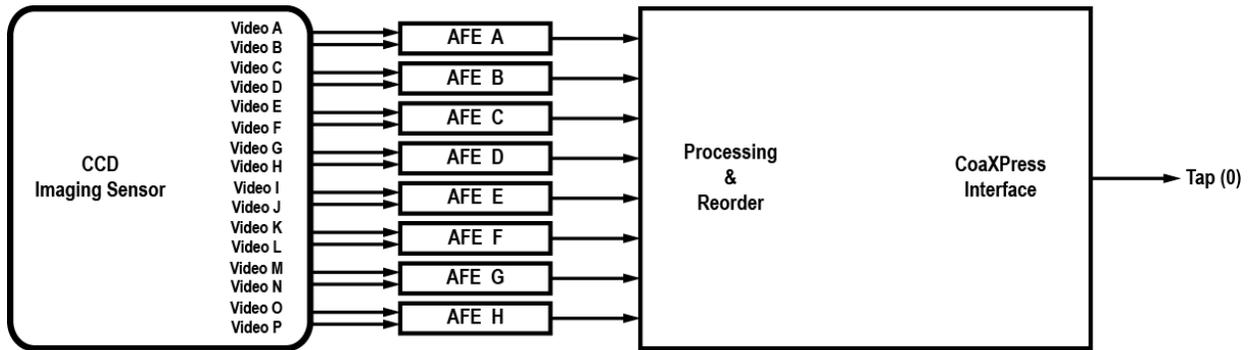


Figure 9.6 Image Data Flow

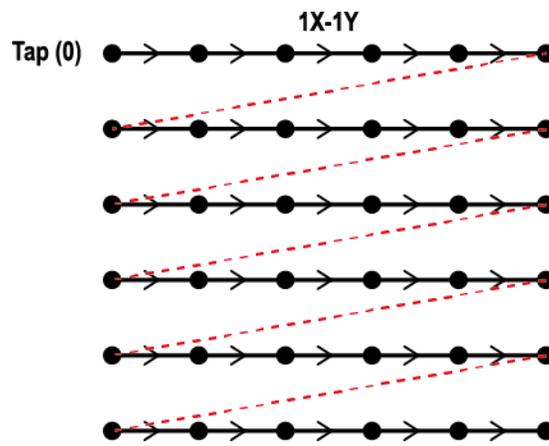


Figure 9.7 Tap Geometry

## 9.5 Pixel Format

The camera processes image data in the unit of 12 bit. You can determine the pixel format (8 bits, 10 bits or 12 bits) of these image data transmitted from the camera by selecting the **Pixel Format** parameter. When the camera is set for 8 bit or 10 bit pixel format, the least 4 or 2 least significant bits will be dropped from overall 12 bits.

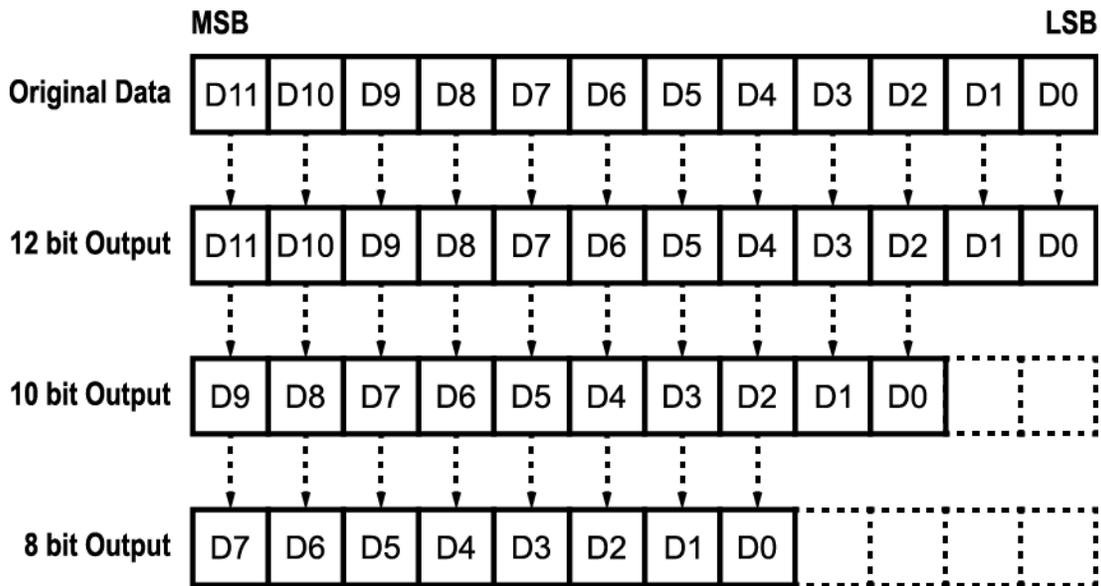


Figure 9.8 Pixel Format

The XML parameter related to the Pixel Format is as follows.

XML Parameters		Description
ImageFormatControl	PixelFormat	Sets the pixel format supported by the device.

Table 9.5 XML Parameter related to Pixel Format

The available pixel formats on the monochrome and color cameras are as follows.

Mono Sensor	Color Sensor
<ul style="list-style-type: none"> <li>• Mono 8</li> <li>• Mono 10</li> <li>• Mono 12</li> </ul>	<ul style="list-style-type: none"> <li>• Bayer GR 8</li> <li>• Bayer GR 10</li> <li>• Bayer GR 12</li> </ul>

Table 9.6 Pixel Format Values

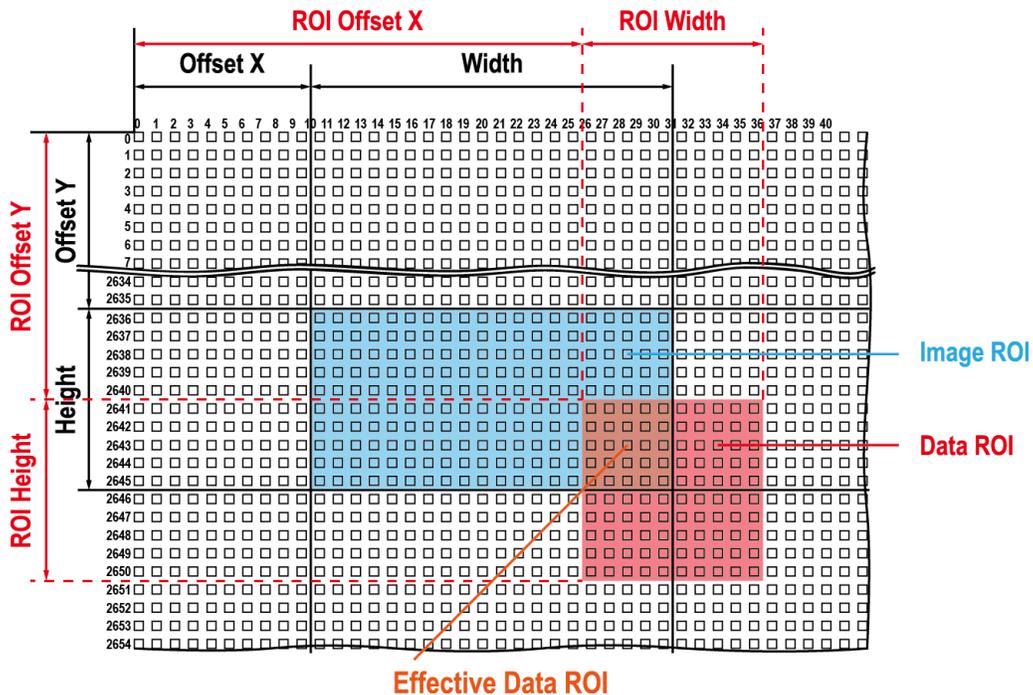
## 9.6 Data ROI (Color Camera)

The **Balance White Auto** feature provided by the color camera uses the pixel data from a Data Region of Interest (ROI) to adjust the related parameters. The XML parameters related to Data ROI are as follows.

XML Parameters		Value	Description
DataRoiControl	RoiSelector	WhiteBalanceAuto	<ul style="list-style-type: none"> <li>Selects a Data ROI used for Balance White Auto.</li> <li>Only available on color cameras</li> </ul>
	RoiOffsetX	-	X coordinate of start point ROI
	RoiOffsetY	-	Y coordinate of start point ROI
	RoiWidth	-	Width of ROI
	RoiHeight	-	Height of ROI

**Table 9.7 XML Parameters related to Data ROI**

Only the pixel data from the area of overlap between the data ROI by your settings and the Image ROI will be effective if you use Image ROI and Data ROI at the same time. The effective ROI is determined as shown in the figure below.



**Figure 9.9 Effective Data ROI**

## 9.7 White Balance (Color Camera)

The color camera includes the white balance capability to adjust the color balance of the images transmitted from the camera. With the white balancing scheme used on VNP-190MX camera, the Green intensity, Red intensity and Blue intensity can be adjusted individually. You can set the intensity of each color by using the **Balance Ratio** parameter. The **Balance Ratio** value can range from 1.0 to 4.0. If the **Balance Ratio** parameter is set to 1.0 for a color, the intensity of the color will not be affected by the white balance mechanism. If the **Balance Ratio** is set to greater than 1.0, the intensity of the color will be proportionally increased to the ratio. For example, if the **Balance Ratio** is set to 1.5, the intensity of that color will be increased by 50%.

The XML parameters related to White Balance are as follows.

XML Parameters		Value	Description
AnalogControl	BalanceRatioSelector	Green	A Balance Ratio will be applied to green pixels.
		Red	A Balance Ratio will be applied to red pixels.
		Blue	A Balance Ratio will be applied to blue pixels.
	BalanceRatio	×1.0 ~ ×4.0	Controls ratio of the selected color by referring to Green

Table 9.8 XML Parameters related to White Balance

### 9.7.1 Balance White Auto

The **Balance White Auto** feature is implemented on the color camera. It will control the white balance of the image acquired from the color camera according to the GeryWorld algorithm. Before using the **Balance White Auto** feature, you need to set the Data ROI for Balance White Auto. If you do not set the related Data ROI, the pixel data from the Image ROI will be used to control the white balance. As soon as the **Balance White Auto** parameter is set to **Once**, the Balance Ratio values for Red and Blue will be automatically adjusted to adjust the white balance by referring to Green. The XML parameters related to Balance White Auto are as follows.

XML Parameters		Value	Description
AnalogControl	BalanceWhiteAuto	Off	Balance White Auto Off
		Once	White Balance is adjusted once and then Off.

Table 9.9 XML Parameters related to Balance White Auto

## 9.8 Gain and Black Level

Increasing the **Gain** parameter increases the slope of the camera's response curve as shown in the figure below. This results in a higher grey value output from the camera for a given amount of output from the imaging sensor.

