

USB 3.0 QSXGA (5Meg)

Monochrome / Color Camera

STC-MBA5MUSB3 (Monochrome)

STC-MCA5MUSB3 (Color)

User's Guide

Sensor Technology Co., Ltd

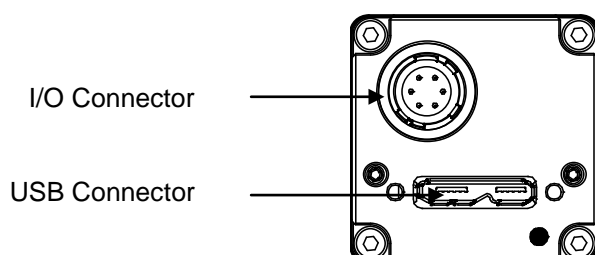
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## 1 System Requirements

- "Windows XP SP2 and later (x86/x64)", "Windows Vista (x86/x64)", "Windows7 (x86/x64)", and "Linux" operating systems are supported.
- There are some cautions when using Intel Core i3, i5, or i7 CPUs. Refer to "4. Usage Cautions for Computers Using Intel Core i3, i5, i7 CPUs" in the Startup Guide for more details.
- When RGB8 (full frame rate output) output format is used for the color camera, a PCI slot GenII or later is required.
- Be sure to use StCamSWare software Ver.3.01 or later.

## 2 Connector Specifications



### 2.1 USB Connector

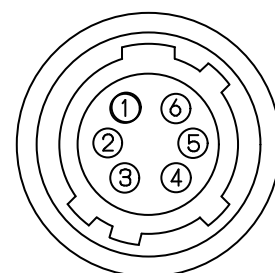
- USB 3.0 micro-B type

### 2.2 I/O Connector

- HR10A-7R-6PB (Hirose) or equivalent
- This connector is for input triggers and output signals.
- Use HR10A-7P-6S (Hirose) or equivalent for the cable side.
- Pin number 6 "IO\_Vcc" is provided to provide as a power source for the output signal circuits (refer the schematic diagrams on page 10 and 11) and this is not the power supply input for the camera itself. This +5V does not affect the voltage of output signals.

#### Pin Assignment

Pin No.	Signal Name	IN / OUT	Voltage	
			Low	High
1	(IO_GND)	-	0V	
2	Output 2 (IO3)	OUT	0.8 V or less	+3 to +26.4 V
3	Output 1 (IO2)	OUT	0.8 V or less	+3 to +26.4 V
4	Input 2 (IO1)	IN	0.7V or less	+1.7 to +5 V
5	Input 1 (IO0)	IN	0.7V or less	+1.7 to +5 V
6	(IO_VCC)	-	+3 to +26.4Vdc	



[Back Side]

### 3 Input / Output Signal Specifications

#### 3.1 Input Signals

##### 3.1.1 Input Signal Functions (Refer also the timing charts on page 43 through 48)

- By using the software, the following input functions can be assigned on “Input 1 (Pin No. 5)” and “Input 2 (Pin No. 4)” of the I/O connector.
- When you select “Trigger” or “Sub-Trigger”, specify the polarity of the signal according to the input you provide.

Function No.	Function Name	Polarity
1)	Disabled (Default)	-
2)	General Input	-
3)	Trigger Input	Positive or Negative
4)	Sub-trigger Input	Positive or Negative

1) Disabled

The input pins are disabled with this setting.

2) General Input

User can read the status of the input pins with this setting.

3) Trigger Input

Trigger input signal is assigned on the input pins with this setting. The trigger signal functions in the “Edge Preset Mode”. In the “Start and Stop Trigger Mode”, this functions as a “Start Trigger”.

4) Sub-trigger Input

Sub-Trigger input signal is assigned on the input pins with this setting. This input functions as “Stop Trigger” in the “Start and Stop Trigger Mode”.

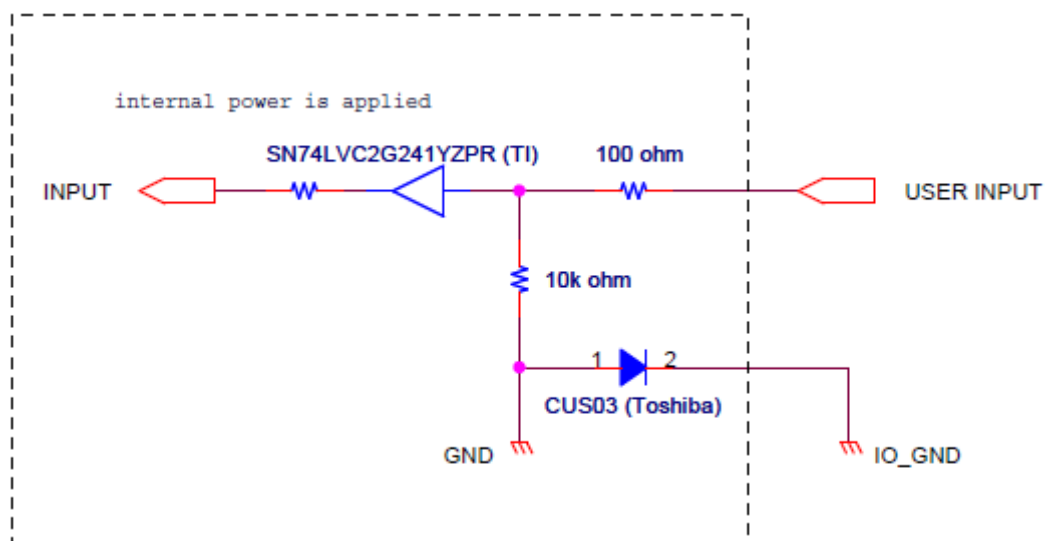
##### 3.1.2 Input Signal Requirements

- Input Signal / Input Voltage: 0 to 5V
- Input Signal / Voltage Level

High Level: 1.7V (min.)

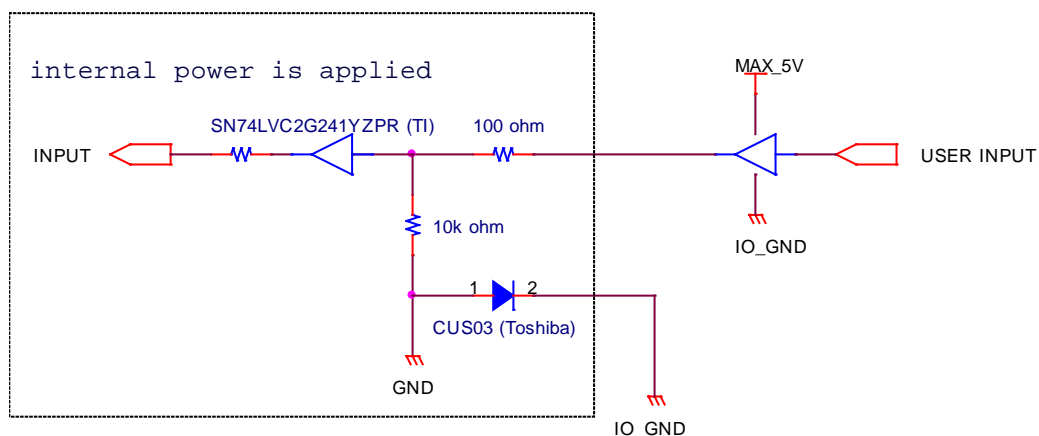
Low Level: 0.7V (max.)

## 3.1.3 Input Signal Circuit

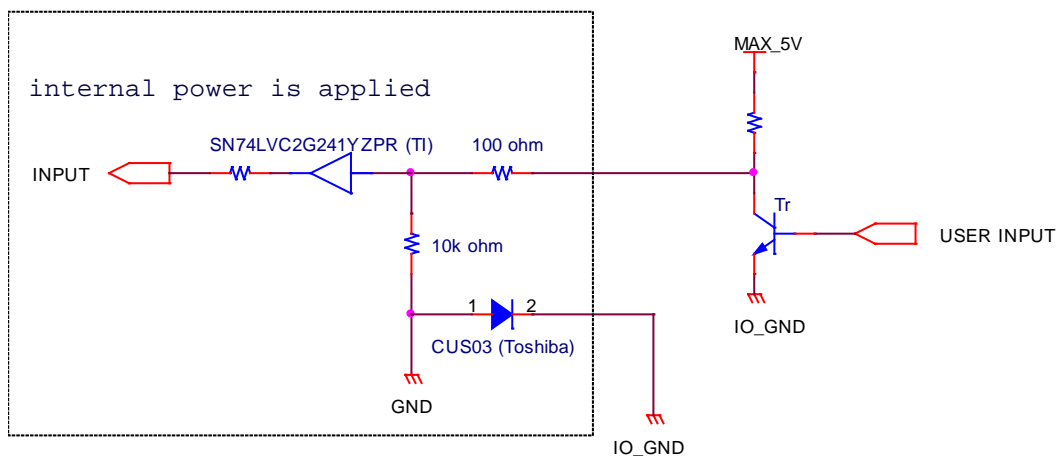


## 3.1.4 Input Signal Circuit Examples

### CAMERA



### CAMERA



\*The voltage applied on “input 1” and “input 2” must be less than or equal to 5V, the absolute maximum input voltage.

## 3.2 Output Signals

### 3.2.1 Output Signal Functions (Refer also the timing charts on page 43 through 48)

- Using the software, the following functions can be set on “Output 1” and “Output 2” of the I/O connector.
- The polarity of Trigger Output Programmable, Trigger Output Loop Through, Exposure End, CCD Read End Output, Strobe Output Programmable, Strobe Output Exposure and Trigger Valid Out is selectable.
- Negative Polarity is recommended to reduce the timing delay due to open collector output.
- Open Collector Output

Function No.	Function Name	Polarity
1)	Disabled (Default)	-
2)	General Output	-
3)	Trigger Output Programmable	Positive or Negative
4)	Trigger Output Loop Through	Positive or Negative
5)	Exposure End	Positive or Negative
6)	Read End Output	Positive or Negative
7)	Strobe Output Programmable	Positive or Negative
8)	Strobe Output Exposure	Positive or Negative
9)	Trigger Valid Out	Positive or Negative

- 1) Disabled  
The output pins are disabled with this setting.
- 2) General Output  
User can change the status of the output pins with this setting.
- 3) Trigger Output Programmable  
Very similar to “Trigger Output Loop Through” below. However, with this setting, you can add delay time. Use “Output Pulse Delay” for this setting.
- 4) Trigger Output Loop Through  
Trigger input signal is looped through as output signal with this setting.
- 5) Exposure End  
The output signal is enabled when the first line exposure ends.  
("Trigger Out Delay" and "Trigger Pulse Width" setting are applied.)
- 6) Read End Output  
The output signal is enabled when video data readout completes.  
("Trigger Out Delay" and "Trigger Pulse Width" setting are applied.)
- 7) Strobe Output Programmable  
Very similar to “Strobe Output Exposure” below. However, with this setting, you can add delay time on start and end. Use “Strobe Start Delay” and “Strobe End Delay” for the settings.
- 8) Strobe Output Exposure  
The synchronized output of first line exposure is output.

## 9) Trigger Valid Out

With the positive polarity setting, high status indicates that the input trigger signal is acceptable. This signal becomes low from the exposure start to the end of image output.

With the negative polarity setting, low status indicates that the input trigger signal is acceptable. This signal becomes high from the exposure start to the end of image output.

※ \*Because this camera is a rolling shutter type, the exposure start timing of each line is not simultaneous.



## 3.2.2 Output Signal Electronic Characteristics

This output signal can be used as a reference signal to send trigger signal into the camera. When the signal is enabled (high at positive and low at negative polarity), the trigger input is permitted.

### ➤ Output Signal : Voltage Level

High Level: Power Input of the I/O Connector (+3 ~ +26.4 V)  
Low Level: Smaller than 0.8 V

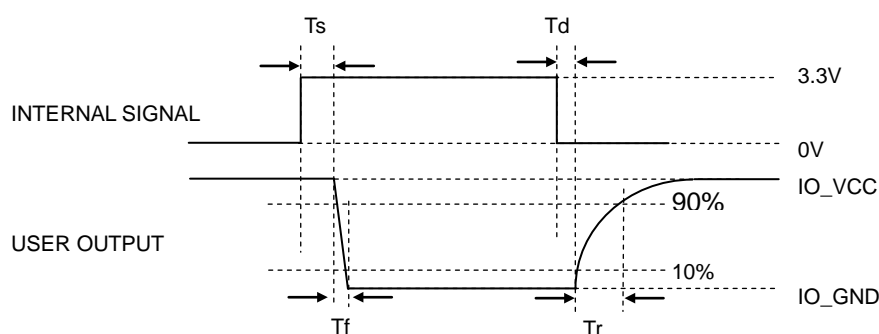
### ➤ Output Signal : Pulse Duration Requirements

Depending on the voltage applied on IO\_Vcc (+3.0 to +26.4Vdc)

Some of the pulse width of the output signals can be programed by the software. Consider the circuit delay characteristics shown below and put enough margin for the setting.

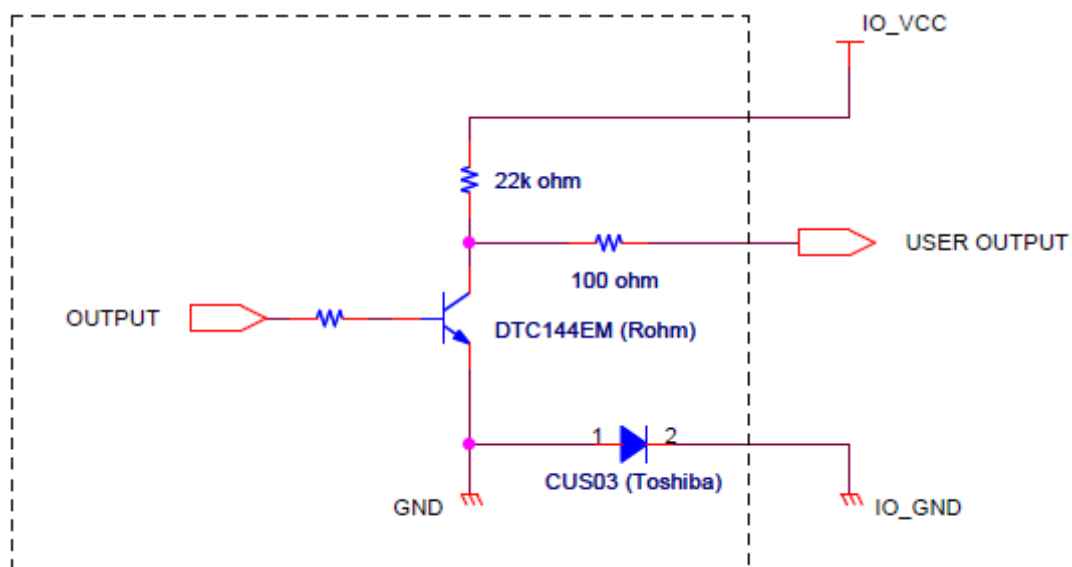
### ➤ Output Signal : Response Timing

The response timing shown below is a reference value measured without an external resistance.



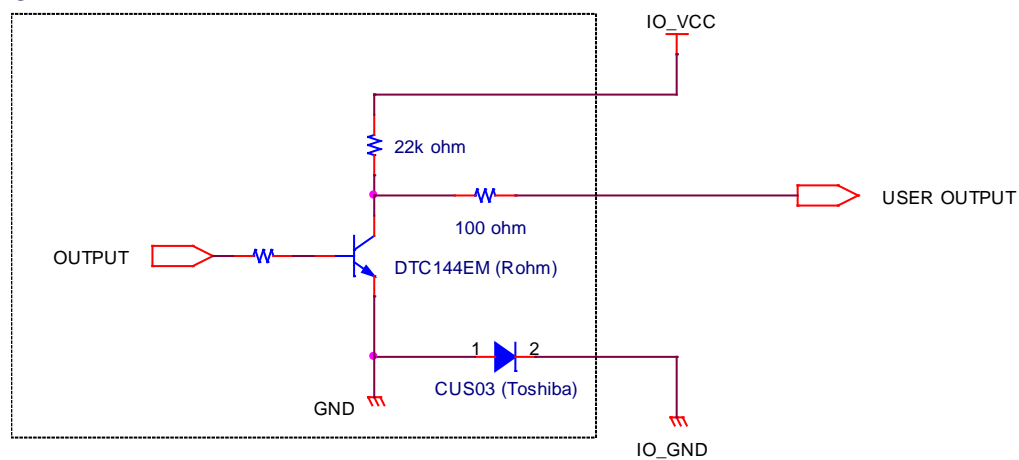
	IO_VCC			
	3.3[V]	5.0[V]	12[V]	24[V]
Td	2.00 [us]	1.82 [us]	1.66 [us]	1.60 [us]
Tr	0.82 [us]	0.84 [us]	1.16 [us]	1.44 [us]
Ts	0.50 [us]	0.56 [us]	0.56 [us]	0.70 [us]
Tf	0.56 [us]	0.66 [us]	1.16 [us]	2.04 [us]

## 3.2.3 Output Signal Circuit

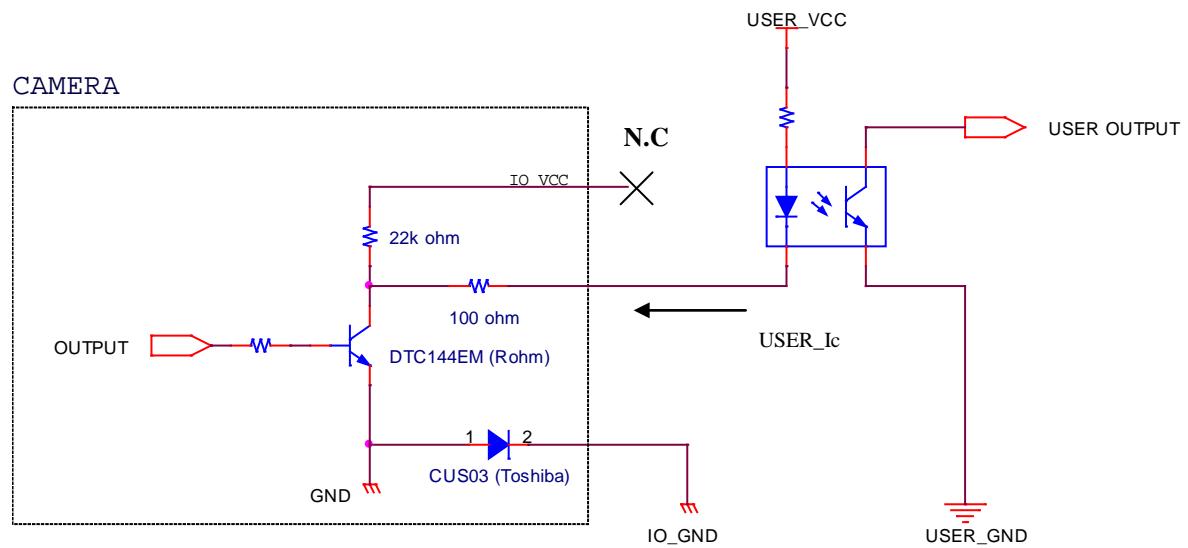


## 3.2.4 Output Signal Circuit Examples

### CAMERA



\*The voltage applied on "IO\_VCC" must be within the range of +3V to +26.4V.



