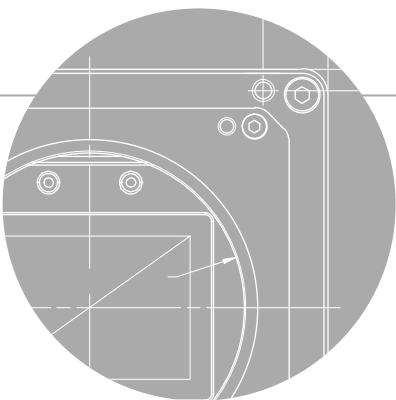


# VP series

## User Manual

English

VP-127MC-M6H  
VP-127MC-C6H



# VIEWWORKS

## Preface

No part of this manual may either be copied, reproduced, translated, or published in any form or by any means (electronic, mechanical, photocopying, or otherwise) without the express written permission of Vieworks, Co., Ltd. (hereinafter 'Vieworks').

This manual may include the website links to companies other than Vieworks. Vieworks is not responsible for any of these links. The copyrights of the materials mentioned herein are owned by each respective author.

Although Vieworks made every effort to ensure the accuracy of this document, it assumes no responsibility for errors or omissions that may appear herein. The figures in this manual may differ depending on the version of the product or operating system, or the way how it runs. Information in this manual is subject to change without notice.

## Before Using This Product

Thank you for choosing VP-127MC-M/C6H™.

- Make sure to read this manual before using the product.
- Make sure to check whatever a professional engineer has finished installation and configuration.
- Make sure to keep this manual at hand as a reference while using the product.
- This manual assumes that you have expertise in how to use an industrial camera.

## The Series

This manual is intended for users of the following products:

- VP-127MC-M/C6H

## About This Manual

This manual is intended for VP-127MC-M/C6H™ camera users. It is recommended to refer to the Frame Grabber's User Manual of yours, with this manual.

## Convention in This Manual

For better understanding, the following conventions are used throughout the manual.

### Names and Fonts

The names and fonts of user interfaces are used as follows:

- The menu and icon names in this manual are used as displayed in the product.
- The menu and icon names are marked in this font.
- Button or keyboard key names are marked in this font.

### Warning, Caution, and Note

This manual shows warnings, cautions, and notes with the following figures:

**Warning!**

This indicates that you need to follow this message for your safety and to prevent the product from damage.

---

**Caution!**

This indicates that you need to follow this message to prevent data from being lost or corrupted.

---

**Note:**

This indicates that this message provides additional information.

---

## Definition of Terms

For clarity, this manual defines some terms as follows:

Term	Definition
Preface	The introductory part preceding the Table of Contents in this manual
Configurator	A sample application provided to control a Vieworks camera of Camera Link

## Revision History

This document has the revision history as follows:

Version	Date	Description
1.0	2022-10-31	Initial Release
1.1	2022-12-16	Modified the mechanical dimension
	2023-01-06	Modified detail on the maximum frame rates per ROI
	2023-01-09	Modified the Trigger Synchronization item in the Specification table

## Contents

<b>Chapter 1. Precautions .....</b>	<b>13</b>
<b>Chapter 2. Warranty .....</b>	<b>14</b>
<b>Chapter 3. Compliance &amp; Certifications .....</b>	<b>15</b>
3.1    FCC Compliance .....	15
3.2    CE: DoC.....	15
3.3    KC .....	15
<b>Chapter 4. Package Component.....</b>	<b>16</b>
<b>Chapter 5. Product Specifications.....</b>	<b>17</b>
5.1    Overview .....	17
5.2    Specifications .....	18
5.3    Camera Block Diagram .....	19
5.4    Spectral Response .....	20
5.5    Mechanical Specification .....	21
<b>Chapter 6. Connecting the Camera.....</b>	<b>22</b>
6.1    Precaution to Center the Image Sensor .....	23
6.2    Precaution about Blurring Compared to the Center .....	23
6.3    Controlling the Camera .....	23
<b>Chapter 7. Camera Interface.....</b>	<b>24</b>
7.1    General Description.....	24
7.2    Camera Link SDR Connector.....	25
7.3    Power Input Receptacle .....	27
7.4    Control I/O Receptacle .....	28
7.5    Trigger Input Circuit.....	29
7.6    Strobe Output Circuit .....	29
<b>Chapter 8. Acquisition Control.....</b>	<b>30</b>
8.1    Overview .....	30
8.2    Acquisition Start/Stop Commands and Acquisition Mode.....	31
8.2.1    Acquisition Start/Stop Commands.....	31

8.2.2	Acquisition Mode.....	31
8.2.3	Exposure Start Trigger .....	32
8.2.4	Applying Trigger Signals .....	33
8.2.5	Exposure Time Control.....	34
8.3	Exposure Start Trigger .....	35
8.3.1	Trigger Mode .....	35
8.3.2	Using a Software Trigger Signal.....	38
8.3.3	Using a CC1 Trigger Signal.....	39
8.3.4	Using an External Trigger Signal .....	40
8.3.5	Exposure Mode .....	42
8.3.6	Short Exposure Mode.....	44
8.3.7	Exposure Offset .....	45
8.4	Setting the Exposure Time .....	46
8.5	Overlapping Exposure with Sensor Readout .....	47
8.6	Global Shutter .....	48
8.7	Maximum Allowed Frame Rate.....	49
8.7.1	Increasing the Maximum Allowed Frame Rate .....	50
<b>Chapter 9. Camera Features.....</b>		<b>51</b>
9.1	Sequence of Signal Processing .....	51
9.2	Image Region of Interest.....	52
9.3	Multi-ROI.....	56
9.4	Binning.....	59
9.5	Pixel Format.....	61
9.6	Camera Link Tap Geometry .....	62
9.7	Camera Link Pixel Clock Speed .....	63
9.8	Data ROI (Color Only) .....	64
9.9	White Balance (Color Only).....	65
9.9.1	Balance White Auto .....	65
9.10	Gain and Black Level .....	66

9.11	Defective Pixel Correction .....	67
9.11.1	Correction Method.....	67
9.12	Dark Signal Non-uniformity Correction .....	68
9.13	Hot Pixel Correction .....	68
9.14	Photo Response Non-uniformity Correction .....	69
9.15	Flat Field Correction.....	70
9.15.1	Flat Field Data Selector .....	73
9.16	Timestamp.....	74
9.17	Event Control.....	75
9.18	Digital I/O Control .....	76
9.19	Debounce.....	78
9.20	Timer Control .....	79
9.21	Cooling Control.....	81
9.22	Temperature Monitor.....	81
9.23	Status LED.....	82
9.24	Test Pattern .....	83
9.25	Reverse X.....	85
9.26	Device Link Throughput Limit.....	86
9.27	Device User ID .....	86
9.28	Device Reset .....	86
9.29	Field Upgrade.....	87
9.30	User Set Control.....	87
9.31	Sequencer Control .....	89
<b>Chapter 10. Camera Configuration .....</b>		<b>92</b>
10.1	Setup Command .....	92
10.2	Actual Runtime of Commands .....	94
10.3	Configurator .....	95
10.4	Command List .....	98
<b>Chapter 11. Troubleshooting .....</b>		<b>105</b>
<b>Appendix A. Defective Pixel Map Download .....</b>		<b>107</b>
<b>Appendix B. Field Upgrade.....</b>		<b>110</b>
<b>Appendix C. Index .....</b>		<b>113</b>

## Tables

Table 5-1	Specifications of VP-127MC-M/C6H.....	18
Table 7-1	Pin Assignments for Camera Link Connector 1.....	25
Table 7-2	Pin Assignments for Camera Link Connector 2.....	26
Table 7-3	Connector Arrangement for the Camera Link Tap Geometry .....	26
Table 7-4	Pin Configurations for Power Input Receptacle .....	27
Table 7-5	Pin Configurations for Control I/O Receptacle.....	28
Table 8-1	Exposure Offset .....	45
Table 8-2	Minimum and Maximum Exposure Time Setting .....	46
Table 9-1	XML Parameters related to ROI .....	53
Table 9-2	Minimum ROI Width and Height Settings.....	53
Table 9-3	Maximum Frame Rates by VC-127MC Vertical ROI Changes (@Pixel Clock 85MHz)....	55
Table 9-4	XML parameters related to Multi-ROI.....	56
Table 9-5	XML Parameters related to Binning .....	59
Table 9-6	XML Parameter related to Pixel Format .....	61
Table 9-7	Pixel Format Values .....	61
Table 9-8	XML Parameter related to Camera Link Tap Geometry .....	62
Table 9-9	XML Parameter related to Camera Link Pixel Clock Speed .....	63
Table 9-10	XML Parameters related to Data ROI.....	64
Table 9-11	XML Parameters related to White Balance .....	65
Table 9-12	XML Parameter related to Balance White Auto .....	65
Table 9-13	XML Parameters related to Gain and Black Level .....	66
Table 9-14	Calculation of Defect Pixel Correction Value .....	67
Table 9-15	Command related to Hot Pixel Correction .....	68
Table 9-16	XML Parameters related to Flat Field Correction.....	72



Table 9-17	XML Parameters related to Timestamp.....	74
Table 9-18	XML Parameters related to Event Control.....	75
Table 9-19	XML Parameters related to Digital I/O Control.....	76
Table 9-20	XML Parameter related to Debounce Time.....	78
Table 9-21	XML Parameters related to Timer Control.....	79
Table 9-22	XML Parameters related to Cooling Control.....	81
Table 9-23	XML Parameters related to Device Temperature.....	81
Table 9-24	Status LED.....	82
Table 9-25	XML Parameter related to Test Pattern.....	83
Table 9-26	XML Parameter related to Reverse X.....	85
Table 9-27	XML Parameter related to Device Link Throughput Limit.....	86
Table 9-28	XML Parameter related to Device User ID.....	86
Table 9-29	XML Parameter related to Device Reset.....	86
Table 9-30	XML Parameters related to User Set Control.....	87
Table 9-31	XML Parameters related to Sequencer Control.....	89
Table 10-1	Command List #1.....	98
Table 10-2	Command List #2.....	99
Table 10-3	Command List #3.....	100
Table 10-4	Command List #4.....	101
Table 10-5	Command List #5.....	102
Table 10-6	Command List #6.....	103
Table 10-7	Command List #7.....	104

## Figures

Figure 5-1	Camera Block Diagram.....	19
Figure 5-2	Spectral Response - Mono .....	20
Figure 5-3	Spectral Response - Color .....	20
Figure 5-4	Mechanical Dimension for VP-127MC-M/C6H .....	21
Figure 7-1	VP-127MC-M/C6H Back Panel.....	24
Figure 7-2	Camera Link Connector.....	25
Figure 7-3	Pin Assignments for Power Input Receptacle .....	27
Figure 7-4	Pin Assignments for Control I/O Receptacle.....	28
Figure 7-5	Trigger Input Schematic.....	29
Figure 7-6	Strobe Output Schematic .....	29
Figure 8-1	Exposure Start Triggering.....	32
Figure 8-2	Frame Acquisition with Software Trigger Signal .....	38
Figure 8-3	External Trigger Delay .....	41
Figure 8-4	Timed Exposure Mode .....	42
Figure 8-5	Trigger Overlapped with Timed Exposure Mode .....	42
Figure 8-6	Trigger Width Exposure Mode .....	43
Figure 8-7	Setting Exposure Time to compensate for the Exposure Offset .....	45
Figure 8-8	Overlapped Exposure and Readout .....	47
Figure 8-9	Global Shutter .....	48
Figure 9-1	Sequence of signal processing to correct images .....	51
Figure 9-2	Region of Interest.....	52
Figure 9-3	Specifying Offset Y for maximum frame rates .....	54
Figure 9-4	Multi-ROI.....	57
Figure 9-5	2 × 2 Binning and 4 × 4 Binning .....	60

Figure 9-6	Camera Link Tap Geometry.....	62
Figure 9-7	Effective Data ROI.....	64
Figure 9-8	Location of Defect Pixel to be corrected .....	67
Figure 9-9	Generation and Application of Flat Field Data.....	71
Figure 9-10	Bilinear Interpolated Magnification .....	71
Figure 9-11	Flat Field Data Selector.....	73
Figure 9-12	User Output .....	77
Figure 9-13	Exposure Active Signal.....	77
Figure 9-14	Debounce .....	78
Figure 9-15	Timer Signal.....	80
Figure 9-16	Grey Horizontal Ramp.....	83
Figure 9-17	Grey Diagonal Ramp.....	84
Figure 9-18	Grey Diagonal Ramp Moving.....	84
Figure 9-19	Sensor Specific .....	84
Figure 9-20	Original Image .....	85
Figure 9-21	Reverse X Image.....	85
Figure 9-22	User Set Control.....	88
Figure 9-23	Sequencer Diagram (Use Case).....	91
Figure 10-1	Actual Runtime of Commands.....	94
Figure 10-2	Add to list in the Camera Scan window.....	95
Figure 10-3	Device Property .....	96
Figure 10-4	Configurator Plus and Device Maintenance.....	97



## Chapter 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 or companion animals 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 temperature.
- 

### 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.
- 

### 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 device.
  - Make sure the power is turned off before connecting the power cord to the camera. Otherwise damage to the camera may result.
-

## Chapter 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.

## Chapter 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.

## Chapter 4. Package Component

---

Package Component



VP-127MC-M/C6H <M72-mount>

---



## Chapter 5. Product Specifications

### 5.1 Overview

The VP-127MC-M/C6H, the latest model of the industrial proven VP series, is a new 127-megapixel resolution CMOS cameras available with the Camera Link interface. The camera is based on the CMOS global shutter image sensor technology (IMX661) from Sony. The VP-127MC-M/C6H camera offers up to 6.2 frames per second at 13376 × 9528 resolution. This camera uses thermoelectric Peltier (TEC) cooling technology developed for and used by many demanding medical market customers. The TEC maintains the operating temperature of the image sensor at up to 15 degrees below ambient temperature. The VP-127MC-M/C6H camera provides a stable operating condition and the ability to expose for a long period of time to increase camera sensitivity. Featuring the stable operating capability and high resolution, this camera is ideal for demanding applications such as FPD, PCB and semiconductor inspections.

#### Main Features

- High Speed 127 Megapixel CMOS Image Sensor
- Thermoelectric Peltier Cooling – about 15 degrees below ambient temperature
- Minimizing the number of hot pixels with TEC
- Global Shutter CMOS Technology
- Output Pixel Format: 8/10/12 bit
- Line Output
- Defective Pixel Correction
- Camera Link Base/Medium/Full/10-Tap
- Camera Link Clock Frequency Selector
- Gain / Black Level Control
- Test Pattern
- Temperature Monitor
- Field Upgrade
- DSNU and PRNU Correction
- Flat Field Correction with Sequencer Control
- Hot Pixel Correction
- GenICam Compatible – XML based Control

## 5.2 Specifications

The technical specifications of the VP-127MC-M/C6H cameras are as follows.

Specifications	VP-127MC-M/C6H	
Resolution (H×V)	13376 × 9528	
Sensor	IMX661	
Sensor Size (Diagonal)	46.15 mm × 32.87 mm (56.73 mm)	
Sensor Type	High Speed CMOS Image Sensor	
Pixel size	3.45 μm × 3.45 μm	
Interface	Camera Link Base / Medium / Full / 10 Tap, 26-pin SDR Connector	
Max. Frame Rate (8 bit)	6.2 fps	
Exposure Time	1 μs ~ 60 s (1 μs step)	
Partial Scan (Max. Speed)	109 fps (10 Tap)	
Pixel Data	Mono	8/10/12 bit
Format	Color	BayerRG 8/10/12 bit
Electronic Shutter	Global Shutter	
Gain Control	Analog	1× ~ 12×
	Digital	1× ~ 32×
Digital Black Level	0~255 LSB in 12 bit	
Trigger Synchronization	Line0(Hardware Trigger), Software Trigger, UserOutput0, CC1, Timer0Active(Timer)	
External Trigger	3.3 ~ 24.0 V, 10 mA, Logical Level Input Optically Isolated	
Software Trigger	Asynchronous, Programmable via Camera API	
Digital I/O	TTL Level Exposure Active, Frame Active, User Output, Timer, Strobe Output	
Dynamic Range	73 dB at 12 bit	
Cooling Method	Thermoelectric Peltier Cooling	
Cooling Performance	15°C below ambient temperature / Standard cooling with a fan	
Mechanical (W×H×L)	110 mm × 110 mm × 89 mm, 1.45 kg (with M72-mount)	
Environmental	Operating: 0°C ~ 40°C, Storage: -40°C ~ 70°C	
Lens Mount	M72-mount	
Power	External	11~24 V DC
	Dissipation	Typical 28.5 W
Compliance	CE, FCC, KC	

Table 5-1 Specifications of VP-127MC-M/C6H

### 5.3 Camera Block Diagram

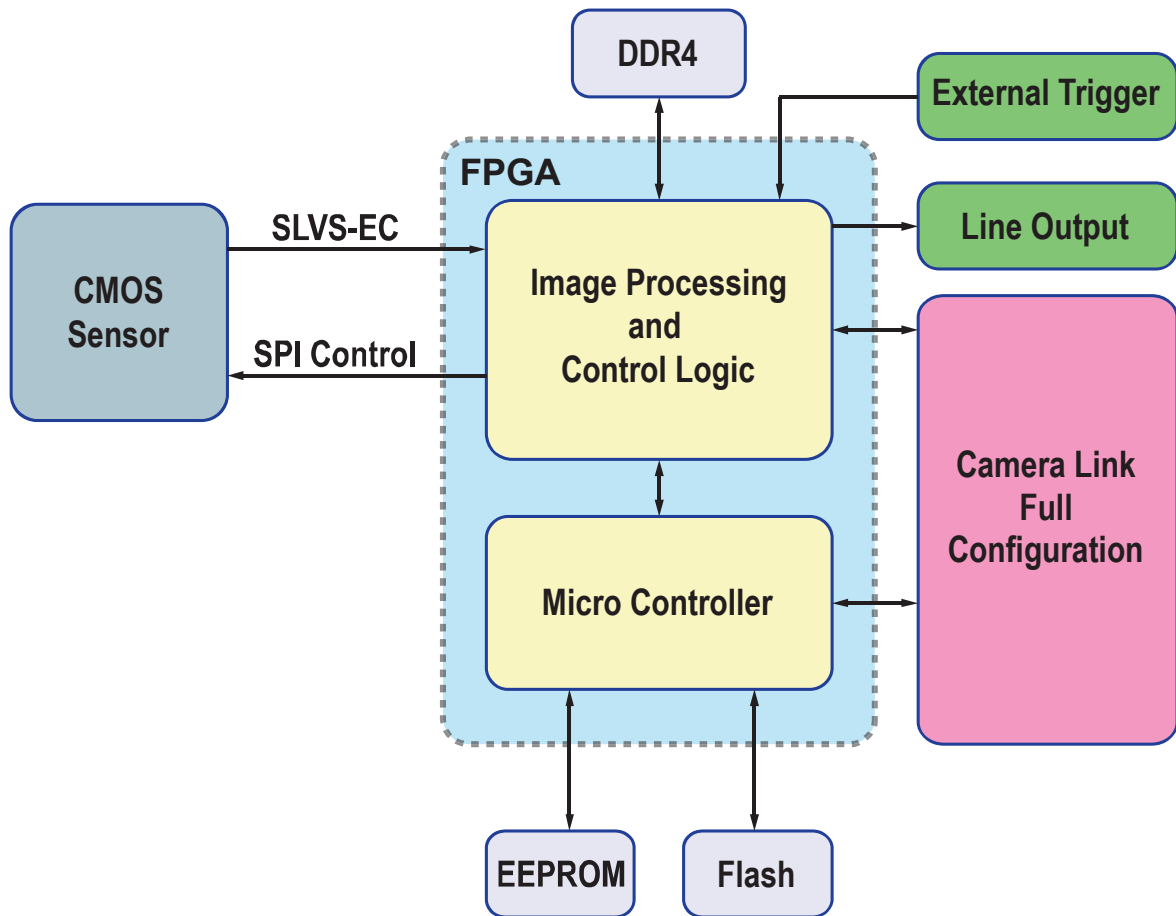


Figure 5-1 Camera Block Diagram

All controls and data processing of the VP-127MC-M/C6H cameras 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 Camera Link interface and then processes them. The Processing & Control logic processes the image data received from the CMOS image sensor and then transmits data through the Camera Link interface. The Processing & Control logic also controls the trigger inputs and strobe outputs, which are sensitive to time. Furthermore, Flash and DDR4 are installed outside FPGA. The DDR4 is used for the frame buffer to process images and the Flash stores the firmware to operate the Micro-Controller.

### 5.4 Spectral Response

The following graph shows the spectral response of the VP-127MC-M/C6H camera.