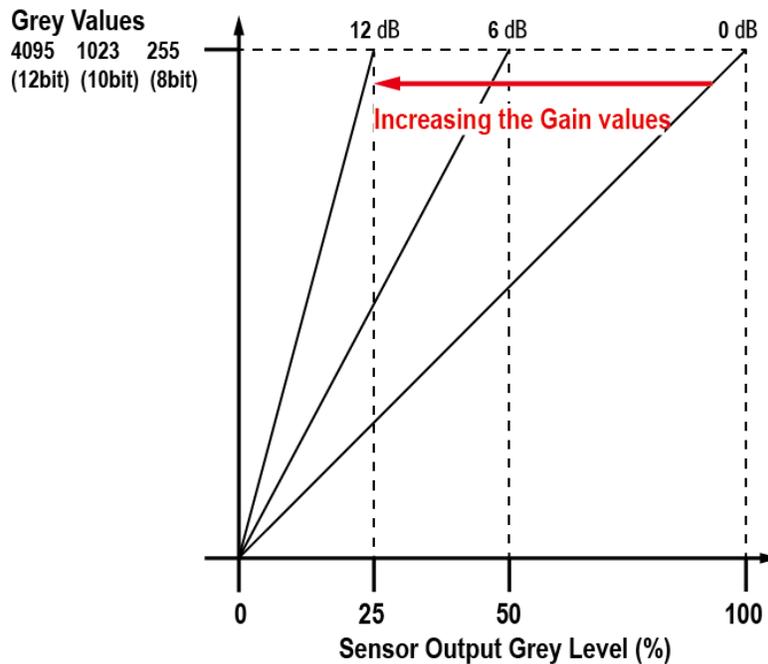


Figure 9.10 Setting the Gain

Adjusting the **Black Level** parameter will result in an offset to the pixel values output from the camera. The XML parameters related to Gain and Black Level are as follows.

XML Parameters		Value	Description
AnalogControl	GainSelector	All	Applies gain to all channels.
	Gain	×1.0 ~ ×4.0	Sets an absolute physical gain value (0 dB ~ 12 dB).
	BlackLevelSelector	All	Applies black level to all channels.
	BlackLevel	0~256	Sets an absolute physical black level value. 0 ~ 256 LSB @ 12 bit

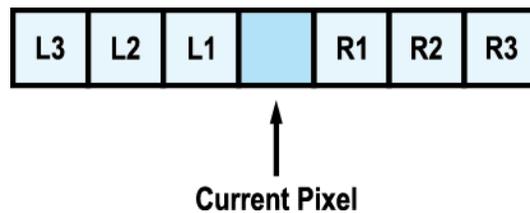
Table 9.10 XML Parameters related to Gain and Black Level

## 9.9 Defective Pixel Correction

The CCD sensor may have Defect Pixels which cannot properly react to the light. Correction is required since it may deteriorate the quality of output image. Defect Pixel information of a CCD used for each camera is entered into the camera during the manufacturing process. If you want to add Defect Pixel information, it is required to enter coordinate of new Defect Pixel into the camera. For more information, refer to [Appendix A](#).

### 9.9.1 Correction Method

A correction value for a Defect Pixel is calculated based on the valid pixel value adjacent in the same line.



**Figure 9.11 Location of Defect Pixel to be corrected**

If the Current Pixel is a Defect Pixel as shown in the figure above, the correction value for this pixel is obtained as shown in the following table depending on whether surrounding pixels are Defect Pixels or not.

Adjacent Defect Pixel (s)	Correction Value of Current Pixel
None	$(L1 + R1) / 2$
L1	R1
R1	L1
L1, R1	$(L2 + R2) / 2$
L1, R1, R2	L2
L2, L1, R1	R2
L2, L1, R1, R2	$(L3 + R3) / 2$
L2, L1, R1, R2, R3	L3
L3, L2, L1, R1, R2	R3

**Table 9.11 Calculation of Defect Pixel Correction Value**

## 9.10 Flat Field Correction

The Flat Field Correction feature improves the image uniformity when you acquire a non-uniformity image due to external conditions. The Flat Field Correction feature of the VNP-190MX camera can be summarized by the following equation:

$$IC = \{ (IR \times (IM/IF)) \}$$

where,

IC: Level value of corrected image;

IR: Level value of original image;

IM: Reference value for Flat Field correction

IF: Level value of Flat Field data.

In actual use conditions, generate Flat Field correction coefficients (IM/IF) and enable the Flat Field Correction feature by following the procedures below.

1. Choose an active Flat Field data location by selecting the **Flat Field Data Selector** parameter.
2. Execute the **Flat Field Data Generate** parameter.  
After executing the **Flat Field Data Generate** parameter, you must acquire one image to generate the scaled down Flat Field data.
3. Execute the **Flat Field Data Save** parameter to save the generated Flat Field data into the non-volatile memory.  
When the scaled-down Flat Field data is applied for correction, the data will be enlarged via Bilinear Interpolation as shown in the Figure 9.13.
4. Set the **Flat Field Correction** parameter to **On** to apply the Flat Field data to the camera.



- It is recommended that you enable the **Defective Pixel Correction** feature before executing the **Flat Field Data Generate** parameter.
- Before executing the **Flat Field Data Generate** parameter, you must set the camera as follows:
  - OffsetX, Y: 0
  - Width, Height: Maximum values
  - Binning: ×1
- After executing an **Acquisition Start** command, you need to operate the camera with free-run mode or apply a trigger signal to acquire an image.

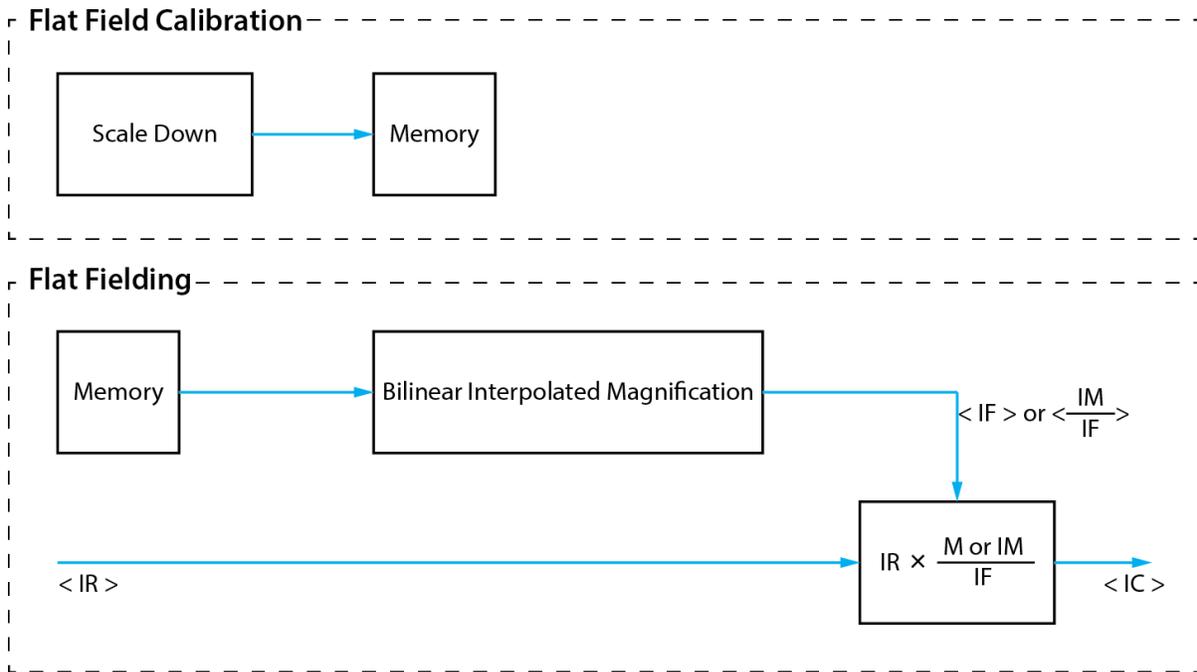


Figure 9.12 Generation and Application of Flat Field Data

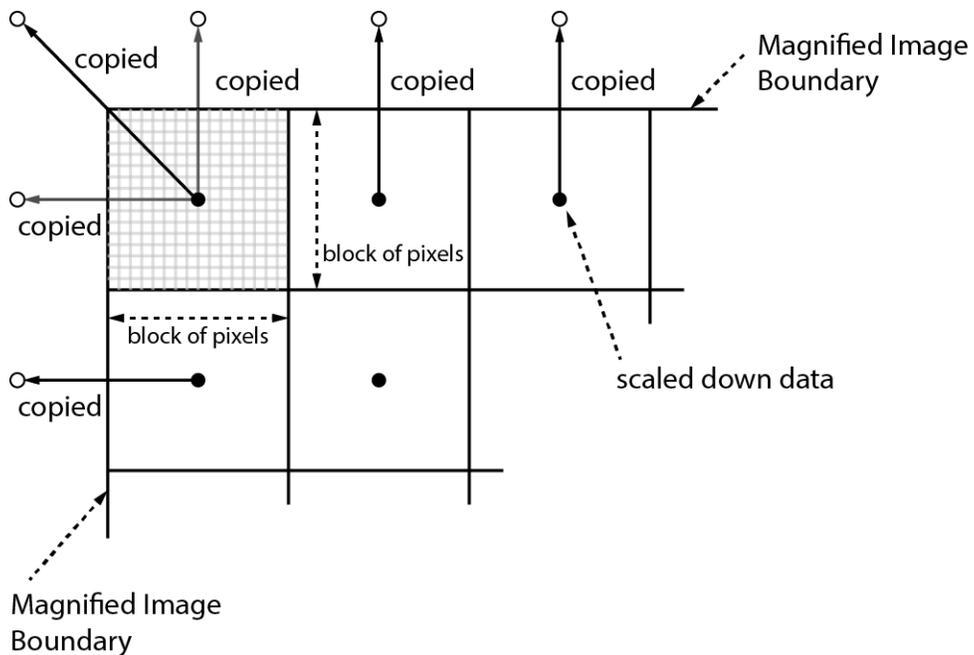


Figure 9.13 Bilinear Interpolated Magnification

The XML parameters related to Flat Field Correction are as follows.

XML Parameters		Value	Description
FlatFieldCorrection	FlatFieldCorrection	Off	Flat Field Correction Off
		On	Enables the Flat Field Correction feature.
	FlatFieldDataGenerate	-	Generates the Flat Field data.
	FlatFieldDataSave	-	Saves the generated Flat Field data in the non-volatile memory. <ul style="list-style-type: none"> <li>The generated data by executing the <b>Flat Field Data Generate</b> parameter is saved in the volatile memory and the data is lost if the camera is reset or if power is turned off. To use the data after the camera is powered on or reset, save them in the non-volatile memory.</li> </ul>
	FlatFieldDataLoad	-	Loads the Flat Field data from the non-volatile memory into volatile memory.
	FlatFieldDataSelector	0 ~ 3	Selects a location to save Flat Field data to or load Flat Field data from.

**Table 9.12 XML Parameters related to Flat Field Correction**

## 9.10.1 Flat Field Data Selector

As mentioned above, the active Flat Field data is stored in the camera's volatile memory and the data is lost if the camera is reset or powered off. To use the active or generated Flat Field data after the camera is powered on or reset, you need to save them in the camera's non-volatile memory. The VNP-190MX camera provides four active Flat Field data locations in the camera's volatile memory and four reserved locations in the camera's non-volatile memory available for saving the active Flat Field data. You can use the **Flat Field Data Selector** parameter to select one of the four reserved locations.