When IO\_Vcc has no connection, the circuit operates as an open collector output.

\*The voltage applied on "IO2" and "IO3" (USER\_VCC) must be less than or equal to 26.4V.

\*The incoming current to "IO2" and "IO3" (USER\_Ic) must be less than or equal to 15mA.

## 4 CameraFunctions

This section will explain camera functions and settings using the StCamSWare software.

Open the settings screen by going to [Setting] from the StCamSWare [Option] menu.

There is a simplified setting screen and an advanced setting screen. From the simplified setting screen, you can adjust the Gain setting, Mirror Image mode setting, Gamma setting, Sharpness (edge enhancement) setting, White Balance setting, and Hue/Saturation setting. The items that can be set differ depending on whether the color or monochrome type is used.

From the advanced setting screen, you can adjust the Gain setting, Gamma setting, Sharpness (edge enhancement) setting, Scan Mode setting, Still Image Pixel Format setting for saving images, Color Interpolation setting, Mirror Mode setting, Rotation mode setting, and more. The items that can be set differ depending on whether the color or monochrome type is used.

With this camera, it is possible to use a combination of hardware trigger functions and software trigger functions.

With the StCamSWare software, for simple operation confirmation, you can set the operation mode (Free Run / Trigger), trigger mode (Edge Preset, Pulse Width, Start/Stop), IO pins, delay time, output signals, and more from the hardware trigger function setting screen.

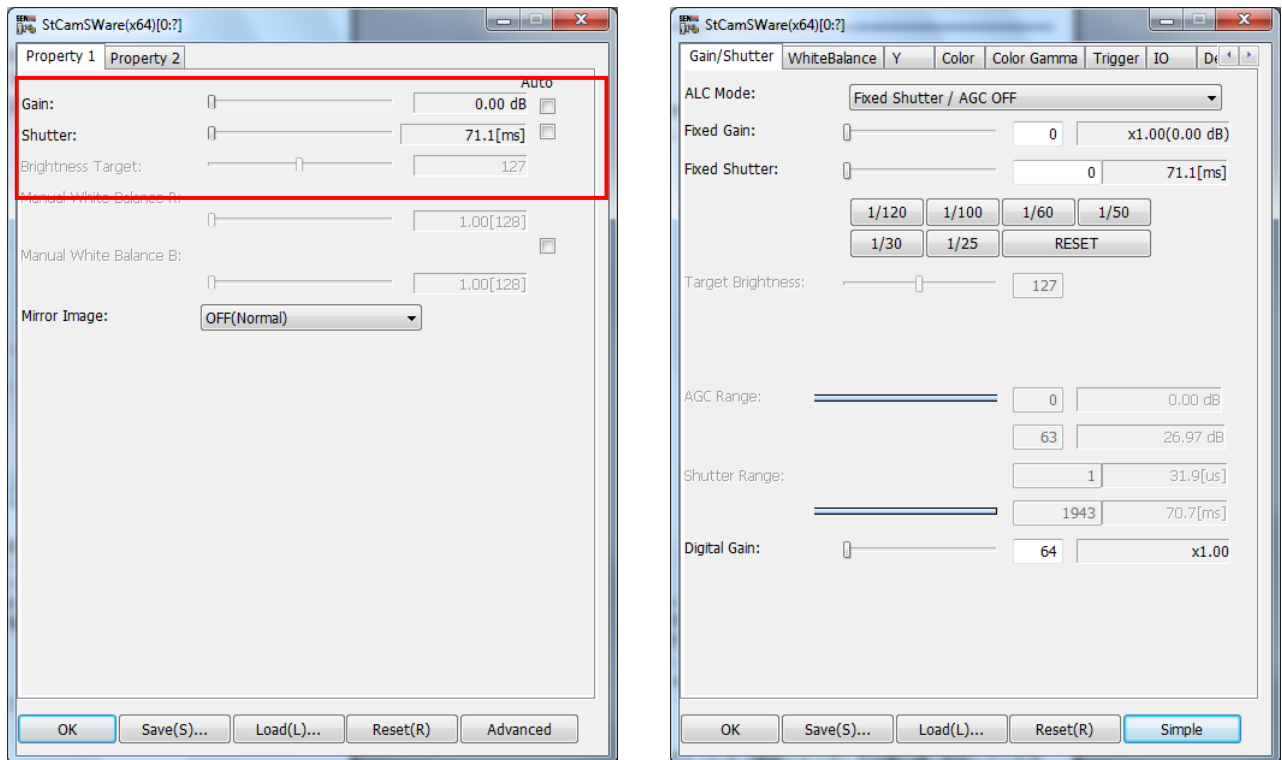
From the software trigger function setting screen, you can set the operation mode (Free Run / Trigger), trigger mode (Edge Preset, Start/Stop), delay time, transmission for the camera trigger signal, and more.

When using the trigger function with the actual application, refer to the sample program "StTrgDisplay\*\*\*.exe" included in the TriggerSDK CD-ROM. ("\*\*\*" differs depending on the development environment (e.g.: VB6, VC6).)

Regarding the usage methods for the StCamSWare software other than for trigger function settings and I/O function settings, refer to the software manual.

## 4.1 Gain and Shutter Settings

You can set the brightness of the image by adjusting the gain and shutter (exposure) of the camera. Settings can be made from the [Property 1] tab of the simplified setting screen, or from the [Gain/Shutter] tab of the advanced setting screen. Setting values are linked.



There are four combinations of Gain (analogue) and Shutter that can be set, which are "Fixed Shutter / Fixed Gain", "Auto Shutter Control / Fixed Gain", "Fixed Shutter / Auto Gain Control (AGC)", and "Auto Shutter Control / Auto Gain Control (AGC)". From the [Property 1] tab of the simplified setting screen, you can switch the Gain and Shutter between Fixed and Auto by placing a check in the "Auto" check box on the right side. From the [Gain / Shutter] tab of the advanced setting screen, you can select one of four combinations for the [ALC Mode] (\*1). Depending of the selected combination, "Fixed Gain", "Fixed Shutter", "Target Brightness", "AGC Range", and "Shutter Range" become enabled for setting.

### ① "Fixed Shutter / Fixed Gain"

Both the shutter and gain can be set by the user. Set the "Fixed Gain" and "Fixed Shutter" to the desired value.

### ② "Auto Shutter Control / Fixed Gain"

The shutter is controlled automatically, and gain can be set by the user. Use "Target Brightness" to set the image brightness you want to maintain, and use "Shutter Range" to set the operation range for the auto shutter. Set the "Fixed Gain" to the desired value.

### ③ "Fixed Shutter / Auto Gain Control (AGC)"

The shutter is set by the user, and gain is controlled automatically. Set the "Fixed Shutter" to the desired value. Use "Target Brightness" to set the image brightness you want to maintain, and use "ACG Range" to set the operation range for the auto gain.

### ④ "Auto Shutter Control / Auto Gain Control (AGC)"

Both the shutter and gain are controlled automatically. Use "Target Brightness" to set the image brightness you want

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to maintain, and use "Shutter Range" and "AGC Range" to set the operation range for the auto shutter and auto gain.

For Gain, there is analog gain and digital gain. Analog gain is controlled by "Fixed Gain" and "Auto Gain Control (AGC)". The setting range for both is **0 to 26.97dB**. Digital gain can be set using "Digital Gain" at the bottom of the [Gain / Shutter] tab from the advanced settings screen. The setting range is **0 to 12.04dB**. When analog gain and digital gain are set to the maximum, it becomes the maximum gain value that can be set for the camera. When the gain is set to a high value, dark images become bright, but noise becomes more obvious.

The setting range for the shutter differs according to the Scan Mode. For full scan, the setting range is **32us to 38s** (\*2).  
When the value is set higher than the number of vertical lines in the image, the frame rate will decrease.

The setting range for "Target Brightness" is **0 to 255**. When a low value is set, the image becomes dark, and when a high value is set, it becomes bright.

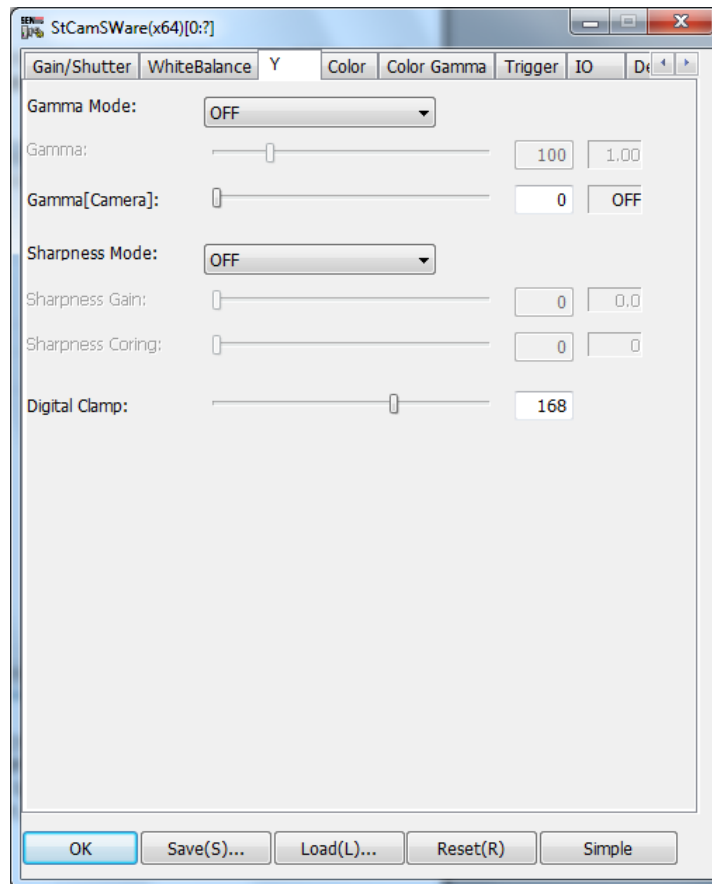
The setting range for "AGC Range" is **15 to 63**.

\*1: ALC is an abbreviation for Auto Luminance Control. Auto shutter control works to maintain the set target brightness for the image. Auto gain control (AGC) works to maintain the set target brightness for the image when there is low luminance.

\*2: When the StCamSWare software is not used, but pulse width trigger mode is used with an external trigger, there is no maximum.

## 4.2 Gamma, Sharpness, and Digital Clamp Settings

With Gamma Mode, gamma correction can be performed for the brightness of the displayed image. With Sharpness Mode, edge enhancement of the displayed image can be set. With Digital Clamp, it is possible to set the offset for the black level of the displayed image. These settings can all be made from the [Y] tab of the advanced setting screen.



With Gamma correction, you can select whether to perform processing by the camera or by the computer. When [Gamma Mode] is used, processing is handled by the computer. It can be set in the range from **0.01 to 5.00** in increments of 0.01. When "Reverse" is selected, gamma correction is performed for images with inverted brightness. When [Gamma [Camera]] is used, processing is handled by the camera. It can be set in the range from **0.1 to 4.0** in increments of 0.1. In both cases, it is OFF when set to "0", and the set value becomes 1. When processing is handled by the computer, the frame rate may decrease.

### ■ Example Settings

For a display gamma of 2.2, when it is set to 2.2, the gamma after correction becomes 1. Set [Gamma Mode] to 220, and set [Gamma [Camera]] to 22.

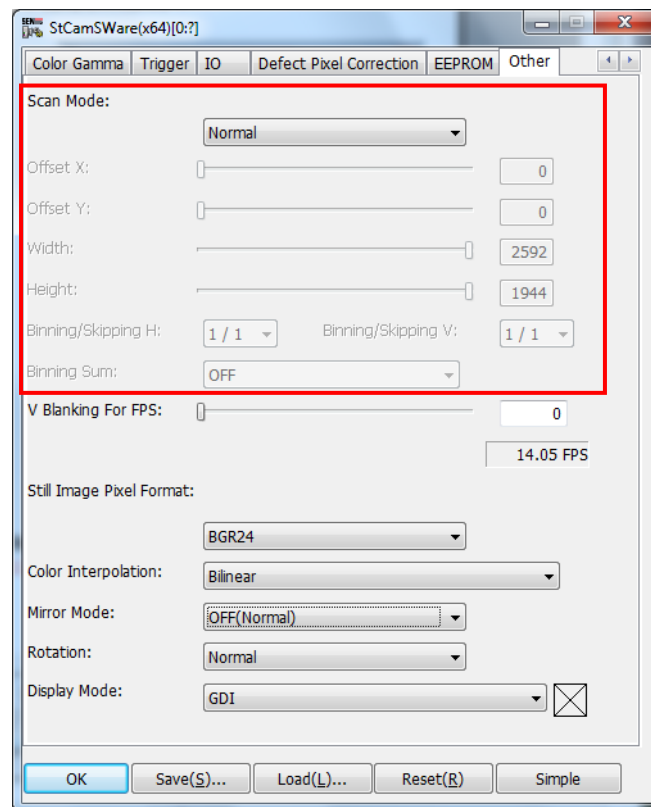
When [Sharpness Mode] is turned ON, it becomes possible to set the "Sharpness Gain" and "Sharpness Coring". [Sharpness Gain] allows you to adjust the degree of enhancement. It can be set in the range from **0 to 50** in increments of 0.1. The smaller the value, the weaker the degree of enhancement, and the larger the value, the stronger the degree of enhancement. [Sharpness Coring] allows you to control enhancement for fine edges. It can be set in the range from **0 to 255** in increments of 1. When the value is small, the enhancement process is performed for fine edges including noise, and when the value is large, enhancement is applied to larger edges.

[Digital Clamp] can be set in the range of **0 to 255**. When this value is smaller than the default value of 128, the set value is subtracted for the image black level, and when it is higher, it is added. When this is set to "0", the black level for light blocking status becomes "0". For 12 bits, the lower 8 bits are set, so for 12-bit output, the set value is 1, and it becomes 1 addition/subtraction. For 10-bit output, the set value is 4, and it becomes 1 addition/subtraction, and for 8-bit output, the set value is 16, and it becomes 1 addition/subtraction.



## 4.3 Scan Mode Settings

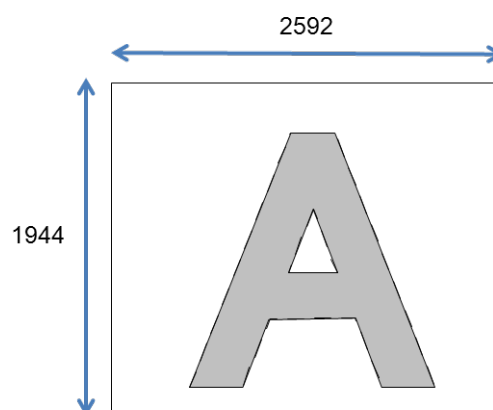
It is possible to set the camera output image size, and set binning / skipping. These settings can be made from the [Other] tab of the advanced setting screen.



Eleven different settings can be selected from [Scan Mode].

### ① "Normal"

A full resolution (2592x1944) images are output. The default frame rate is **14fps**(\*1).