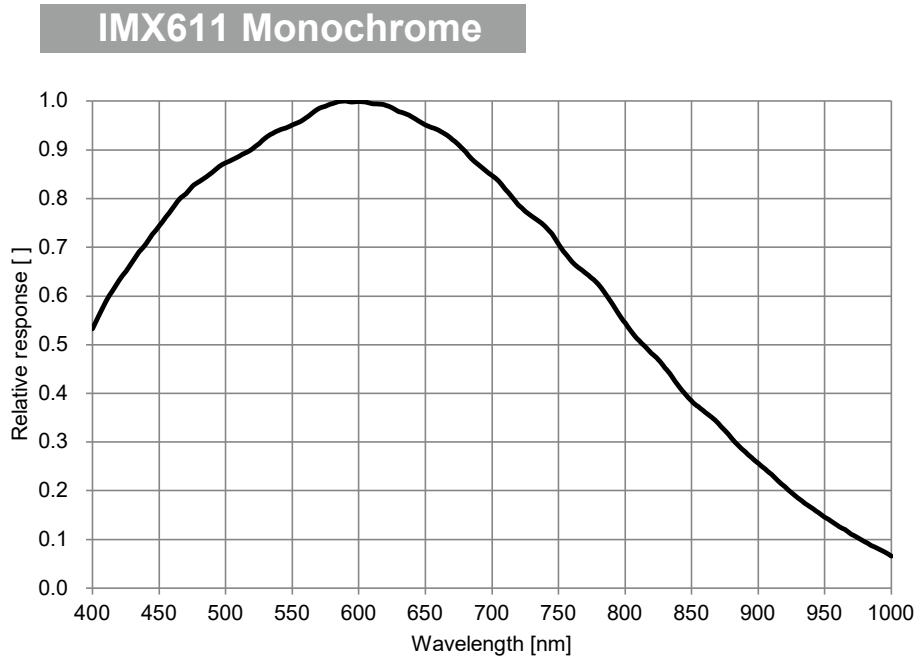


Figure 5-2 Spectral Response - Mono

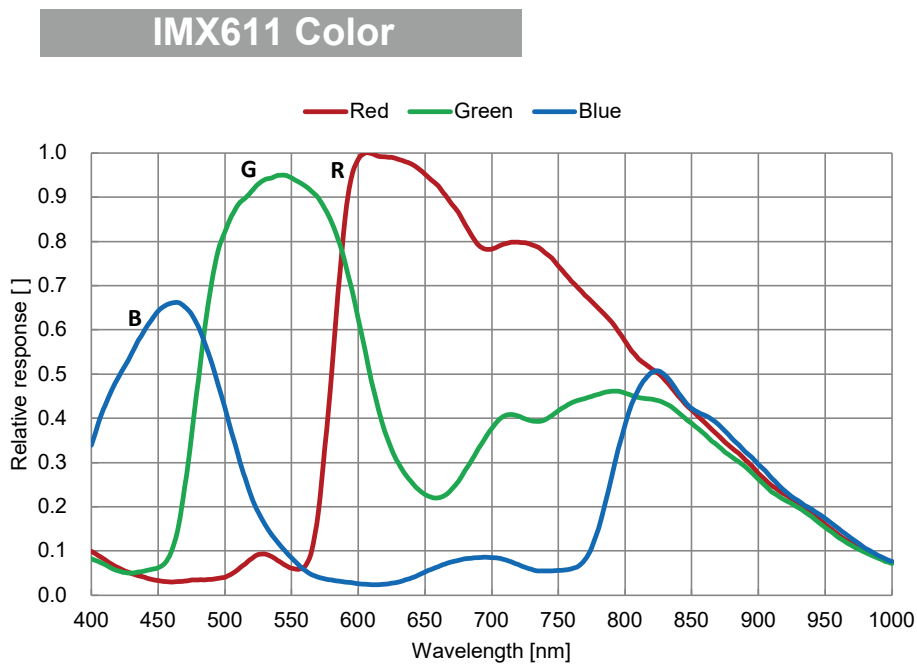


Figure 5-3 Spectral Response - Color

### 5.5 Mechanical Specification

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

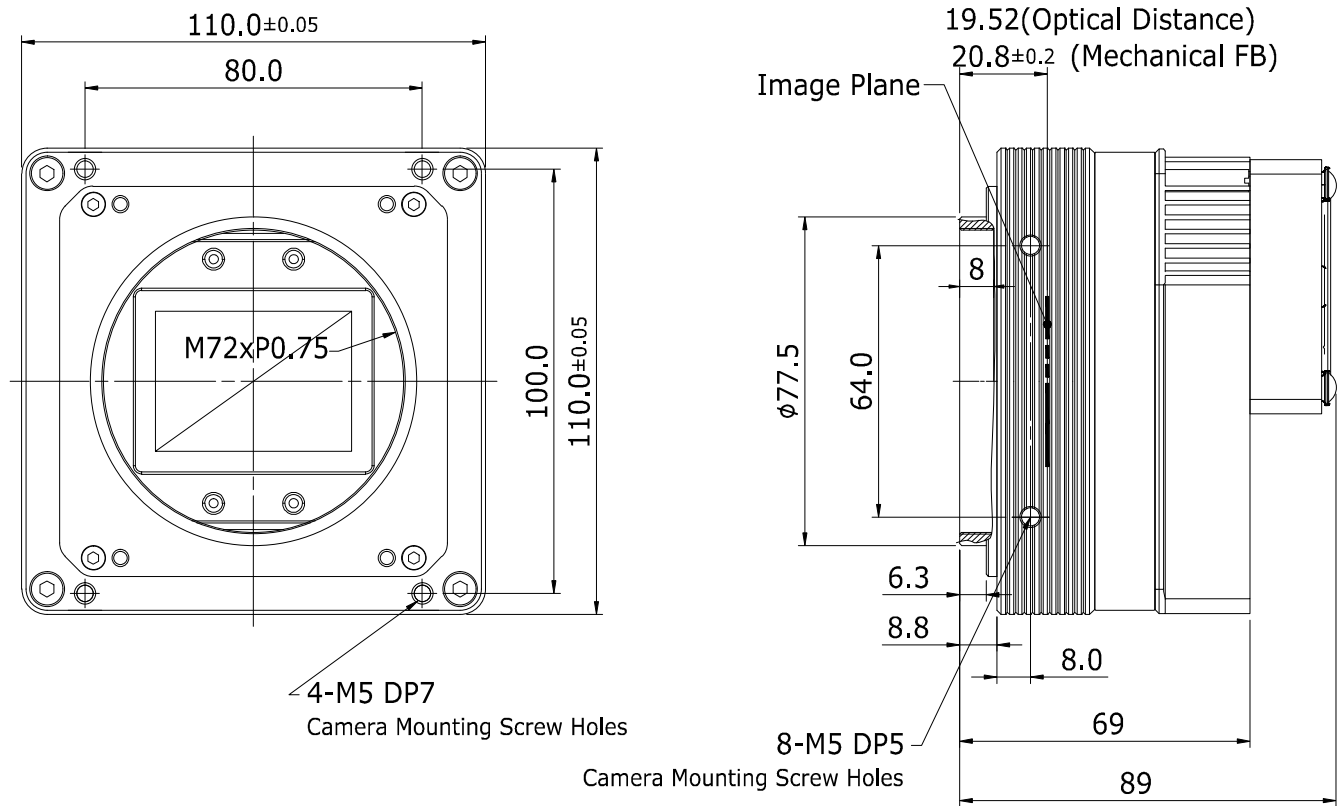


Figure 5-4 Mechanical Dimension for VP-127MC-M/C6H

## Chapter 6. Connecting the Camera

The following instructions assume that you have installed a Camera Link Frame Grabber in your computer including related software. For more detailed information, refer to your Camera Link 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 Camera Link1 connector on the camera and the other end of the coax cable into the Base connector of the Camera Link Frame Grabber in your computer. Plug one end of the other Camera Link cable into the Camera Link2 connector on the camera and the other end of the Camera Link cable into the Medium/Full connector on the Camera Link frame grabber.
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.

### Precautions for using Camera Link Medium / Full / 10 Tap Configuration



#### Caution!

The VP-127MC-M/C6H cameras support the Camera Link Base / Medium / Full / 10 Tap configuration. To operate the camera in the medium, full or 10 tap configuration, you must connect the camera to the Camera Link frame grabber using two Camera Link cables. Make sure that you connect both Camera Link1 (Base) and Camera Link2 (Medium/Full) connectors on the camera to their respective connectors on the Camera Link frame grabber.

---

## 6.1 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.

## 6.2 Precaution about Blurring Compared to the 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.

## 6.3 Controlling the Camera

- You can control the camera by using the Configurator.
- You can download the latest Configurator at <http://vision.vieworks.com>.
- Please refer to your Camera Link frame grabber user manual.

## Chapter 7. Camera Interface

### 7.1 General Description

As shown in the following figure, four types of connectors and an LED indicator are located on the back of the camera and have the functions as follows:

- ① Status LED: displays power status and operation mode.
- ② 6 pin Power Input Receptacle: supplies power to the camera.
- ③ 4 pin Control I/O Receptacle: inputs external trigger signals and outputs strobe signals.
- ④ 26 pin SDR Connector 1  
(Camera Link Base): transmits video data and controls the camera.
- ⑤ 26 pin SDR Connector 2  
(Camera Link Medium/Full): transmits video data.

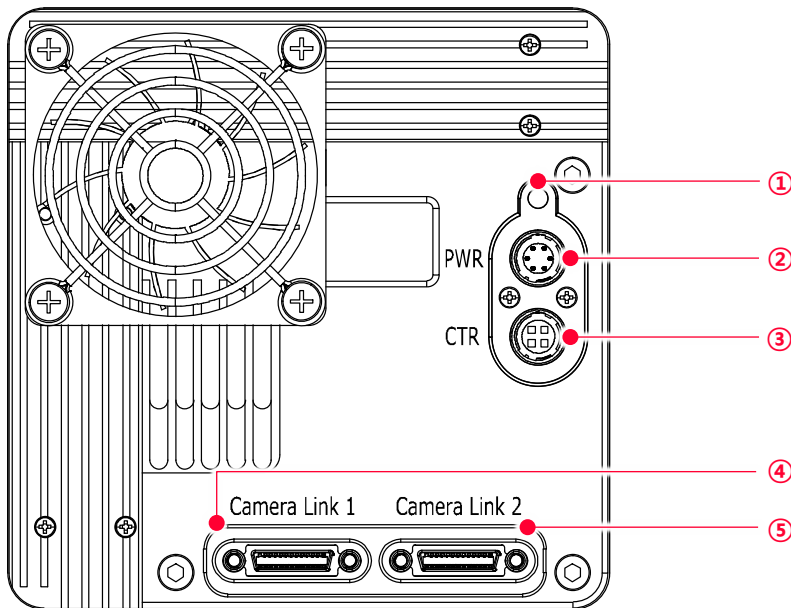


Figure 7-1 VP-127MC-M/C6H Back Panel



## 7.2 Camera Link SDR Connector

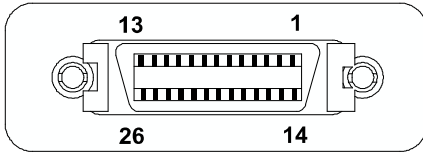


Figure 7-2 Camera Link Connector

The Camera Link connectors on the camera comply with the Camera Link standard and the following lists show the pin assignments of the connectors.

PAIR List	Pin	Signal Name	Type	Description
PAIR 0	1	Ground	Ground	Cable Shield
	14	Ground	Ground	Cable Shield
PAIR 1	2	-X0	LVDS - Out	Camera Link Transmitter
	15	+X0	LVDS - Out	Camera Link Transmitter
PAIR 2	3	-X1	LVDS - Out	Camera Link Transmitter
	16	+X1	LVDS - Out	Camera Link Transmitter
PAIR 3	4	-X2	LVDS - Out	Camera Link Transmitter
	17	+X2	LVDS - Out	Camera Link Transmitter
PAIR 4	5	-XCLK	LVDS - Out	Camera Link Transmitter
	18	+XCLK	LVDS - Out	Camera Link Transmitter
PAIR 5	6	-X3	LVDS - Out	Camera Link Transmitter
	19	+X3	LVDS - Out	Camera Link Transmitter
PAIR 6	7	+ SerTC	LVDS - In	Serial Data Receiver
	20	- SerTC	LVDS - In	Serial Data Receiver
PAIR 7	8	- SerTFG	LVDS - Out	Serial Data Transmitter
	21	+ SerTFG	LVDS - Out	Serial Data Transmitter
PAIR 8	9	- CC 1	LVDS - In	Software External Trigger
	22	+ CC 1	LVDS - In	Software External Trigger
PAIR 9	10	N/C	N/C	N/C
	23	N/C	N/C	N/C
PAIR 10	11	N/C	N/C	N/C
	24	N/C	N/C	N/C
PAIR 11	12	N/C	N/C	N/C
	25	N/C	N/C	N/C
PAIR 12	13	Ground	Ground	Cable Shield
	26	Ground	Ground	Cable Shield

Table 7-1 Pin Assignments for Camera Link Connector 1

PAIR List	Pin	Signal Name	Type	Description
PAIR 0	1	Ground	Ground	Cable Shield
	14	Ground	Ground	Cable Shield
PAIR 1	2	-Y0	LVDS - Out	Camera Link Transmitter
	15	+Y0	LVDS - Out	Camera Link Transmitter
PAIR 2	3	-Y1	LVDS - Out	Camera Link Transmitter
	16	+Y1	LVDS - Out	Camera Link Transmitter
PAIR 3	4	-Y2	LVDS - Out	Camera Link Transmitter
	17	+Y2	LVDS - Out	Camera Link Transmitter
PAIR 4	5	-YCLK	LVDS - Out	Camera Link Transmitter
	18	+YCLK	LVDS - Out	Camera Link Clock Tx
PAIR 5	6	-Y3	LVDS - Out	Camera Link Channel Tx
	19	+Y3	LVDS - Out	Camera Link Channel Tx
PAIR 6	7	-	Not Used	Connected with 100 ohm
	20	-	Not Used	
PAIR 7	8	-Z0	LVDS - Out	Camera Link Transmitter
	21	+Z0	LVDS - Out	Camera Link Transmitter
PAIR 8	9	-Z1	LVDS - Out	Camera Link Transmitter
	22	+Z1	LVDS - Out	Camera Link Transmitter
PAIR 9	10	-Z2	LVDS - Out	Camera Link Transmitter
	23	+Z2	LVDS - Out	Camera Link Transmitter
PAIR 10	11	-ZCLK	LVDS - Out	Camera Link Transmitter
	24	+ZCLK	LVDS - Out	Camera Link Clock Tx
PAIR 11	12	-Z3	LVDS - Out	Camera Link Channel Tx
	25	+Z3	LVDS - Out	Camera Link Channel Tx
PAIR 12	13	Ground	Ground	Cable Shield
	26	Ground	Ground	Cable Shield

Table 7-2 Pin Assignments for Camera Link Connector 2

Model	Camera Link Tap Geometry	CL Configuration	CL Connector 1	CL Connector 2
VP-127MC	2 Tap	BASE	○	X
	4 Tap	MEDIUM	○	○
	8 Tap	FULL	○	○
	10 Tap	10 Tap	○	○

Table 7-3 Connector Arrangement for the Camera Link Tap Geometry



**Caution!**

When you connect a Camera Link frame grabber to the Camera Link connectors on the camera using Camera Link cables, make sure you connect the cables to their correct connectors. If you connect the Camera Link connector 1 on the camera to a connector other than connector 1 of the Camera Link frame grabber, the camera may not transmit images correctly or the serial communication between the camera and the computer 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:

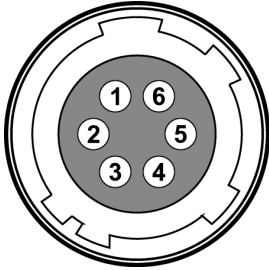


Figure 7-3 Pin Assignments for Power Input Receptacle

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

Table 7-4 Pin Configurations for Power Input Receptacle



**Note:**

- A recommended mating connector for the Hirose 6 pin connector is the Hirose 6 pin plug (part # HR10A-7P-6S) or the equivalent.
- It is recommended that you use the power adapter, which has at least 3 A current output at 11 ~ 24 V voltage output (You need to purchase a power adapter separately.).

#### Precaution for Power Input



**Caution!**

- Make sure the power is turned off before connecting the power cord to the camera. Otherwise, damage to the camera may result.
- If the voltage applied to the camera is greater than specified in the specifications, damage to the camera may result.

## 7.4 Control I/O Receptacle

The Control I/O 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:

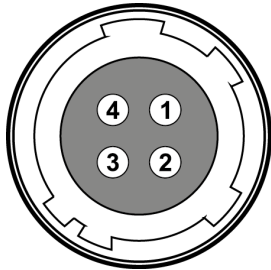


Figure 7-4 Pin Assignments for Control I/O Receptacle

Pin Number	Signal	Type	Description
1	Trigger Input +	Input	3.3 V ~ 24.0 V TTL input
2	Trigger Input -	Input	-
3	DC Ground	-	DC Ground
4	Line 1 Output	Output	3.3 V TTL Output Output resistance: 47 $\Omega$

Table 7-5 Pin Configurations for Control I/O Receptacle



**Note:**

A recommended mating connector for the Hirose 4-pin connector is the Hirose 4-pin plug (part # HR10A-7P-4P) or the equivalent.

### 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. With the Debounce feature, you can specify the width of input signal to be considered as a valid input signal. An external trigger circuit example is shown below.

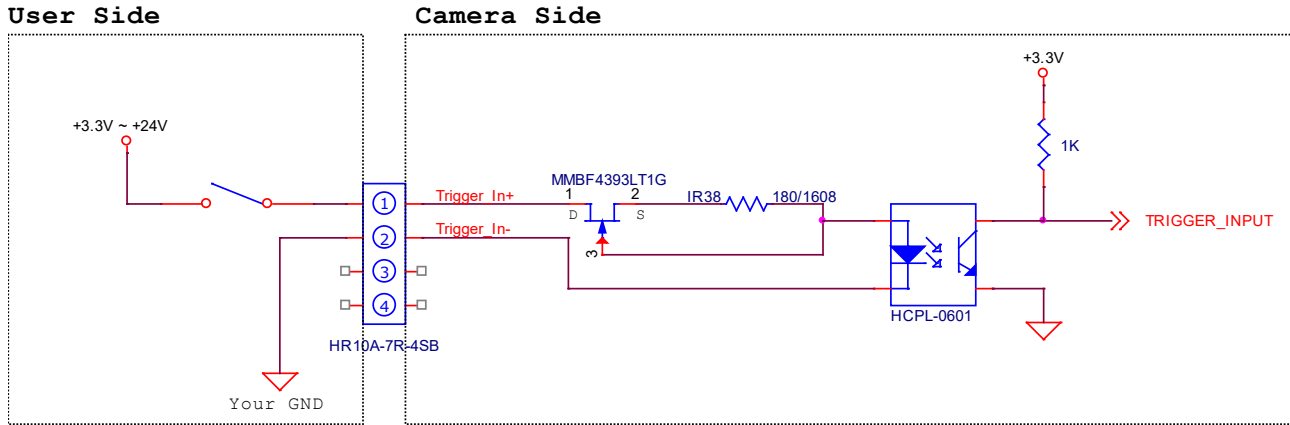


Figure 7-5 Trigger Input Schematic

### 7.6 Strobe Output Circuit

The strobe output signal comes out through a 3.3 V output level of TTL Driver IC. A pulse width of signal is synchronized with an exposure (shutter) signal of the camera.

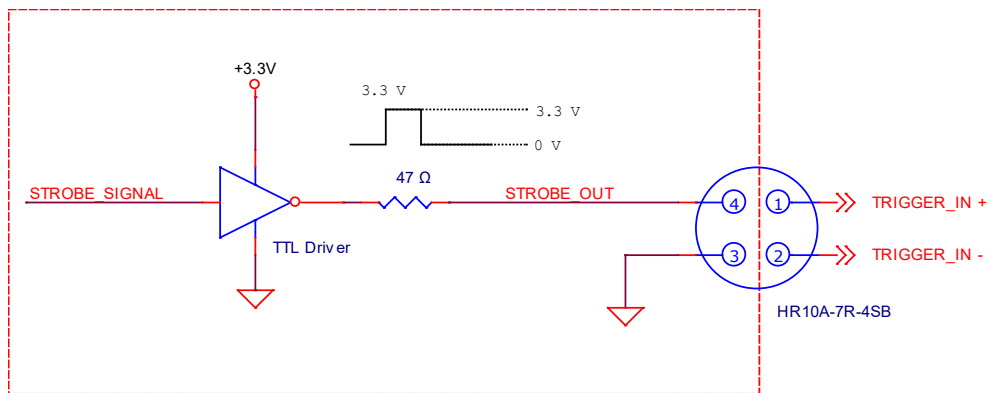


Figure 7-6 Strobe Output Schematic

## Chapter 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 Acquisition Mode parameter
- Exposure start trigger
- Exposure time control
- Frame acquisition process on the camera
- Global shutter
- Maximum Allowed Frame Rate



**Note:**

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.

---

## 8.2 Acquisition Start/Stop Commands and Acquisition Mode

This section describes function available to use via the followings:

- Acquisition Start/Stop commands
- Acquisition Mode

The details about each item above is described in the order from the following section.

### 8.2.1 Acquisition Start/Stop Commands

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

Executing an Acquisition Stop command terminates the camera's ability to acquire images.

### 8.2.2 Acquisition Mode

The Acquisition Mode parameter affects directly how the Acquisition Start command works. There are three of types available to select in this parameter as follows:

- Continuous:  
Acquires frames continuously once the Acquisition Start command is called until the Acquisition Stop command is called.
- SingleFrame:  
Acquires one single frame after the Acquisition Start command is called, and then, finishes acquiring images with calling the Acquisition Stop command automatically.
- MultiFrame:  
Acquires frames as many as the numbers designated on the AcquisitionFrameCount parameter after the Acquisition Start command is called, and then, finishes acquiring images with calling the Acquisition Stop command automatically.

**Note:**

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. If a user calls an Acquisition Stop command on the way of image acquisition, the work will finish after finishing the ongoing acquisition all.

---

### 8.2.3 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.

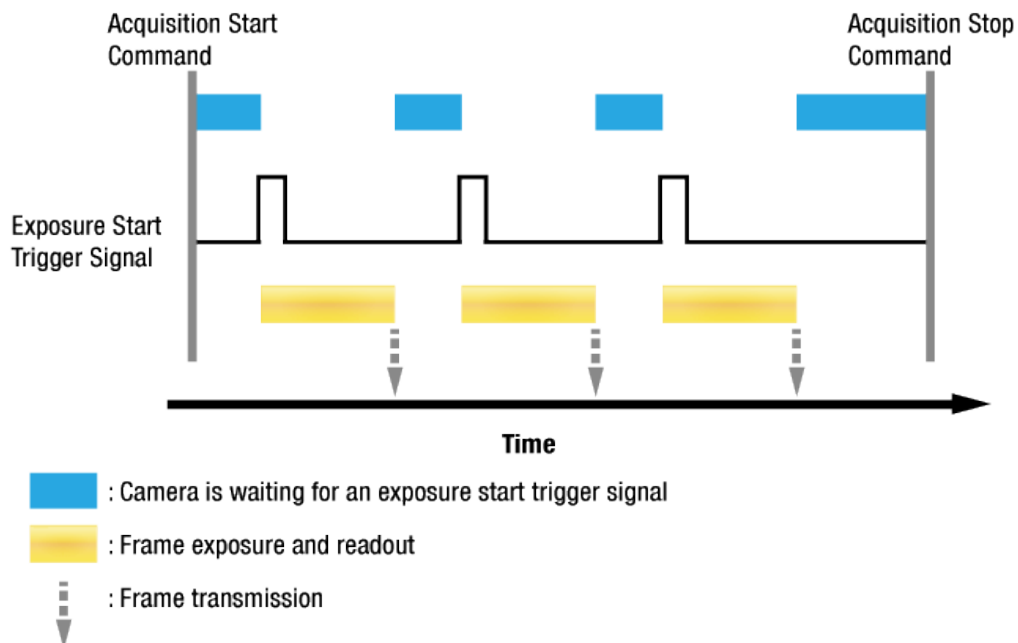


Figure 8-1 Exposure Start Triggering



## 8.2.4 Applying Trigger Signals

The paragraphs above mention “applying a trigger signal”. There are five ways to apply an exposure start trigger signal to the camera: via **Software**, via **User Output0**, via **CC1**, **Timer0Active** or via **Line0** (commonly referred to a 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 **User Output0** ('sts 10'), you must set the **Trigger Source** parameter to **User Output0**. At that point, you can apply an exposure start trigger signal to the camera by switching the **User Output Value** parameter between **On** (rise) and **Off** (fall).

To apply trigger signals via Camera Link Frame Grabber, you must set the **Trigger Source** parameter to **CC1**. At that point, each time a proper external trigger signal is applied to the camera by using the APIs provided by a Camera Link Frame Grabber manufacturer, the exposure start trigger signal will be applied to the camera. For more information, refer to your Camera Link Frame Grabber User Manual.

To apply trigger signals via the user-defined Timer feature, you must set the **Trigger Source** parameter to **Timer0 Active**. When you set the **Timer Trigger Source** parameter to **Line0** in the **Counter And Timer Control** category, you can apply an exposure start trigger signal to the camera by using a Timer that uses the **Line0** signal as the source signal.