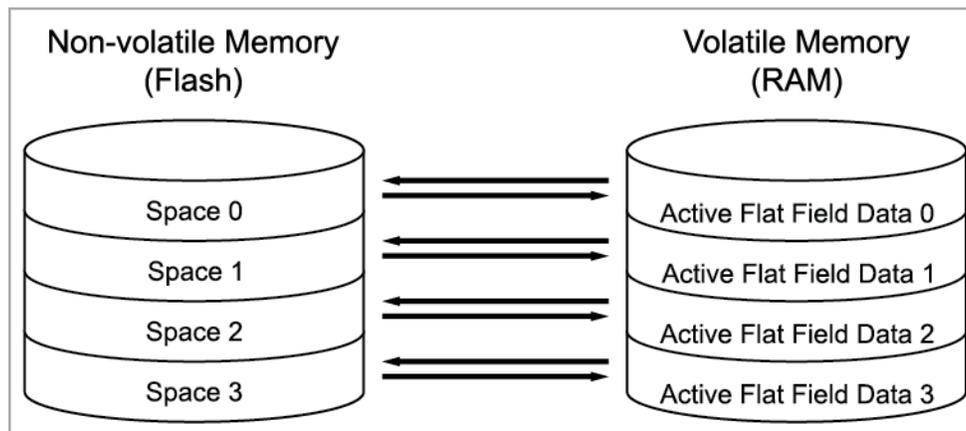


Figure 9.14 Flat Field Data Selector

### Saving Flat Field Data

There is a one-to-one correspondence between active Flat Field data locations in the volatile memory and reserved locations for Flat Field data in the non-volatile memory. In order to save the generated active Flat Field data into a reserved location in the camera's flash memory, you must choose a Flat Field data location before generating Flat Field data by using the **Flat Field Data Selector** parameter.

1. Use the **Flat Field Data Selector** parameter to specify a Flat Field data location, and then generate Flat Field data.
2. Execute the **Flat Field Data Save** parameter to save the active Flat Field data to the selected reserved location.

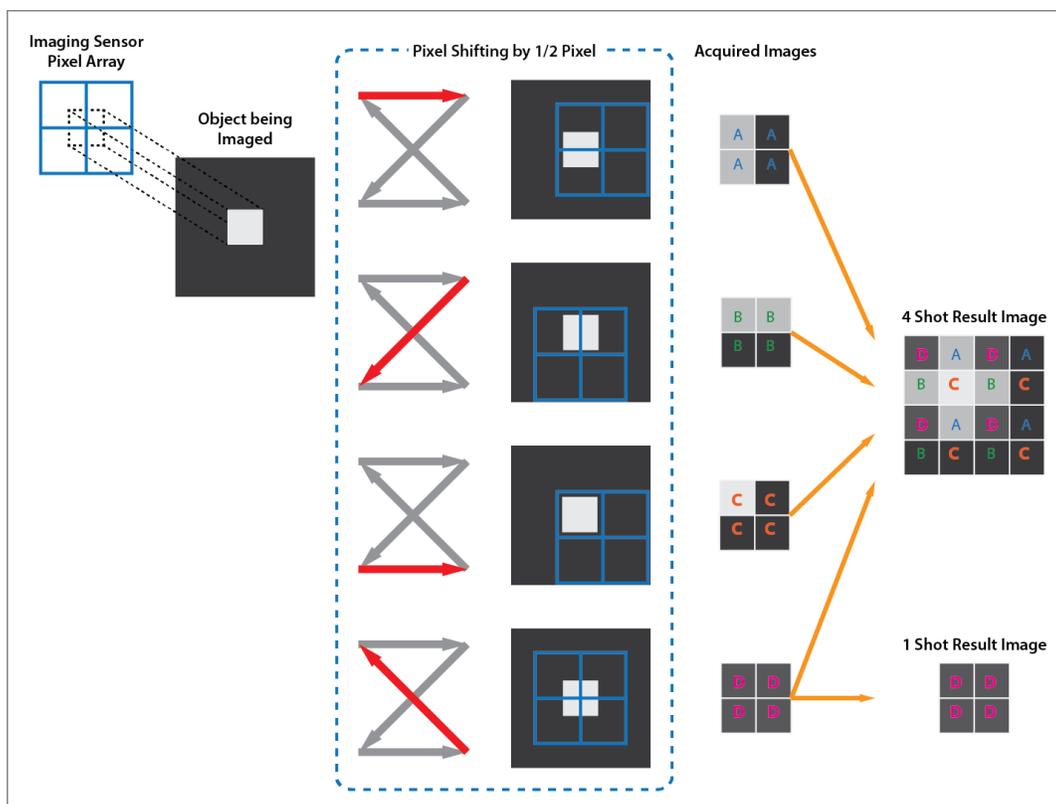
### Loading Flat Field Data

If you saved a Flat Field data into the camera's non-volatile memory, you can load the saved Flat Field data from the camera's non-volatile memory into the camera's active Flat Field data location.

1. Use the **Flat Field Data Selector** parameter to specify a reserved location whose Flat Field data will be loaded into the camera's active Flat Field data location.
2. Execute the **Flat Field Data Load** parameter to load the selected Flat Field data into the active Flat Field data location.

## 9.11 Pixel Shifting

The VNP-190MX camera has a feature to shift the imaging sensor to X and Y direction precisely using 2D-Stage. The resulting image can be combined of 4 individual images captured by shifting the imaging sensor to X and Y direction as shown in the figure below. Thus, the output image offers improved resolution (4 Shot Result Image) in comparison with a standard output image (1 Shot Result Image). Combing the images should be done on the PC side with software processing. Please contact local dealer or factory representative for the details on the sample software combining the images.



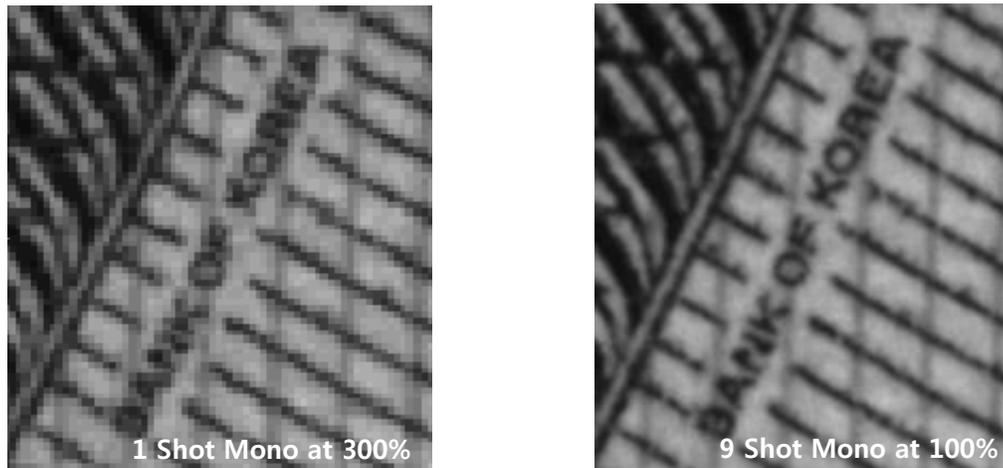
**Figure 9.15 Comparison of a Pixel Shifting Image with a Standard Image**



- The camera contains components sensitive to heat, shock or vibration. Handle this camera with the maximum care. Operate the camera at temperature between 10°C and 40°C.
- Due to a temperature difference between the inside and outside of the product, moisture may condense inside or outside the camera. This moisture condensation may cause a malfunction of the camera or shorten the product life cycle. If some condensation occurs, turn off the camera and wait about an hour until the moisture evaporates.

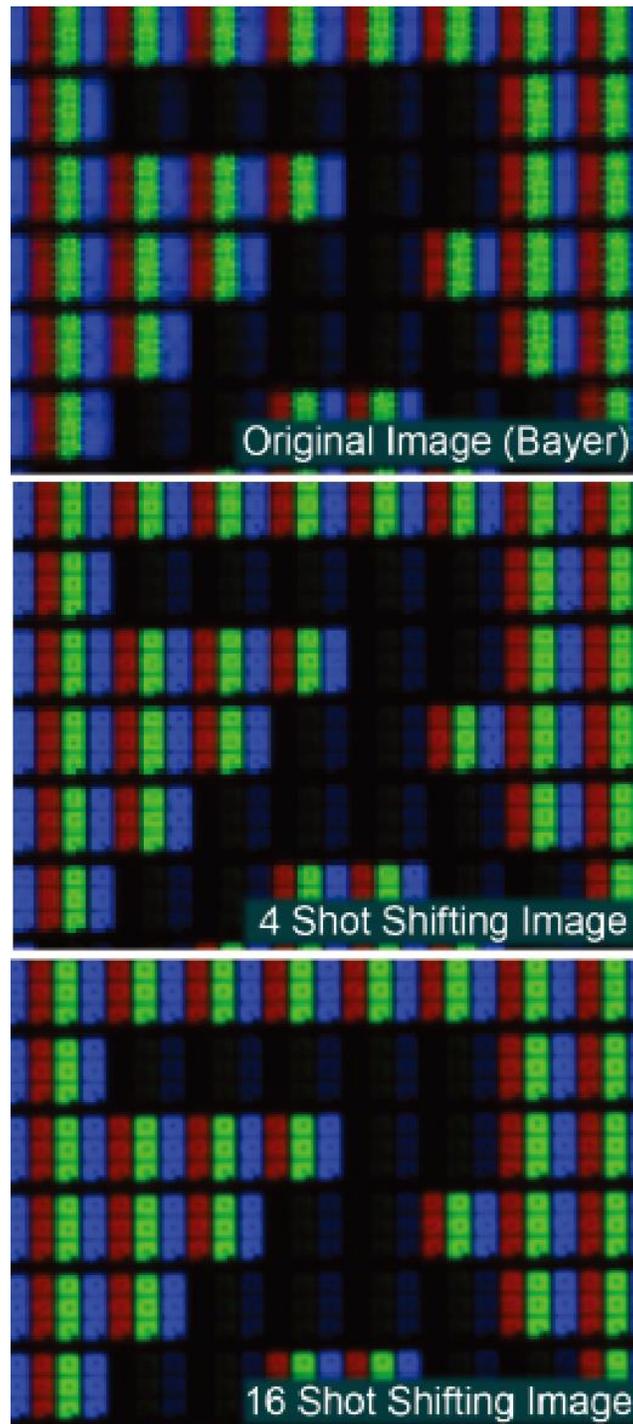
### 9.11.1 Pixel Shifting and True Color Resolution

One benefit of pixel shifting technology in comparison to fixed sensor cameras is its ability to acquire more than 4 times higher resolution than the fixed one. The figures below show a standard output image and 9× shifting output image. In case of the VNP-190MX camera, the output image will have  $26,568 \times 15,840$  (420.8 Megapixel) resolution if the pixel shifting is applied. Otherwise, the resolution of output image is  $8,856 \times 5,280$  (47 Megapixel) without pixel shifting.



**Figure 9.16 Standard (left) vs. 9 Shot Pixel Shifting (right)**

Another benefit of pixel shifting technology compared to fixed CCD is acquiring True Color images. If a camera uses Bayer Interpolation to produce a color image, unwanted artifacts may occur such as color moiré or false color pixels. Using pixel shifting, no color artifacts or aliasing will occur and the color resolution is optimized.