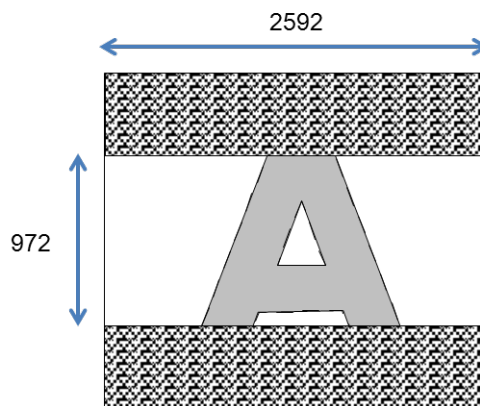


② "1/1 Partial"

For this camera, output is the same as "Normal".

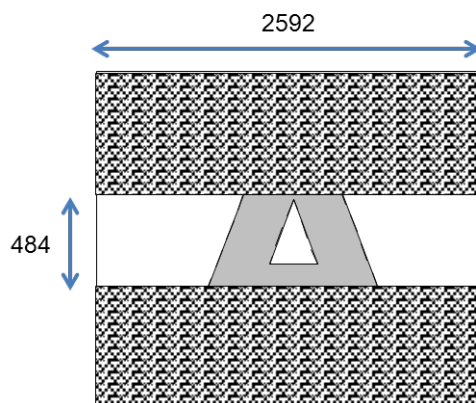
③ "1/2 Partial"

The width is full resolution, and 1/2 of the height of the "Normal" image from the center portion is output (2592x972). The frame rate is approximately **28fps**, which is double that of "Normal".



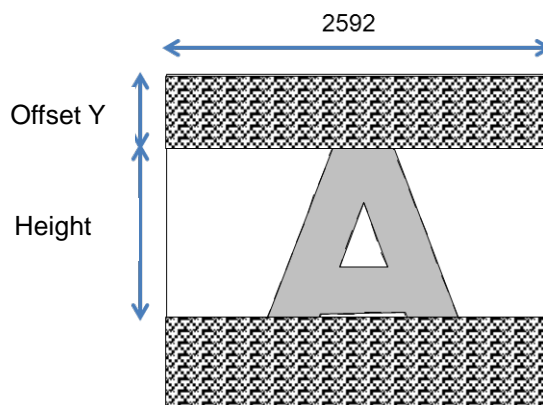
④ "1/4 Partial"

The width is full resolution, and 1/4 of the height of the "Normal" image from the center portion is output (2592x484). The frame rate is **55fps**, which is about four times that of "Normal".



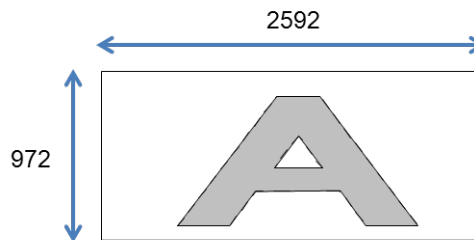
⑤ "Variable Partial"

The width is full resolution, and you can set your desired image height. Use "Offset Y" to set the cutoff starting line. The setting range is **0 to 1912** in 4-line increments. Use "Height" to set the bottom cutoff line. The setting range is **32 to 1944** in 4-line increments. The frame rate changes according to the height.



⑥ "Binning"

The width is full resolution, and 1/2 of the height of the "Normal" image is output (2592x972). The image maintains the FOV because two adjacent pixels with the same color information are combined into one pixel.

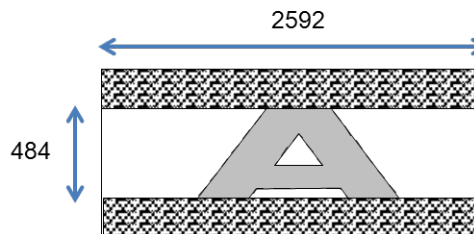


⑦ "Binning 1/1 Partial"

For this camera, output is the same as "Binning".

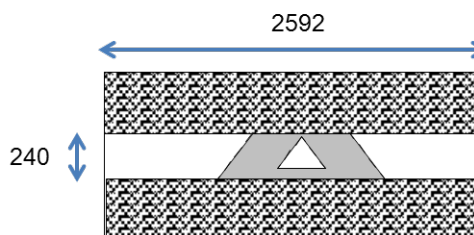
⑧ "Binning 1/2 Partial"

The width is full resolution, and approximately 1/4 of the height of the "Normal" image is output (2592x484). The image becomes the center portion of the "Binning" image.



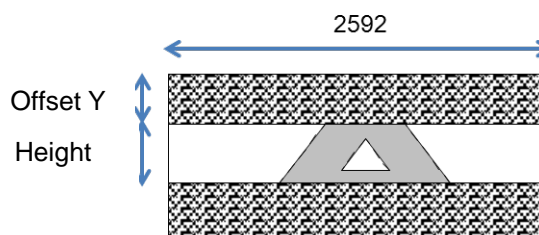
⑨ "Binning 1/4 Partial"

The width is full resolution, and approximately 1/8 of the height of the "Normal" image is output (2592x240). The image becomes the center portion of the "Binning" image.



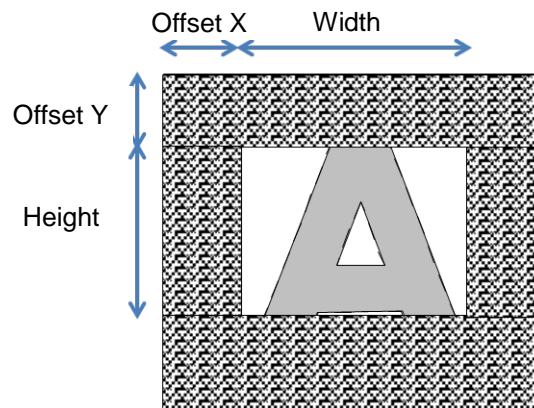
⑩ "Binning Arbitrary Partial"

The width is full resolution, and you can set your desired image height within the "Binning" height. Use "Offset Y" to set the cutoff starting line. The setting range is **0 to 1880** in 4-line increments. Use "Height" to set the bottom cutoff line. The setting range is **32 to 972** in 4-line increments.



## ⑪ "AOI"

You can set your desired width and height to extract only the desired portion of the image. Use "Offset X" to set the horizontal cutoff starting point. The setting range is **0 to 2560**. Use "Width" to set the number of pixels for the horizontal cutoff. The setting range is **32 to 2592**. Use "Offset Y" to set the vertical cutoff starting line. The setting range is **0 to 1880**. Use "Height" to set the vertical cutoff line number. The setting range is **32 to 1944**. For AOI, it is possible to set the image size from a minimum of 32x32 up to a maximum of 2592x1944 by using different combinations of vertical/horizontal cutoff and height/width. The adjustment increment is 4 lines in the vertical direction, and 4 pixels in the horizontal directions. The frame rate changes according to the image size.



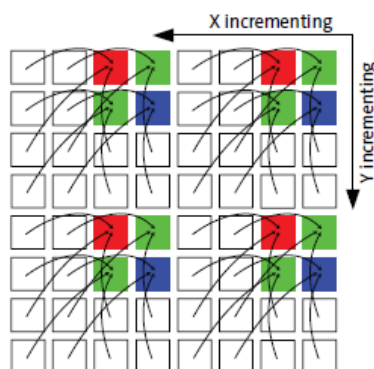
It is possible to set the binning (\*2), skipping (\*3), or both for the extracted image. Use "Binning/Skipping H" and "Binning/Skipping V" to set the combination of binning and skipping in the horizontal and vertical directions.

When horizontal binning is set to 2 or higher, it is possible to add adjacent pixels with the same color data only in the horizontal direction. This is effective for usage with low luminance. Turn "Binning Sum" ON.

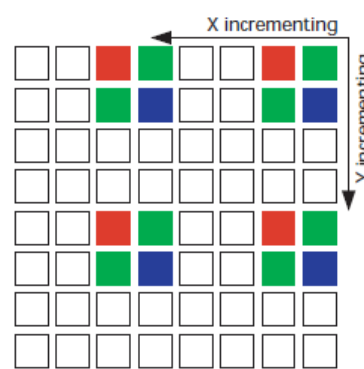
\*1: Adjust the camera V blanking time to set it within the range of 6.88 to 14fps.

\*2: Both vertical and horizontal binning can be set to 1/2 and 1/4. The 1/2 setting creates one pixel by averaging two adjacent pixels with the same color information. The 1/4 setting creates one pixel by averaging four adjacent pixels with the same color information.

\*3: For skipping, 1/2, 1/3, 1/4, 1/5, 1/6, and 1/7 can be set for the horizontal direction, and 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, and 1/8 can be set for the vertical direction. The 1/2 setting uses pixels with the same color information that are separated by one pixel. Similarly, the 1/3 setting skips two pixels, the 1/4 setting skips three pixels, and the 1/8 setting skips 7 pixels.



1/2 Horizontal Binning and 1/2 Vertical Binning

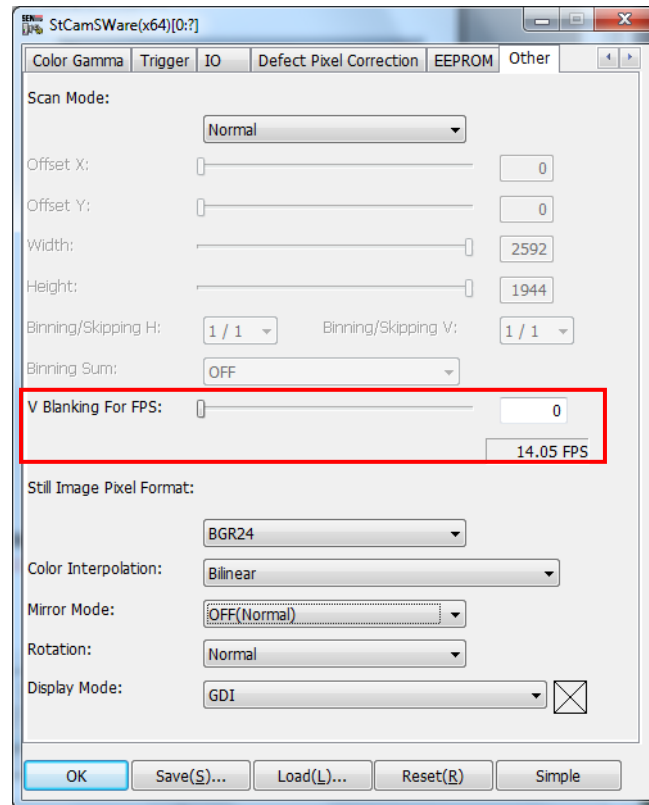


1/2 Horizontal Skipping and 1/2 Vertical

Skipping

## 4.4 Frame Rate Settings

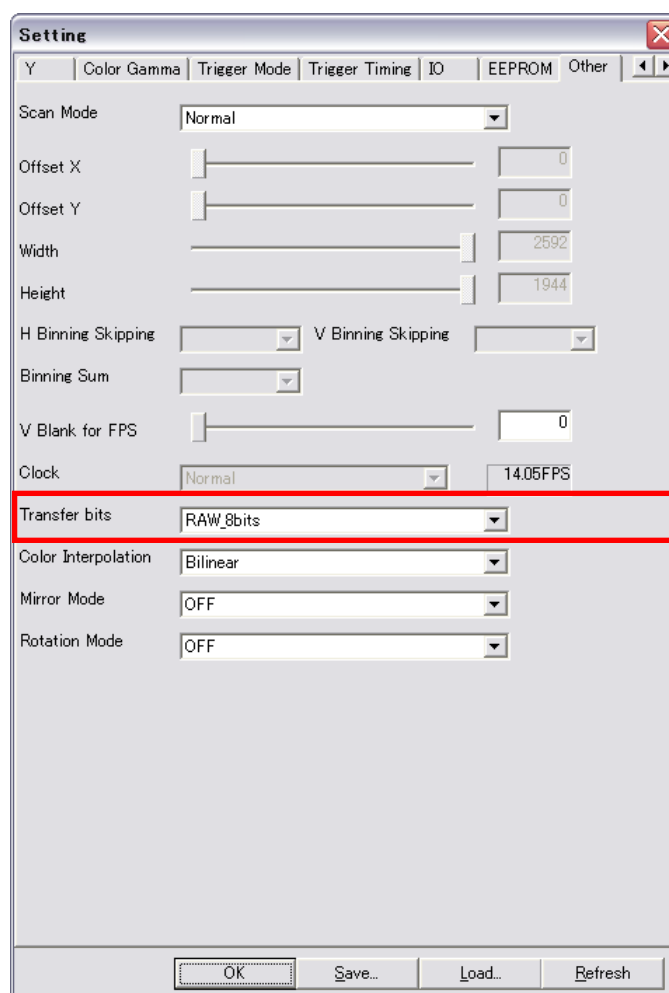
It is possible to adjust the camera V blanking time to adjust the frame rate. These settings can be made from the [Other] tab of the advanced setting screen.



It can be set in the range of **0 to 2035** using [V Blanking For FPS]. When it is set to "0" for "Normal" Scan Mode, it becomes the maximum frame rate of 14fps, and when it is set to 2035, it becomes the minimum frame rate of 6.88fps. This set value does not directly set the sensor V blanking time. Based on the set value, the blanking time is calculated by the camera internally.

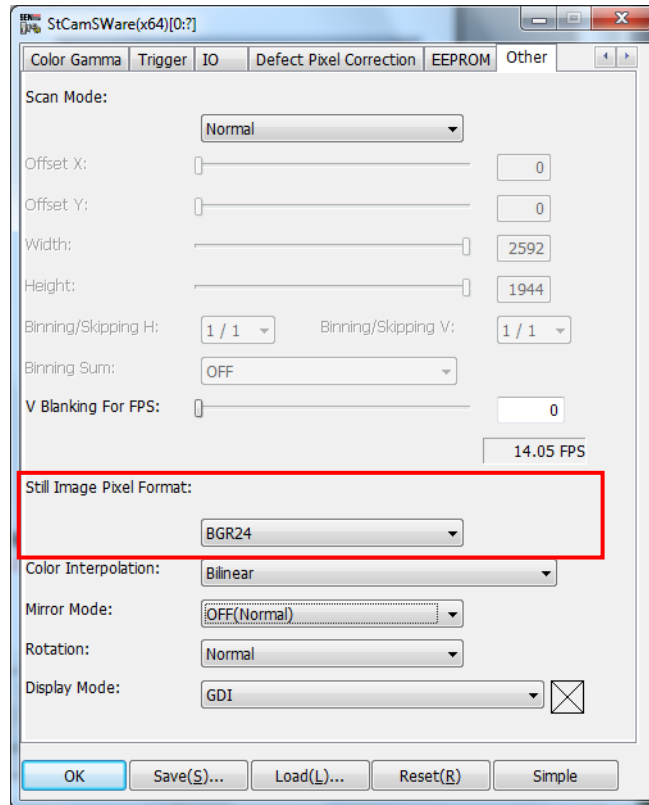
## 4.5 Image Output Format Setting

It is possible to select the image output format for normal usage. From the [Mode] menu of the sample program StTrgDisplay, select [Setting], and make settings from the [Other] tab of the setting screen.



For a monochrome camera, "RAW\_8bits", "RAW\_10bits", and "RAW\_12bits" can be selected from [Transfer bits]. For a color camera, "RAW\_8bits", "RAW\_10bits", "RAW\_12bits", "MONO\_8bits", "MONO\_10bits", "MONO\_12bits", and "BGR\_8bits" can be selected.

With the StCamSWare software, it is possible to set the pixel format for saving still images. This setting can be made from the [Other] tab of the advanced setting screen.

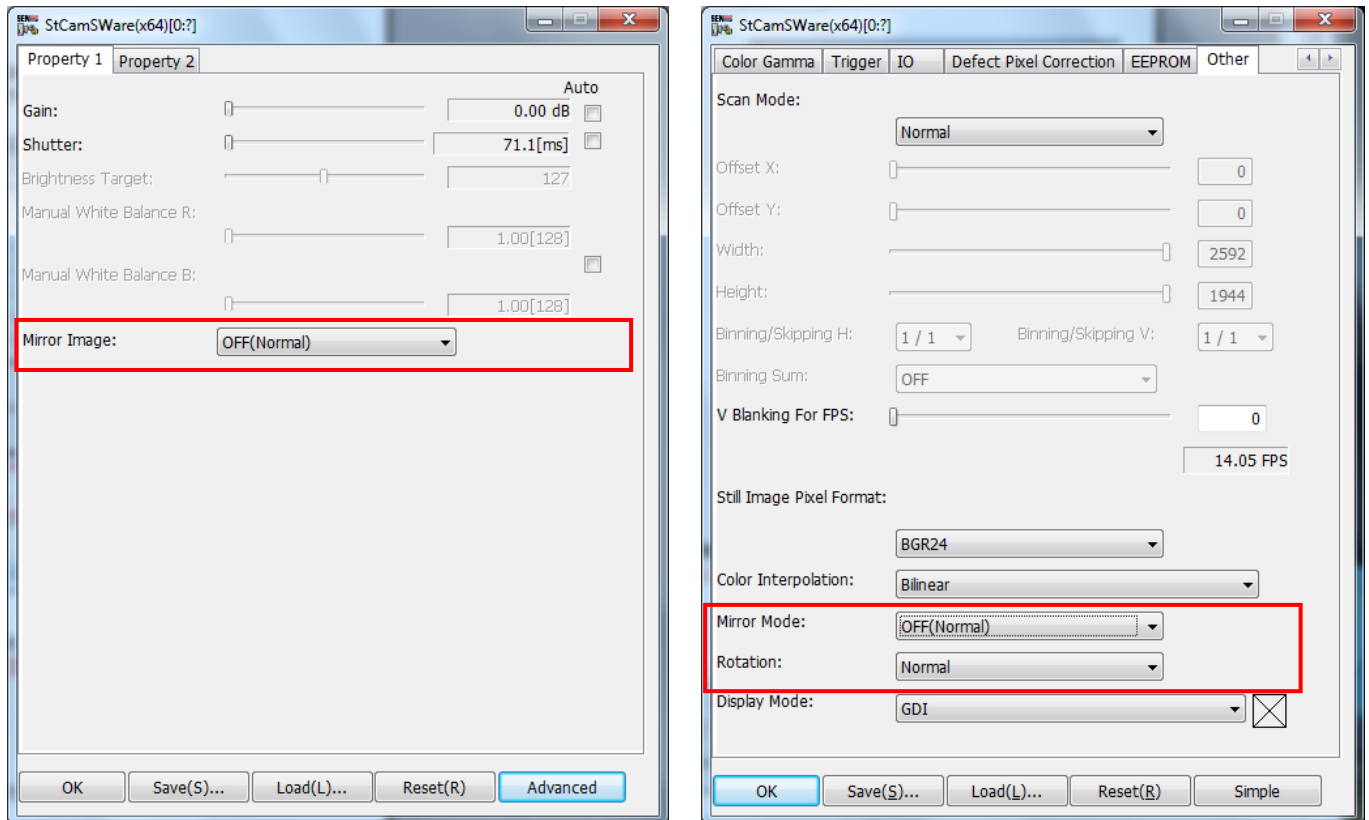


From [Still Image Pixel Format], "GRAY8", "BGR24", and "BGR32" can be selected.