To apply trigger signals via hardware (external), you must set the **Trigger Source** parameter to **Line0**('sts 22'). 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.

### 8.2.5 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**, the **Exposure Time** parameter will determine the exposure time for each frame.

If the **Trigger Source** parameter is set to **User Output0**, **CC1**, **Timer0Active** or **Line0**, 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 User Output, CC1, Timer or hardware (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.

## 8.3 Exposure Start Trigger

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**, **User Output0**, **CC1**, **Timer0Active** or **Line0**. 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**.

#### 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 **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('set n'), see [8.4 Setting the Exposure Time](#).

### 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('gst') for the exposure start trigger on your computer.
- **User Output0:** You can apply an exposure start trigger signal to the camera by switching the **User Output Value** parameter between **On** and **Off**('suov 1/0') on your computer.
- **CC1:** You can apply an exposure start trigger signal via **CC1** of the **Camera Link Frame Grabber**. For more information, refer to your **Camera Link Frame Grabber User Manual**.
- **Line0:** 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.
- **Timer0Active:** You can apply an exposure start trigger signal to the camera using a user defined **Timer** signal. When you set the **Timer Trigger Source** parameter to **Line0**('stts 22') in the **Digital I/O** category, you can specify a delay for the **Line0** signal by using the **Timer Delay** parameter('stdl n'). For more information, refer to [9.20 Timer Control](#).

You must also set the **Trigger Activation** parameter after setting the **Trigger Source** parameter('sta 0/1').

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

- **Falling Edge:** Specifies that a falling edge of the electrical signal will act as the exposure start trigger.
- **Rising Edge:** Specifies that a rising 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 **CC1** or **Line0**, the exposure time for each frame acquisition will be determined by the **Exposure Mode** parameter settings as follows:

- **Exposure Mode = Timed:** Exposure time can be controlled with the **Exposure Time** parameter.
- **Exposure Mode = Trigger Width:** Exposure time can be controlled by manipulating the external trigger signal.

When the **Trigger Mode** parameter is set to **On** and the **Trigger Source** parameter is set to **User Output0**, the exposure time for each frame acquisition will be determined by the **Exposure Mode** parameter settings as follows:

- **Exposure Mode = Timed:** Exposure time can be controlled with the **Exposure Time** parameter.
- **Exposure Mode = Trigger Width:** Exposure time can be controlled by switching the **User Output Value** parameter between **On** and **Off**.

### 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.

The exposure time for each acquired frame will be determined by the value of the camera's **Exposure Time** parameter.

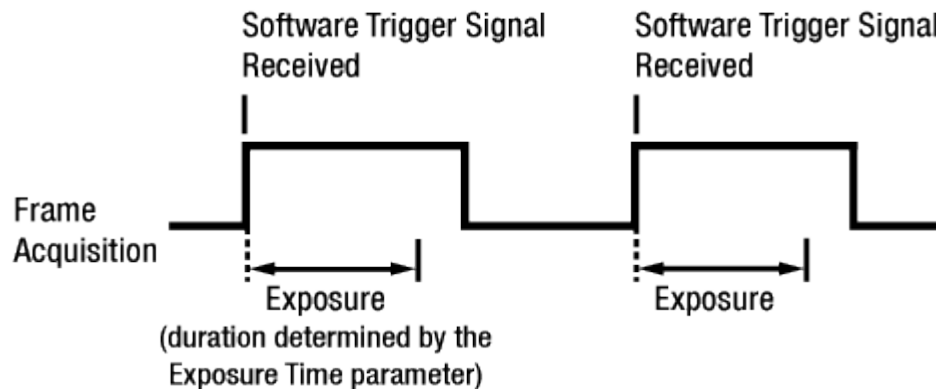


Figure 8-2 Frame Acquisition with Software Trigger Signal

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 CC1 Trigger Signal

If the **Trigger Mode** parameter is set to **On** and the **Trigger Source** parameter is set to **CC1**, you must apply a CC1 trigger signal to the camera to begin each frame acquisition. A CC1 trigger signal will act as the exposure start trigger signal for the camera. For more information, refer to your Camera Link frame grabber user manual.

A rising edge or falling edge of the CC1 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 CC1 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 CC1 signal, the period of the CC1 trigger signal will determine the rate at which the camera is acquiring frames:

$$\frac{1}{\text{CC1 signal period in seconds}} = \text{Frame Rate}$$

For example, if you are operating a camera with a CC1 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('stm 1')** and the **Trigger Source** parameter is set to **Line0('sts 22')**, an externally generated electrical signal injected into the Control I/O Receptacle 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('sta 1/0') 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 500ms (0.5 s):

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



## External Trigger Delay

When you set the Trigger Source parameter to `Timer0Active`, you can specify a delay between the receipt of a hardware trigger signal and when the trigger becomes effective.

1. Set the Trigger Source parameter in the Acquisition Control category to `Line0`.
2. Set the Timer Delay parameter to the desired Timer delay in microseconds.
3. Set the Trigger Source parameter in the Acquisition Control category to `Timer0Active`.
4. Execute the Acquisition Start command and inject an externally generated electrical signal into the Control I/O Receptacle. Then, the delay set by the Timer Delay parameter expires and the exposure for image acquisition begins.

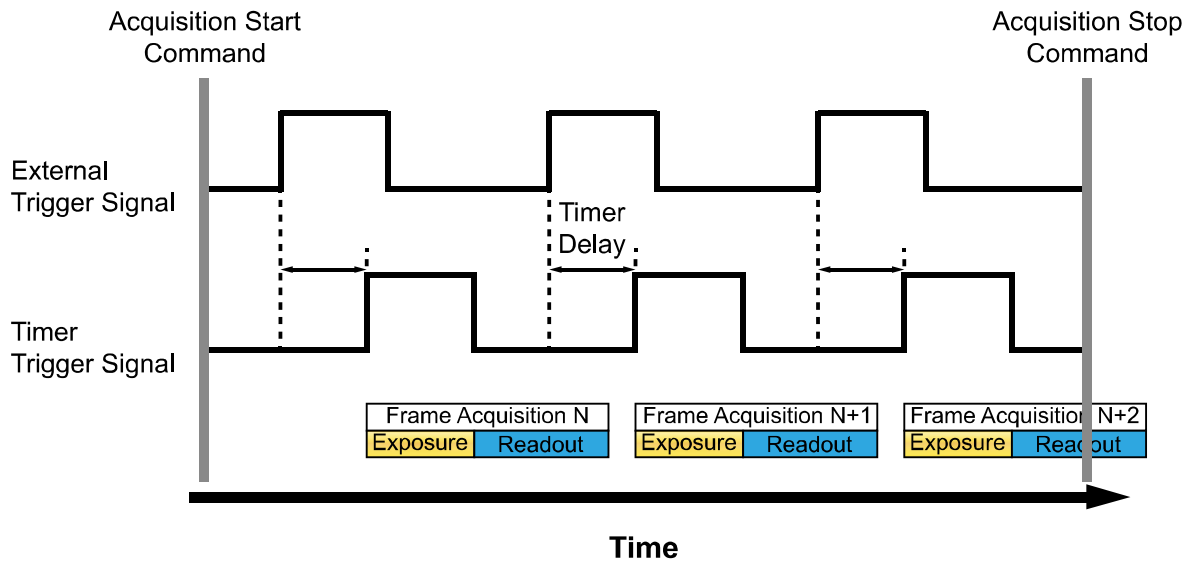


Figure 8-3 External Trigger Delay

### 8.3.5 Exposure Mode

If you are triggering the start of frame acquisition with an externally (CC1 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. The following figure illustrates Timed exposure with the camera set for rising edge triggering.

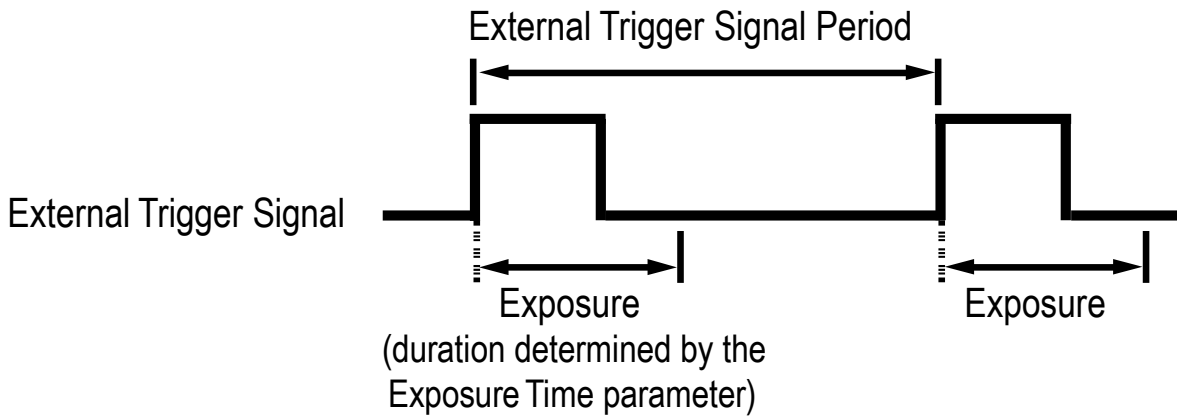


Figure 8-4 Timed Exposure Mode

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.

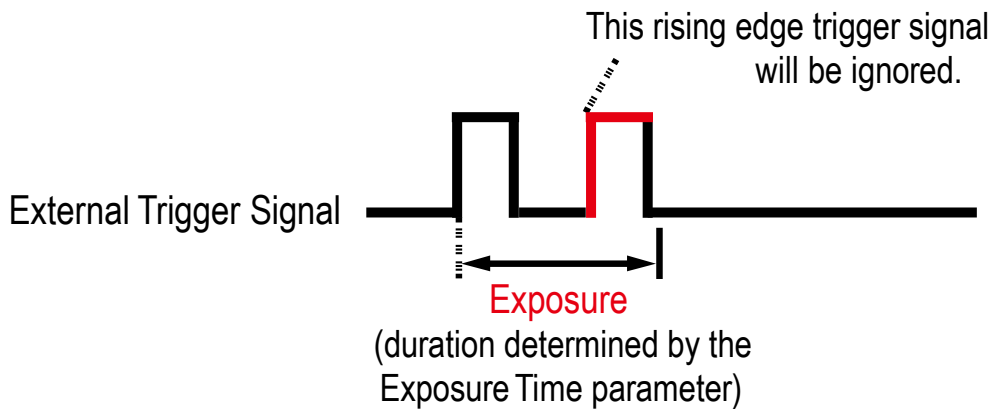


Figure 8-5 Trigger Overlapped with Timed Exposure Mode

### Trigger Width Exposure Mode

When the Trigger Width exposure mode ('sem 1' or 'ses 1') is selected, the length of the exposure for each frame acquisition will be directly controlled by the external trigger signal (CC1 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. The following figure 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.

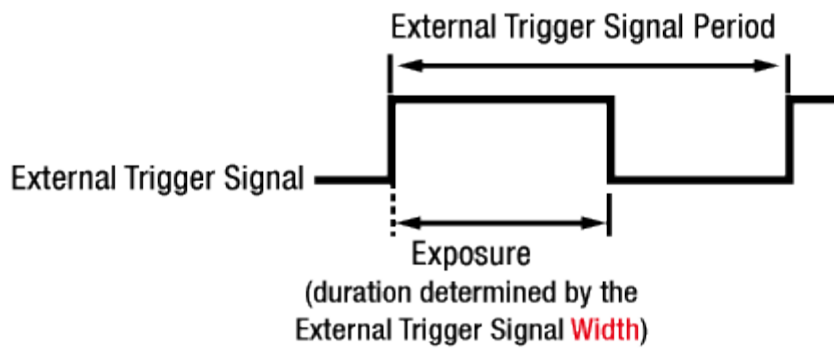


Figure 8-6 Trigger Width Exposure Mode

### 8.3.6 Short Exposure Mode

The VP-127MC-M/C6H cameras provide the **Short Exposure Mode** which allows you to set a shorter exposure time than the normal Exposure Mode. The available setting range of the exposure time (refer to Table 8-2) and the Exposure Offset values (refer to Table 8-1) vary depending on the Short Exposure Mode setting.

- Short Exposure Mode = Off: Enables the normal Exposure Mode.
- Short Exposure Mode = Super Short: Allows you to set a shorter exposure time by adding a shorter Exposure Offset to the exposure time than the normal Exposure Mode.
- Short Exposure Mode = Ultra Short: Allows you to set the shortest exposure time by adding the shortest Exposure Offset to the exposure time.



#### Exposure Mode

When you set the Short Exposure Mode parameter to Off, both the Timed and Trigger Width exposure mode are available. However, with the Short Exposure Mode set to Ultra Short, the Timed exposure mode is only available.

Acquiring frames at a rate lower than the maximum allowed frame rate with the Short Exposure Mode parameter set to Super Short may result in an offset to the pixel values output by the camera.

---

### 8.3.7 Exposure Offset

The VP-127MC-M/C6H cameras add an **Exposure Offset** automatically to the exposure time determined by the **Exposure Time** parameter or the width of the external trigger signal.

To acquire an image with the desired exposure time, you must compensate for the **Exposure Offset** as follows.

1. Subtract the **Exposure Offset** from the desired exposure time.
2. Set the **Exposure Time** parameter with the resulting time or use the resulting time as the high or low time for the external trigger signal.

Short Exposure Mode	Exposure Offset
Off (Normal Exposure Mode)	6.95 $\mu$ s
Super Short	0.00 $\mu$ s
Ultra Short	0.00 $\mu$ s

Table 8-1 Exposure Offset

For example, when setting **Off** on the **Short Exposure Mode** parameter and setting **Trigger Width** on the **Exposure Mode** parameter, if you want to set an exposure time to about 500  $\mu$ s, set the **Exposure Time** parameter to 22  $\mu$ s ( $500 - 477.4685 = 22.5315 \approx 22$ ) as the high or low time for the external trigger signal.

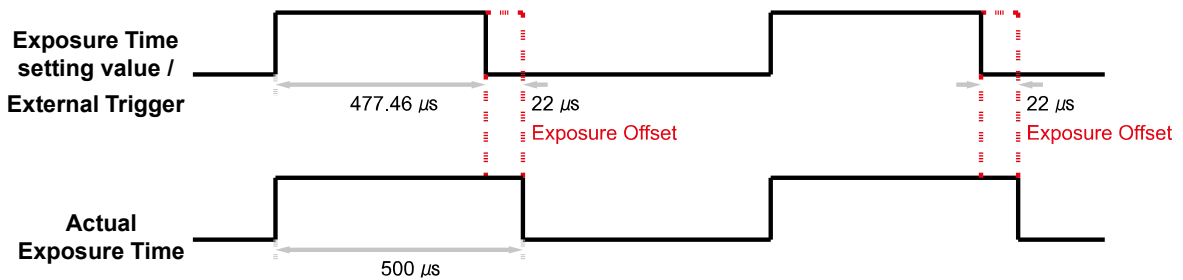


Figure 8-7 Setting Exposure Time to compensate for the Exposure Offset

## 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.
- the Trigger Mode is set to On, the Trigger Source is set to CC1, Timer0Active or Line0, and the Exposure Mode is set to Timed.

The VP-127MC-M/C6H cameras add an Exposure Offset (refer to Table 8-1) automatically to the exposure time determined by the Exposure Time parameter. The Exposure Time parameter sets the exposure time in microseconds ( $\mu s$ ). The minimum and maximum exposure time settings for the cameras are shown in the following table.

Short Exposure Mode	Minimum Exposure Time	Maximum Exposure Time †
Off (Normal Exposure Mode)	481.21 $\mu s$	60,000,000 $\mu s$
Super Short	7.24 $\mu s$	488.16 $\mu s$
Ultra Short	1.02 $\mu s$	7.43 $\mu s$

†: 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 8-2 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 image 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 VP-127MC-M/C6H 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 a new trigger signal is applied to the camera while reading out the previous frame, the camera begins the process of exposing a new frame. This situation is illustrated in the following figure with the Trigger Mode set to On, the Trigger Source set to Line0 and the Exposure Mode set to TriggerWidth.

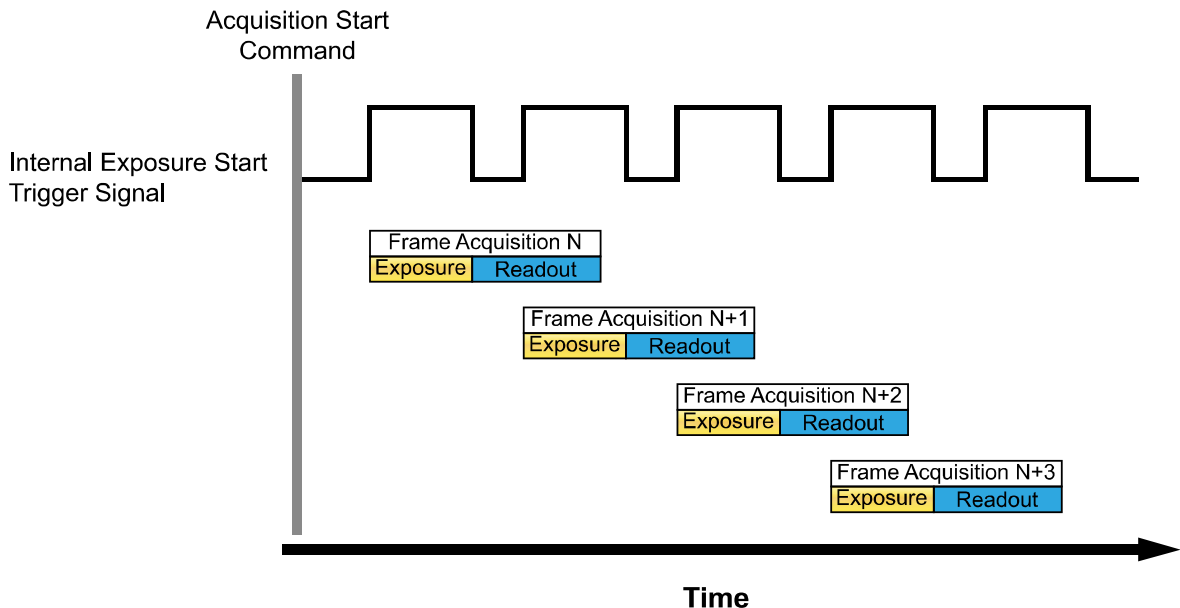


Figure 8-8 Overlapped Exposure and Readout

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: Frame Period  $\leq$  Exposure Time + Readout Time

## 8.6 Global Shutter

The VP-127MC-M/C6H camera is equipped with an image sensor that has an electronic global shutter. When an exposure start trigger signal is applied to the camera equipped with a global shutter, exposure begins for all lines in the sensor as shown in the figure below. Exposure continues for all lines in the sensor until the programmed exposure time ends or when the exposure start trigger signal ends the exposure time if the camera is using the TriggerWidth exposure mode. At the end of the exposure time, exposure ends for all lines in the sensor. Immediately after the end of exposure, pixel data readout begins and proceeds line by line until all pixel data is read out of the sensor. A main characteristic of a global shutter is that for each frame acquisition, all of the pixels in the sensor start exposing at the same time and all end exposing at the same time. This means that image brightness tends to be more uniform over the entire area of each acquired image, and it helps to minimize problems with acquiring images of object in motion.

The camera can provide an Exposure Active output signal that will go high when the exposure time for a frame acquisition begins and will go low when the exposure time ends.

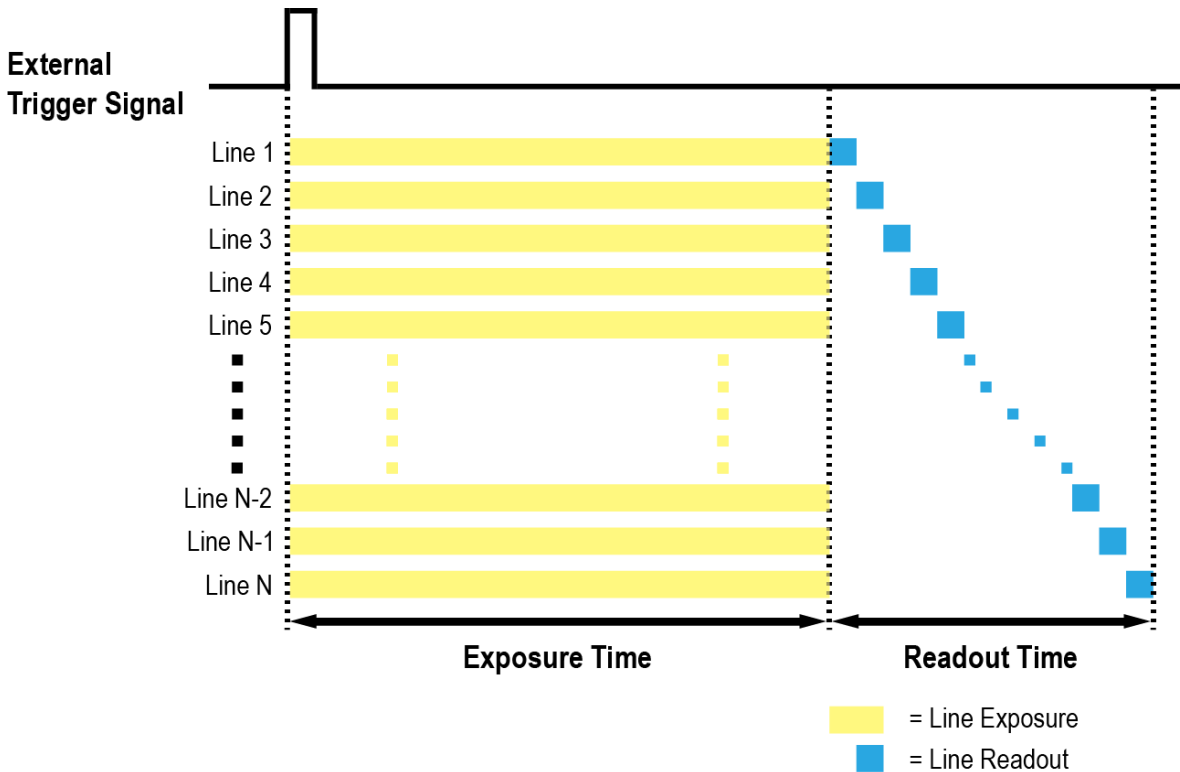


Figure 8-9 Global Shutter



## 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 image 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 and width are determined by the camera's Height and Width settings in the Image Format Control category.
- The Camera Link Tap Geometry. When the camera is set for a Camera Link Tap Geometry that uses more taps, it can typically transfer data out of the camera faster than when it is set for a Camera Link Tap Geometry that uses less taps.
- The exposure time for acquired frames. If you use very long exposure time, 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.
- Decreasing the size of the Image ROI may increase the maximum allowed frame rate. If possible, decrease the height of the Image ROI.
- If you have set the Camera Link Pixel Clock speed to a low value, consider setting it to a higher value. Before setting the camera's Pixel Clock to a higher value, make sure that your frame grabber is compatible with the higher Pixel Clock speed.
- If you are using a Camera Link Tap Geometry with a low number of taps, consider using a Camera Link Tap Geometry with a high number of taps. This will usually increase the maximum allowed frame rate.
- 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 time, it is possible that your exposure time is limiting the maximum allowed frame rate. If you are using a long exposure time, 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.).