**Figure 9.17 Standard Image Color vs. Pixel Shifting Image Color**

## 9.11.2 Sequence Mode

### 9.11.2.1 Pixel Shifting Sequence Mode

The following Sequence Modes of pixel shifting are available on the VNP-190MX camera:

- 1. Mono 4 Frame (Doubled vertical and horizontal resolution)
- 2. Mono 9 Frame (Tripled vertical and horizontal resolution)
- 3. Mono 2 Frame H (Doubled horizontal resolution)
- 4. Mono 2 Frame V (Doubled vertical resolution)
- 5. Bayer 4 Frame (Full color resolution, no increase in resolution)
- 6. Bayer 16 Frame (Full color resolution, doubled vertical and horizontal resolution)

### 9.11.2.2 Operation of Sequence Mode

In the Sequence Mode, the position of the stage has been predefined and thus you can operate the sequence just by applying a trigger signal to the camera. The default position of the stage is (0, 0) and the following position will vary depending on the sequence mode. Once one cycle of operation has completed, the stage position returns to (0, 0). When the camera is running in the Free-Run mode, the sequence mode will be deactivated because the sequence mode is synchronized only with Software Trigger, External Trigger or CoaXPress Trigger. Refer to [Appendix C](#) for the position configurations according to the sequence modes. The minimum trigger period can be obtained as shown in the following expression:

- When sum of exposure time and stage setup time is shorter than frame transfer time:  
(Frame Transfer Time > Exposure Time + Stage Setup Time)
  - Minimum Trigger Period = Frame Transfer Time
- When sum of exposure time and stage setup time is longer than frame transfer time:  
(Frame Transfer Time < Exposure Time + Stage Setup Time)
  - Minimum Trigger Period = Exposure Time + Stage Setup Time

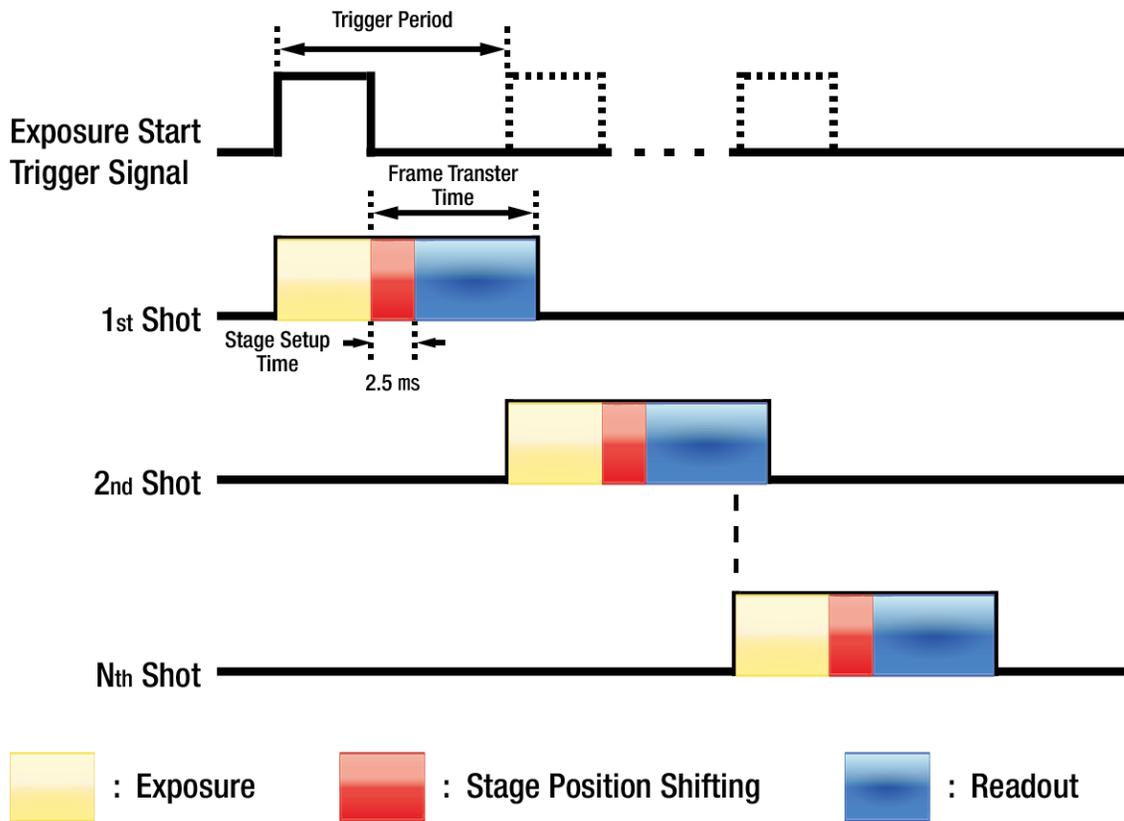


Figure 9.18 Sequence Mode Timing Diagram

The XML parameter related to Sequence Mode is as follows.

XML Parameters	Value	Description
StageControl	Off	Sequence Off
	Mono4Frame	4 shot Mono
	Mono9Frame	9 shot Mono
	Mono2FrameH	2 shot Mono in horizontal direction
	Mono2FrameV	2 shot Mono in vertical direction
	Bayer4Frame	4 shot Color (Color Camera Only)
	Bayer16Frame	16 shot Color (Color Camera Only)

Table 9.13 XML Parameters related to Sequence Mode

### 9.11.2.3 Multi Shot

When **Multi Shot** is enabled, the sequence operation that is followed by the first trigger input will be performed automatically by internal trigger. Internal trigger is generated by calculating the optimized timing reflecting trigger delay and stage setup time. Trigger input from the external ports will be ignored until completing the readout of the last image.

Multi Shot Enable: 1 trigger N snap  
 Sequence is performed in sequence with one trigger input.

Multi Shot Disable: 1 trigger 1 snap  
 Exposure synchronizes with trigger input and N times trigger input is required to acquire N images.

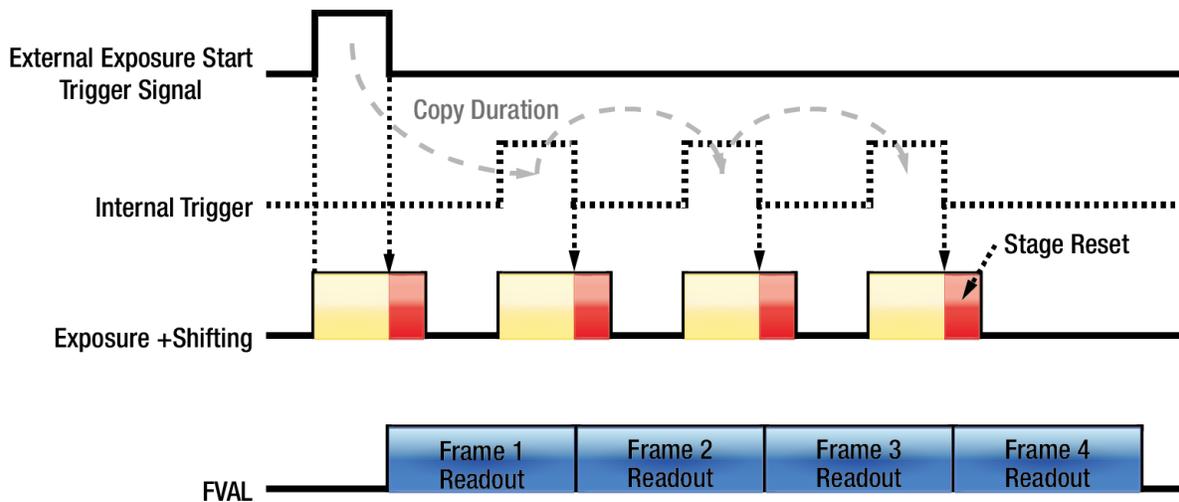


Figure 9.19 Timing Diagram when Multi Shot is enabled on Sequence 4 Shot Mode

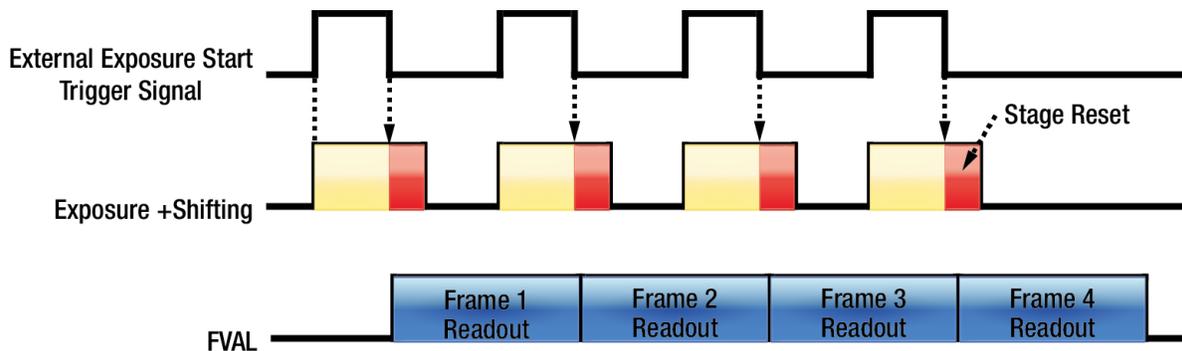


Figure 9.20 Timing Diagram when Multi Shot is disabled on Sequence 4 Shot Mode

The XML parameter related to Multi Shot is as follows.

XML Parameters		Value	Description
StageControl	MultishotEnable	Off	Multi Shot feature Off
		On	Enables the Multi Shot feature.

**Table 9.14 XML Parameters related to Multi Shot**

### 9.11.2.4 Stage Reset

Executing the **Stage Reset** command will reset the stage. Stage reset performs the following two features depending on the current status of the stage.

- Sequence Mode reset
  - When the **Stage Reset** command is executed while running the stage, the camera stops and resets the sequence, and then returns to the waiting for the trigger input status.
- Stage Position Sensor Calibration
  - Zero points can be changed according to temperature changes since the displacement sensor of the stage is sensitive to temperature. This feature adjusts zero point of the displacement sensor so that the sensor can be maintained within the operating range.



Zero point drift (the displacement sensor strays from the stage's operating range) may occur according to changes to mechanical parts of the camera or to the temperature on the installation environment. In this case, executing a **Stage Reset** command will compensate zero point drift to operate the stage normally.

### 9.11.2.5 Calibration Auto

This feature is only available when the Sequence Mode is enabled. If the **Calibration Auto** feature is set to **On**, the displacement sensor of the stage will be reset (zero point adjustment) whenever one cycle of sequence is completed.

### 9.11.2.6 Stage Status

In the Sequence Mode, you can determine whether the stage normally operates or not by counting the number of images acquired. When you set the **Sequence Mode** to **Mono4Frame**, for example, the camera will acquire and transfer four images. However, if the camera unexpectedly stops the sequence, the camera cannot acquire and transfer four images in this abnormal operation status. In this case, read the **StageStatus** parameter value in the **StageControl** category and then send it to local dealer or factory representative. Vieworks can diagnose the camera with the error code.



An impact of 5G or more would distort the operation range of the stage or alignment of the sensor and cause permanent damage to the stage since it is mechanically sensitive to shocks. Please handle the camera with care.

The XML parameters related to Stage Reset and Stage Status are as follows.