- ① "GRAY8"  
The image is saved as a file with 8 bits of data per pixel. This is only for the monochrome camera.
- ② "BGR24"  
The image is saved as a file with 8 bits of data per R/G/B pixel for a total of 24 bits. This is good for when 24-bit data per pixel is needed for processing the saved image file. This is compatible with both the monochrome and color cameras.
- ③ "BGR32"  
The image is saved as a file with 8 bits of data per R/G/B pixel plus 8 bits of dummy data for a total of 32 bits. This is good for when 32-bit data per pixel is needed for processing the saved image file. This is compatible with the color camera.

## 4.6 Mirror Image / Rotation Settings

It is possible to mirror or rotate the image output from the camera. This setting can be made from the [Other] tab of the advanced setting screen. From the [Property 1] tab of the simplified setting screen, only Mirror Image can be set.



From [Mirror Image], you can select "Normal", "Mirror Horizontally", "Mirror Vertically", or "Mirror Horizontally and Vertically" for mirror processing by either the PC or camera. When processing is handled by the computer, the frame rate may decrease.

- ① "Normal"  
The image is displayed normally.
- ② "Mirror Horizontally" "Mirror Horizontally (Camera)"  
The image is displayed mirrored horizontally. "For "Mirror Horizontally", processing is handled by the computer, and for "Mirror Horizontally (Camera)", processing is handled by the camera.
- ③ "Mirror Vertically" "Mirror Vertically (Camera)"  
The image is displayed mirrored vertically. "For "Mirror Vertically", processing is handled by the computer, and for "Mirror Vertically (Camera)", processing is handled by the camera.
- ④ "Mirror Horizontally and Vertically" "Mirror Horizontally and Vertically (Camera)"  
The image is displayed mirrored horizontally and vertically. "For "Mirror Horizontally and Vertically", processing is handled by the computer, and for "Mirror Horizontally and Vertically (Camera)", processing is handled by the camera.

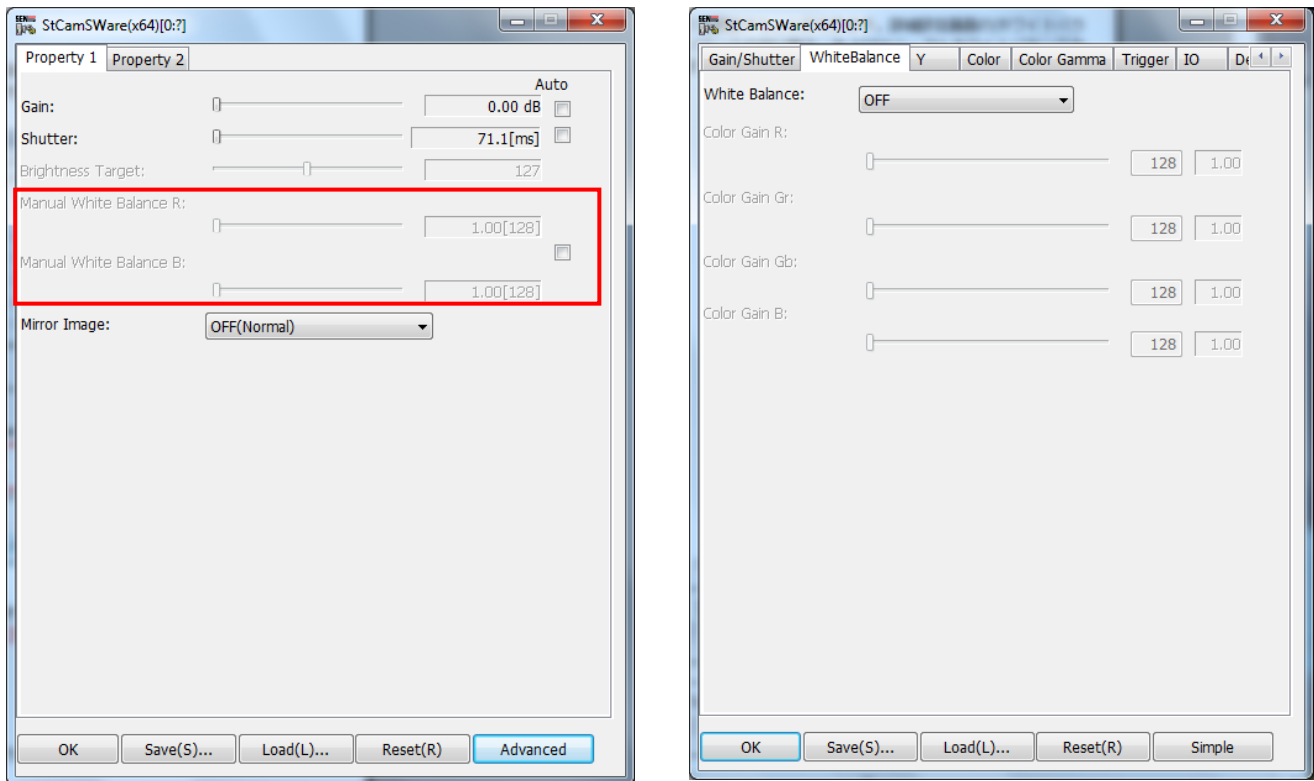


For [Rotate], you can select either "Normal" "90° Clockwise", or "90° Counterclockwise". When processing is handled by the computer, the frame rate may decrease.

- ① "Normal"  
The image is displayed normally.
- ② "90° Clockwise"  
The image is displayed rotated clockwise 90°.
- ③ "90° Counterclockwise"  
The image is displayed rotated counterclockwise 90°.

## 4.7 White Balance Mode Settings (Only for Color Camera)

It is possible to adjust the white balance of output images taken under various color temperature light sources. This setting can be made from the [WhiteBalance] tab of the advanced setting screen. From the [Property 1] tab of the simplified setting screen, it is only possible to switch between Auto / Manual White Balance and adjust the R and B for Manual White Balance.



For [White Balance], you can select either "OFF", "Manual WB", "AWB", and "One Shot AWB".

- ① "OFF"  
The white balance is not adjusted.
- ② "Manual WB" (Manual White Balance)  
You can manually set the gain for each RGB element separately according to the light source. When "Manual WB" is selected, it is possible to set [Manual R], [Manual Gr], [Manual Gb], and [Manual B]. The setting range for each is **1.00 to 3.99** in increments of 0.01.
- ③ "AWB" (Auto White Balance)  
The white balance is adjusted automatically for each frame according to the light source. When "AWB" is selected, it is possible to adjust [Manual Gr] and [Manual Gb]. The setting range for each is **1.00 to 3.99** in increments of 0.01.
- ④ "One Shot AWB" (One Shot Auto White Balance)  
White balance is adjusted using the frame that is displayed when "One Shot AWB" is selected according to the light source. Adjustment is made automatically until the value reaches the set white balance value, and after it is reached, the value is fixed. When "One Shot AWB" is selected, it is possible to adjust [Manual Gr] and [Manual Gb]. The setting range for each is **1.00 to 3.99** in increments of 0.01.

Auto white balance adjustment is performed using G as the standard. According to the sensor's Bayer array shown below, set it for Gr (G element in the same line with R elements) and Gb (G element in the same line with R elements) (\*1).

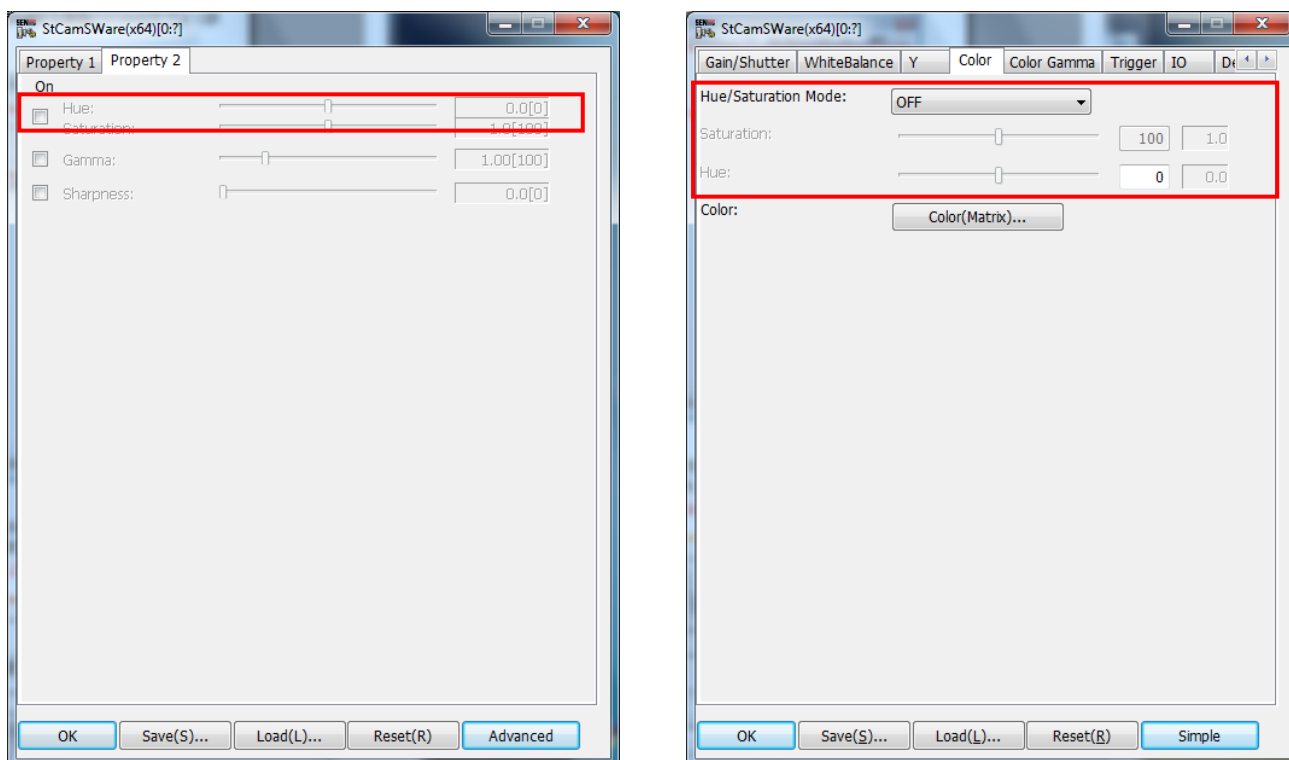
Gr	R	Gr	R	Gr
B	Gb	B	Gb	B
Gr	R	Gr	R	Gr

With this camera, white balance is adjusted by the camera, so the frame rate is not affected.

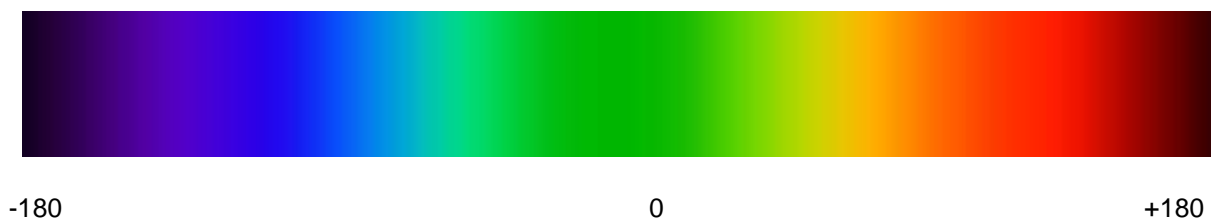
\*1: Gr is affected by R, and Gb is affected by B, so they cannot be the same value without adjustment.

## 4.8 Hue / Saturation Settings (Only for Color Camera)

You can set the hue and saturation for the output image. Settings can be made from the [Property 2] tab of the simplified setting screen, or from the [Color] tab of the advanced setting screen.

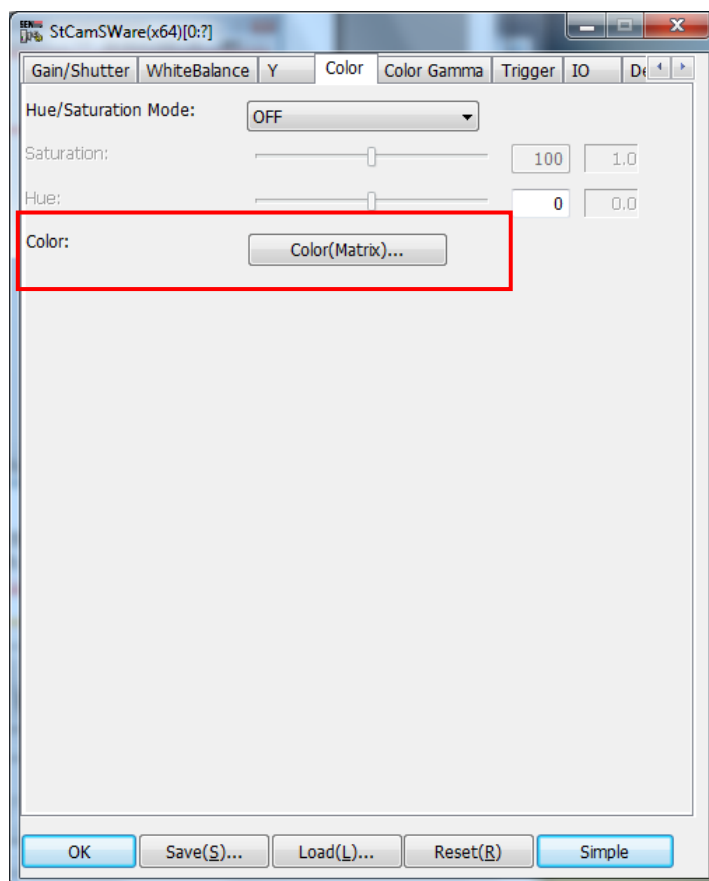


[Hue/Saturation Mode] can be turned ON/OFF. When it is set to "ON", it becomes possible to adjust the "Saturation" and "Hue". [Saturation] allows you to adjust the color density. It can be set in the range from **0 to 2.0** in increments of 0.1. [Hue] allows you to adjust the color phase. It can be set in the range from **-180.0 to +180.0** in increments of 0.1 (refer to the following figure). When processing is handled by the computer, the frame rate may decrease.

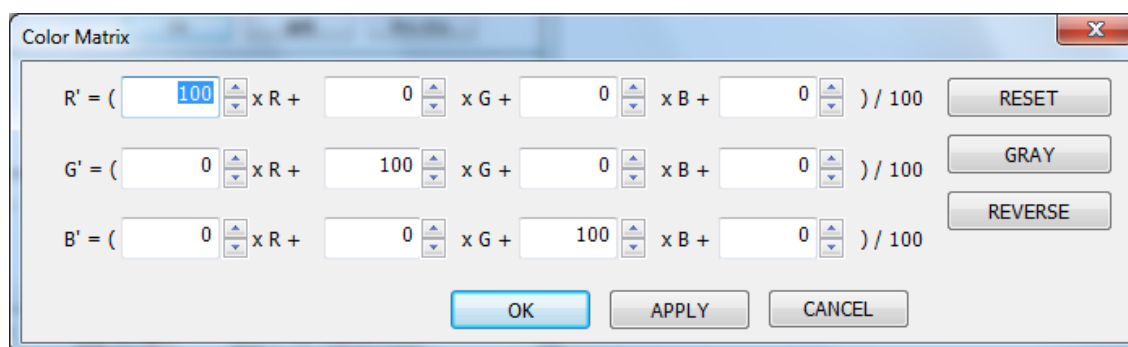


## 4.9 Color Interpolation Settings (Only for Color Camera)

You can set the color components for the output image for performing color correction. This setting can be made from the [Color] tab of the advanced setting screen.