**Note:**

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.

---

## Chapter 9. Camera Features

### 9.1 Sequence of Signal Processing

To acquire the best-quality images, the VP-127MC-M/C6H camera handles signals in the following sequence:

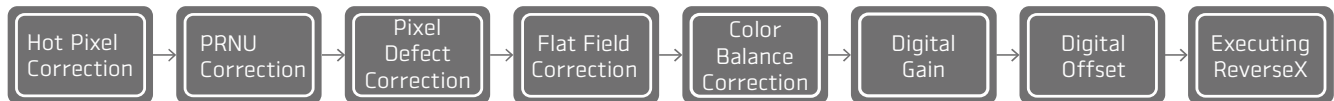


Figure 9-1 Sequence of signal processing to correct images

After finishing the current job, doing all the prior jobs to the current work again is recommended. It may affect the other jobs that have been done before the current job.

## 9.2 Image 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 increase the maximum allowed frame rate by decreasing the Width and/or Height parameters. The ROI is referenced to the top left corner [origin (0, 0)] of the sensor array as shown below.

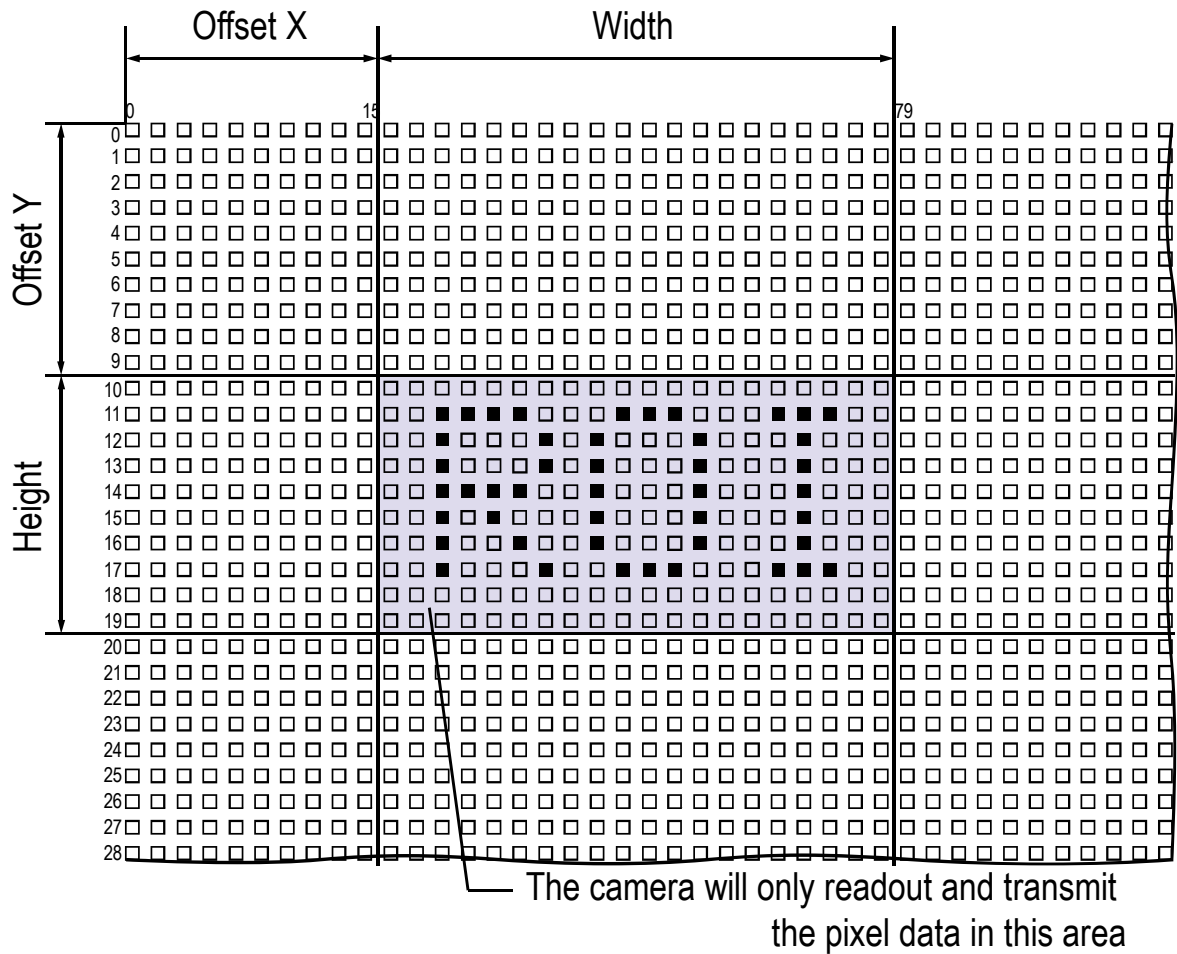


Figure 9-2 Region of Interest

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>	-	Sets the Width of the Image ROI.
	Height <sup>b</sup>	-	Sets the Height of the Image ROI.
	OffsetX <sup>c</sup>	-	Sets the horizontal offset from the origin to the Image ROI.
	OffsetY <sup>c</sup>	-	Sets the 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**

You can change the size of ROI by setting the **Width** and **Height** parameters in the **Image Format Control** category. You can also change the position of the ROI origin by setting the **Offset X** and **Offset Y** parameters. Make sure that the **Width + Offset X** value is less than the **Width Max** value, and the **Height + Offset Y** value is less than the **Height Max** value. You must set the size of the ROI first, and then set the Offset values since the **Width** and **Height** parameters are set to its maximum value by default.

- On the VP-127MC-M/C6H camera, the **Width** parameter must be set to a multiple of 32, and the **Height** parameter must be set to a multiple of 4.

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

Camera Model	Minimum Width Settings	Minimum Height Settings
VP-127MC-M/C6H	64	4

**Table 9-2 Minimum ROI Width and Height Settings**

In the case of this product, the frame rate may differ depending on the Offset Y value when changing the Height parameter because of specialty of its sensor. For the maximum frame rates, it is recommended to set the Offset Y value so that the ROI's center is located on the sensor's vertical center precisely, referring to the following figure.

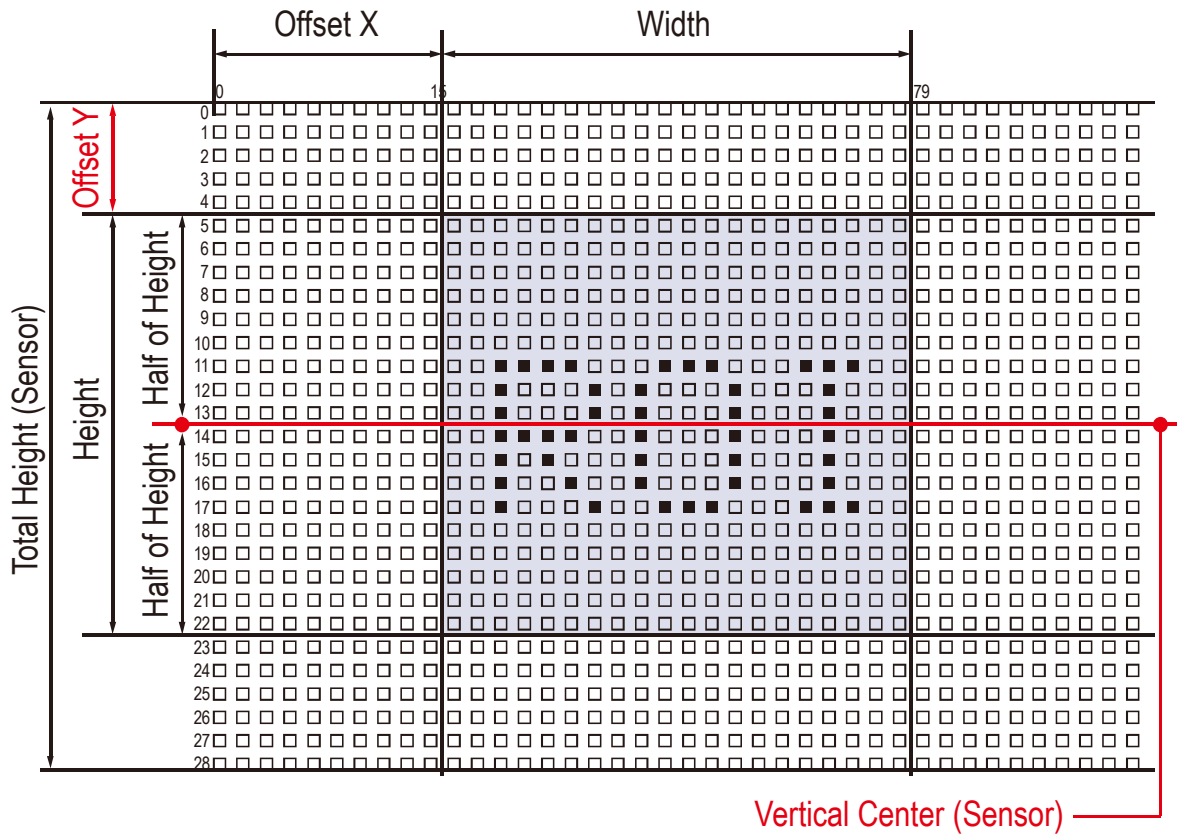


Figure 9-3 Specifying Offset Y for maximum frame rates

On the VP-127MC-M/C6H camera, the maximum allowed frame rates depending on Vertical ROI changes are shown below.

ROI Size (H × V)	2 Tap	4 Tap	8 Tap	10 Tap
13376 × 4	22.0 fps	44.0 fps	86.3 fps	109.6 fps
13376 × 1000	8.1 fps	16.2 fps	32.2 fps	40.3 fps
13376 × 2000	4.9 fps	9.9 fps	19.7 fps	24.6 fps
13376 × 3000	3.5 fps	7.1 fps	14.1 fps	17.7 fps
13376 × 4000	2.7 fps	5.5 fps	11.0 fps	13.8 fps
13376 × 5000	2.3 fps	4.6 fps	9.1 fps	11.3 fps
13376 × 6000	1.9 fps	3.9 fps	7.7 fps	9.6 fps
13376 × 7000	1.7 fps	3.3 fps	6.7 fps	8.3 fps
13376 × 8000	1.5 fps	3.0 fps	5.9 fps	7.3 fps
13376 × 9528	1.2 fps	2.5 fps	5.0 fps	6.2 fps
64 × 9528	18.5 fps	18.5 fps	18.5 fps	18.5 fps
640 × 9528	18.5 fps	18.5 fps	18.5 fps	18.5 fps
1280 × 9528	12.9 fps	18.5 fps	18.5 fps	18.5 fps
2560 × 9528	6.5 fps	12.9 fps	18.5 fps	18.5 fps
3840 × 9528	4.3 fps	8.6 fps	17.2 fps	18.5 fps
5120 × 9528	3.2 fps	6.5 fps	12.9 fps	16.1 fps
6400 × 9528	2.6 fps	5.2 fps	10.4 fps	12.9 fps
7680 × 9528	2.1 fps	4.3 fps	8.6 fps	10.8 fps
8960 × 9528	1.8 fps	3.7 fps	7.4 fps	9.3 fps
10240 × 9528	1.6 fps	3.2 fps	6.5 fps	8.1 fps
11264 × 9528	1.4 fps	2.9 fps	5.9 fps	7.4 fps

Table 9-3 Maximum Frame Rates by VC-127MC Vertical ROI Changes (@Pixel Clock 85MHz)



### Caution!

Your Frame Grabber may place additional restrictions on how the ROI location and size must be set. Refer to your Frame Grabber user manual for more information.

### 9.3 Multi-ROI

The VP-127MC-M/C6H camera provides the Multi-ROI feature which allows you to define up to 8 regions of the sensor array. When an image is acquired, only the pixel information from the defined regions will be readout of the sensor. The pixel data read out of the regions will then be combined together and will be transmitted from the camera as a single image.

The XML parameters related to Multi-ROI are as follows.

XML Parameters	Value	Description
MultiROIControl	MultiROISelector	Region0 - Region7 - Selects the ROI to set.
	MultiROIMode	On/Off Enables / Disables the selected ROI.
	MultiROIWidth	- Width setting for the selected ROI
	MultiROIHeight	- Height setting for the selected ROI
	MultiROIOffsetX	- Horizontal offset from the origin to the selected ROI
	MultiROIOffsetY	- Vertical offset from the origin to the selected ROI
	MultiROIValid <sup>a</sup>	- Verifies the validation of the Multi-ROI setting values.
	MultiROIStatus	Active/Inactive Displays the status of the Multi ROI feature. Active: The Multi-ROI feature is in use. Inactive: The Multi-ROI feature is not in use.

The unit for all parameters in this table is pixel.

a: If the setting values for the Multi-ROI feature are valid, 'True' will be returned or the check box will be selected.

Table 9-4 XML parameters related to Multi-ROI

It is recommended that you first set the **MultiROIWidth** parameter, since all of the regions must be the same width. The next step in the setup process is to define each individual region as desired. Up to 8 regions can be set up ranging from 0 through 7. Use the **MultiROISelector** parameter to select which ROI to set and then set the ROI to On/Off by using the **MultiROIMode** parameter. Then, set the **MultiROIOffsetX**, **MultiROIOffsetY** and **MultiROIHeight** parameters to define each region.



In the figure below, for example, three regions have been set. With these settings, the camera would output an image as follows:

- MultiROI Width × the total height of the three regions (Region0 Height + Region1 Height + Region2 Height)

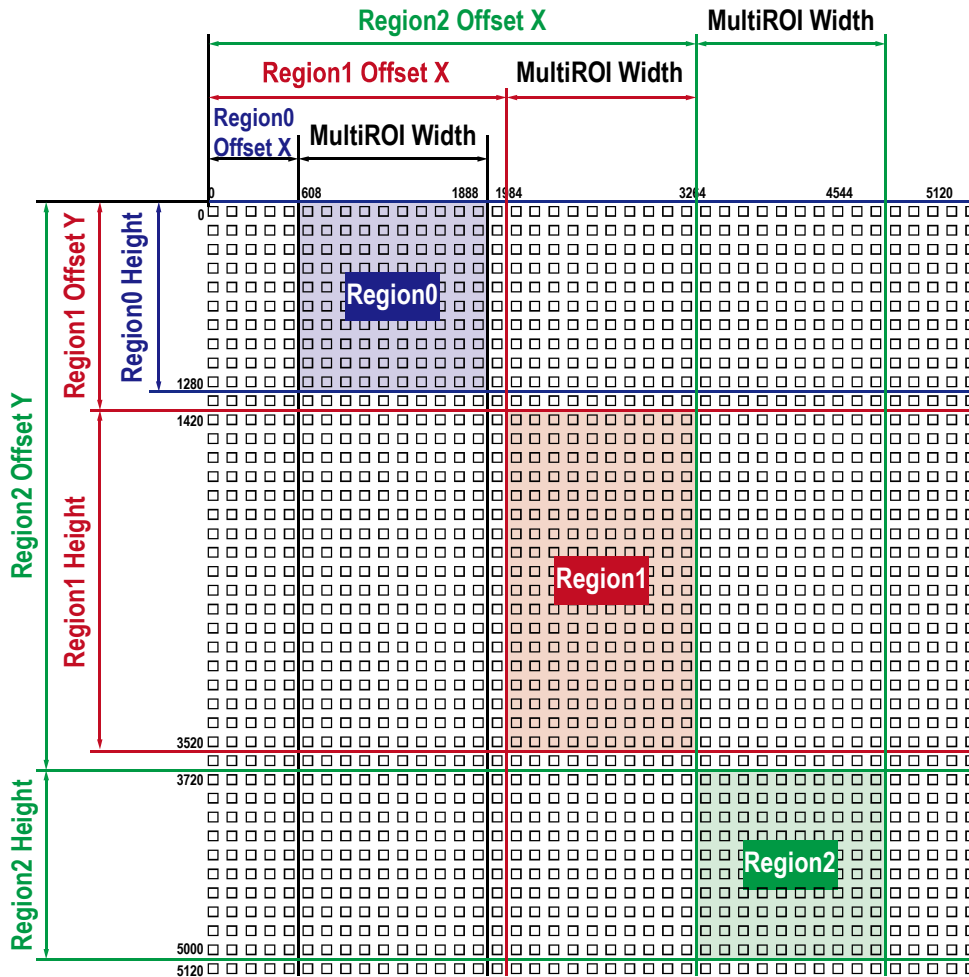


Figure 9-4 Multi-ROI

There are several things to keep in mind when setting the Multi-ROI feature on the VP-127MC-M/C6H camera:

- The sum of the Multi-ROI Offset X value plus the Multi-ROI Width value must not exceed the Width value of the camera's sensor.
- The sum of the Multi-ROI Offset Y value plus the Multi-ROI Height value must not exceed the Height value of the camera's sensor.
- The Multi-ROI Offset X and Multi-ROI Width value must be a multiple of 32.
- The Multi-ROI Offset Y and Multi-ROI Height value must be a multiple of 4.
- The MultiROI Width values are equal, so the widths of the Region 0, Region 1, and Region 2 are the same in the figure above.
- You can save the Multi-ROI setting values as a User Set and then load the values to the camera when desired. For more information, refer to 9.30 User Set Control.

## 9.4 Binning

The 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	
ImageFormat Control	BinningSelector	Sensor	Applies the Binning in analog by the sensor.
		Logic	Applies the Binning in digital by the logic.
	Binning HorizontalMode	Sum	Adds pixel values from the adjacent pixels as specified in the Binning Horizontal, and then sends them as one pixel.
		Average	Adds pixel values from the adjacent pixels as specified in the Binning Horizontal and divides them by the number of combined pixels, and then sends them as one pixel.
	BinningHorizontal	1×, 2×, 4×	The number of horizontal pixels to combine together. 4× is supported only for monochrome.
	Binning VerticalMode	Sum	Adds pixel values from the adjacent pixels as specified in the Binning Vertical, and then sends them as one pixel.
		Average	Adds pixel values from the adjacent pixels as specified in the Binning Vertical and divides them by the number of combined pixels, and then sends them as one pixel.
	BinningVertical	1×, 2×, 4×	The number of vertical pixels to combine together. 4× is supported only for monochrome.

Table 9-5 XML Parameters related to Binning

For example, if you set  $2 \times 2$  binning, the camera's resolution is reduced to  $1/4$ . If you set the Binning Mode to Sum, the maximum allowed resolution of the image is reduced  $1/2$  and the responsivity of the camera is quadrupled. If you set the Binning Mode to Average, the maximum allowed resolution of the image is reduced to  $1/2$ , but there is no difference in responsivity between a binned image and an original image. The Width Max and Height Max parameter, 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.

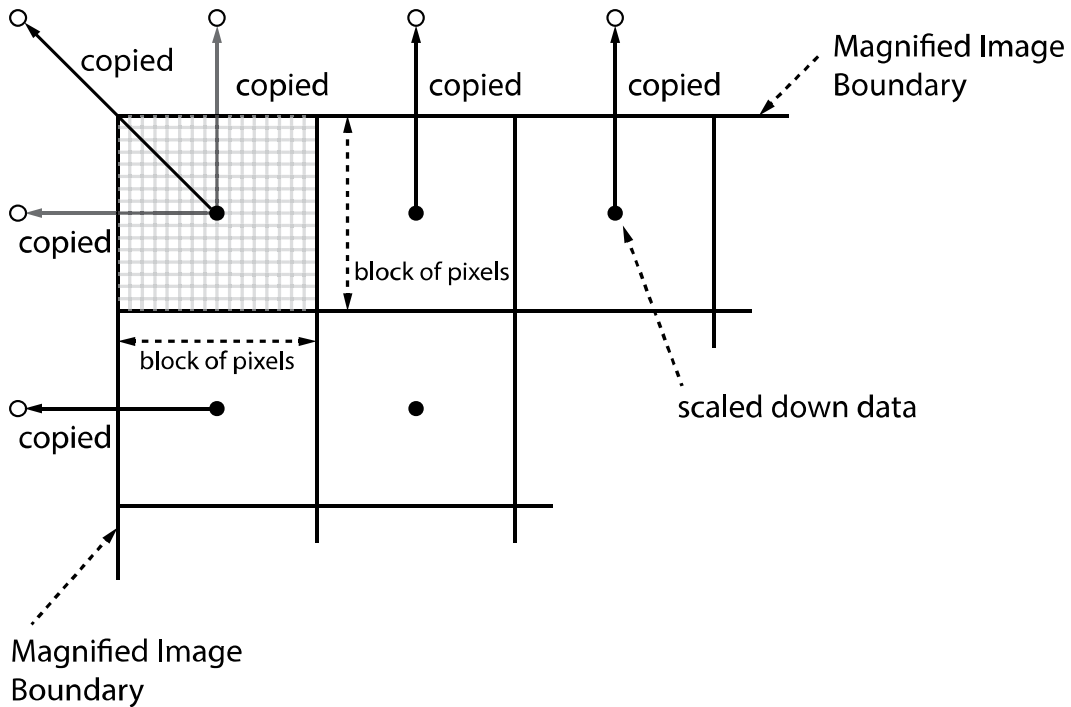


Figure 9-5  $2 \times 2$  Binning and  $4 \times 4$  Binning

## 9.5 Pixel Format

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

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

Table 9-6 XML Parameter related to Pixel Format

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

Mono Sensor	Color Sensor
Mono 8	Mono 8
Mono 10	Mono 10
Mono 12	Mono 12
	Bayer RG 8
	Bayer RG 10
	Bayer RG 12

Table 9-7 Pixel Format Values

### 9.6 Camera Link Tap Geometry

The VP-127MC-M/C6H cameras support 2 Tap, 4 Tap, 8 Tap and 10 Tap Camera Link Tap Geometry. The number of taps represents the number of pixel data that will be output on each cycle of the Camera Link Pixel Clock. The maximum allowed frame rate will be changed according to the Camera Link Tap Geometry settings. The image data is transmitted in the interleaved order as shown in the figure below.