XML Parameters		Value	Description
StageControl	StageReset	-	Resets the stage.
	CalibrationAuto	Off	Not to execute the Stage Reset after completing one cycle of sequence.
		On	Execute the Stage Reset automatically after completing one cycle of sequence.
	StageStatus	-	Returns an error code if the stage operates abnormally.

**Table 9.15 XML Parameters related to Stage Reset and Stage Status**

### 9.11.2.7 Stage Index Display

When the **Stage Index Display** feature is enabled in the Sequence Mode, you can output images with the specified grey level for the (0, 0) coordinates. Thus, you can verify the order of images acquired.

For example, if the **Sequence Mode** parameter is set to **Mono4Frame**, the grey level for the (0, 0) coordinate of the first image is '0', the grey level for the (0, 0) coordinate of the second image is '1', the grey level for the (0, 0) coordinate of the third image is '2', and the grey level for the (0, 0) coordinate of the fourth image is '3'.

The XML parameter related to Stage Index Display is as follows.

XML Parameters		Value	Description
StageControl	StageIndexDisplay	Off	Disables the Index Display when acquiring images in the Sequence Mode.
		On	Enables the Index Display when acquiring images in the Sequence Mode.

**Table 9.16 XML Parameters related to Stage Index Display**

## 9.12 Sequencer Control

The Sequencer Control provided by the VNP-190MX camera allows you to apply different sets of parameter settings, called 'Sequencer Set', to a sequence of image acquisitions. As the camera acquires images, it applies one Sequencer Set after the other. This allows the camera to respond quickly to changing imaging requirements. For example, changes in illumination conditions influence the imaging requirements.

With the User Set Control feature, you can save user defined Sequencer Sets in the camera's non-volatile memory. Then after the camera is powered on or reset, the Sequencer Sets are available according to the **User Set Default** parameter. Each Sequencer Set is identified by an index number ranging from 0 to 31. Accordingly, you can define up to 32 different Sequencer Sets.

On the VNP-190MX camera, only the Flat Field data can be configured for Sequencer Sets. This means that four different Flat Field data (0 – 3) can be applied to different Sequencer Sets during the Pixel Shifting sequence.

The XML parameters related to Sequencer Control are as follows.

XML Parameters		Value	Description
SequencerControl	SequencerMode	On	Enables the Sequencer.
		Off	Sequencer Off
	SequencerConfigurationMode	On	Enables the Sequencer Configuration Mode.
		Off	Sequencer Configuration Mode Off
	SequencerSetSelector	0~31	Selects an index number of a Sequencer Set to be configured.
	SequencerSetActive	0~31	Displays the index number of the Sequencer Set that is currently active.
	SequencerSetCount	1~32	Sets the number of Sequencer Sets to be applied.
SequencerReset	-	Returns to <b>Sequencer Set 0</b> .	

**Table 9.17 XML Parameters related to Sequencer Control**



To apply Sequencer Sets on the VNP-190MX camera, you must operate the camera in the Pixel Shifting Stage Mode.

## Use Case – Applying Four Different Flat Field Data to Sequencer Sets

For example, assume that four different Flat Field data optimized for White, Green, Red and Blue pixels are applied to four different Sequencer Sets to inspect LCD panels.

1. Set the **Sequencer Mode** parameter to **Off**.
2. Sets the **Sequencer Configuration Mode** parameter to **On**.
3. Set the **Sequencer Set Selector** parameter to **0** and set the **Flat Field Data Selector** parameter to **0**.  
Then, set the **Sequencer Set Selector** parameter to **1, 2 and 3** and set the **Flat Field Data Selector** parameter to **1, 2 and 3** respectively.
4. Set the **Sequencer Set Count** parameter to **4**.
5. Set the **Sequencer Configuration Mode** parameter to **Off**, and then set the **Sequencer Mode** parameter to **On**.

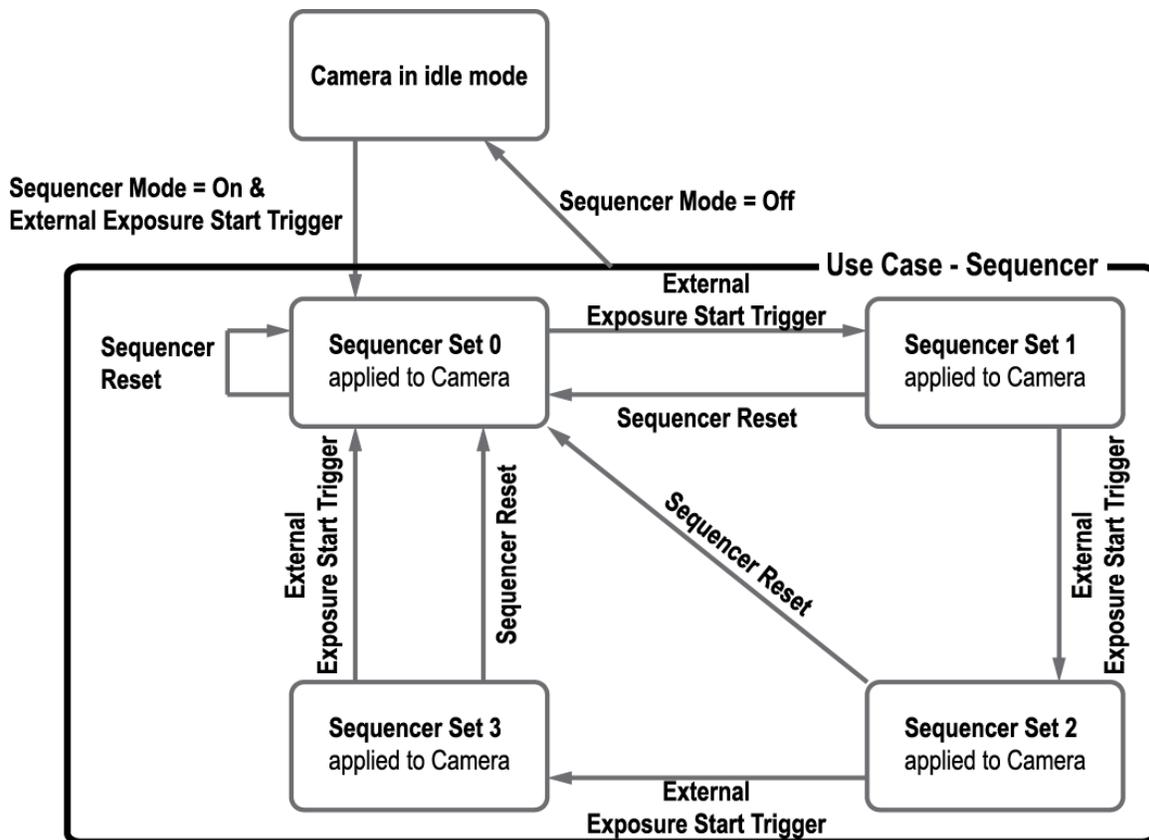


Figure 9.21 Sequencer Diagram (Use Case)



- The use case described above assumes that the **Sequence Mode** parameter is set to **Mono4Frame** and the **Multishot Enable** parameter is set the **On** to operate the camera in the Pixel Shifting mode.
- You can save the user defined Sequencer Sets in the camera's non-volatile memory by using the User Set Control feature. For more information, refer to [9.24 User Set Control](#).
- Executing the **Sequencer Reset** parameter allows to return to the **Sequencer Set 0** status at any time while cycling through the Sequencer.

## 9.13 Dark Signal Non-uniformity Correction

In theory, when an area scan camera captures a frame in complete darkness, all of the pixel values in the frame should be near zero and they should be equal. In practice, however, slight variations in the performance of the pixels in the sensor will cause some variations in the pixel values output from the camera when the camera is capturing in darkness. This variation is known as Dark Signal Non-uniformity (DSNU). The VNP-190MX camera provides the DSNU Correction feature.

## 9.14 Photo Response Non-uniformity Correction

In theory, when a digital camera acquires images with the camera viewing a uniform light-colored target in bright light, all of the pixel values in the image should be near the maximum grey value and they should be equal. In practice, however, slight variations in the performance of the pixels in the sensor, variations in the optics, and variations in the lighting will cause some variations in the pixel values output from the camera. This variation is known as Photo Response Non-Uniformity (PRNU). The VNP-190MX camera provides the PRNU correction feature. The PRNU Correction feature implemented on the VNP-190MX camera acquires one or more images under the unsaturated lighting condition and then obtains the average grey level value of the entire image. Then, PRNU coefficients for each pixel will be generated according to the average grey level value. These correction values will be generated and applied to the VNP-190MX camera during the manufacturing process.

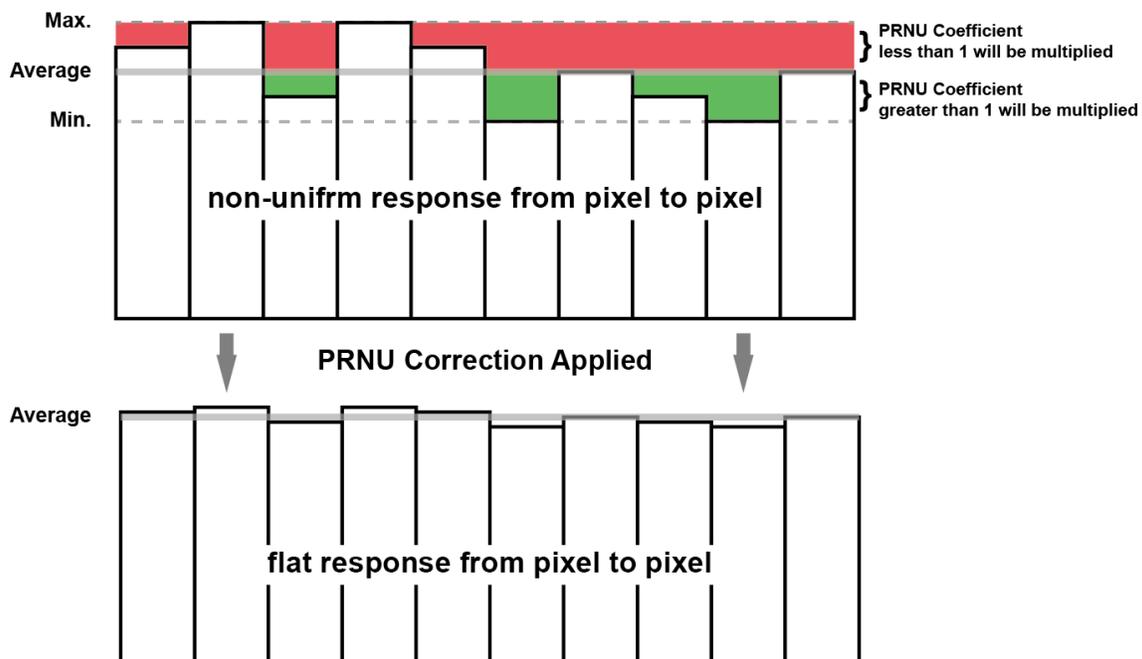


Figure 9.22 PRNU Correction

## 9.15 Temperature Monitor

A sensor chip is embedded in the camera to monitor the internal temperature.

The XML parameters related to Device Temperature are as follows.