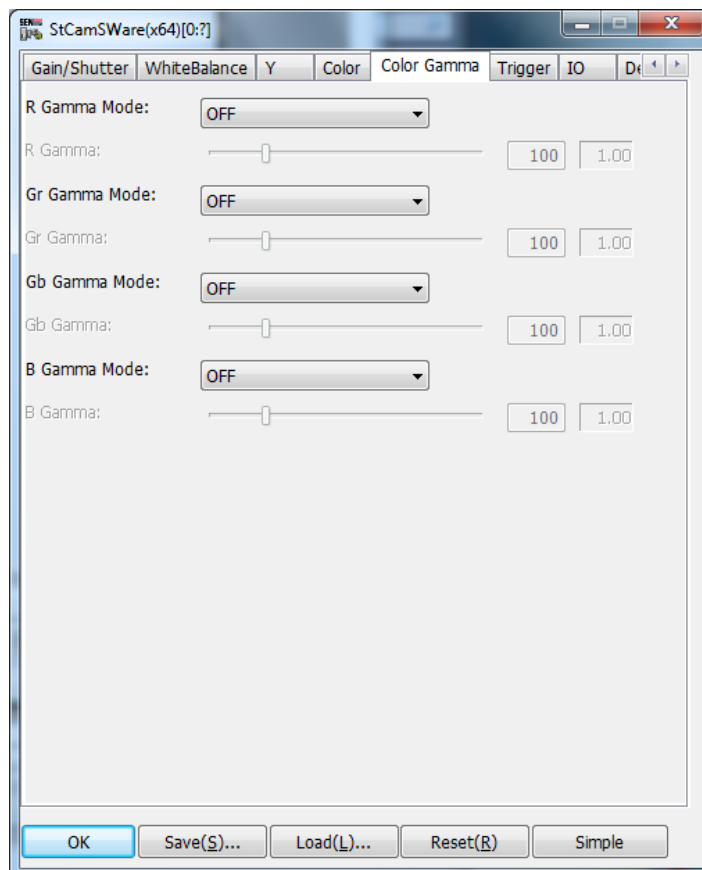


Click the "Color (Matrix)" button to bring up the following Color Matrix screen for making adjustments. When "GRAY" is selected and the "Apply" button is clicked, a monochrome image is output. When "REVERSE" is selected and the "Apply" button is clicked, a negative-positive reverse image is output. This is good for when a unique color image needs to be acquired by adjusting the color matrix. When processing is handled by the computer, the frame rate may decrease.



## 4.10 Color Gamma Setting (Only for Color Camera)

You can set the gamma conversion for the each RGB color element of the output image. Settings can be made from the [Color Gamma] tab of the advanced setting screen.

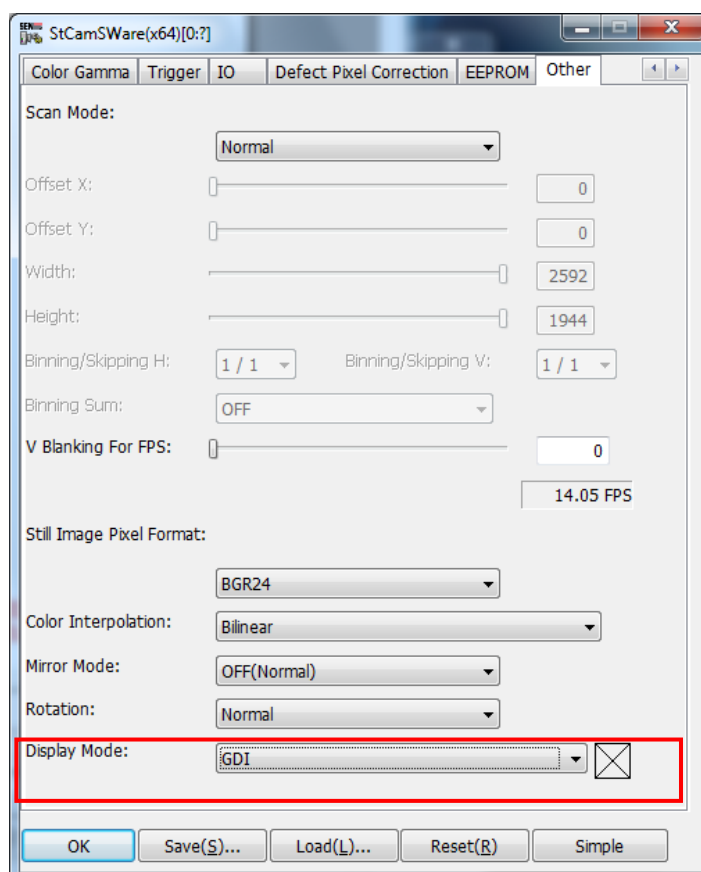


"OFF", "ON" or "Reverse" can be selected separately for [R Gamma Mode], [Gr Gamma Mode], [Gb Gamma Mode], and [B Gamma Mode]. When processing is handled by the computer, the frame rate may decrease.

- ① "OFF"  
The gamma becomes 1.00 for the selected color element.
- ② "ON"  
You can set the gamma for the selected color element. It can be set in the range of **0.01 to 5.00** in increments of 0.01.
- ③ "Reverse"  
For the selected color element, the brightness is reversed and you can set the gamma. It can be set in the range of **0.01 to 5.00** in increments of 0.01.

## 4.11 Display Mode Settings

You can set the Display Mode for when using DirectDraw. This setting can be made from the [Other] tab of the advanced setting screen.



This process is enabled when SDK is used. CPU load and image quality when an image is magnified may be improved depending on the Display Mode that is selected. Speed may decrease or operations may not be executed correctly depending on the usage environment.

Nine different display modes can be selected from [Display Mode].

- ① GDI  
This is the standard display method.
- ② GDI [HALFTONE]
- ③ DirectDraw Offscreen  
Figures and text data drawn using the SDK and video are combined and displayed by the video card. Image data is 16-bit data.
- ④ DirectDraw Overlay  
Figures and text data on the chroma key and video are displayed. Image data is 16-bit data. It is not possible to acquire a screenshot using the Print Screen function.

⑤ DirectDraw Offscreen HQ

Figures and text data drawn using the SDK and video are combined and displayed by the video card. Image data is 24-bit data.

⑥ DirectDraw Overlay HQ

Figures and text data on the chroma key and video are displayed. Image data is 24-bit data. It is not possible to acquire a screenshot using the Print Screen function.

⑦ DirectX

Figures, text data, and video are displayed using DirectX.

⑧ DirectX [V sync ON]

Figures, text data, and video are displayed using DirectX. It may be possible to reduce tearing depending on the video card.

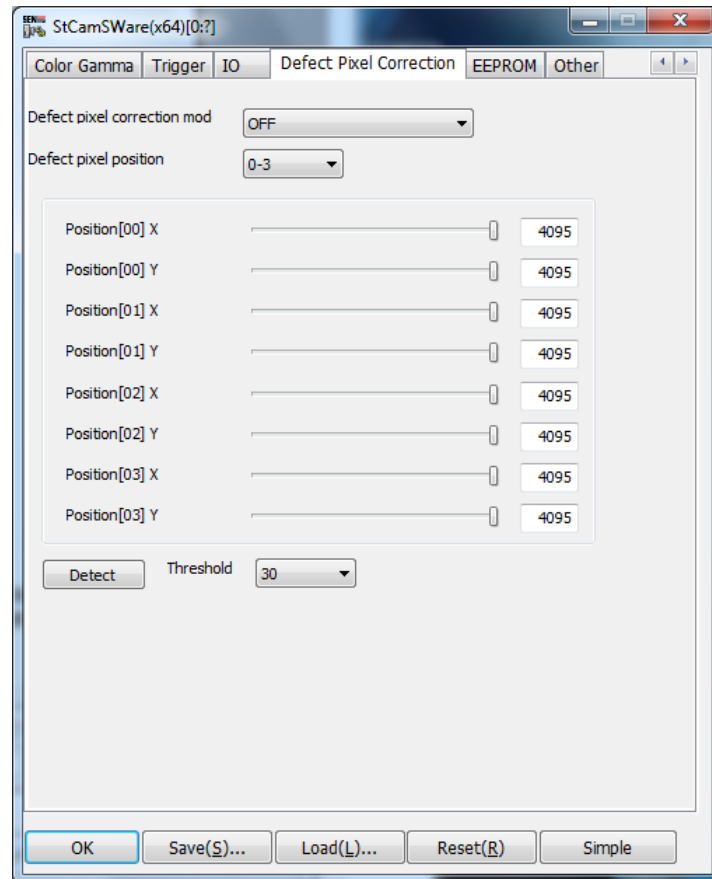
⑨ DirectX [V sync ON2]

Figures, text data, and video are displayed using DirectX. It may be possible to reduce tearing depending on the video card. Use this when tearing is not improved by using DirectX [V sync ON].



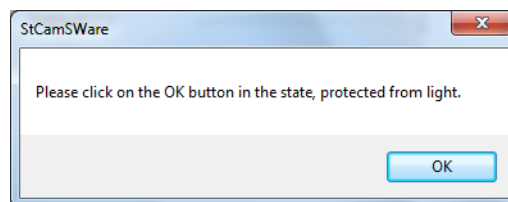
## 4.12 Defect Pixel Correction

Up to 64 defect points on the sensor can be corrected. Setting can be made from the [Defect Pixel Correction] tab of the advanced setting screen.



When [Defect pixel correction mode] is turned ON, pixels at the relevant coordinates are corrected if there is defect pixel information (\*1).

To detect defective pixels, set the [Threshold] and click [Detect]. The following message will appear. Press [OK] after blocking the camera from light.



After defect pixel detection has completed, [Position [xx]] in the center of the screen shows the XY coordinates of the defective pixels. Information for the first four points are displayed. To display information for other defective pixels, switch the display using [Defect Pixel Position].

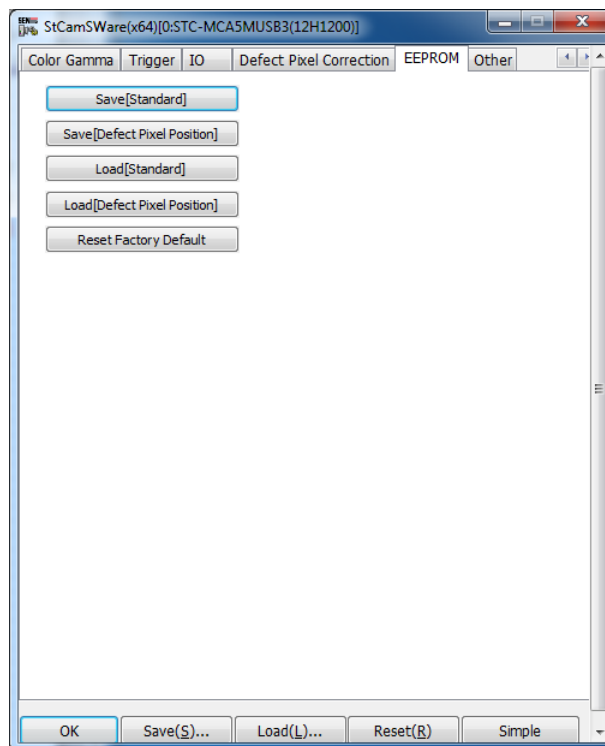
To manually specify an XY coordinate for a defective pixel, directly enter a value for [Position[xx]].

The defect pixel information can be saved to the EEPROM in the camera (refer to "4.13 Saving and Loading to EEPROM).

\*1: There is no defect pixel information when shipped.

## 4.13 Saving and Loading to EEPROM

Camera settings are saved to the EEPROM inside the camera. Settings that are saved to the EEPROM can be read at the specified time and when the power is turned ON, and can be reflected to the camera. It can be operated from the [EEPROM] tab of the advanced setting screen. Keep in mind that only camera settings are saved, and image process settings made on the computer are not saved.



[Save[Standard]] Saves information other than defect pixel position to the camera EEPROM.

[Save[Defect Pixel Position]] Saves defect pixel position information to the camera EEPROM.

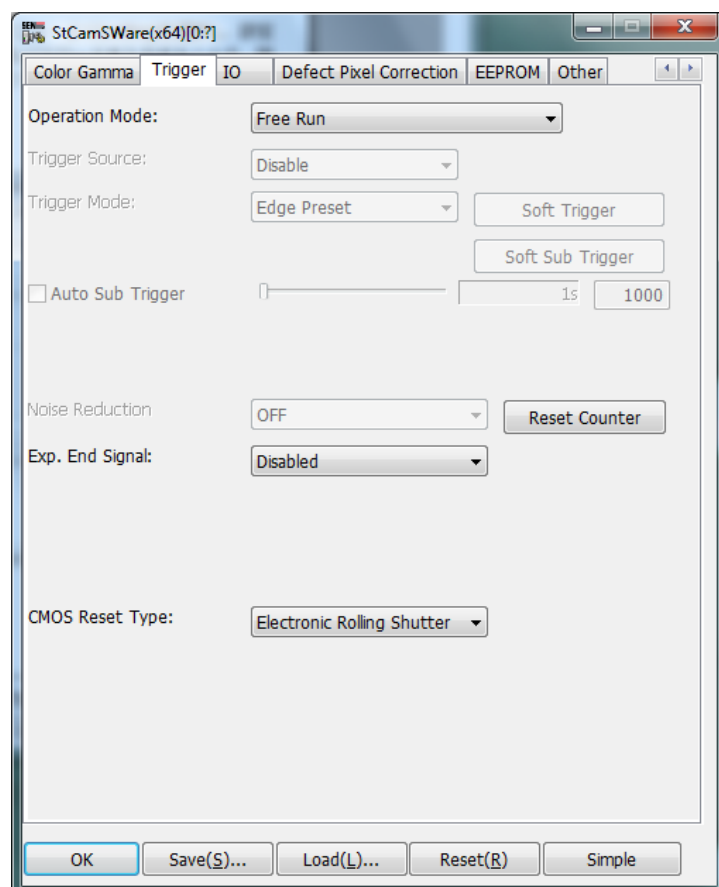
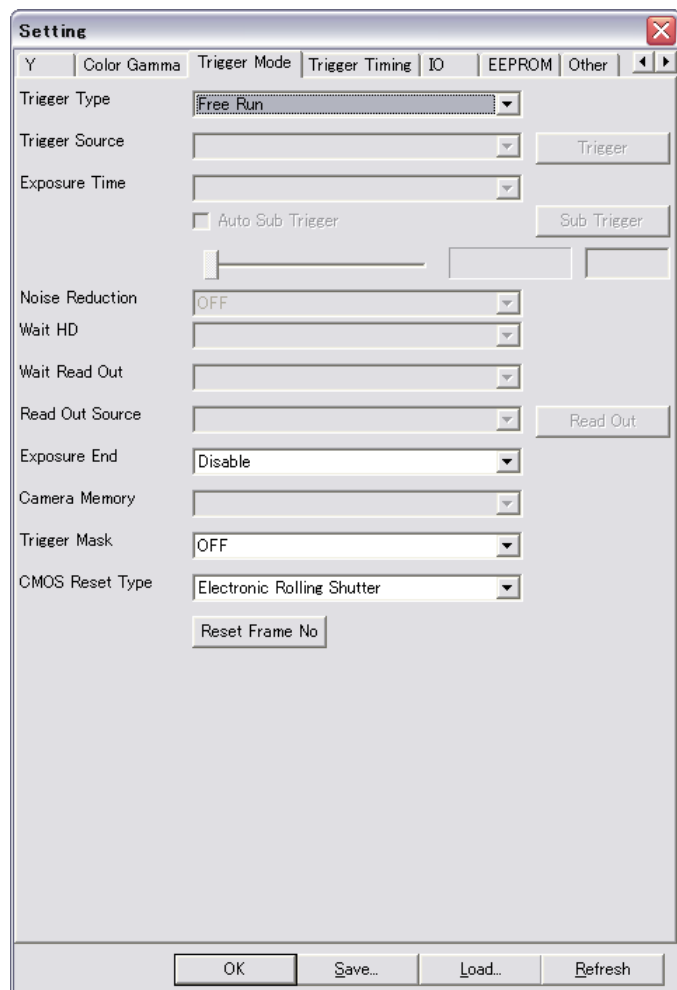
[Load[Standard]] Information other than defect pixel position is read from the EEPROM and reflected to the camera.

[Load[Defect Pixel Position]] Defect pixel position information is read from the EEPROM and reflected to the camera.

[Reset Factory Default] Defaults are reflected to the camera.

## 4.14 Operation Mode Settings

You can set the camera operation mode. From the [Mode] menu of the sample program StTrgDisplay, select [Setting], and make settings from the [Trigger Mode] tab of the setting screen. With the StCamSWare software, enter the password to enable the [Trigger] tab of the advanced setting screen to confirm the operation of certain functions. For more details about the password and password input method, refer to the Startup Guide.



You can set the camera operation mode to either "Free Run" (sequential discharge) or "Trigger". In "Trigger" mode, the trigger source can be selected as either "Hardware Trigger" for input from the I/O signal connector on the back of the camera (refer to "2.2 I/O Signal Connector") or "Software Trigger" for input from software such as StTrgDisplay. For "Trigger" mode, you can select either "Edge Preset", "Pulse Width", or "Start/Stop" depending on the exposure timer setting method.

## 4.14.1 Free Run Mode

Images are continuously output from the camera to create a video. Output is done at the camera's maximum frame rate. When the default settings are used (Full scan, V Blanking: 0), approximately 14 images are output per second. The exposure time is the preset value in the camera.