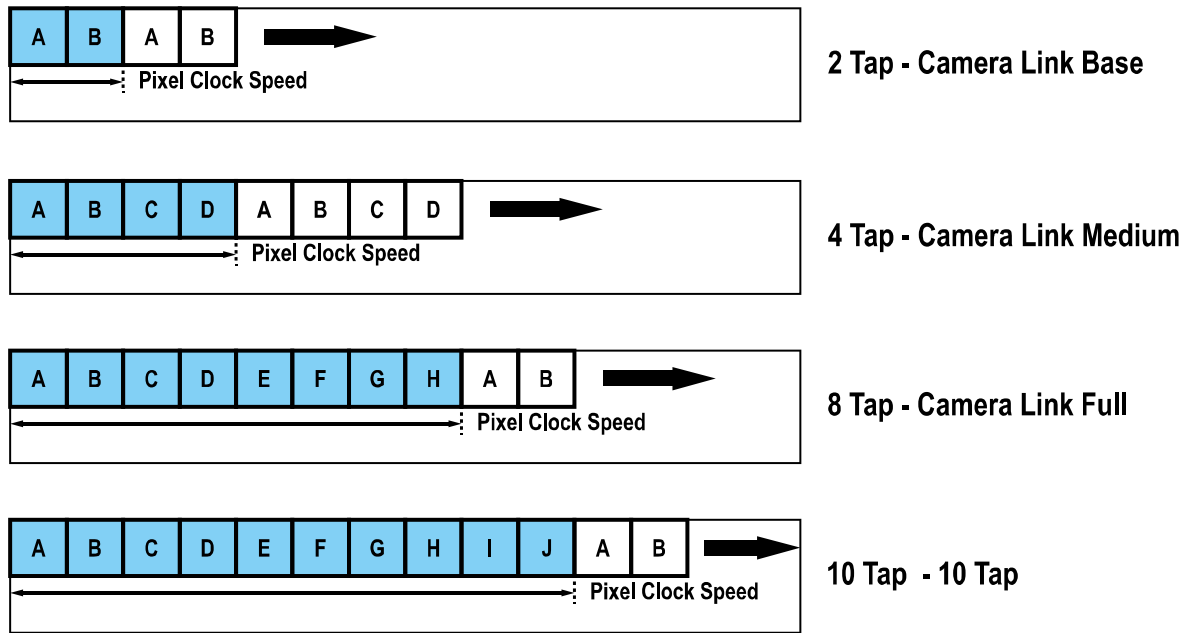


Figure 9-6 Camera Link Tap Geometry

The XML parameter related to Camera Link Tap Geometry is as follows.

XML Parameter	Value	Description
Camera Link Tap Geometry	2: 1X2-1Y	Sets the Camera Link Tap Geometry to 2 Tap.
	4: 1X4-1Y	Sets the Camera Link Tap Geometry to 4 Tap.
	8: 1X8-1Y	Sets the Camera Link Tap Geometry to 8 Tap.
	10: 1X10-1Y	Sets the Camera Link Tap Geometry to 10 Tap.

Table 9-8 XML Parameter related to Camera Link Tap Geometry

## 9.7 Camera Link Pixel Clock Speed

The VP-127MC-M/C6H cameras provide selectable Camera Link Pixel Clock speeds. The Pixel Clock speed determines that the rate at which pixel data will be transmitted from the camera to the frame grabber in your computer via the Camera Link interface. Setting the camera for a higher Pixel Clock speed will increase the rate at which image data is transferred from the camera to the frame grabber. Before setting the camera's Pixel Clock speed, make sure you determine the maximum Pixel Clock speed supported by your frame grabber. Then, you should not attempt to set the camera's Pixel Clock speed that exceeds the maximum Pixel Clock speed for your frame grabber.

The XML parameter related to Camera Link Pixel Clock speed is as follows.

XML Parameter	Value	Description
Camera Link Pixel Clock Speed	Clock0	Sets the Camera Link Pixel Clock speed to 85 MHz.
	Clock1	Sets the Camera Link Pixel Clock speed to 65 MHz.
	Clock2	Sets the Camera Link Pixel Clock speed to 45 MHz.

Table 9-9 XML Parameter related to Camera Link Pixel Clock Speed

### 9.8 Data ROI (Color Only)

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	Selects a Data ROI used for Balance White Auto. Only available on the color camera
	RoiOffsetX	-	X coordinate of start point ROI
	RoiOffsetY	-	Y coordinate of start point ROI
	RoiWidth	32 - 13376	Width of ROI
	RoiHeight	2 - 9528	Height of ROI

Table 9-10 XML Parameters related to Data ROI

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

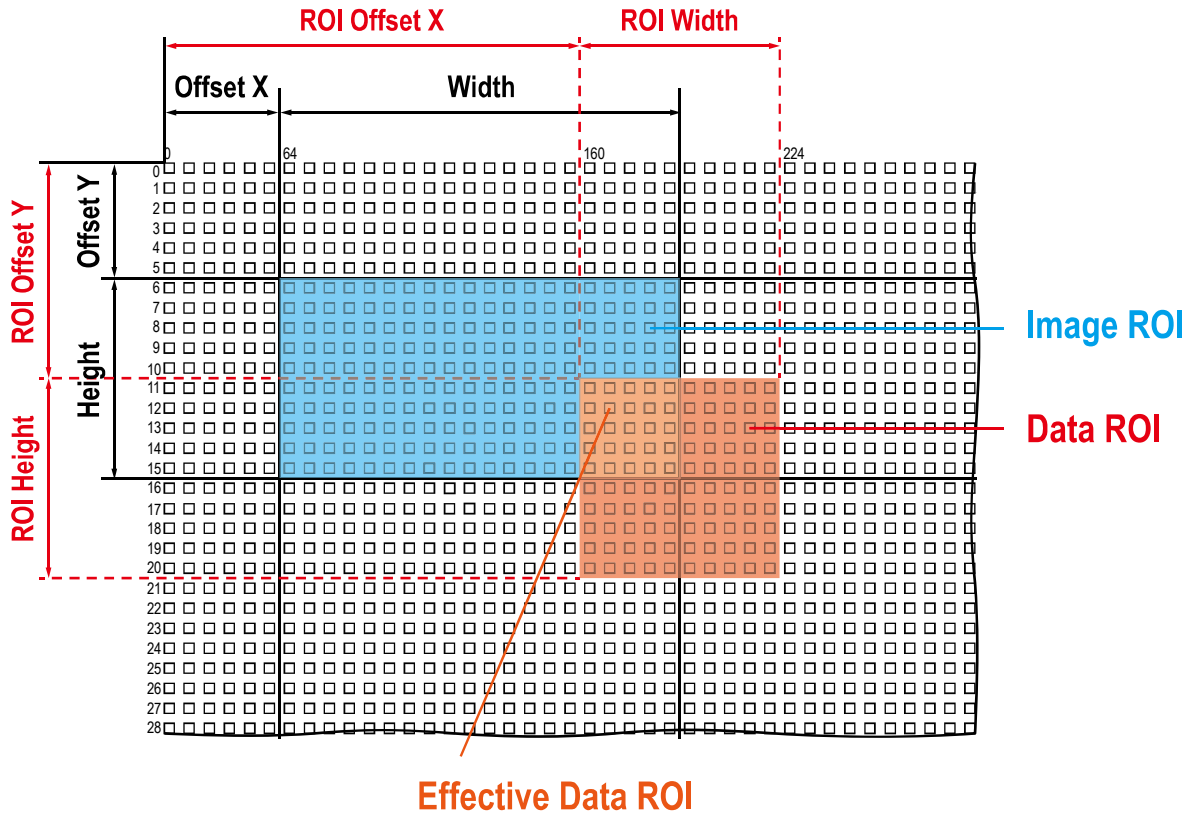


Figure 9-7 Effective Data ROI



## 9.9 White Balance (Color Only)

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 the VC-25MC-31 I camera, the Red, Green and Blue intensities 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 be unaffected by the white balance mechanism. If the **Balance Ratio** parameter 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	BalanceRatio Selector	Red	A Balance Ratio value will be applied to red pixels.
		Green	A Balance Ratio value will be applied to green pixels.
		Blue	A Balance Ratio value will be applied to blue pixels.
	BalanceRatio	×1.0 ~ ×4.0	Adjusts the ratio of the selected color.

Table 9-11 XML Parameters related to White Balance

### 9.9.1 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 GreyWorld 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 Parameter		Value	Description
AnalogControl	BalanceWhite Auto	Off	Balance White Auto Off
		Once	White Balance is adjusted once and then Off.

Table 9-12 XML Parameter related to Balance White Auto

## 9.10 Gain and Black Level

Increasing the **Gain** parameter increases all pixel values of the image. This results in a higher grey value output from the camera for a given amount of output from the image sensor.

1. Selects the Gain Control (Analog All, Digital All) to be adjusted by using the Gain Selector parameter.
2. Sets the Gain parameter to the desired value.

Adjusting the **Black Level** parameter will result in an offset to the pixel values output from the camera.

1. Selects the Black Level Control (Analog All, Digital All) to be adjusted by using the Black Level Selector parameter.
2. Sets the Black Level parameter to the desired value. The available setting range varies depending on the Pixel Format settings.

The XML parameters related to **Gain** and **Black Level** are as follows.

XML Parameters		Value	Description
Analog Control	GainSelector	AnalogAll	Applies the Gain value to all analog channels.
		Digital All	Applies the Gain value to all digital channels.
	Gain	1.0x - 12.0x	Sets an analog gain value.
		1.0x - 32.0x	Sets a digital gain value.
	BlackLevelSelector	DigitalAll	Applies the Black Level value to all digital channels.
	BlackLevel	8 bit: 0 - 15.93 10 bit: 0 - 63.75 12 bit: 0 - 255.00	Sets a black level value.

Table 9-13 XML Parameters related to Gain and Black Level

## 9.11 Defective Pixel Correction

The CMOS 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 CMOS 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.

### 9.11.1 Correction Method

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

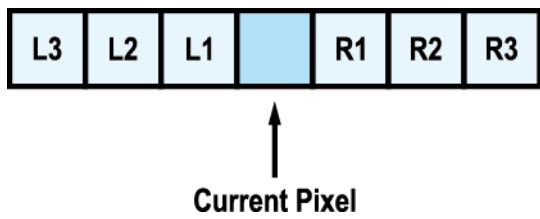


Figure 9-8 Location of Defect Pixel to be corrected

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 9-14 Calculation of Defect Pixel Correction Value

## 9.12 Dark Signal Non-uniformity Correction

In theory, when an area scan camera acquires images in complete darkness, all of the pixel values in the image 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 acquiring in darkness. This variation is known as Dark Signal Non-uniformity (DSNU). The VP-127MC-M/C6H cameras provide the DSNU Correction feature.



**Note:**

For the VP-127MC-M/C6H, there is no need to adjust for users because the DSNU Correction feature is built in the camera.

## 9.13 Hot Pixel Correction

When you acquire images with long exposure times or operate the camera under the condition of high ambient temperature, hot pixels may be appeared on the images due to the characteristics of the high resolution CMOS image sensor. The VP-127MC-M/C6H cameras provide the Hot Pixel Correction feature to remove hot pixels.

The XML parameter related to Hot Pixel Correction is as follows.

XML Parameters		Value	Description
DSNUControl	Hot Pixel Correction	Off	Disables the Hot Pixel Correction feature.
		On	Enables the Hot Pixel Correction feature.

Table 9-15 Command related to Hot Pixel Correction

## 9.14 Photo Response Non-uniformity Correction

In theory, when an area scan 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 or all of them 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. This variation is known as Photo Response Non-uniformity (PRNU), and the VP-127MC-M/C6H cameras provide the PRNU Correction feature. The PRNU Correction feature applied in the VP-127MC-M/C6H camera acquires one or more images under the unsaturated lighting condition and then obtains the average grey level value of the image per a block. 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 VP-127MC-M/C6H camera during the manufacturing process.

**Note:**

For the VP-127MC-M/C6H, there is no need to adjust for users because the PRNU Correction feature is built in the camera.

---

## 9.15 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 VP-127MC-M/C6H camera can be summarized by the following equation.

$$IC = IR / IF$$

IC: Level value of corrected image

IR: Level value of original image

IF: Level value of Flat Field data

In actual use conditions, generate a Flat Field correction data and then save the data into the non-volatile memory of the camera by following the procedure below.

1. 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 correction data.

2. Use the **Flat Field Data Selector** parameter to specify a location to save the generated Flat Field correction 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 are used for correction, they are expanded and applied with a Bilinear Interpolation as shown in the **Figure 9-9**.

To disregard the generated Flat Field correction data and load the existing Flat Field correction data, execute the **Flat Field Data Load** parameter before executing the **Flat Field Data Save** parameter.

4. Set the **Flat Field Correction** parameter to **On** to apply the Flat Field data to the camera.



### Caution!

- 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
- After executing the Acquisition Start command, you need to operate the camera with the free-run mode or apply a trigger signal to acquire an image.

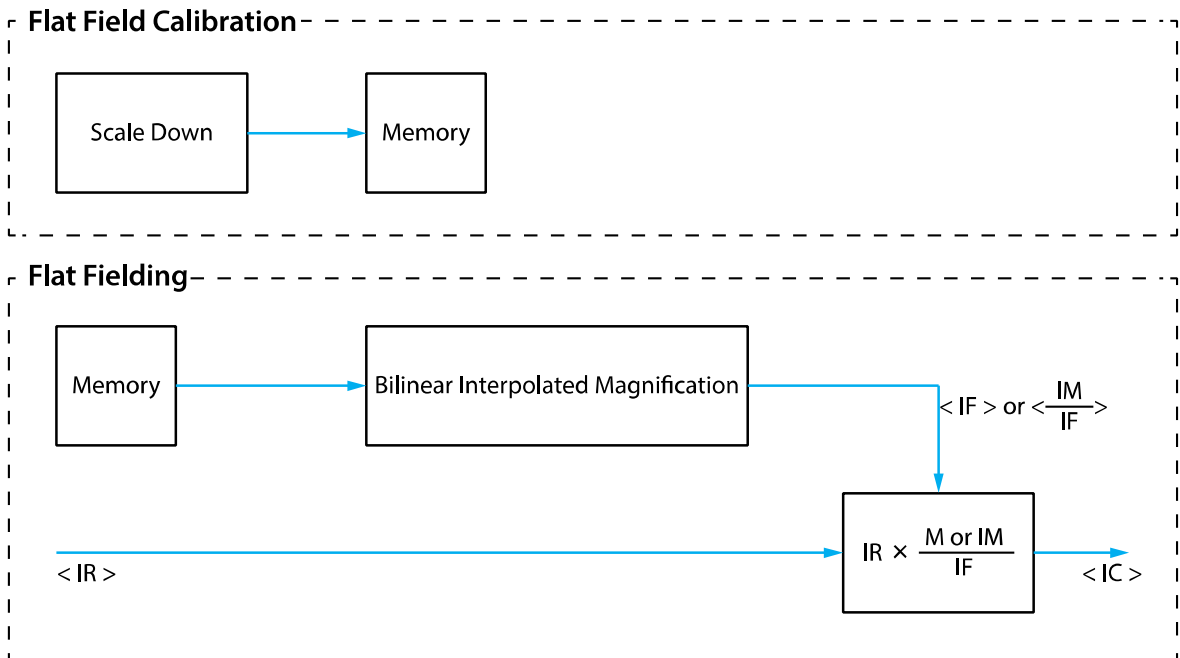


Figure 9-9 Generation and Application of Flat Field Data

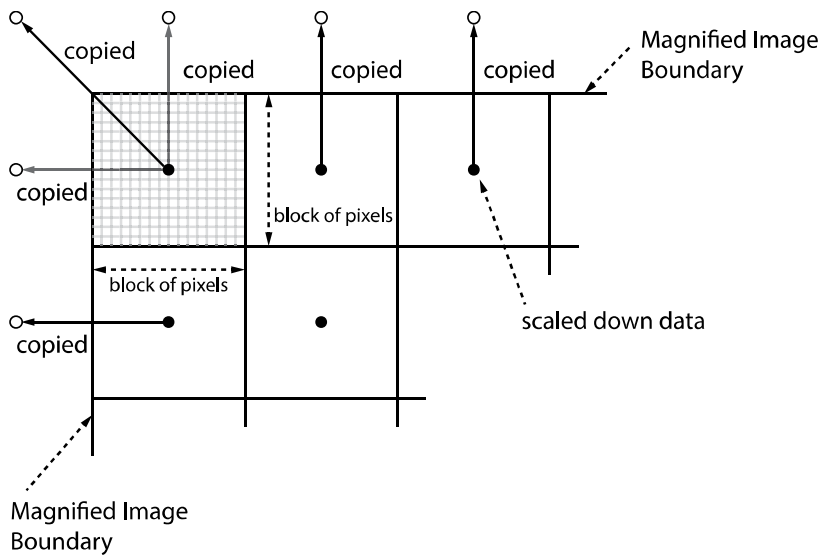


Figure 9-10 Bilinear Interpolated Magnification

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

XML Parameters	Value	Description	
FlatFieldControl	FlatFieldCorrection	Off	Disables the Flat Field Correction feature.
		On	Enables the Flat Field Correction feature.
FlatFieldData Selector	FlatFieldData Selector	Space0 ~ Space11	Selects a location to save Flat Field data to or load Flat Field data from. Space0~Space11:User defined location
		FlatFieldTargetSelector	Auto
	FlatFieldTargetSelector	User Set	Manually sets the target value of the image after correction.
FlatFieldTargetLevel	1 - 4095	Sets the target value of the image after correction when FlatFieldTargetSelector is set to User Set. <ul style="list-style-type: none"> <li>The setting range is based on the 12-bit Pixel Format.</li> </ul>	
FlatFieldData Generate	-	Generates the Flat Field data.	
FlatFieldDataSave	-	Saves the generated Flat Field correction data in the non-volatile memory. The data generated by executing the Flat Field Data Generate parameter are saved in the volatile memory so that the data are 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.	
FlatFieldDataLoad	-	Loads the Flat Field data from the non-volatile memory into volatile memory.	

Table 9-16 XML Parameters related to Flat Field Correction



### 9.15.1 Flat Field Data Selector

As mentioned above, the generated Flat Field correction data are stored in the camera's volatile memory and the data are lost if the camera is reset or powered off. To use the generated Flat Field correction data after the camera is powered on or reset, you need to save them in the camera's non-volatile memory. The VP-127MC-M/C6H camera provides twelve reserved locations in the camera's non-volatile memory available for saving and loading the Flat Field correction data. You can use the Flat Field Data Selector parameter to select a location as desired.

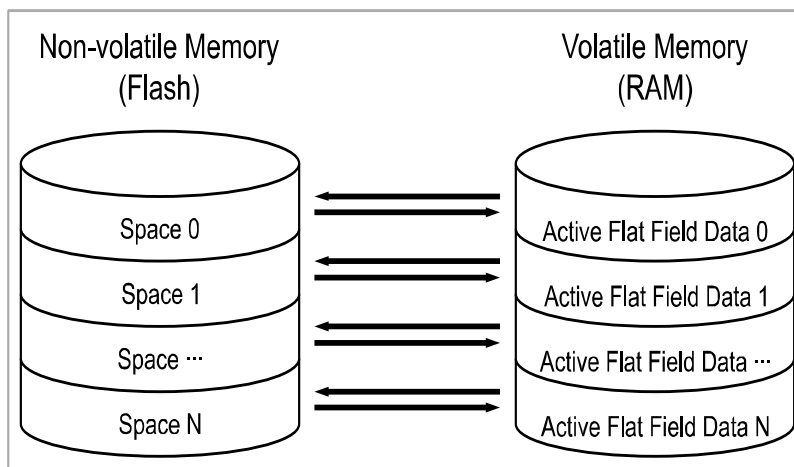


Figure 9-11 Flat Field Data Selector

### Saving Flat Field Data

In order to save the active Flat Field data into a reserved location in the camera's Flash memory, follow the procedure below.

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

### Loading Flat Field Data

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

## 9.16 Timestamp

VP-127MC-M/C6H camera provides a Timestamp feature.

XML parameters related to Timestamp are as follows.

XML Parameters		Description
DeviceControl	Timestamp	Indicates the current Timestamp value of the connected device.
	TimestampIncrement	Indicates the increment of Timestamp.
	TimestampReset	Changes the current Timestamp value into 0 and restarts counting.
	TimestampResetValue	Designates time to reset Timestamp as 0, by the form in the numeric value.
	TimestampLatch	Latches the current value of Timestamp.
	TimestampLatchValue	Indicates prior value before resetting the Timestamp value.

Table 9-17 XML Parameters related to Timestamp

## 9.17 Event Control

VP-127MC-M/C6H camera provides an Event Notification feature. With the Event Notification feature, the camera can generate an event and transmit a related event message to the PC whenever a specific situation has occurred.

The VP-127MC-M/C6H camera can generate and transmit events for the following type of situation:

- When the TestEventGenerate parameter is executed (Test)

XML parameters related to Event Control are as follows.

XML Parameters	Value	Description	
EventControl	EventSelector	Test	Transfers the Test event generated from the execution of the TestEventGenerate parameter.
	Event Notification	On	Enables the selected event notification.
		Off	Disables the selected event notification.
TestControl	TestPendingAck	-	Sets time to wait before writing the device's pending acknowledge feature.
	TestEventGenerate	-	Generates a Test event.

Table 9-18 XML Parameters related to Event Control

## 9.18 Digital I/O Control

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

The XML parameters related to Digital I/O Control are as follows.

XML Parameters	Value	Description	
DigitalIOControl	LineSelector	Line0	Configures the items related to the pins of No.2 and No.3 among 6 of the pins.
		Line1	Configures the items related to the pin No.4 among 6 of the pins.
	LineMode	Input	Appears under Line0 is chosen.
		Output	Appears under Line1 is chosen.
	LineInverter	FALSE	Disables inversion on the output signal of the line.
		TRUE	Enables inversion on the output signal of the line.
	LineSource	Off	Disables the line output.
		Frame Active	Outputs pulse signals indicating a line readout time.
		LineActive	Outputs pulse signals indicating a frame readout time.
		Exposure Active	Outputs pulse signals indicating the current exposure time.
		UserOutput0	Outputs pulse signals set by User Output Value.
		Timer0 Active	Outputs user-defined Timer signals as pulse signals.
		Counter0 Active	Outputs user-defined Counter signals as pulse signals.
	UserOutput Selector	UserOutput0	Outputs pulse signals set by User Output Value.
	UserOutput Value	FALSE	Sets the bit state of the line to Low.
		TRUE	Sets the bit state of the line to High.
	Debounce Time	0 ~ 1,000,000	Sets a Debounce Time in microseconds (Default: 0.5 $\mu$ s).

Table 9-19 XML Parameters related to Digital I/O Control

When you set the Line Source to UserOutput0, you can use the user setting values as output signals.

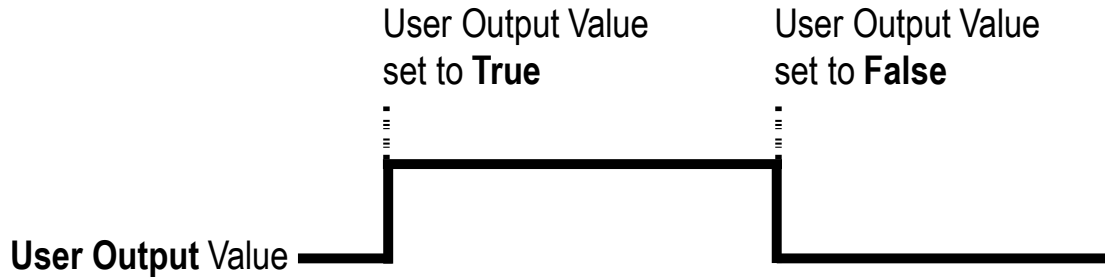


Figure 9-12 User Output

The camera can provide an Exposure Active output signal. The signal goes high when the exposure time for each frame acquisition begins and goes low when the exposure time ends as shown in the figure below. This signal can be used as a flash trigger and is also useful when you are operating a system where either the camera or the object being imaged is movable. Typically, you do not want the camera to move during exposure. You can monitor the Exposure Active signal to know when exposure is taking place and thus know when to avoid moving the camera.