XML Parameters		Value	Description
DeviceControl	DeviceTemperatureSelector	Sensor	Sets a temperature measuring spot to the image sensor.
		Mainboard	Sets a temperature measuring spot to the mainboard.
	DeviceTemperature	-	Displays device temperature in Celsius.

**Table 9.18 XML Parameter related to Device Temperature**

## 9.16 Status LED

A LED is installed on the back panel of the camera to inform the operation status of the camera. LED status and corresponding camera status are as follows:

- Steady Red: The camera is not initialized.
- Slow Flashing Red: A CXP link is not configured.
- Fast Flashing Orange: The camera is checking a CXP link configuration.
- Steady Green: A CXP link is configured.
- Fast Flashing Green: The camera is transmitting image data.

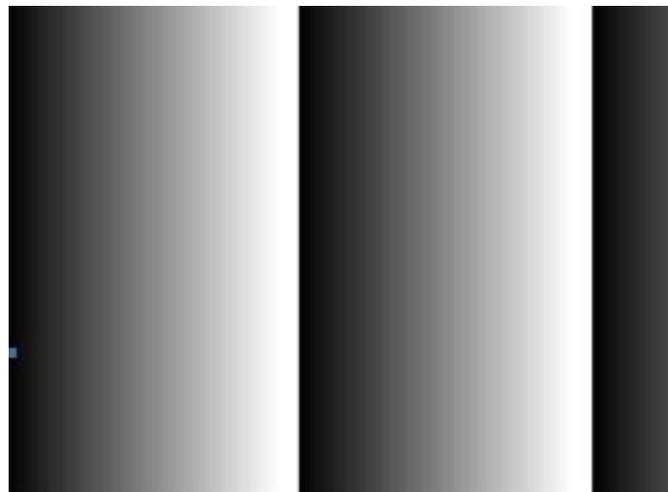
## 9.17 Test Pattern

To check whether the camera operates normally or not, it can be set to output test patterns generated in the camera, instead of image data from the image sensor. Three types of test patterns are available; image with different value in horizontal direction (Grey Horizontal Ramp), image with different value in diagonal direction (Grey Diagonal Ramp), and moving image with different value in diagonal direction (Grey Diagonal Ramp Moving).

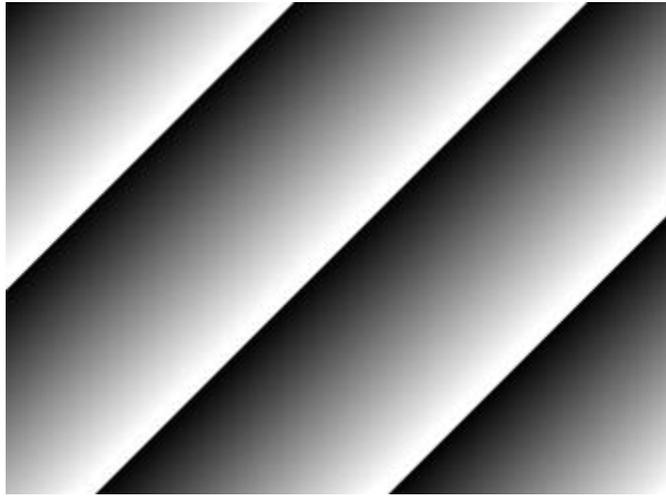
The XML parameter related to Test Pattern is as follows.

XML Parameters		Value	Description
ImageFormatControl	TestPattern	Off	Test Pattern Off
		GreyHorizontalRamp	Sets to Grey Horizontal Ramp.
		GreyDiagonalRamp	Sets to Grey Diagonal Ramp.
		GreyDiagonalRampMoving	Sets to Grey Diagonal Ramp Moving.

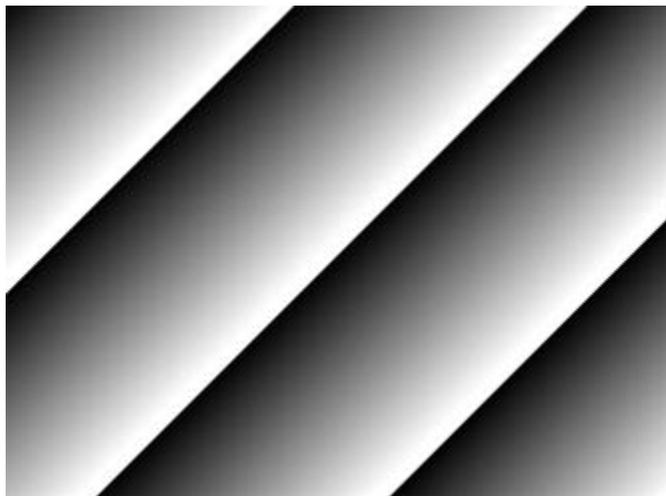
**Table 9.19 XML Parameter related to Test Pattern**



**Figure 9.23 Grey Horizontal Ramp**



**Figure 9.24 Grey Diagonal Ramp**



**Figure 9.25 Grey Diagonal Ramp Moving**



The test pattern may look different because the region of the test pattern may vary depending on the camera's resolution.

## 9.18 Reverse X

The Reverse X feature lets you flip images horizontally. This feature is available in all operation modes of the camera.



Figure 9.26 Original Image

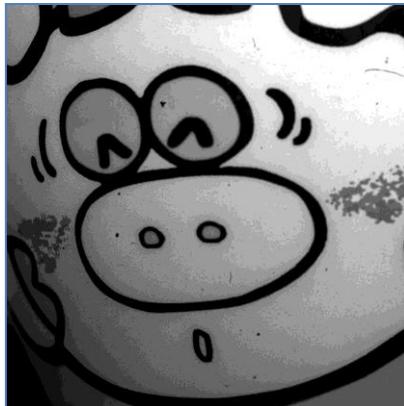


Figure 9.27 Reverse X Image



When you enable the **Reverse X** feature with the **Pixel Format** parameter set to **Bayer** on a color camera, the alignment of the color filter will be changed.

## 9.19 Digital IO Control

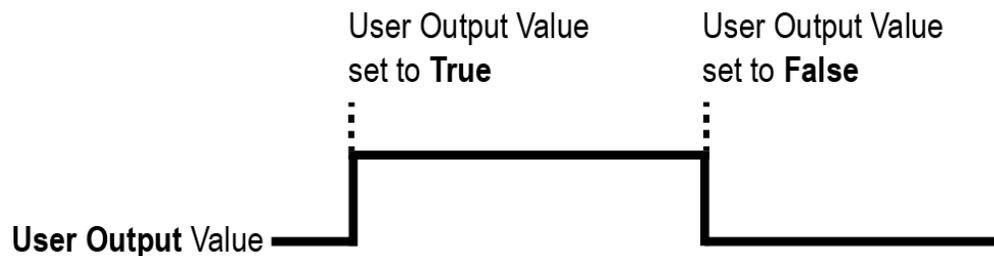
The control I/O receptacle of the camera can be operated in various modes.

The XML parameters related to Digital IO Control are as follows.

XML Parameters	Value	Description
LineInverter	FALSE	Disables inversion of the output signal of the line.
	TRUE	Enables inversion of the output signal of the line.
DigitalIOControl LineSource	Off	Disables the line output.
	ExposureActive	Outputs pulse signals indicating the current exposure time.
	FrameActive	Outputs pulse signals indicating a frame readout time.
	UserOutput	Outputs pulse signals set by the UserOutputValue parameter.
	Timer0Active	Outputs user-defined Timer signals as pulse signals.
UserOutputValue	FALSE	Sets the bit state of the line to Low.
	TRUE	Sets the bit state of the line to High.

**Table 9.20 Digital IO Control**

When you set the **Line Source** to **User Output**, you can use the user setting value as output signals.



**Figure 9.28 User Output**

## 9.19.1 Debounce

The Debounce feature of the VNP-190MX camera allows to supply only valid signals to the camera by discriminating between valid and invalid input signals. The **Debounce Time** parameter specifies the minimum time that an input signal must remain High or Low in order to be considered as a valid input signal. When you use the Debounce feature, be aware that there is a delay between the point where the valid input signal arrives and the point where the signal becomes effective. The duration of the delay is determined by the Debounce Time parameter setting value. When you set the **Debounce Time** parameter, High and Low signals shorter than the setting value are considered invalid and ignored as shown in the figure below.

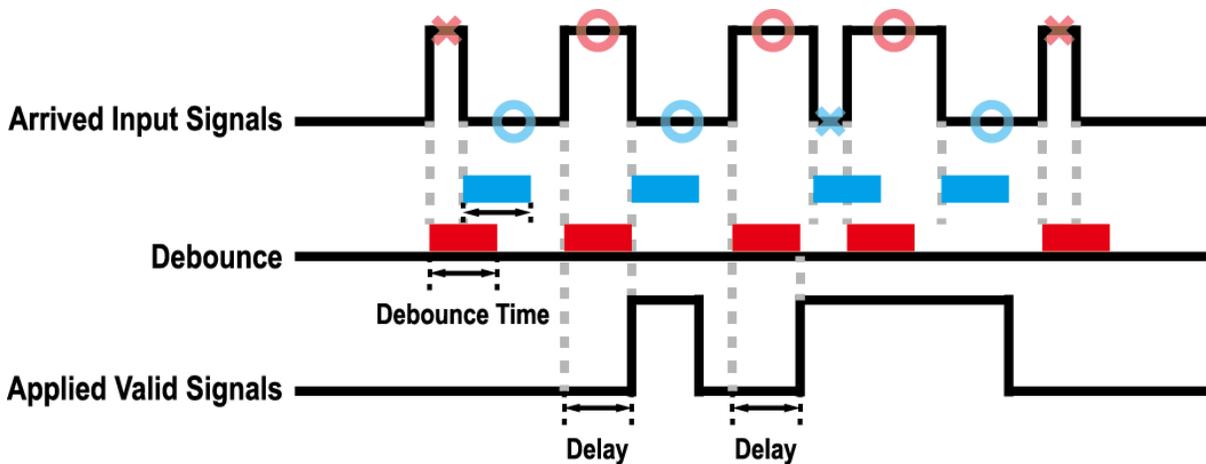


Figure 9.29 Debounce

The XML parameter related to Debounce is as follows.

XML Parameters		Value	Description
DigitalIOControl	DebounceTime	0 – 1,000,000 $\mu$ s	Sets a Debounce Time value in microseconds (Default: 0.5 $\mu$ s).

Table 9.21 XML Parameter related to Debounce Time

## 9.20 Counter and Timer Control

When the **Line Source** parameter in the **Digital IO Control** category is set to **Timer0 Active**, the camera can provide output signals by using the Timer. The VNP-190MX camera has one Timer designated as Timer0 and exposure start is the only trigger source event available to start the Timer.