### ■ Setting Method

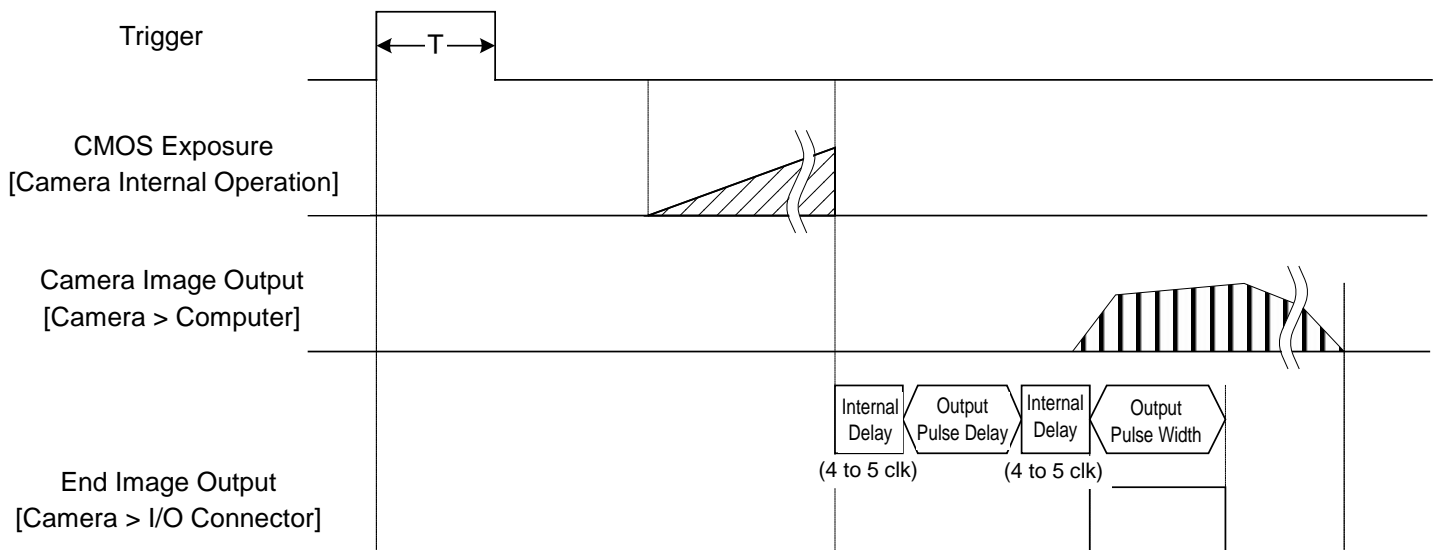
Select "Free Run" as the StTrgDisplay [Trigger Type] or StCamSWare [Operation Mode].

## 4.14.2 Trigger Mode (Software Trigger)

Still images are acquired using the trigger signal input from the software. One still image is acquired for one trigger signal. You can select the exposure time as either the preset value (Edge Preset) or as the interval between two trigger signals (Start/Stop).

### ① Edge Preset

Exposure starts when the trigger signal is input (\*1), and the exposure time is the time set by the software. The image is output immediately after exposure is complete. This operation mode is good for when you want exposure controlled by the software and want images to be output immediately after exposure ends.



### ■ Setting Method

For StTrgDisplay, select "Trigger" as the [Trigger Type], select "Software" as the [Trigger Source], and select "Edge Preset" as the [ExposureTime]. Click the "Trigger" button at the right side of the setting screen to input the trigger signal.

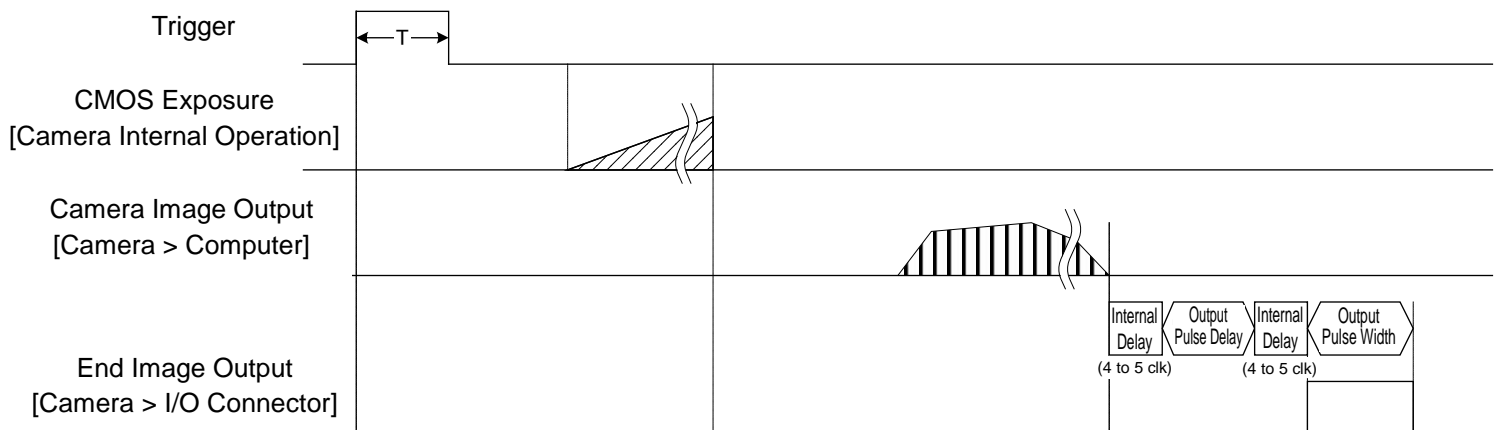
For StCamSWare, select "Trigger" as the [Operation Mode], select "Software" as the [Trigger Source], and select "Edge Preset" as the [Trigger Mode]. Click the "Soft Trigger" button at the right side of the setting screen to input the trigger signal.

To control the exposure time, go to the StCamSWare [Gain / Shutter] tab (refer to "4.1 Gain and Shutter Settings"). The setting value for [Shutter] becomes the exposure time.

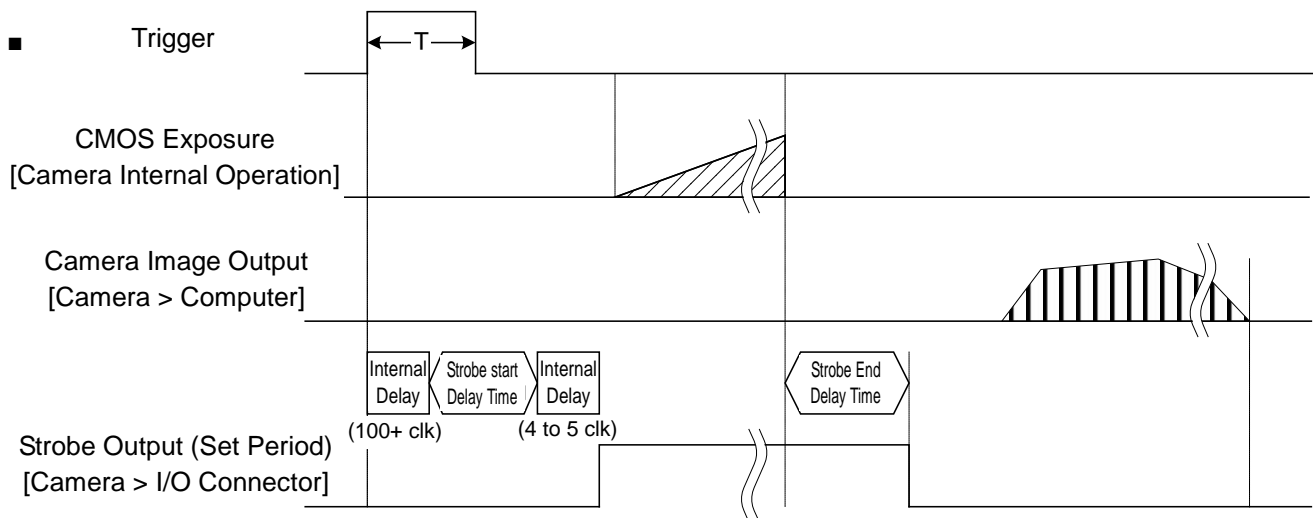
## ② Start/Stop

Exposure starts when the trigger signal is input (\*1), and the exposure ends when the sub trigger signal is input. The image is output immediately after exposure is complete. The exposure time is the time between when the trigger signal is input by the software until the sub trigger signal is input. This operation mode is good when you want to have a long exposure. It is also possible to set the sub trigger signal input to auto.

### Entering the sub trigger signal manually



### Entering the sub trigger signal automatically



## Setting Method

For StTrgDisplay, select "Trigger" as the [Trigger Type], select "Software" as the [Trigger Source], and select "Start/Stop" as the [ExposureTime]. When the "Trigger" button at the right side of the setting screen is clicked, the trigger signal can be input, and when the "Sub Trigger" button is clicked, the sub trigger signal can be input. To have the sub trigger signal input automatically, place a check in the "Auto Sub Trigger" check box and set the time for inputting the sub trigger signal.

For StCamSWare, select "Trigger" as the [Operation Mode], select "Software" as the [Trigger Source], and select "Start/Stop" as the [Trigger Mode]. When the "Soft Trigger" button at the right side of the setting screen is clicked, the trigger signal can be input, and when the "Sub Trigger" button is clicked, the sub trigger signal can be input. To have the sub trigger signal input automatically, place a check in the "Auto Sub Trigger" check box and set the time for inputting the sub trigger signal.

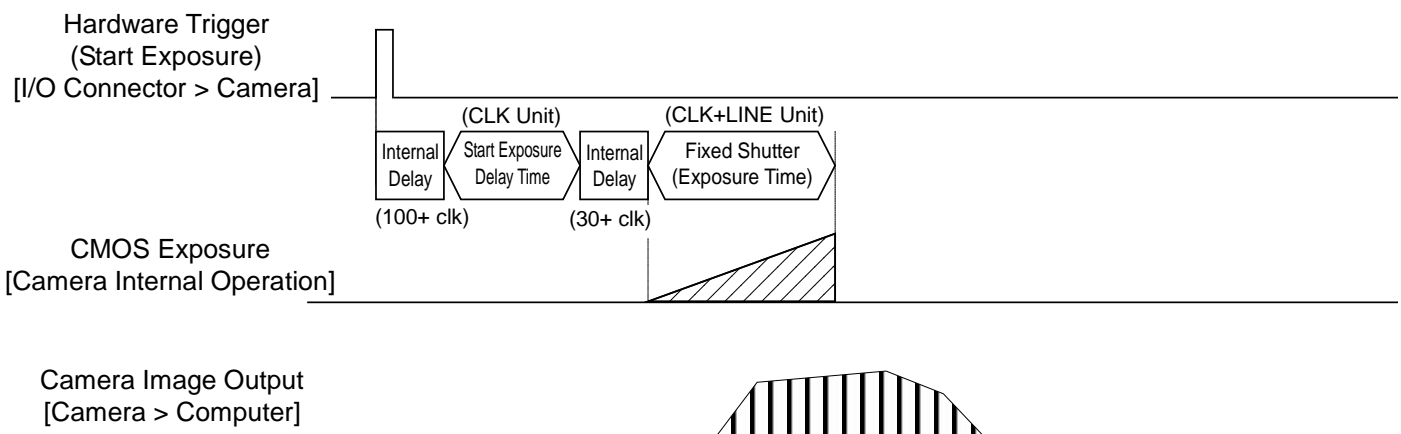
\*1: When the trigger signal is set to High Active (trigger signal is active during High), exposure starts when it rises. \*1: When the trigger signal is set to Low Active (trigger signal is active during Low), exposure starts when it goes down.

## 4.14.3 Trigger Mode (Hardware Trigger)

Still images are acquired using the trigger signal input from the hardware. One still image is acquired for one trigger signal. You can select the exposure time as either the preset value (Edge Preset), trigger signal valid period (Pulse Width), or as the interval between two trigger signals (Start/Stop). With this camera, the hardware trigger can be executed from the I/O signal connector on the back of the camera (refer to "2.2 I/O Signal Connector").

### ① Edge Preset

Exposure starts when the trigger signal is input (\*1), and the exposure time is the time set by the software. The image is output immediately after exposure is complete. This operation mode is good for when you want the exposure start time to be controlled externally and want images to be acquired immediately after exposure ends.

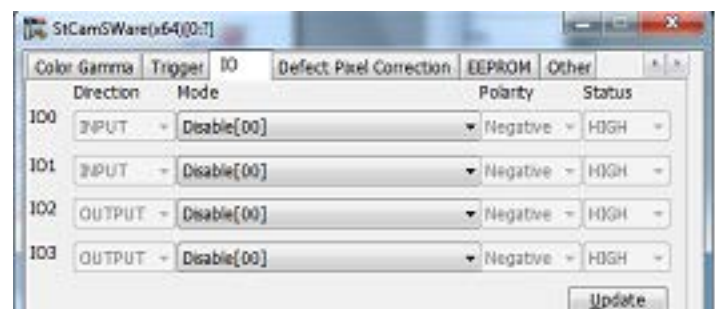
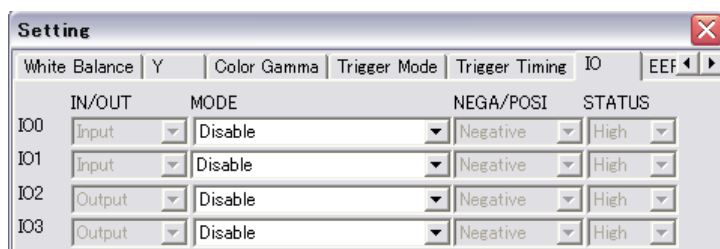


### ■ Setting Method

For StTrgDisplay, select "Trigger" as the [Trigger Type], select "Hardware" as the [Trigger Source], and select "Edge Preset" as the [ExposureTime]. From the [IO] tab, specify the pin for inputting the trigger signal (refer to the lower-left image).

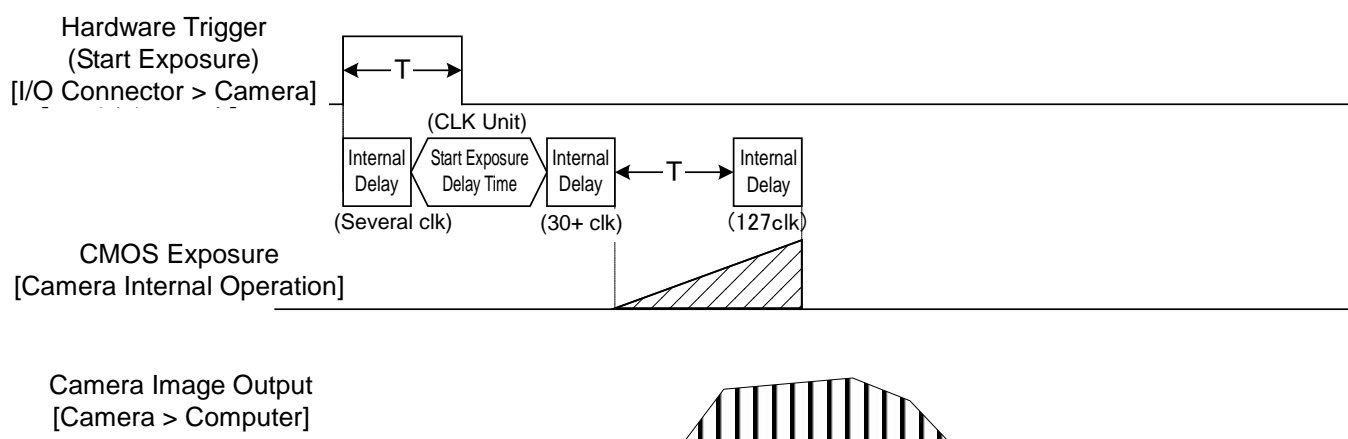
For StCamSWare, select "Trigger" as the [Operation Mode], select "Hardware" as the [Trigger Source], and select "Edge Preset" as the [Trigger Mode]. From the [IO] tab, specify the pin for inputting the trigger signal, and then click the [Update] button (refer to the lower-right image).

To control the exposure time, go to the StCamSWare [Gain / Shutter] tab (refer to "4.1 Gain and Shutter Settings"). The setting value for [Shutter] becomes the exposure time.



## ② Pulse Width

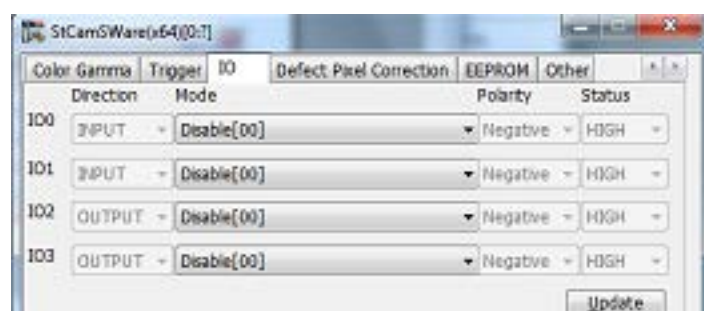
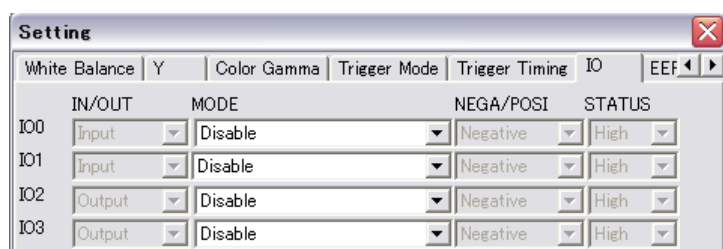
Exposure starts when the trigger signal is input (\*1), and the exposure continues for the trigger signal pulse width period. The image is output immediately after exposure is complete. This operation mode is good for when you want the exposure start time and exposure to be controlled externally and want images to be acquired immediately after exposure ends.