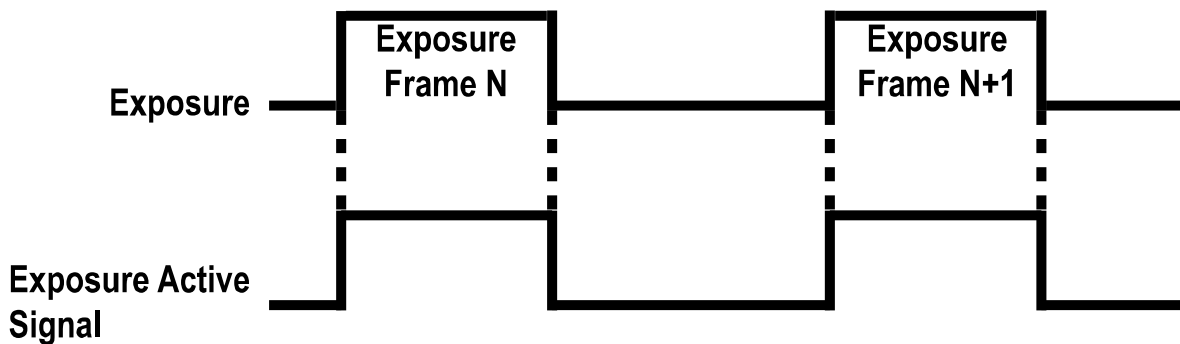


Figure 9-13 Exposure Active Signal

### 9.19 Debounce

The Debounce feature of the VP-127MC-M/C6H cameras 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.

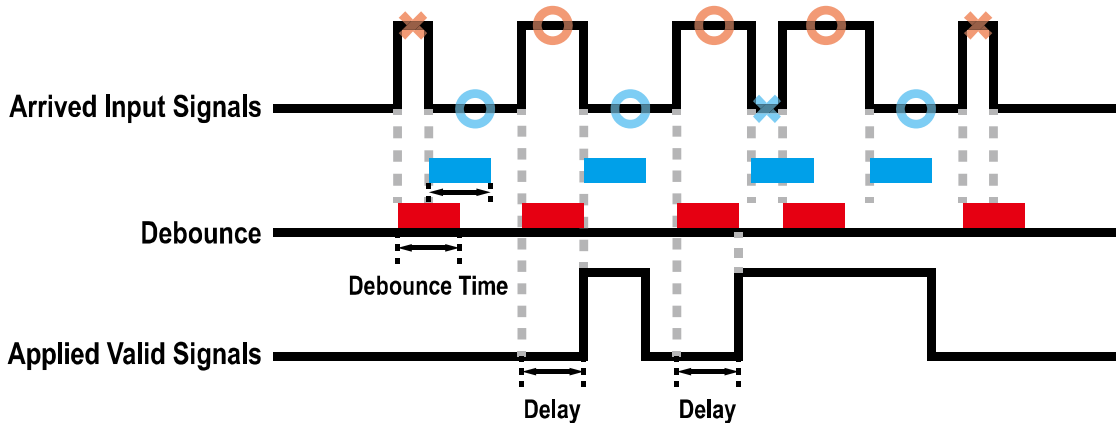


Figure 9-14 Debounce

The XML parameter related to Debounce Time is as follows.

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

Table 9-20 XML Parameter related to Debounce Time

## 9.20 Timer Control

When the Line Source parameter is set to `Timer0Active`, the camera can provide output signals by using the Timer. On the VP-127MC-M/C6H camera, the Frame Active, Exposure Active event or external trigger signal is available as Timer source signal.

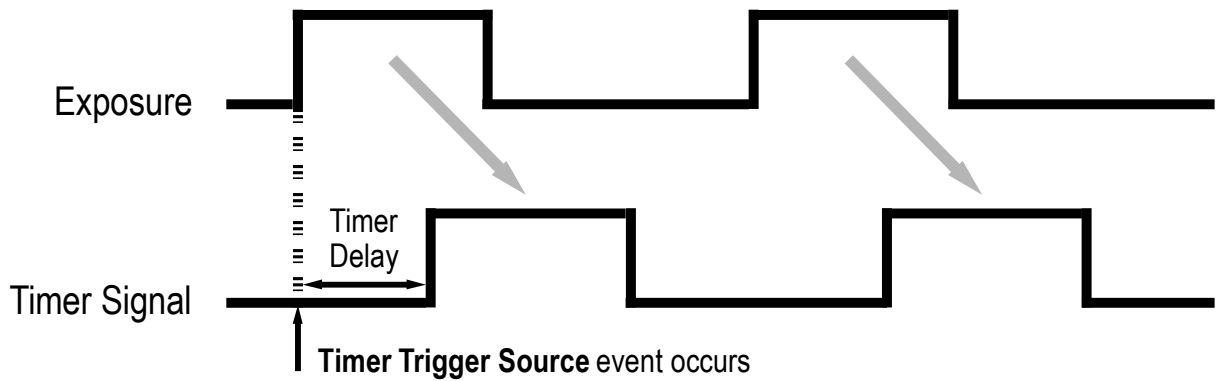
The XML parameters related to Timer are as follows.

XML Parameters	Value	Description	
CounterAnd TimerControl	TimerSelector	Timer0	Selects a Timer to configure.
	TimerDuration	1 ~ 60,000,000 $\mu$ s	Sets the duration of the Timer output signal to be used when Timer Trigger Activation is set to Rising/Falling Edge.
	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.
	TimerValue	-	Displays the current value of the selected Timer.
TimerStatus	TimerIdle		Indicates that the Timer is in idle state.
	TimerTriggerWait		Indicates that the Timer is waiting for a trigger signal.
	TimerActive		Indicates that the Timer is in active state.
TimerTrigger Source	Off		Disables the Timer trigger.
	ExposureActive		Sets the Timer to use the current exposure time as the source signal.
	FrameActive		Sets the Timer to use a frame readout time as the source signal.
	Line0		Sets the Timer to use the external trigger signal as the source signal.
	Counter0Active		Sets the Counter0 to use the external trigger signal as the source signal.
TimerTrigger Activation	RisingEdge		Specifies that a rising edge of the selected trigger signal will act as the Timer trigger.
	FallingEdge		Specifies that a falling edge of the selected trigger signal will act as the Timer trigger.
	AnyEdge		Specifies that a rising or falling edge of the selected trigger signal will act as the Timer trigger.
	LevelHigh		Specifies that the Timer output signal will be valid as long as the selected trigger signal is High.
	LevelLow		Specifies that the Timer output signal will be valid as long as the selected trigger signal is Low.

Table 9-21 XML Parameters related to Timer Control

For example, when the Timer Trigger Source is set to Exposure Active and the Timer Trigger Activation is set to Level High, the Timer will act as follows.

1. When the source signals set by the Timer Trigger Source parameter are applied, the Timer will start operations.
2. The delay set by the Timer Delay parameter 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 9-15 Timer Signal



## 9.21 Cooling Control

A fan is installed on the rear panel of the camera to radiate heat. You can set the fan to turn on or off. You can also set the fan 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	TargetTemperature	-10°C ~ 80°C Turns on the fan automatically when the temperature set in this parameter.
	FanOperationMode	Off Turns off the fan.
		On Turns on the fan.
	PeltierOperationMode	Off Turns off the Thermoelectric Peltier.
		On Turns on the Thermoelectric Peltier when the internal temperature exceeds the value set in the Target Temperature parameter.
FanSpeed	- Displays the current Fan RPM.	

Table 9-22 XML Parameters related to Cooling Control

## 9.22 Temperature Monitor

The camera has an embedded sensor chip 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 9-23 XML Parameters related to Device Temperature

## 9.23 Status LED

A LED is installed on the rear panel of the camera to inform the operation status of the camera.

LED status and corresponding camera status are as follows:

Status LED	Description
Steady Red	The camera is not initialized.
Steady Green	A Camera Link stands by.
Fast Flashing Green	The camera is transmitting image data.

Table 9-24 Status LED

## 9.24 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. Four types of test patterns are available; images with different values in horizontal direction (Grey Horizontal Ramp), images with different values in diagonal direction (Grey Diagonal Ramp), moving images with different values in diagonal direction (Grey Diagonal Ramp Moving) and images with different values in horizontal direction output from the image sensor (Sensor Specific).

The XML parameter related to Test Pattern is as follows.

XML Parameter		Value	Description
ImageFormat Control	TestPattern	Off	Disables the Test Pattern feature.
		GreyHorizontalRamp	Sets to Grey Horizontal Ramp.
		GreyDiagonalRamp	Sets to Grey Diagonal Ramp.
		GreyDiagonalRampMoving	Sets to Grey Diagonal Ramp Moving.
		SensorSpecific	Sets to the Test Pattern generated by the image sensor.

Table 9-25 XML Parameter related to Test Pattern

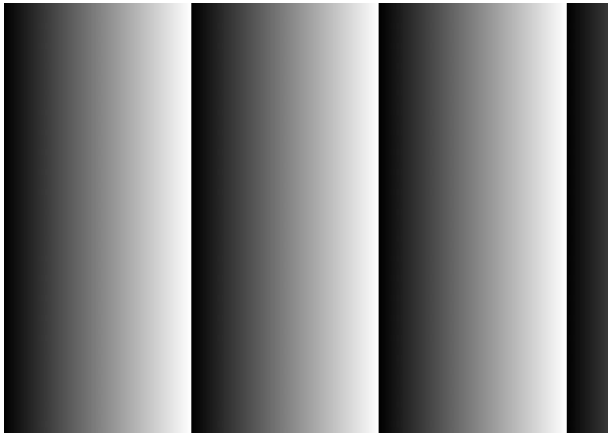


Figure 9-16 Grey Horizontal Ramp

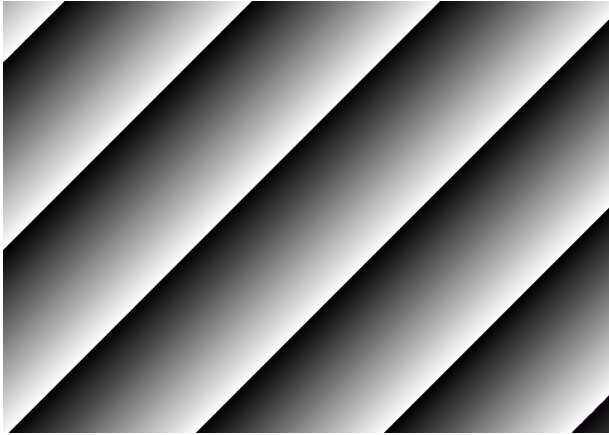


Figure 9-17 Grey Diagonal Ramp



Figure 9-18 Grey Diagonal Ramp Moving

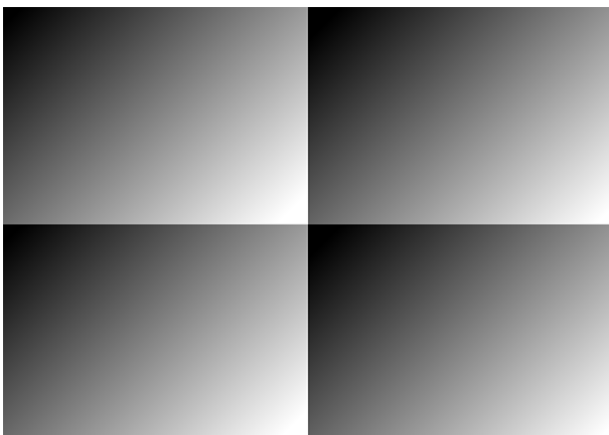


Figure 9-19 Sensor Specific



**Caution!**

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

## 9.25 Reverse X

The Reverse X feature lets you flip images horizontally. This feature is available in almost all of operation modes of the camera, except for the Test Image mode.

XML Parameter		Value	Description
ImageFormatControl	ReverseX	FALSE	Disables the Reverse X feature.
		TRUE	Flips images horizontally.

Table 9-26 XML Parameter related to Reverse X



Figure 9-20 Original Image



Figure 9-21 Reverse X Image

## 9.26 Device Link Throughput Limit

The Device Link Throughput Limit feature allows you to limit the maximum available bandwidth for data transmission to your computer.

The XML parameter related to Device Link Throughput Limit is as follows.

XML Parameters	Description
DeviceControl DeviceLinkThroughputLimit	Limits the maximum available bandwidth (Bps).

Table 9-27 XML Parameter related to Device Link Throughput Limit



### Caution!

To ensure good image quality, we recommend that you set the Device Link Throughput Limit parameter to the maximum value. Otherwise, the image quality can decrease. In case of the VP-127MC-M/C6H, its maximum value is 8000.

## 9.27 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 Parameter	Description
DeviceControl DeviceUserID	Input user-defined information (16 bytes).

Table 9-28 XML Parameter related to Device User ID

## 9.28 Device Reset

Resets the camera physically to power off and on.

The XML parameter related to Device Reset is as follows.

XML Parameter	Description
DeviceControl Device Reset	Resets the camera physically.

Table 9-29 XML Parameter related to Device Reset

## 9.29 Field Upgrade

The camera provides a feature to upgrade the Firmware and FPGA logic through the Camera Link interface rather than disassemble the camera in the field. Refer to **Appendix B** for more details about how to upgrade.

## 9.30 User Set Control

You can save the current camera settings to the camera's internal Flash memory. You can also load the camera settings from the camera's internal Flash memory. 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 UserSet1 settings.
		UserSet2	Selects the UserSet2 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. The Default is a Factory Default Settings and allowed to load only.	
UserSetDefault		Default	Applies the Factory Default settings when reset.
		UserSet1	Applies the UserSet1 when reset.
		UserSet2	Applies the UserSet2 when reset.

Table 9-30 XML Parameters related to User Set Control

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

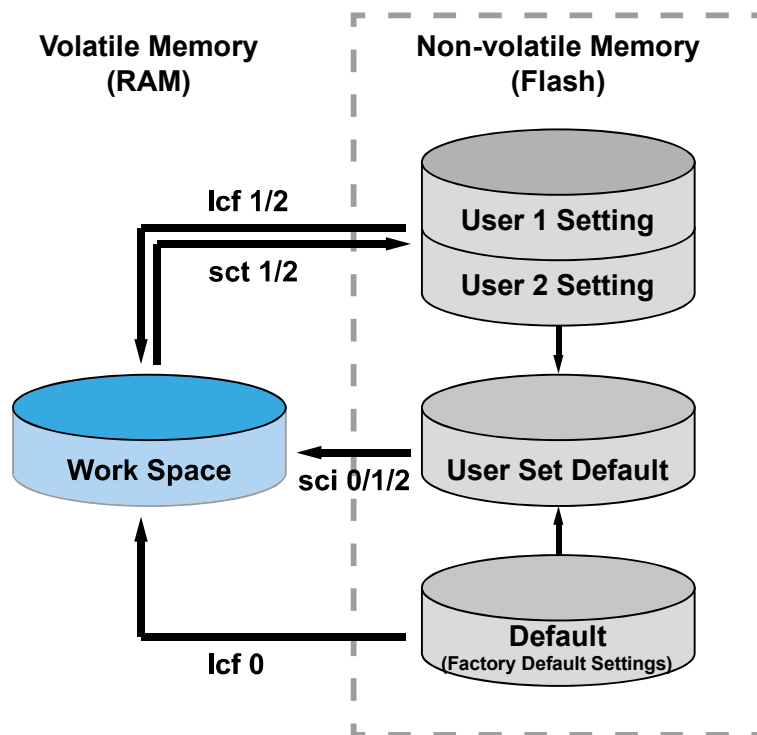


Figure 9-22 User Set Control



## 9.31 Sequencer Control

The Sequencer Control provided by the VP-127MC-M/C6H cameras 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 VP-127MC-M/C6H cameras, only the Flat Field correction data can be configured for Sequencer Sets.

The XML parameters related to Sequencer Sets are as follows.

XML Parameters		Value	Description
Sequencer Control	SequencerMode	Off	Disables the Sequencer.
		On	Enables the Sequencer.
	Sequencer ConfigurationMode	Off	Disables the Sequencer Configuration Mode.
		On	Enables the Sequencer Configuration Mode.
	Sequencer FeatureSelector	FlatFieldData	Selects a feature to be applied to Sequencer Sets.
		GainDigitalAll	
		ExposureTime	
	Sequencer FeatureEnable	Off	Disables the selected feature for the application of Sequencer Sets.
		On	Enables the selected feature for the application of Sequencer Sets.
	Sequencer SetSelector	0 – 31	Selects an index number of a Sequencer Set to be configured.
SequencerSetActive	-	Displays the index number (0 – 31) of the Sequencer Set that is currently active.	
SequencerSetCount	1 – 32	Sets the number of Sequencer Sets to be applied.	
SequencerReset	-	Returns to Sequencer Set 0.	

Table 9-31 XML Parameters related to Sequencer Control



### Caution!

To apply Sequencer Sets, you must set the Trigger Mode parameter to On.

## Use Case – Applying Four Different Sets of Flat Field Correction Data, Gain and Exposure Time Settings to Sequencer Sets

For example, assume that four different sets of Flat Field correction data, Gain and Exposure settings 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. Select a feature to be applied to Sequencer Sets by using the Sequencer Feature Selector parameter.

You must select features to be applied to Sequencer Sets prior to entering the Sequencer Configuration Mode.

Set the Sequencer Feature Selector parameter to Flat Field Data Selector, and then set the Sequencer Feature Enable parameter to On.

Set the Sequencer Feature Selector parameter to Gain Digital All, and then set the Sequencer Feature Enable parameter to On.

Set the Sequencer Feature Selector parameter to Exposure Time, and then set the Sequencer Feature Enable parameter to On.

3. Set the Sequencer Configuration Mode parameter to On.
4. Set the Sequencer Set 0 first.

Set the Sequencer Set Selector parameter to 0, and then set the Flat Field Data Selector parameter to Space0 in the Flat Field Control category. Then, set the Gain parameter to 1 in the Analog Control category, and then set the Exposure Time parameter to 10000 in the Acquisition Control category.

5. By following the procedure in the step 4, set the Sequencer Set 1, Sequencer Set 2 and Sequencer Set 3 as shown below.

Sequencer Set 1 → Flat Field Data Selector = Space 1, Gain = 2, Exposure Time = 20000

Sequencer Set 2 → Flat Field Data Selector = Space 2, Gain = 3, Exposure Time = 30000

Sequencer Set 3 → Flat Field Data Selector = Space 3, Gain = 4, Exposure Time = 40000

6. Set the Sequencer Set Count parameter to 4.
7. Set the Sequencer Configuration Mode parameter to Off, and then set the Sequencer Mode parameter to On.

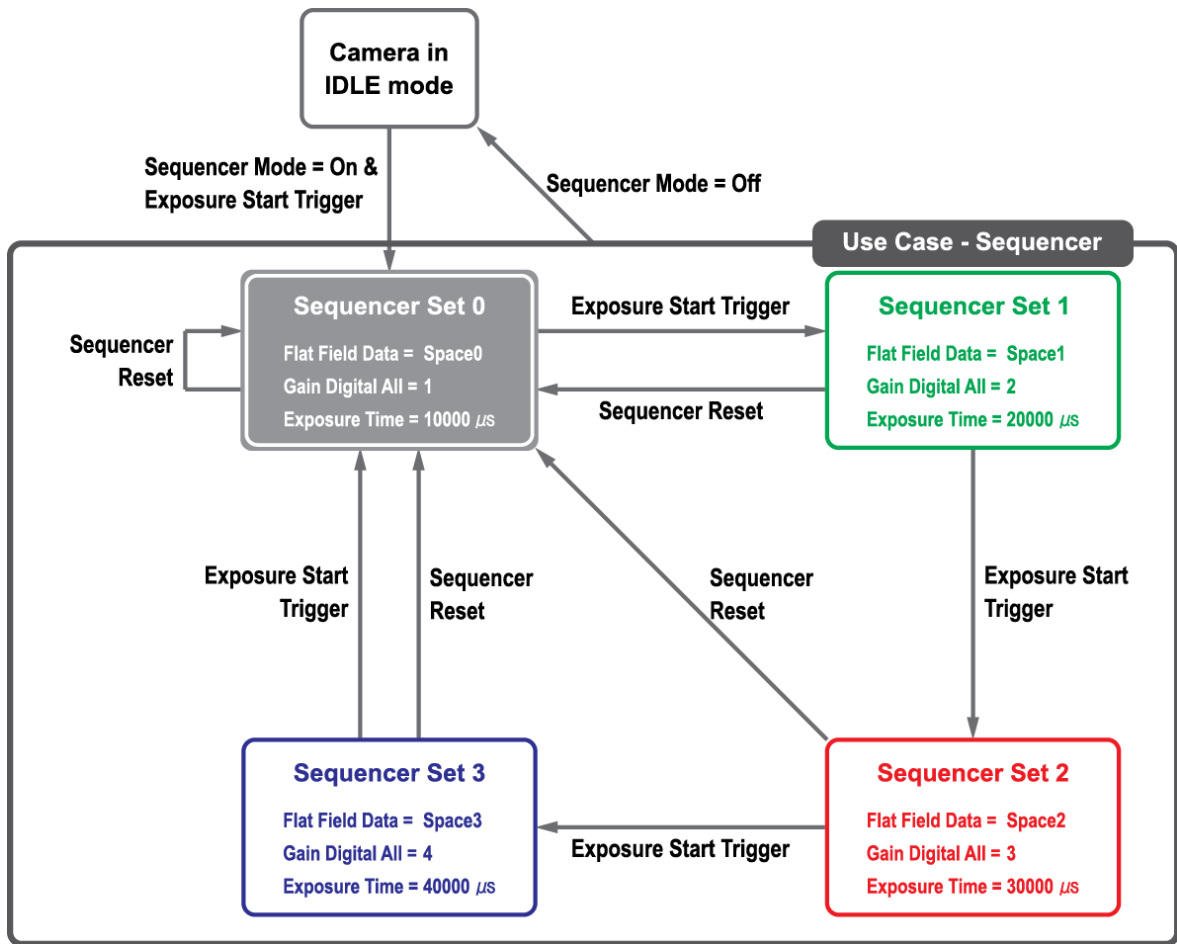


Figure 9-23 Sequencer Diagram (Use Case)



**Note:**

- When you set the Sequencer Configuration Mode parameter to On, the following features will be enabled for the application of Sequencer Sets by default.  
Flat Field Data Selector = Enabled, Space0  
Gain Digital All = Enabled, Gain = 1  
Exposure Time = Enabled, 10000
- 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 9.30 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.