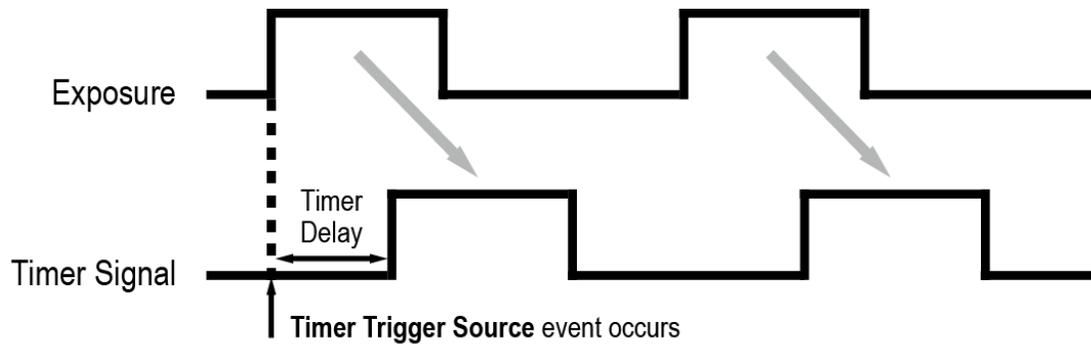
The XML parameters related to Counter and Timer Control are as follows.

XML Parameters		Value	Description
CounterAndTimerControl	TimerDuration	0 – 60,000,000 $\mu$ s	Sets the duration of the Timer output signal.
	TimerDelay	0 – 60,000,000 $\mu$ s	Sets the delay time to be applied before starting the Timer.
	TimerReset	-	Resets the Timer and starts it again.
	TimerTriggerSource	Off	Disables the Timer trigger.
		Exposure	Sets the Timer to use the exposure start as source signals.
	TimerTriggerActivation	Falling Edge	Specifies that a falling edge of the selected trigger signal will act as the Timer trigger.
		Rising Edge	Specifies that a rising edge of the selected trigger signal will act as the Timer trigger.
		Level Low	Specifies that the Timer output signal will be valid as long as the selected trigger signal is Low.
		Level High	Specifies that the Timer output signal will be valid as long as the selected trigger signal is High.

**Table 9.22 XML Parameters related to Counter and Timer Control**

For example, when the **Timer Trigger Activation** is set to **Level High**, the Timer will act as follows:

1. When source signals set by the **Timer Trigger Source** (Exposure is only available) are applied, the Timer will start operations.
2. The delay set by the **Timer Delay** begins to expire.
3. When the delay expires, the Timer signal goes high as long as the source signal is high.



\* **Timer Trigger Activation** is set to **Level High**.

**Figure 9.30** Timer Signal

## 9.21 Cooling Control

A fan is installed on the rear panel of the camera and Thermoelectric Peltier is installed inside the camera to control the image sensor temperature. You can set the fan and Peltier to turn on or off. You can also set the fan and/or Peltier to turn on when a specified internal temperature is reached.

The XML parameters related to Cooling Control are as follows.

XML Parameters		Value	Description
CoolingControl	FanOperationMode	Off	Turns off the fan.
		On	Turns on the fan.
	TargetTemperature	10°C~80°C	Sets the target temperature to operate the fan and/or Thermoelectric Peltier.
	FanSpeed	–	Displays the current Fan RPM.
	PeltierOperationMode	Off	Turns off the Thermoelectric Peltier.
On		Turns on the Thermoelectric Peltier when the internal temperature exceeds the value set in the <b>Target Temperature</b> parameter.	

**Table 9.23 XML Parameters related to Cooling Control**

## 9.22 Device User ID

You can input user defined information up to 16 bytes.

The XML parameter related to Device User ID is as follows.

XML Parameters		Description
DeviceControl	DeviceUserID	Input user defined information (16 bytes).

**Table 9.24 XML Parameter related to Device User ID**

## 9.23 Device Reset

Resets the camera physically to power off and on. You must configure a link again because the camera will be released from the link between the camera and CXP Frame Grabber after reset.

The XML parameter related to Device Reset is as follows.

XML Parameters		Description
DeviceControl	DeviceReset	Resets the camera physically.

**Table 9.25 XML Parameter related to Device Reset**

## 9.24 User Set Control

You can save the current camera settings to the camera's internal ROM. You can also load the camera settings from the camera's internal ROM. The camera provides two setups to save and three setups to load settings.

The XML parameters related to User Set Control are as follows.

XML Parameters		Value	Description
UserSetControl	UserSetSelector	Default	Selects the Factory Default settings.
		UserSet1	Selects the User Set1 settings.
		UserSet2	Selects the User Set2 settings.
	UserSetLoad	-	Loads the User Set specified by User Set Selector to the camera.
	UserSetSave	-	Saves the current settings to the User Set specified by User Set Selector. <ul style="list-style-type: none"> <li>The Default is a Factory Default Settings and allowed to load only.</li> </ul>
	UserSetDefault	Default	Applies the Factory Default settings when reset.
		UserSet1	Applies the User Set1 when reset.
		UserSet2	Applies the User Set2 when reset.

**Table 9.26 XML Parameters related to User Set Control**

The camera settings stored in the Default can be loaded into the camera's work space, but cannot be changed. The settings set in the work space will be lost if the camera is reset or powered off. To use the current setting values in the work space after a reset, you must save the settings to one of the user spaces.

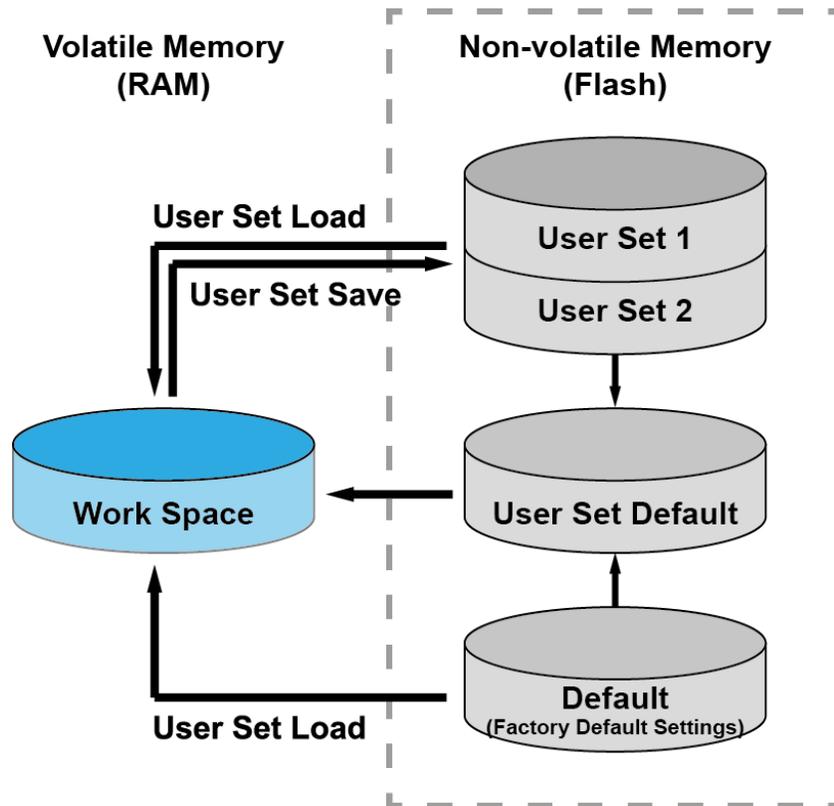


Figure 9.31 User Set Control

## 9.25 Field Upgrade

The camera provides a feature to upgrade the Firmware and FPGA logic through the CoaXPress interface rather than disassemble the camera in the field. Refer to [Appendix B](#) for more details about how to upgrade.

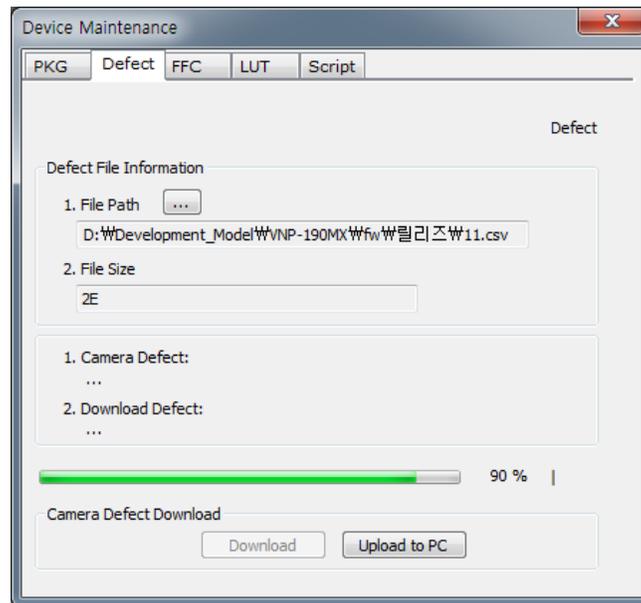
## 10 Troubleshooting

When you have a problem with a Vieworks camera, please check the following:

- If no image is displayed on your computer,
  - Ensure that all the cable connections are secure.
  - Ensure that the power supply is properly connected.
  - Ensure that trigger signal is applied correctly when you set the Trigger Mode parameter to On.
  
- If images are not clear,
  - Ensure the camera lens or glass is clean.
  - Check the lens aperture is adjusted properly.
  
- If images are dark,
  - Ensure your camera lens is not blocked.
  - Check the exposure time is set properly.
  - Check the aperture is opened properly.
  - Check the Gain value is not set too small.
  
- If you identify abnormal operation or overheating sign,
  - Ensure that power supply is properly connected.
  - Stop using the camera when you notice smoke or abnormal overheating.
  
- If you have a problem using the Trigger Mode,
  - Ensure that the Software trigger related parameters are configured correctly.
  - Ensure that the trigger related parameters on your CXP Frame Grabber are configured correctly when you set the Trigger Source parameter to CXPin.
  - Ensure that cable connections are secure when you set the Trigger Source parameter to LineIn0.
  
- If there is a communication failure between the camera and computer,
  - Ensure coax cables are connected properly.
  - Ensure that you have configured a CXP Frame Grabber in your computer correctly and the camera is connected properly to the CXP Frame Grabber.



- Once the download is complete, the saving process will begin. During the saving process, make sure not to disconnect the power cord.

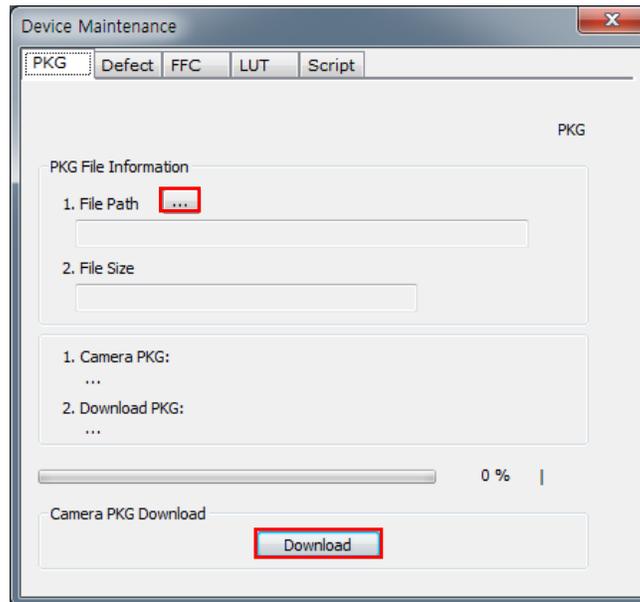


- After completing the download, click the **OK** button to close the confirmation.