## ■ Setting Method

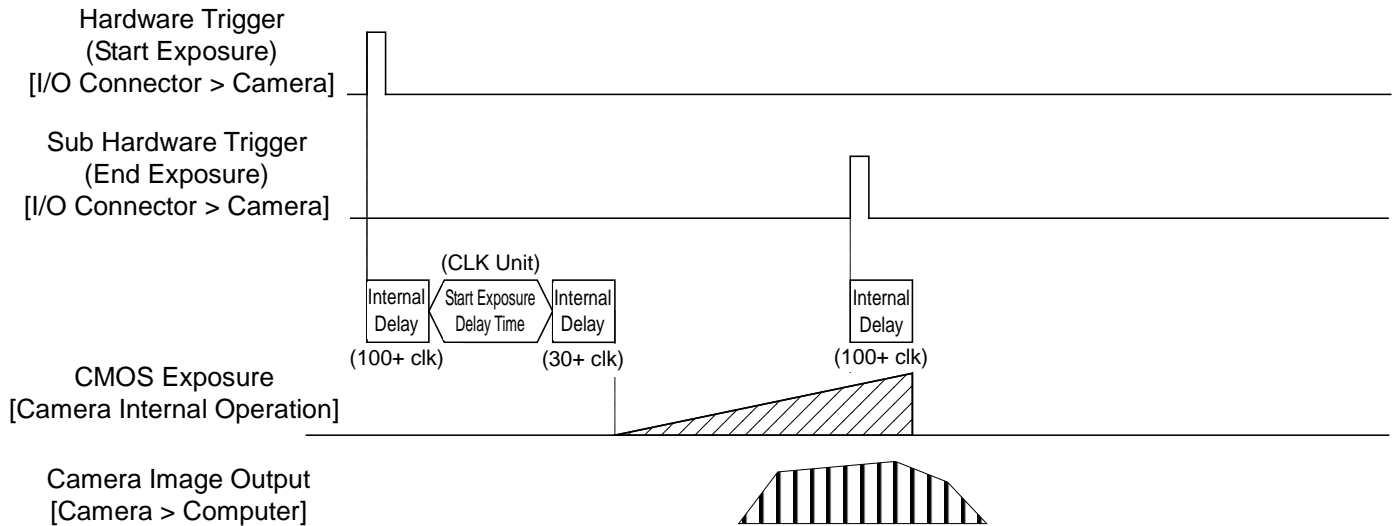
For StTrgDisplay, select "Trigger" as the [Trigger Type], select "Hardware" as the [Trigger Source], and select "Pulse Width" as the [ExposureTime]. From the [IO] tab, specify the pin for inputting the trigger signal (refer to the lower-left image).

For StCamSWare, select "Trigger" as the [Operation Mode], select "Hardware" as the [Trigger Source], and select "Pulse Width" as the [Trigger Mode]. From the [IO] tab, specify the pin for inputting the trigger signal, and then click the [Update] button (refer to the lower-right image).



### ③ Start/Stop

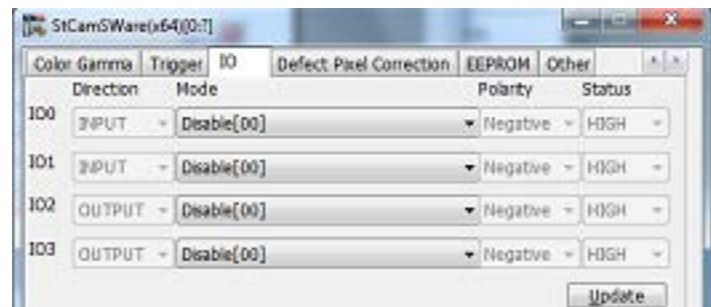
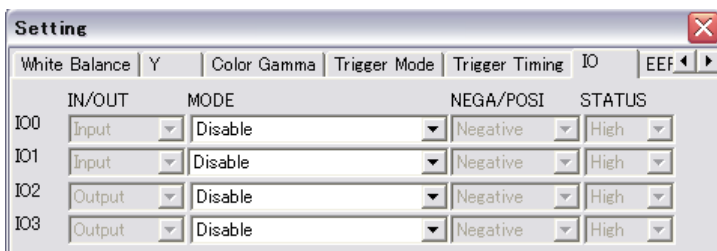
Exposure starts when the trigger signal is input (\*1), and the exposure ends when the sub trigger signal is input. The image is output immediately after exposure is complete. The exposure time is the time between when the external trigger signal is input until the sub trigger signal is input. This operation mode is good when you want to have a long exposure.



### ■ Setting Method

For StTrgDisplay, select "Trigger" as the [Trigger Type], select "Hardware" as the [Trigger Source], and select "Start/Stop" as the [ExposureTime]. From the [IO] tab, specify the pin for inputting the trigger signal (refer to the lower-left image).

For StCamSWare, select "Trigger" as the [Operation Mode], select "Hardware" as the [Trigger Source], and select "Pulse Width" as the [Trigger Mode]. From the [IO] tab, specify the pin for inputting the trigger signal, and then click the [Update] button (refer to the lower-right image).



\*1: When the trigger signal is set to High Active (trigger signal is active during High), exposure starts when it rises. \*1: When the trigger signal is set to Low Active (trigger signal is active during Low), exposure starts when it goes down.

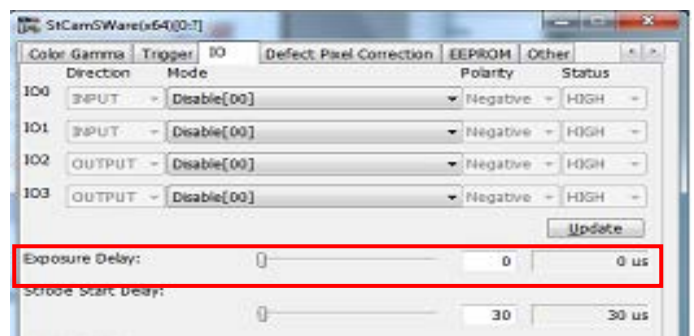
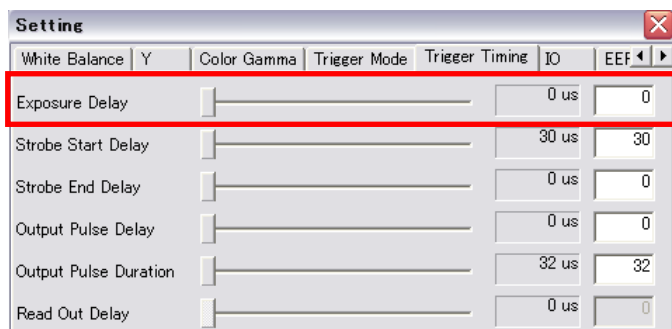


## [Cautions and Supplementary Information for when Using Trigger Mode]

- When Trigger Mode is used, set the ALC/AGC mode for the camera setting to "Fixed Shutter / Fixed Gain" (refer to "4.1 Gain and Shutter Settings").
- It is also possible to execute exposure control by combining software signals and hardware signals. It is necessary to make I/O signal setting. For more details on the setting method, refer to "4.15 I/O Signal Settings".

### ➤ Exposure Start Time

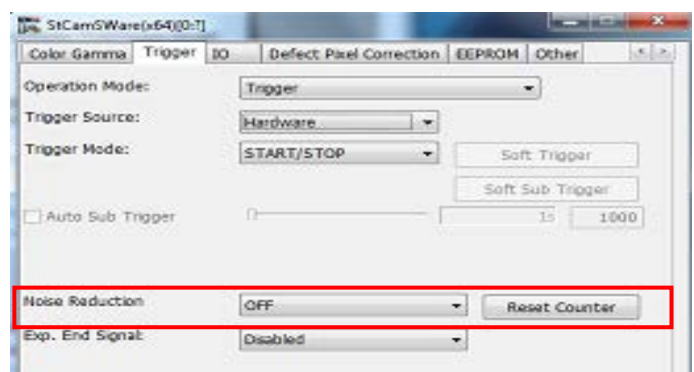
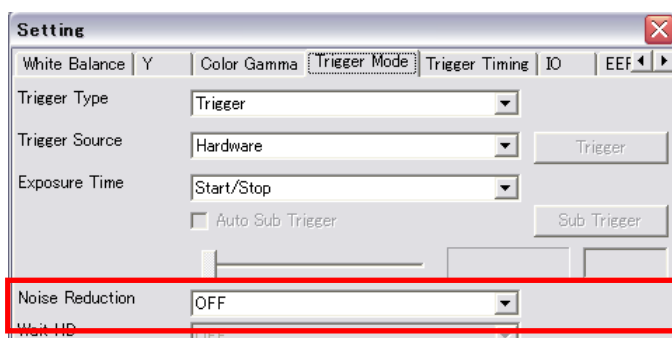
The exposure start time should begin immediately after the trigger signal is input. However, in reality, there is some internal delay after the trigger signal is input. If you do not want exposure to begin immediately, you can set the Exposure Delay so that the exposure start time is delayed after the trigger signal is input. For Exposure Delay, go to the [Trigger Timing] tab of StTrgDisplay (lower-left image), or go to the [IO] tab of StCamSWare (lower-right image).



### ➤ Noise Reduction

When Pulse Width or Start/Stop is used, you can set the noise reduction. Go to the [Trigger Mode] tab of StTrgDisplay (lower-left image), or go to the [Trigger] tab of StCamSWare (lower-right image).

[OFF]	Noise reduction is not performed.
[Easy]	Noise is detected in the acquired image and noise reduction is performed.
[Complex]	Noise reduction is performed using the image acquired earlier while light was blocked.
[Calibration]	The acquired image is registered as the image while light was blocked.



■ Setting Method (When using [Complex])

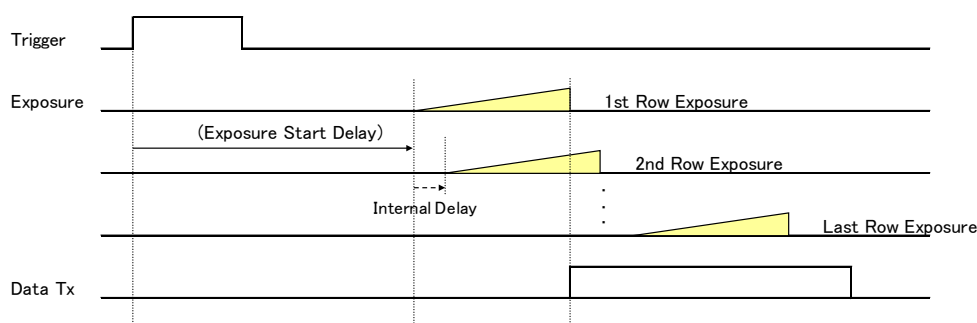
- (1) Set the desired shooting status for the camera (e.g. shutter and gain).
- (2) Block the light.
- (3) Select [Calibration].
- (4) Acquire an image while light is being blocked.
- (5) Select [Complex].
- (6) Stop blocking the light.

※ When camera settings such as the exposure time and gain are changed, it is necessary to perform steps (1) to (6) again.

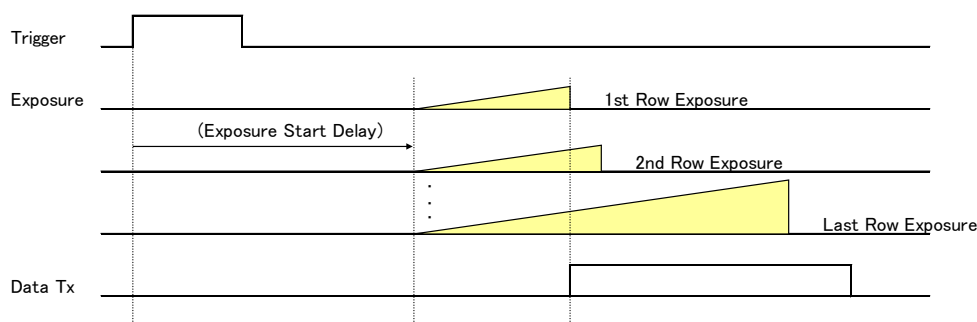
## 4.14.4 CMOS Reset Type

With this camera, you can select the sensor exposure type as either "Electronic Rolling Shutter (ERS)" or "Global Reset Release (GRR)". When GRR is used under low light, the exposure at the bottom portion of image is longer than the exposure at the upper portion, so it becomes brighter.

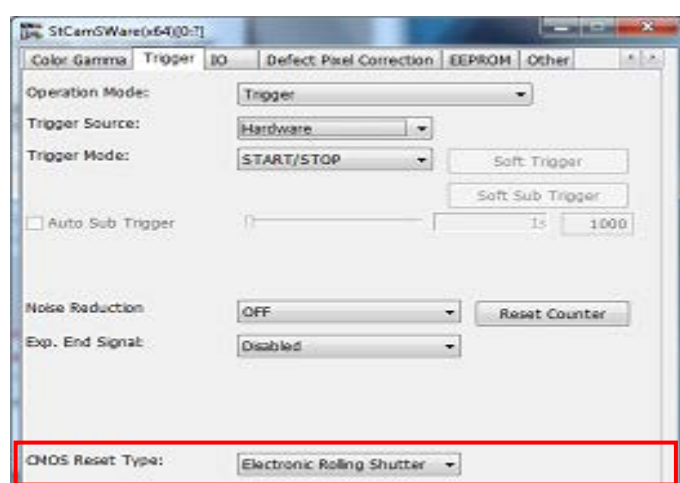
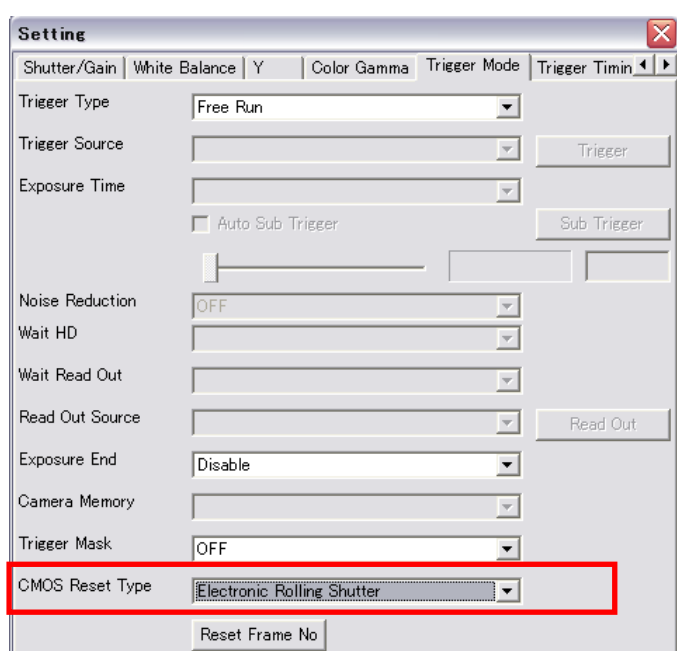
### ERS (For Edge Preset)



### GRR (For Edge Preset) Note: This function works on Trigger-mode.



Go to the [Trigger Mode] tab of StTrgDisplay (lower-left image), or go to the [Trigger] tab of StCamSWare (lower-right image).



## 4.15 I/O Signal Settings

You can set the input signal and output signal for the I/O signal connector. There are two exclusive terminals for input signals, and two exclusive terminals for output signals, so setting should be made according to the usage. From the [Mode] menu of the sample program StTrgDisplay, select [Setting], and make settings from the [IO] tab of the setting screen. With the StCamSWare software, enter the password to enable the [IO] tab of the advanced setting screen to confirm function operation. For more details about the password and password input method, refer to the Startup Guide.