## Chapter 10. Camera Configuration

### 10.1 Setup Command

You can configure all camera settings via RS-644 serial interface of the Camera Link. When you want to control the camera using a terminal or access directly to the camera at your application, you need to set your network as follows:

- Baud Rate: 115200 bps
- Data Bit: 8 bit
- Parity Bit: No parity
- Stop Bit: 1 stop bit
- Flow Control: None

All camera setting commands are transmitted in the ASCII command type except a command for transmitting a large file such as firmware download. All camera setting commands are transmitted from the user application, and then the camera returns a response ('OK', 'Error' or information) for a command. When you execute a write command, the camera returns a response to inform whether the command has been successfully executed. When you execute a read command, the camera returns an error or information.

```
Command format:
<command> <parameter1> <parameter2> <cr>
0 - 2 parameters follow the command.
Response:
If a write command is successfully executed
OK <cr> <lf>
```

e.g., Write command

```
In response to a "set 100" command the camera will return (in hex value)
Command:73 65 74 20 31 30 30 0D
      set 100<cr>
Response:      73 65 74 20 31 30 30 0D 0A      4F 4B 0D 0A      3E
              set 100<cr><lf>                  OK<cr><lf>      >
              Echo                             result      prompt
```

```
If a read command is successfully executed
<parameter1> <cr> <lf>
```

e.g., Read command

```
In response to a "get" command the camera will return (in hex value)
Command :      67 65 74 0D
              get <cr>
Response :      67 65 74 0D 0A      31 30 30 0D 0A 3E
              get<cr><lf>          100<cr><lf>  >
              Echo                  response  prompt
```

```
If a command is not executed successfully
Error: <Error code> <cr> <lf>
```

Prompt:

A prompt always follows the response. `>' is used as a prompt.

Types of Error Code

0x80000481: value of parameter is not valid.

0x80000482: the number of parameters is not matched.

0x80000484: command does not exist.

0x80000486: no permission to execute.

## 10.2 Actual Runtime of Commands

When you execute a command, the actual runtime of the command varies depending on the type of the command and the operating status of the camera.

All commands except Set Exposure Time ('set') command are applied to change the settings as illustrated below, on the rising edge of a REQ\_Frame signal before starting the readout process. When you execute the 'set' command, the exposure time setting will be changed and applied at the starting of the exposure.

If you operate the camera with the Trigger Mode set to On, you must execute commands before applying the trigger signals in order to synchronize image outputs with the commands.

If you execute a command in the Free-Run mode, you may acquire up to two images that are not affected by the command execution. This is true because it is hard to verify the current operating status of the camera in the Free-Run mode.

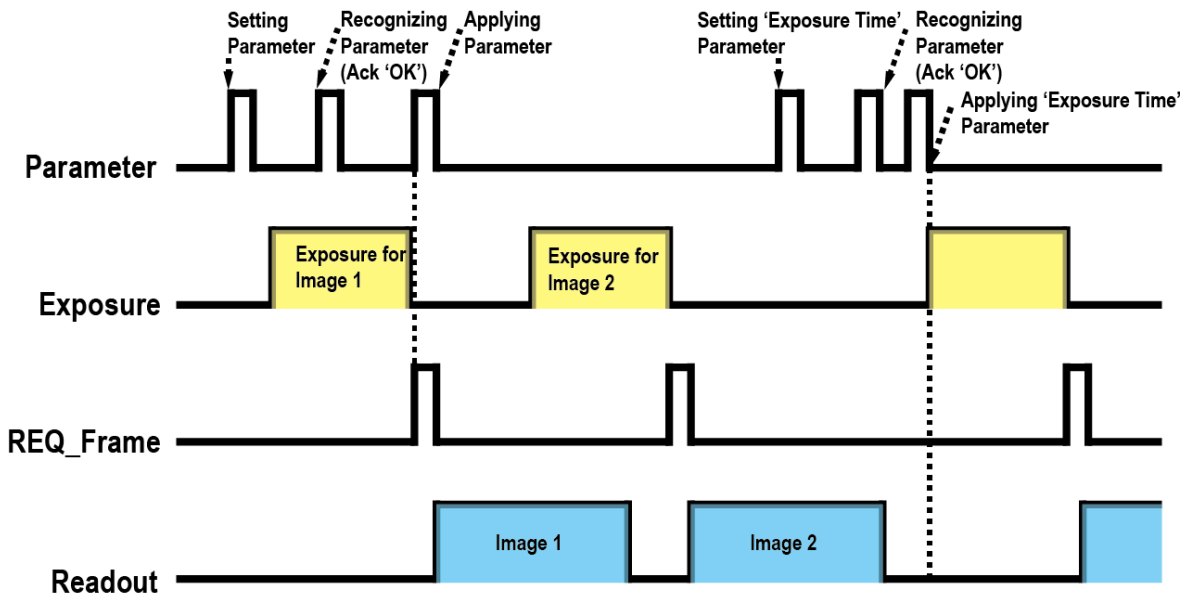


Figure 10-1 Actual Runtime of Commands

## 10.3 Configurator

The Configurator, a sample application, is provided to control Vieworks Camera Link cameras. The Configurator allows you to change the camera's parameters and control the camera.

### Starting the Configurator

After connecting the camera to your computer (refer to [Chapter 6 Connecting the Camera](#), you can run the Configurator by following the procedure below.

1. Execute the Configurator.exe file after the camera is powered on. The Camera Scan window appears.
2. The Configurator probes if a camera is connected to your computer and then displays the model name of the connected camera in the Camera Scan window.
3. Right-click the model name of the camera, and then click the **Add to List** menu. By adding a Vieworks Camera Link camera which supports XML-based control to the list, you can configure the camera with a newer version of the Configurator.

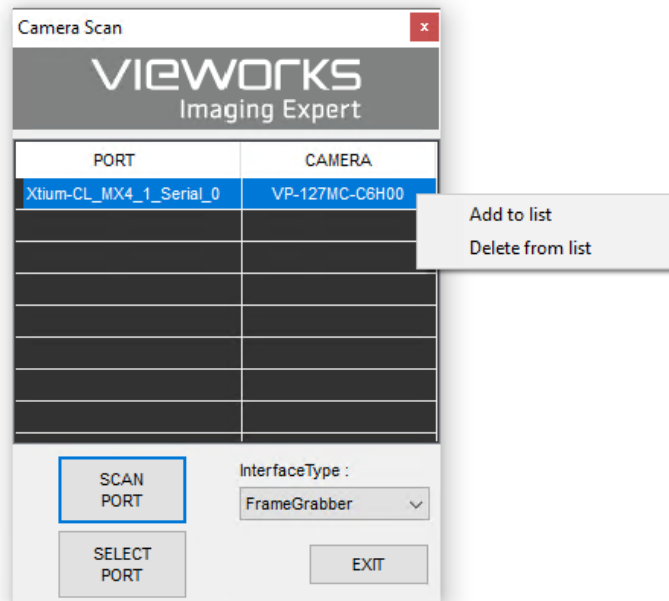


Figure 10-2 Add to list in the Camera Scan window

4. Double-click the model name of the camera. The Device Property and Configurator Plus windows appear.

The Device Property window displays controls for setting camera parameters.

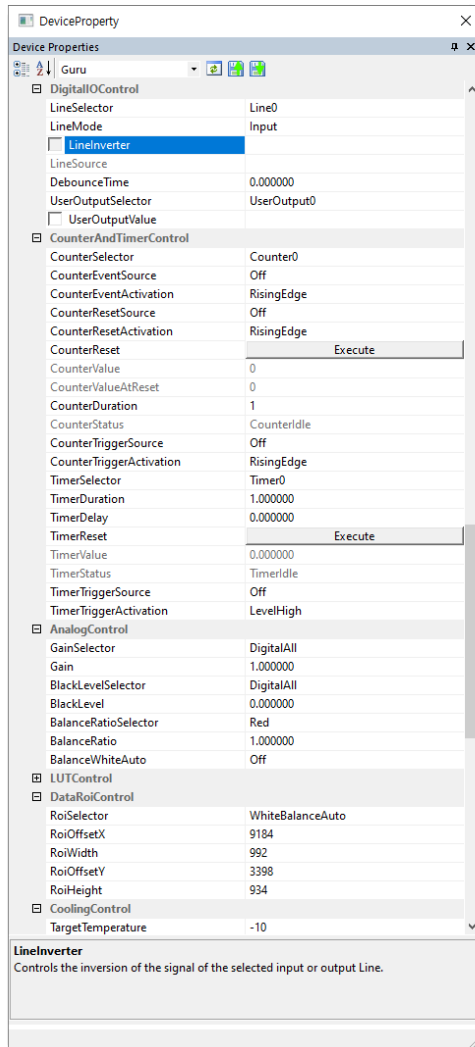


Figure 10-3 Device Property



In the Configurator Plus window, you can display the Device Property and/or Device Maintenance windows. In the Device Maintenance window, you can download a Defective Pixel Map or upgrade camera's MCU, FPGA and XML files.

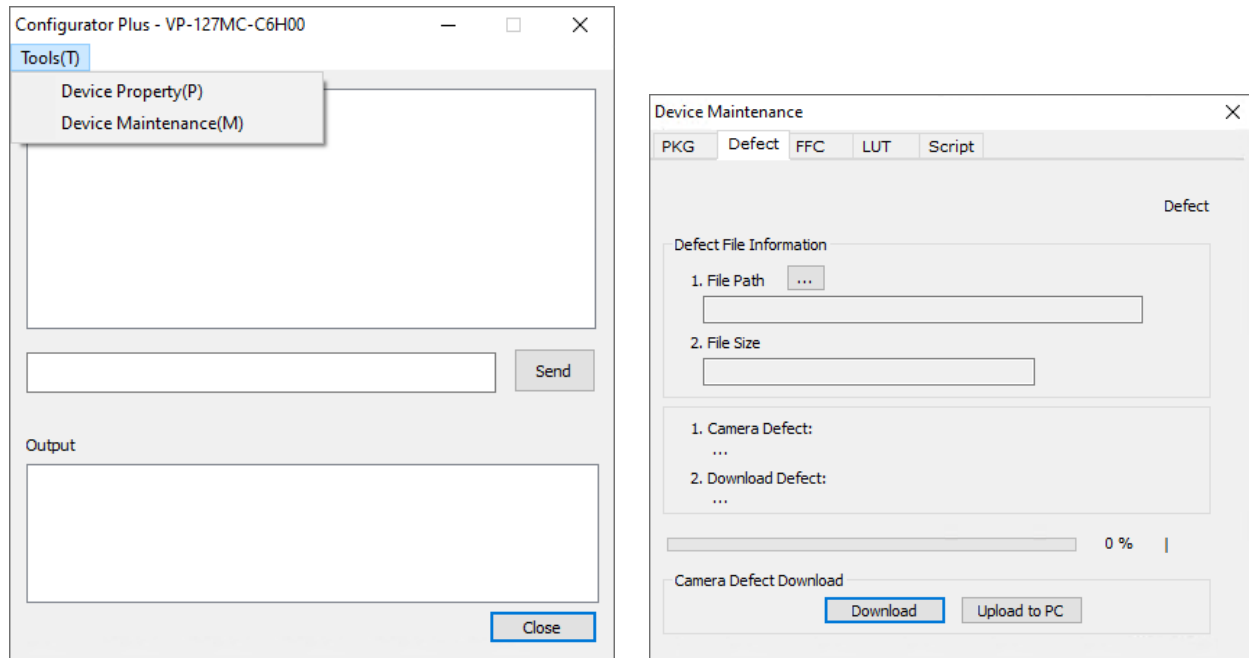


Figure 10-4 Configurator Plus and Device Maintenance

## 10.4 Command List

You can set all features provided by the VP-127MC-M/C6H cameras by using the following commands.

Command	Syntax	Return Value	Description
Help	help	String	Displays a list of all commands.
Set ROI Offset X	sox n	OK	X coordinate of start point ROI
Get ROI Offset X	gox	n	n: X axis offset
Set ROI Offset Y	soy n	OK	Y coordinate of start point ROI
Get ROI Offset Y	goy	n	n: Y axis offset
Set Image Width	siw n	OK	Sets a width of the Image ROI.
Get Image Width	giw	n	n: Width value
Set Image Height	sih n	OK	Sets a height of the Image ROI.
Get Image Height	gih	n	n: Height value
Set Binning Selector	sbns 0 1	OK	Selects the Binning engine.
Get Binning Selector	gbns	0 1	0: Sensor 1: Logic
Set Binning Horizontal Mode	sbhm 0 1	OK	Sets the Binning mode to apply to Binning Horizontal.
Get Binning Horizontal Mode	gbhm	0 1	0: Sum 1: Average
Set Binning Horizontal	sbh 1 2 3 4	OK	The number of horizontal pixels to combine together.
Get Binning Horizontal	gbh	1 2 3 4	1 2 3 4: ×1, ×2, ×3, ×4
Set Binning Vertical Mode	sbvm 0 1	OK	Sets the Binning mode to apply to Binning Vertical.
Get Binning Vertical Mode	gbvm	0 1	0: Sum 1: Average
Set Binning Vertical	sbv 1 2 3 4	OK	The number of vertical pixels to combine together.
Get Binning Vertical	gbv	1 2 3 4	1 2 3 4: ×1, ×2, ×3, ×4
Acquisition Start	ast	OK	Starts image acquisitions.
Acquisition Stop	asp	OK	Stops image acquisitions.

Table 10-1 Command List #1

Command	Syntax	Return Value	Description
Set Test Image Get Test Image	sti 0 1 2 3 16 gti	OK 0 1 2 3 16	Sets the Test Image. 0: Disables the Test Image feature. 1: Sets to Grey Horizontal Ramp. 2: Sets to Grey Diagonal Ramp. 3: Sets to Grey Diagonal Ramp Moving. 16: Sets to the Test Image provided by the image sensor.
Set Camera Link Tap Geometry Get Camera Link Tap Geometry	stg 2 4 8 10 gtg	OK 2 4 8 10	Sets the Camera Link Tap Geometry. 2: 1X2-1Y (2 Tap) 4: 1X4-1Y (4 Tap) 8: 1X8-1Y (8 Tap) 10: 1X10-1Y (10 Tap)
Set Data Bit Get Data Bit	sdb 8 10 12 gdb	OK 8 10 12	Sets the Pixel Format. 8: 8 bit 10: 10 bit 12: 12 bit
Set Camera Link Clock Selector Get Camera Link Clock Selector	sccs 0 1 2 gccs	OK 0 1	Sets the Camera Link Pixel Clock speed. 0: 85 MHz 1: 65 MHz 2: 45 MHz
Set Defect Correction Get Defect Correction	sdc 0 1 gdc	OK 0 1 2	Sets the Defect Pixel Correction. 0: Disables the Defect Pixel Correction. 1: Enables the Defect Pixel Correction.
Set Horizontal Flip Get Horizontal Flip	shf 0 1 ghf	OK 0 1	Sets the Reverse X (Horizontal Flip). 0: Disables the Reverse X. 1: Enables the Reverse X.

Table 10-2 Command List #2

Command	Syntax	Return Value	Description
Set Trigger Mode Get Trigger Mode	stm 0 1 gtm	OK 0 1	Sets the Trigger Mode. 0: Trigger Mode Off (Free run mode) 1: Trigger Mode On
Set Exposure Mode Get Exposure Mode	sem/ses 0 1 gem/ges	OK 0 1	Sets the Exposure mode. 0: Timed 1: Trigger Width
Set Trigger Source Get Trigger Source	sts 3 10 14 18 22 gts	OK 3 10 14 18 22	Specifies a source signal when the Trigger Mode is set to On. 3: Software 10: User Output0 14: CC1 18: Timer0 Active 22: Line0
Generate SW Trigger	gst	OK	Generates a Software trigger signal.
Set Trigger Activation Get Trigger Activation	sta 0 1 gta	OK 0 1	Sets the activation mode for the selected source signal when the Trigger Mode is set to On. 0: Falling Edge 1: Rising Edge
Set Exposure Time Get Exposure Time	set n get	OK n	Sets an exposure time. n: Exposure time in microseconds (Setting range: 1 – 60,000,000 $\mu$ s)
Set Frame Rate Get Frame Rate	sfr n gfr	OK n	Sets the rate at which the exposure start trigger will be generated when the Trigger Mode is set to Off.
Set Black Level Get Black Level	sbl n gbl	OK n	Sets the black level value. n: Black Level (Setting range: 0 ~ 255)
Set Digital Gain Get Digital Gain	sdg n gdg	OK n	Sets the digital gain value. n: Gain (Setting range: 1 $\times$ ~ 32 $\times$ )

Table 10-3 Command List #3

Command	Syntax	Return Value	Description
Generate Flat Field Data	gfd none 0 n	OK	Executes the Flat Field Generator. none / 0: Auto-adjusts the target value of the image after correction. n: Manually sets the target value of the image after correction (1 - 4095 @ 12 bit).
Set Flat Field Data Selector Get Flat Field Data Selector	sfd 0 1 ... 11 gfd	OK 0 1 ... 11	Selects a Flat Field correction data location. 0 ~ 11: User defined locations
Save Flat Field Data	sfd	OK	Saves the generated Flat Field correction data in the selected FFC data location.
Load Flat Field Data	lfd	OK	Loads the FFC data from the non-volatile memory into the volatile memory.
Set Flat Field Correction Get Flat Field Correction	sfc 0 1 gfc	OK 0 1	Sets the Flat Field Correction feature. 0: Disables the Flat Field Correction. 1: Enables the Flat Field Correction.
Set Point DSNU Correction Get Point DSNU Correction	sdsnp 0 1 gdsnp	OK 0 1	Sets the Hot Pixel Correction feature. 0: Disables the Hot Pixel Correction. 1: Enables the Hot Pixel Correction.
Set Fan Mode Get Fan Mode	sfm 0 1 2 gfm	OK 0 1 2	Sets the Fan operation mode. 0: Fan Off 1: Fan On 2: Temperature
Set Peltier Operation Mode Get Peltier Operation Mode	sptm 0 1 gptm	OK 0 1	Sets the Peltier operation mode. 0: Peltier Off 1: Peltier On
Set Target Temperature Get Target Temperature	stt n gtt	OK n	Sets the temperature to operate the fan when the Fan Operation Mode is set to Temperature. n: -10°C ~ 80°C

Table 10-4 Command List #4

Command	Syntax	Return Value	Description
Set Line Source Get Line Source	slnc 0 4 5 6 10 18 26 glnc	OK 0 4 5 6 10 18 26	Specifies a source signal for the control I/O receptacle. 0: Disables the Line input/output. 4: Frame Active 5: LineActive 6: Exposure Active 10: User Output0 18: Timer0 Active 26: Counter0Active
Set Line Inverter Get Line Inverter	slni 0 1 glni	OK 0 1	Sets whether to invert the line output. 0: Disables inversion on the line output. 1: Enables inversion on the line output.
Set User Output Value Get User Output Value	suov 0 1 guov	OK 0 1	Sets the User Output value. 0: Sets the bit state of the line to Low. 1: Sets the bit state of the line to High.
Set Timer Trigger Source Get Timer Trigger Source	stts 0 4 6 22 26 gtts	OK 0 4 6 22 26	Specifies the source signal for the Timer output signal. 0: Disables the Timer trigger. 4: Frame Active 6: Exposure Active 22: Line0 26: Counter0Active
Set Timer Duration Get Timer Duration	stdu n gtdu	OK n	Sets the duration of the Timer output signal. n: 1 – 60,000,000 $\mu$ s
Set Timer Delay Get Timer Delay	stdl n gtdl	OK n	Sets the delay time for the Timer. n: 0 – 60,000,000 $\mu$ s
Set Timer Trigger Activation Get Timer Trigger Activation	stta 0 1 2 3 4 gtta	OK 0 1 2 3 4	Sets the activation mode for the Timer. 0: Falling Edge 1: Rising Edge 2: Level Low 3: Level High 4: Any Edge
Set Debounce Time Get Debounce Time	sdbt n gdbt	OK n	Sets the Debounce time. n: Debounce time in microseconds (0 – 1,000,000 $\mu$ s)

Table 10-5 Command List #5

Command	Syntax	Return Value	Description
Set Sequencer Mode Get Sequencer Mode	ssqm 0 1 gsqm	OK 0 1	Sets the Sequencer mode. 0: Disables the Sequencer Mode. 1: Enables the Sequencer Mode.
Set Sequencer Config. Mode Get Sequencer Config. Mode	ssqcm 0 1 gsqcm	OK 0 1	Sets the Sequencer Configuration mode. 0: Disables the Sequencer Configuration mode. 1: Enables the Sequencer Configuration mode.
Set Sequencer Set Selector Get Sequencer Set Selector	ssqss n gsqss	OK n	Selects an index number of a Sequencer Set to be configured. n: Sequencer Set index number (0 ~ 31)
Set Sequencer Set Count Get Sequencer Set Count	ssqsc n gsqsc	OK n	Sets the number of Sequencer Sets to be applied. n: 1 ~ 32
Get Sequencer Set Active	gsqsa	n	Displays the index number of the Sequencer Set that is currently active. n: 0 ~ 31
Reset Sequencer	rsq	OK	Returns to Sequencer Set 0.
Set AWB Offset X Get AWB Offset X	swx n gwx	OK n	Sets a horizontal offset from the origin to the AWB ROI.
Set AWB Offset Y Get AWB Offset Y	swy n gwy	OK n	Sets the vertical offset from the origin to the AWB ROI.
Set AWB Width Get AWB Width	sww n gww	OK n	Sets a width for the AWB ROI.
Set AWB Height Get AWB Height	swh n gwh	OK n	Sets a height for the AWB ROI.
Set RGB Gain Get RGB Gain	srg r g b g grg r g b	OK g	Sets the intensity of color pixels. r g b: Red / Green / Blue pixels g: Gain value (1.0× ~ 4.0×)
Auto White Balance	arg	OK	Automatically adjusts the white balance once.

Table 10-6 Command List #6

Command	Syntax	Return Value	Description
Load Config. From	lcf 0 1 2	OK	Loads the camera setting values. 0: Loads the Factory Default Setting. 1: Loads the User 1 Setting. 2: Loads the User 2 Setting.
Save Config. To	sct 1 2	OK	Saves the current camera setting values. 1: Saves to the User 1 Setting. 2: Saves to the User 2 Setting.
Set Config. Initialization	sci 0 1 2	OK	Specifies setting values to be loaded when reset. 0: Factory Default Setting 1: User 1 Setting 2: User 2 Setting
Get Config. Initialization	gci	0 1 2	
Get Model Name	gmn	String	Displays the camera model name.
Get MCU Version	gmv	String	Displays the version of the camera MCU.
Get FPGA Version	gfv	String	Displays the version of the camera FPGA.
Get Serial Number	gsn piece	String	Displays the serial number of the camera.
Get Current Temperature	gct	String	Displays device temperature in Celsius.
Get Fan RPM	gfrpm	String	Displays the Fan RPM.
Reset Hardware	rst	-	Resets the camera physically to power off and on.

Table 10-7 Command List #7



## Chapter 11. 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 signals are applied correctly when you operate the camera with trigger signals.
- 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 the 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 to small.
- If you identify abnormal operation or overheating sign,
  - Ensure the 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 you CC1 Frame Grabber are configured correctly when you set the Trigger Source parameter to CC1.
  - Ensure that cable connections are secure when you set the Trigger Source parameter to Line0.
- If there is communication failure between the camera and computer,
  - Ensure coax cables are connected properly.
  - Ensure that you have configured a Camera Link Frame Grabber in your computer correctly and the camera is connected properly to the Camera Link Frame Grabber.