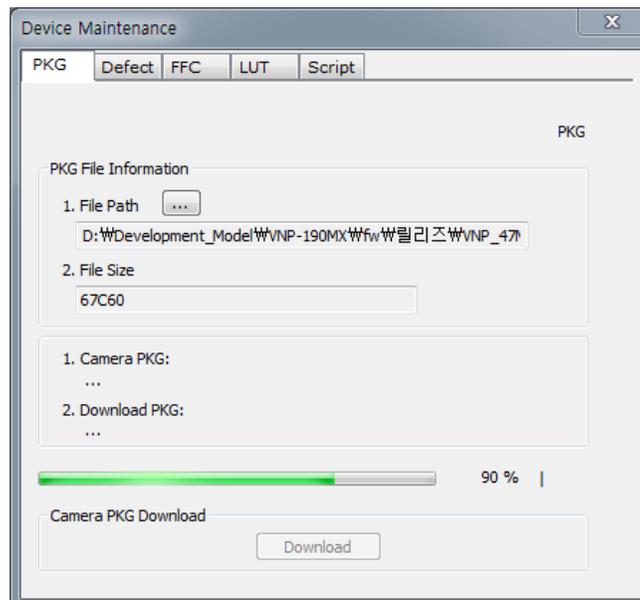
## Appendix B Field Upgrade

### B.1 MCU

1. Run Vieworks Imaging Solution 7.X and click the **Configure** button to display the window as shown below.
2. Select the **PKG** tab, click the File Path button, search and select the MCU upgrade file (\*.mcu), and then click the **Download** button.



3. MCU upgrade file download starts and the downloading status is displayed at the bottom of the window.

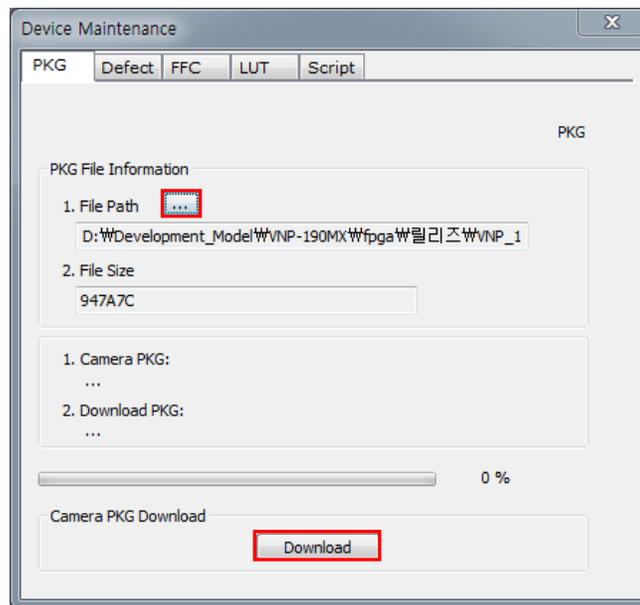


- Once all the processes have been completed, turn the camera power off and turn it back on again. Check the DeviceVersion parameter value to confirm the version.

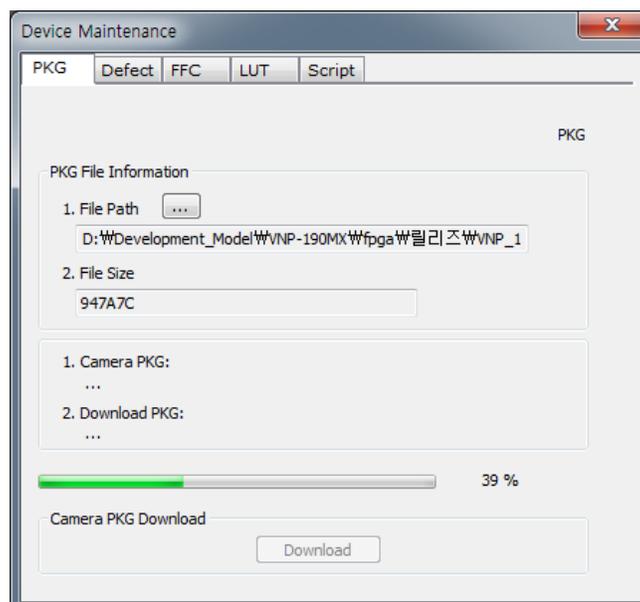
DeviceControl	
DeviceScanType	Areascan
DeviceVendorName	VIEWWORKS
DeviceModelName	VC-12MX-C180
DeviceManufacturerInfo	
DeviceVersion	M:0.4.4 F:1.1.1
DeviceSerialNumber	Z9-ECMADW001

## B.2 FPGA

1. Run Vieworks Imaging Solution 7.X and click the Configure button to display the window as shown below.
2. Select the **PKG** tab, click the File Path button, search and select the FPGA upgrade file (\*.fpga), and then click the **Download** button.

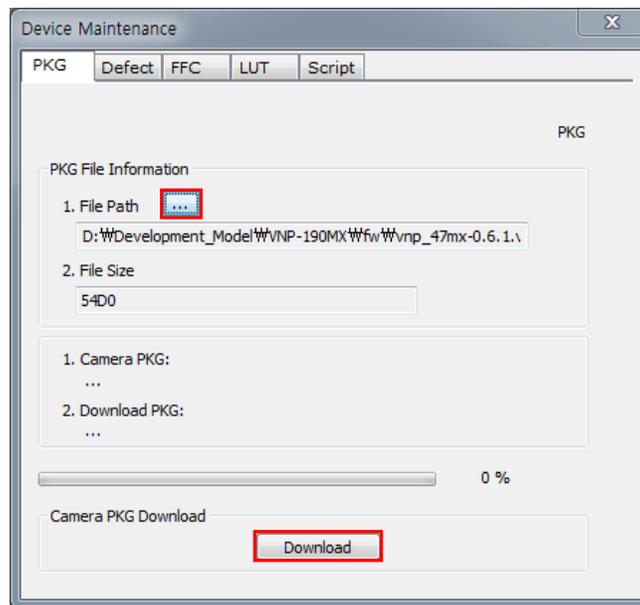


3. The subsequent processes are identical to those of MCU upgrade.

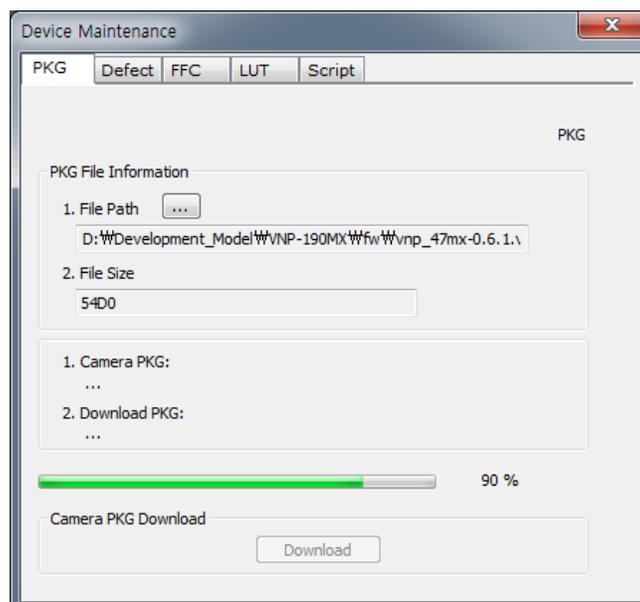


## B.3 XML

1. Run Vieworks Imaging Solution 7.X and click the **Configure** button to display the window as shown below.
2. Select the **PKG** tab, click the File Path button, search and select the XML upgrade file (\*.vxf), and then click the **Download** button.



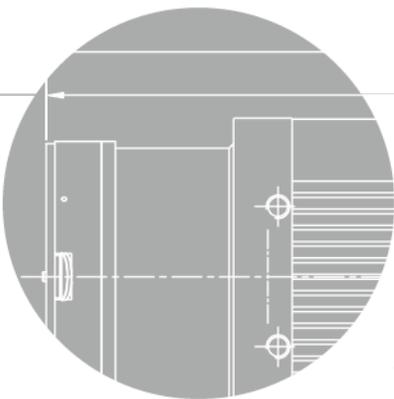
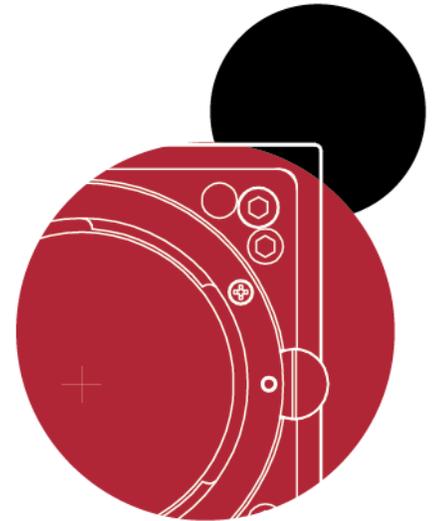
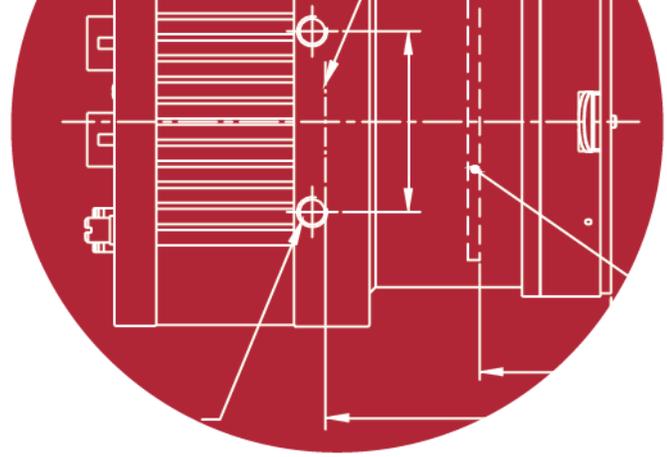
3. The subsequent processes are identical to those of MCU upgrade.



## Appendix C Position settings according to Sequence Modes

### Ratio for 1 Pixel

Order	Mono4Frame		Mono9Frame		Mono2FrameH		Mono2FrameV		Bayer4Frame		Bayer16Frame	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
1	0	0	0	0	0	0	0	0	0	0	0	0
2	1/2	0	1/3	0	1/2	0	0	1/2	1	0	1	0
3	0	1/2	2/3	0	-	-	-	-	0	1	0	1
4	1/2	1/2	0	1/3	-	-	-	-	1	1	1	1
5	-	-	1/3	1/3	-	-	-	-	-	-	1/2	0
6	-	-	2/3	1/3	-	-	-	-	-	-	3/2	0
7	-	-	0	2/3	-	-	-	-	-	-	1/2	1
8	-	-	1/3	2/3	-	-	-	-	-	-	3/2	1
9	-	-	2/3	2/3	-	-	-	-	-	-	0	1/2
10	-	-	-	-	-	-	-	-	-	-	1	1/2
11	-	-	-	-	-	-	-	-	-	-	0	3/2
12	-	-	-	-	-	-	-	-	-	-	1	3/2
13	-	-	-	-	-	-	-	-	-	-	1/2	1/2
14	-	-	-	-	-	-	-	-	-	-	3/2	1/2
15	-	-	-	-	-	-	-	-	-	-	1/2	3/2
16	-	-	-	-	-	-	-	-	-	-	3/2	3/2



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