IN/OUT	MODE	NEGA/POSI	STATUS
IO0	Input	Disable	Negative High
IO1	Input	Disable	Negative High
IO2	Output	Disable	Negative High
IO3	Output	Disable	Negative High

SW: Low Low Low Low

LED: Red OFF Green OFF

Camera Type: STC-MCA5MUSB3  
 FPGA Version: 000A  
 Firm Version: 010B  
 SDK Version: 3.1.0.3005

Buttons: OK Save... Load... Refresh

Direction	Mode	Polarity	Status
IO0	INPUT	Disable[00]	Negative HIGH
IO1	INPUT	Disable[00]	Negative HIGH
IO2	OUTPUT	Disable[00]	Negative HIGH
IO3	OUTPUT	Disable[00]	Negative HIGH

Buttons: Update

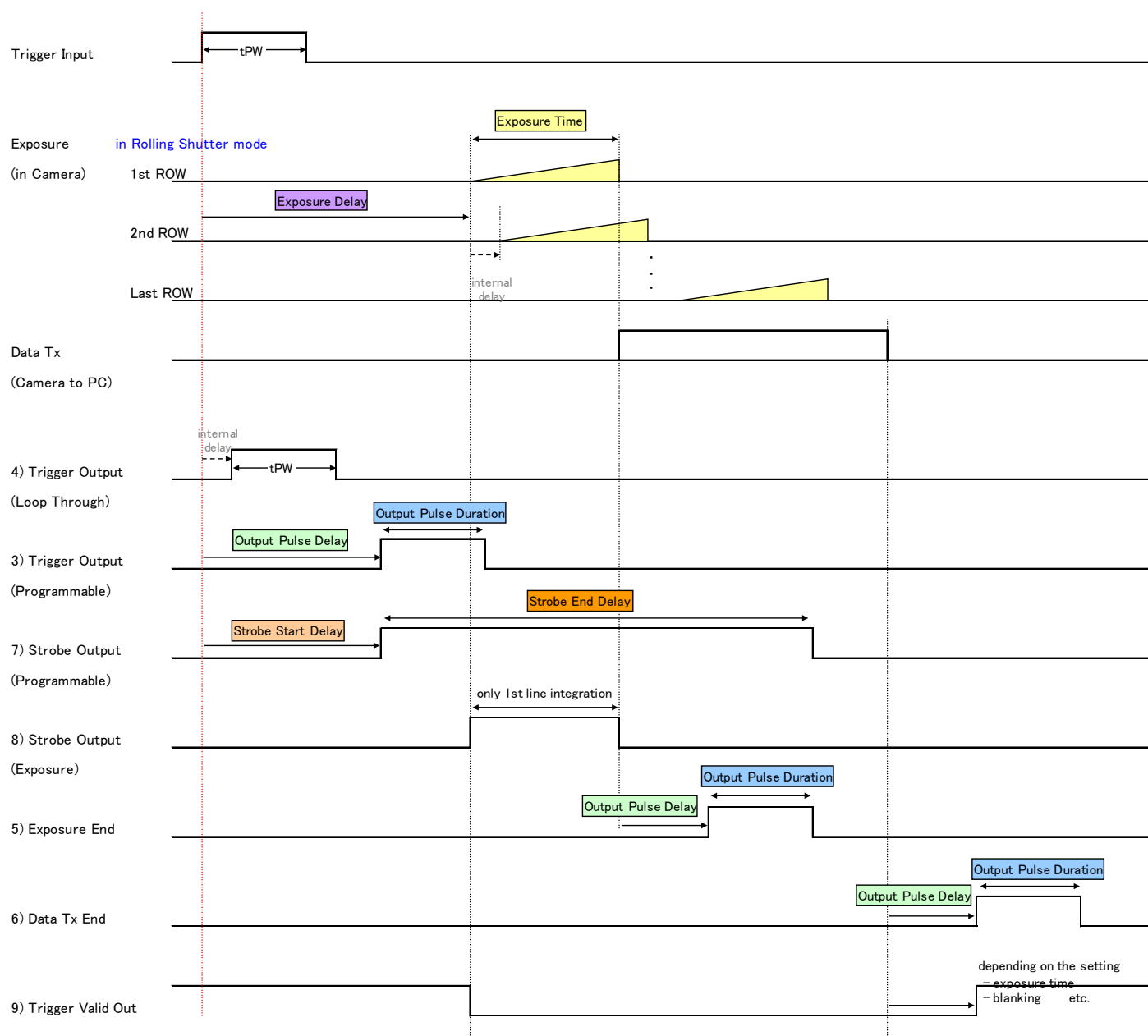
Exposure Delay: 0 0 us  
 Strobe Start Delay: 30 30 us  
 Strobe End Delay: 0 0 us  
 Output Pulse Delay: 0 0 us  
 Output Pulse Duration: 32 32 us

Buttons: OK Save(S)... Load(L)... Reset(R) Simple

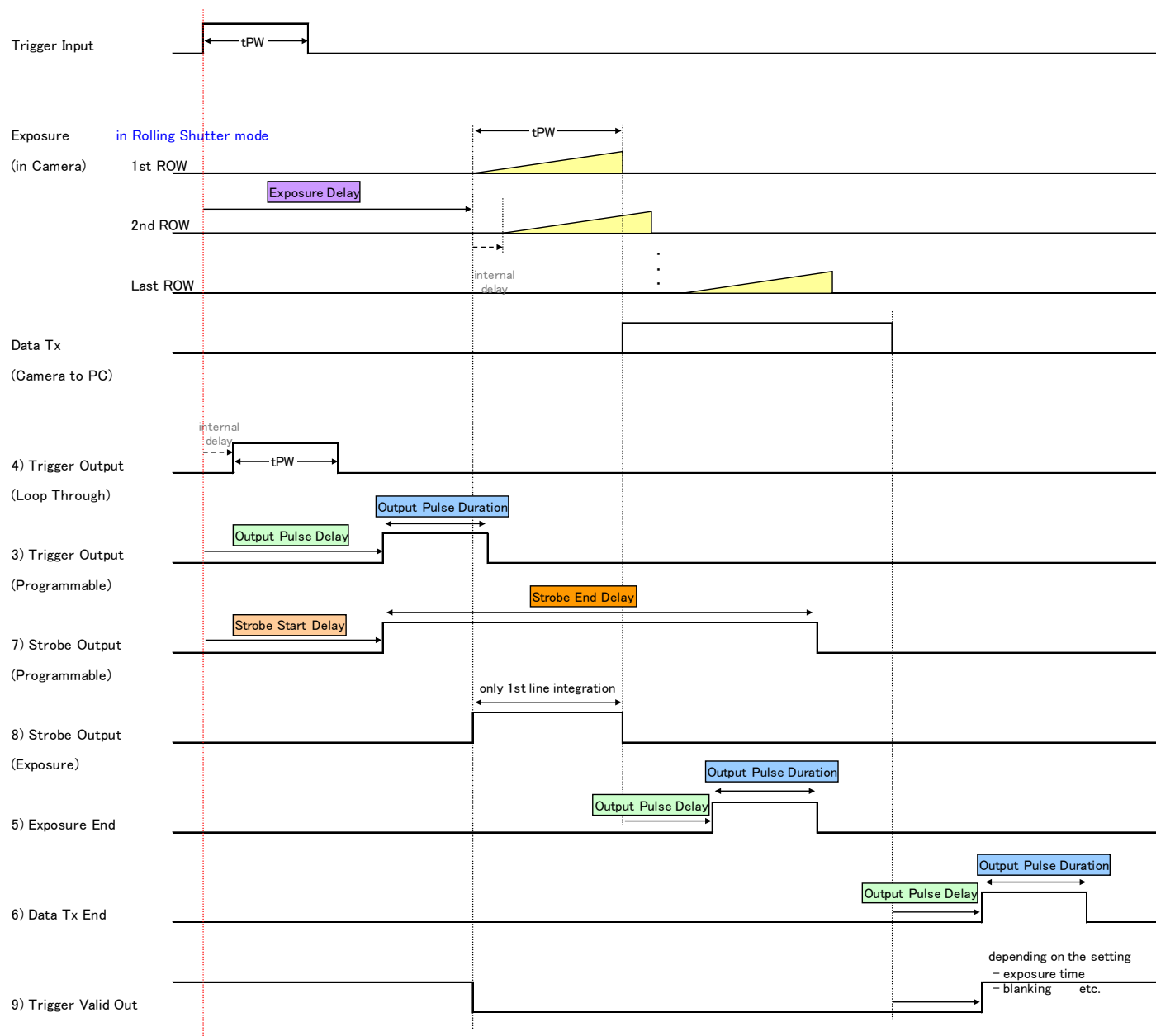
For an overview of each I/O signal, refer to "3. I/O Signal Specifications". The following shows the timing of each output signal.

This differs according to the CMOS Reset Type and Trigger Mode.

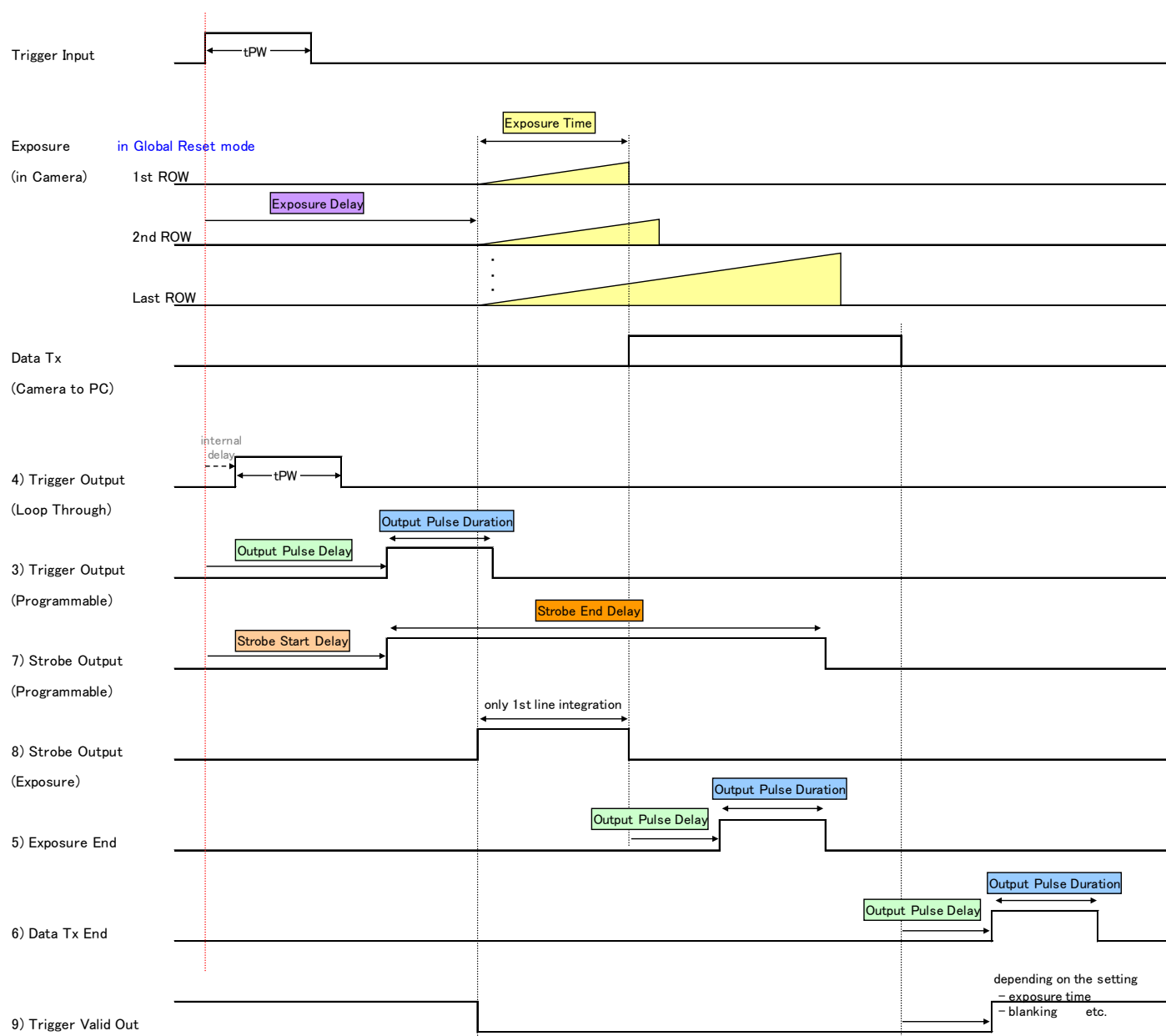
## 4.15.1 Rolling Shutter / Edge Preset



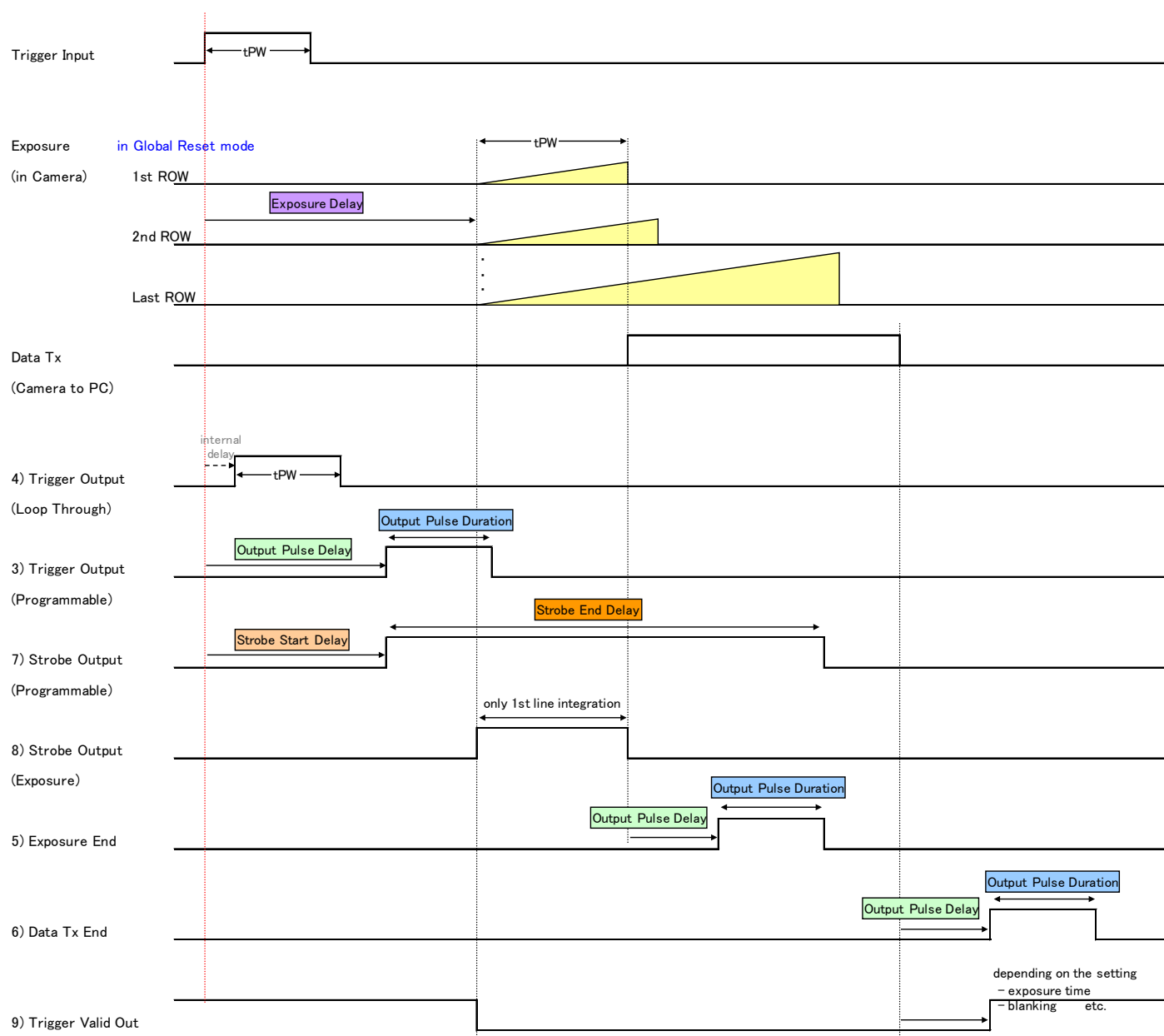
## 4.15.2 Rolling Shutter / Pulse Width



## 4.15.3 Global Reset Release / Edge Preset



## 4.15.4 Global Reset Release / Pulse Width





## 4.15.5 Software Options for Output Signals and Control Signals

Specifications / User's Guide		StTrgDisplay	StCamSWare	Note
1)	Function Disabled (Default)	Disable	Disable	Output Signal
2)	General Output	General Output	General Output	Output Signal
3)	Trigger Output (Delay)	Trigger Output Programmable	Trigger Output	Output Signal
4)	Trigger Output (Through)	Trigger Output Loop Through	Trigger Output (Through)	Output Signal
5)	Exposure End Output	Exposure End	Exposure End	Output Signal
6)	Readout End Output	CCD Read End Output	CCD Discharge End	Output Signal
7)	Strobe Output (Set Period)	Strobe Output Programmable	Strobe Output (Set Time)	Output Signal
8)	Strobe Output (Exposure Period)	Strobe Output Exposure	Strobe Output (Exposure Time)	Output Signal
9)	Trigger Valid Period	Trigger Valid Out	Trigger Valid Period	Output Signal
-	-	Exposure Delay	Exposure Delay	Control Signal
-	-	Strobe Start Delay	Strobe Start Delay	Control Signal
-	-	Strobe End Delay	Strobe End Delay	Control Signal
-	-	Output Pulse Delay	Output Pulse Delay	Control Signal
-	-	Output Pulse Duration	Output Pulse Width	Control Signal

※ "Exposure Time" indicates the shutter. For more details on the setting method, refer to "4.1 Gain and Shutter Settings".

StTrgDisplay Screen

StCamSWare Screen

## 5 Revision History

Rev.	Revision Date	Revision Contents	Note
1.00	2012/09/10	● Newly Issued	
1.01	2012/10/4	● Revised "4.14.4 CMOS Reset Type" "4.15 I/O Signal Settings"	
1.02	2013/01/22	● Revised Compatible with StCamSWare(V3.02)	

〒243-0018

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