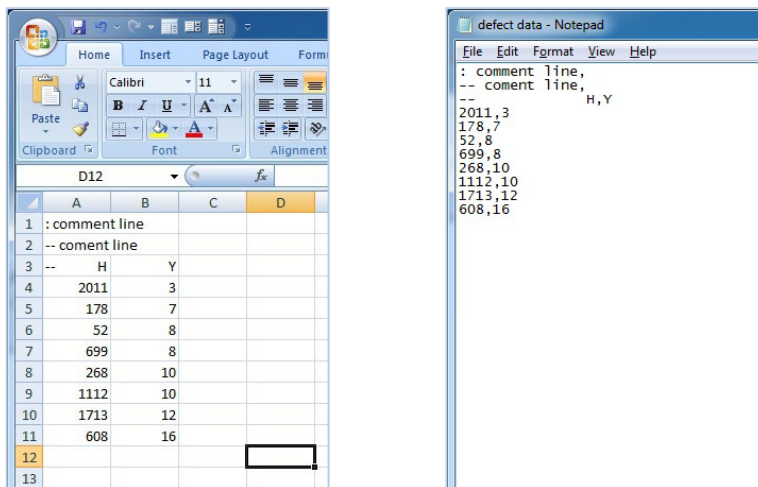
## Appendix A. Defective Pixel Map Download

1. Create the Defective Pixel Map data in Microsoft Excel format as shown in the left picture below and save as a CSV file (\*.csv). The picture in the right shows the created Excel file opened in Notepad. The following rules need to be applied when creating the file.

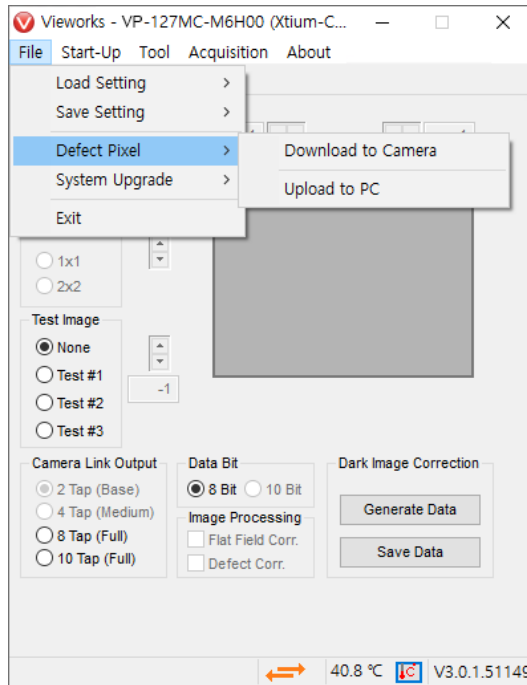
Lines beginning with ':' or '--' are treated as notes.

You must enter the horizontal value first and then vertical value for coordinates of each defect pixel.

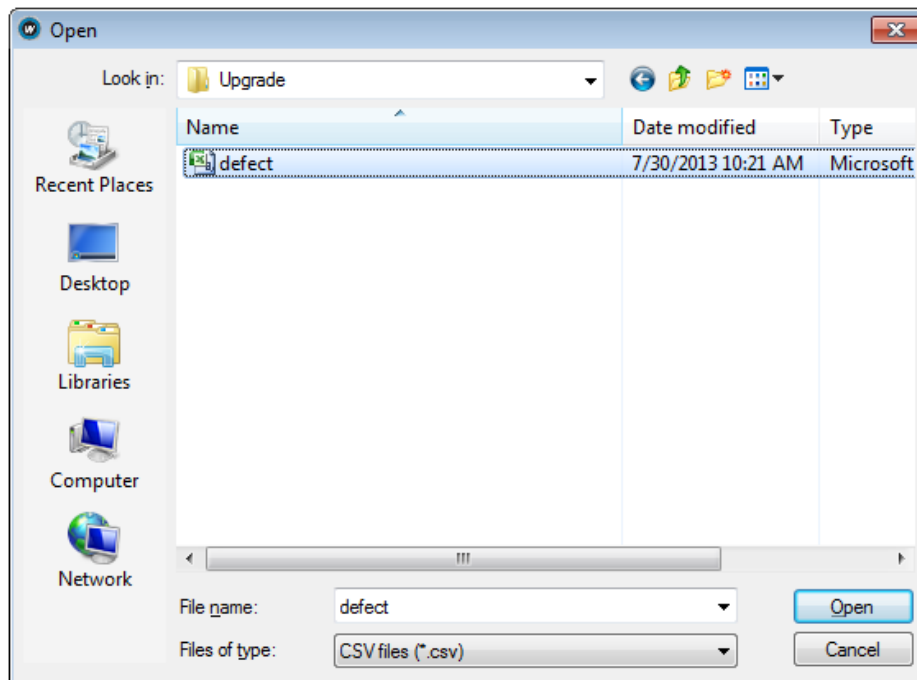
Coordinate values for each pixel can be placed in any order.



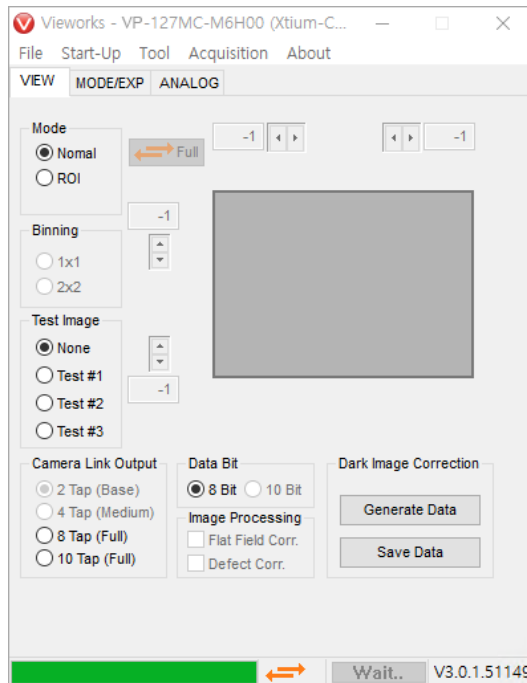
2. Select File > Defect Pixel > Download to Camera in the Configurator.



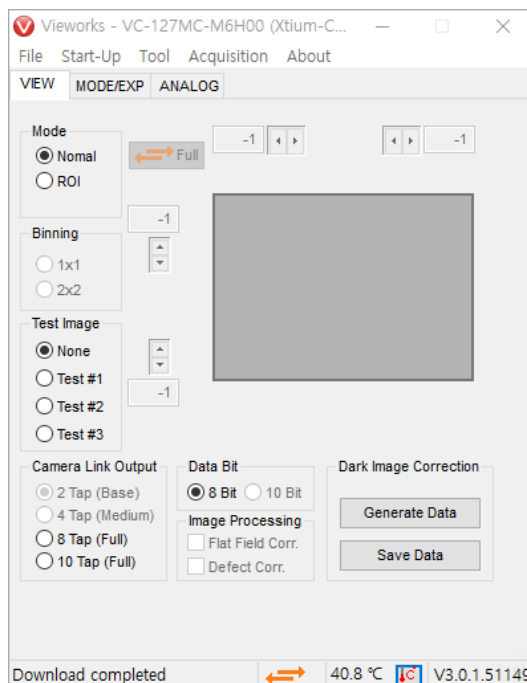
3. Search and select the created file, and then click **Open**.



4. The Configurator starts downloading Defective Pixel Map to the camera and the downloading status is displayed at the bottom of the window.



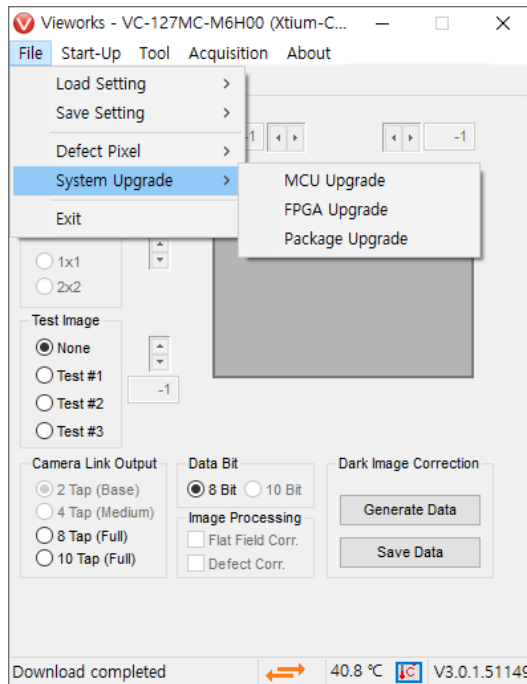
5. Once the download is complete, the saving process will begin. During the saving process, make sure not to disconnect the power cord.
6. Once all the processes are complete, the Download completed message will appear at the bottom of the window.



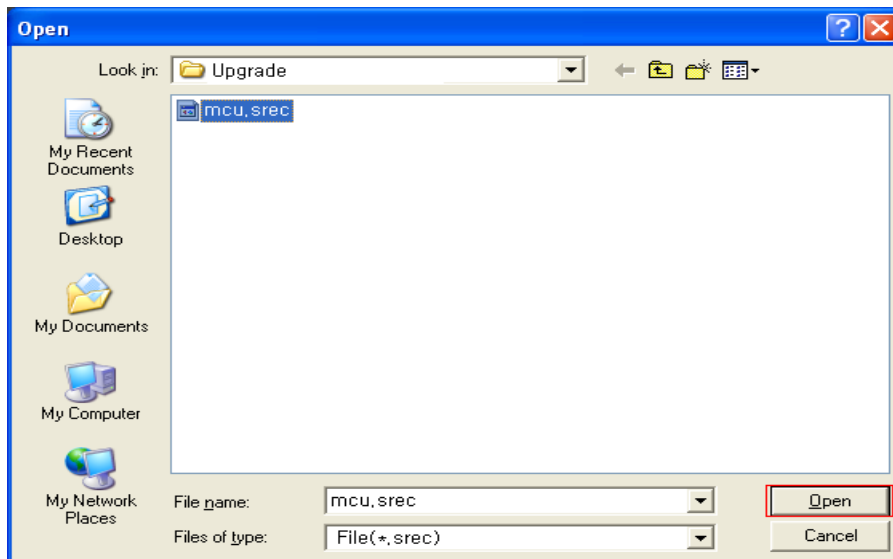
## Appendix B. Field Upgrade

You can upgrade the MCU and FPGA of the camera by following the procedures below. After executing the Acquisition Start command ('ast'), the System Upgrade menu will be deactivated. To activate the System Upgrade menu, execute the Acquisition Stop command ('asp').

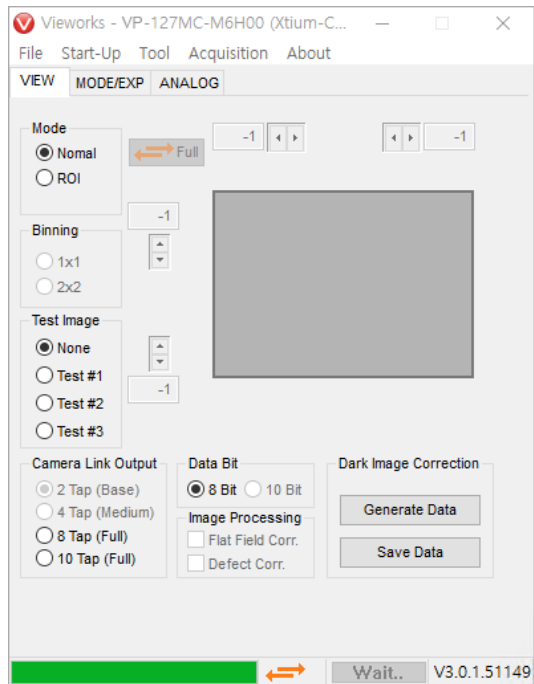
1. Select File > System Upgrade > Package Upgrade in the Configurator.



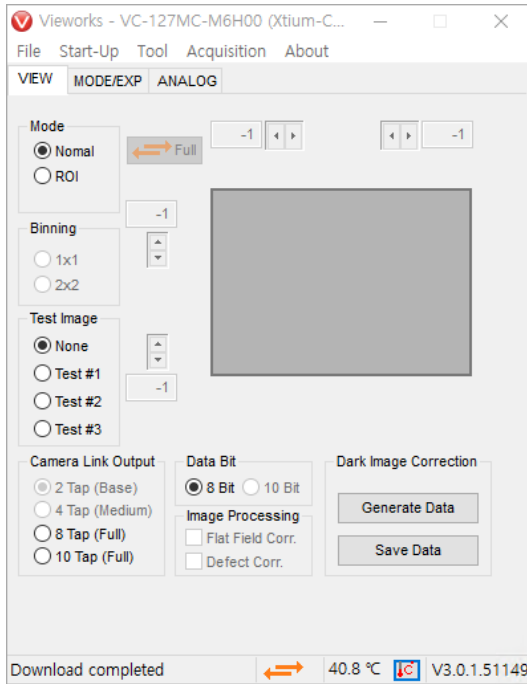
2. Search and select the provided MCU or FPGA file and then click Open.



- The camera begins downloading the upgrade file and the downloading status is displayed at the bottom of the window. This process may require several minutes to complete. If you want to cancel, click Cancel.



- Once the download is complete, the saving process will begin. If a power failure occurs during the saving process, the camera cannot be restored. Make sure that the power connection is secure.



- Once all the processes are complete, turn the camera power off and turn it back on again. Select Tool > Terminal and enter the 'gmv' command to confirm the version. You can also select About > Camera Info to confirm the file version.





## Appendix C. Index

### 4

4-pin connector.....28

### 6

6-pin connector.....27

### A

acquisition control.....30

Acquisition Mode

    Continuous parameter.....31  
    MultiFrame parameter .....31  
    SingleFrame parameter .....31

Acquisition Mode parameter .....31

acquisition process.....47

Acquisition Start command.....31

Acquisition Stop command.....31

### B

back panel.....24

Bayer RG 8/10/12 .....60

block diagram .....19

### C

Camera Link connector..... 24

camera ON&OFF .....85

camera's pixel formats.....60

camera's temperature, parameters .....80

CC1 .....33

circuit .....29

Configurator .....23

Configurator download.....23

Continuous parameter.....31

correction data into a sequencer set .....89

### D

diagram.....19

dimension .....21

downloading Configurator.....23

**E**

Exposure Mode	
Timed .....	34
TriggerWidth .....	34
Exposure Mode parameter .....	34
Exposure Offset.....	46

**F**

falling edge .....	36
Flat Field Correction data, generation.....	69
Flat Filed data into a sequencer .....	89
frame acquisition process .....	47
Free-run.....	35

**G**

generating data of Flat Field correction.....	69
---	----

**H**

Hirose .....	27, 28
Hirose 4-pin connector.....	28
Hirose 6-pin connector.....	27

**I**

inputting information of user's choice.....	85
---	----

**K**

key features .....	17
--------------------	----

**L**

LED status .....	81
level high .....	36
level low.....	36
Line0 .....	33

**M**

main features.....	17
mechanical dimension .....	21
Mono 8/10/12 .....	60
MultiFrame parameter .....	31
Multi-ROI, determination .....	57

**O**

order of signals .....	51
overlapped exposure .....	47

**P**

pixel formats.....	60
preface.....	2, 4
PRNU.....	68

**Q**

QE.....	20
quantum efficiency.....	20

**R**

reset physically .....85

rising edge .....36

ROI-origin position.....53

ROI-size setting.....53

**S**

schematic diagram .....29

sequence of signals .....51

setting Exposure Time.....46

signal processing .....51

signals' order .....51

signals' sequence.....51

SingleFrame parameter .....31

Software .....33

specification.....18

spectral sensitivity .....20

strobe output .....29

**T**

tilt settings ..... 23

Timed ..... 34

Timer0Active ..... 33

trigger input..... 29

Trigger Signals ..... 33

Trigger Source

- CC1 ..... 33
- Line0..... 33
- Software..... 33
- Timer0Active ..... 33
- UserOutput0..... 33

Trigger Source parameter ..... 33

TriggerWidth ..... 34

TriggerWidth mode..... 43

**U**

UserOutput0..... 33

**V**

Vieworks Imaging Solution ..... 4

VIS ..... 4

VP-127MC specification ..... 18

X

XML parameter

Analog Control ..... 65

AnalogControl ..... 64

AnyEdge ..... 78

Average ..... 58

BalanceRatio ..... 64

BalanceRatioSelector ..... 64

BalanceWhiteAuto ..... 64

BinningHorizontal ..... 58

BinningHorizontalMode ..... 58

BinningSelector ..... 58

BinningVertical ..... 58

BinningVerticalMode

    Average ..... 58

    Sum ..... 58

BlackLevel ..... 65

BlackLevelSelector ..... 65

CounterAndTimeControl ..... 78

DataRoiControl ..... 63

Debounce Time ..... 77

DebounceTime ..... 75

Device Reset ..... 85

DeviceControl ..... 80, 85

DeviceLinkThroughputLimit ..... 85

DeviceTemperature ..... 80

DeviceTemperatureSelector ..... 80

DeviceUserID ..... 85

DigitalOControl ..... 75, 77

EventNotification ..... 74

EventSelector ..... 74

ExposureActive ..... 75

FallingEdge ..... 78

FanOperationMode ..... 80

FanSpeed ..... 80

Flat Field Data Selector ..... 72

FlatFieldControl ..... 71

FlatFieldCorrection ..... 71

FlatFieldDataGenerate ..... 71

FlatFieldDataLoad ..... 71

FlatFieldDataSave ..... 71

FlatFieldDataSelector ..... 71

FrameActive ..... 75

Gain ..... 65

GainSelector ..... 65

GreyDiagonalRamp ..... 82

GreyDiagonalRampMoving ..... 82

GreyHorizontalRamp ..... 82

Height ..... 53

HeightMax ..... 53

Hot Pixel Correction ..... 67

ImageFormatControl ..... 53, 58, 84

Input ..... 75

LevelHigh ..... 78

LevelLow ..... 78

Line 0 ..... 75

Line 1 ..... 75

LineInverter ..... 75

LineMode ..... 75

LineSelector ..... 75

LineSource ..... 75

MultiROIControl ..... 55

MultiROIHeight ..... 55

MultiROIMode ..... 55

MultiROIOffsetX ..... 55

MultiROIOffsetY ..... 55

MultiROISelector ..... 55

MultiROIStatus ..... 55

MultiROIValid ..... 55

MultiROIWidth ..... 55

OffsetX ..... 53

OffsetY ..... 53

Output ..... 75

PRNU Generate ..... 68

PRNU Selector ..... 68

PRNULoad ..... 68

PRNUMode ..... 68

PRNUSave ..... 68

PRNUTargetLevel ..... 68

ReverseX ..... 84

RisingEdge ..... 78

RoiHeight ..... 63

RoiOffsetX ..... 63

RoiOffsetY ..... 63

RoiSelector ..... 63

RoiWidth ..... 63

SensorHeight ..... 53

SensorSpecific ..... 82

SensorWidth ..... 53

SequencerConfigurationMode ..... 88

SequencerControl ..... 88

SequencerFeatureEnable ..... 88

SequencerFeatureSelector ..... 88

SequencerMode ..... 88

SequencerSetActive ..... 88

SequencerSetCount ..... 88

SequencerSetSelector ..... 88

Sum ..... 58

TargetLevelAUTO ..... 68

TargetTemperature ..... 80

TestPattern ..... 82

Timer0Active ..... 75

TimerActive ..... 78

TimerDelay ..... 78

TimerDuration ..... 78

TimerIdle ..... 78

TimerReset ..... 78

TimerSelector ..... 78

TimerStatus ..... 78

TimerTriggerActivation ..... 78

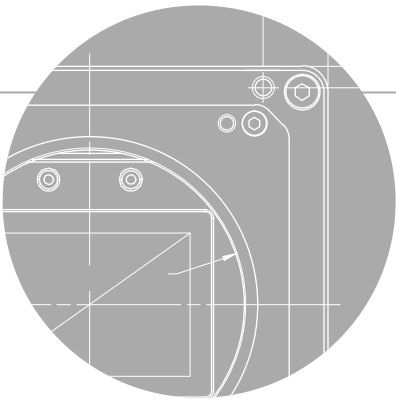
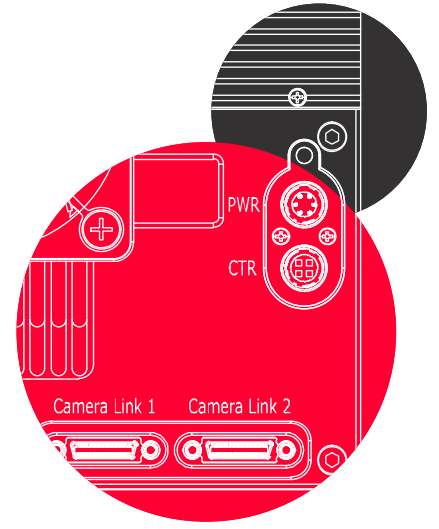
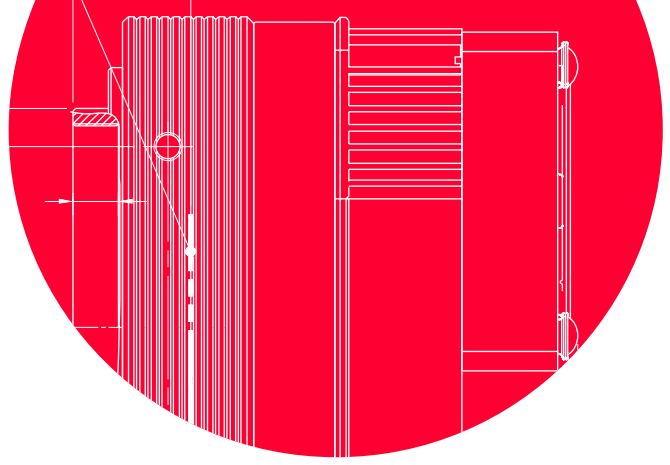
TimerTriggerSource ..... 78

TimerTriggerWait ..... 78

TimerValue ..... 78

Timestamp.....	73	UserSet1.....	86
TimestampIncrement.....	73	UserSet2.....	86
TimestampLatch.....	73	UserSetControl.....	86
TimestampLatchValue.....	73	UserSetLoad.....	86
TimestampReset.....	73	UserSetSave.....	86
TimestampResetValue.....	73	UserSetSelector.....	86
UserDefault.....	86	White Balance Auto.....	63
UserOutput0.....	75	Width.....	53
UserOutputValue.....	75	WidthMax.....	53





## Vieworks Co., Ltd.

41-3, Burim-ro, 170beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do  
14055 Republic of Korea

Tel: +82-70-7011-6161

Fax: +82-31-386-8631

<http://vision.vieworks.com>

[vision@vieworks.com](mailto:vision@vieworks.com)