SENTECH

5 MP GigE CMOS Series

Product Specifications

Features

- 5 Megapixel Resolution
- CMOS Rolling Shutter
- Monochrome or Color Models
- Power over Ethernet

Product Precautions

- **Handle the camera with care. Do not abuse the camera. Avoid striking or shaking it. Improper handling or storage could damage the camera.**
- **Do not pull or damage the camera cable.**
- **During camera use, do not wrap the unit in any material. This will cause the internal temperature of the unit to increase.**
- **Do not expose the camera to moisture, or do not try to operate it in wet areas.**
- **Do not operate the camera beyond its temperature, humidity and power source ratings.**
- **While the camera is not being used, keep the lens or lens cap on the camera to prevent dust or contamination from getting in the Sensor or filter area and scratching or damaging this area.**
- **Do not keep the camera under the following conditions:**
  - **In wet, moist, and high humidity areas**
  - **Under hot direct sunlight**
  - **In high temperature areas**
  - **Near an object that releases a strong magnetic or electric field**
  - **Areas with strong vibrations**
- **Apply the power that satisfies the requirements specified in this document to the camera.**
- **Use a soft cloth to clean the camera. Use pressured air spray to clean the surface of the glass. DO not scratch the surface of the glass.**
- **The camera is a general-purpose electronic device; using the camera for the equipment that may threaten human life or cause dangers to human bodies directly in case of failure or malfunction of the camera is not guaranteed. Use the camera for special purposes at your own risk.**

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1 Introduction

This document describes the specification of the following cameras:

STC-SCA503POE	(5M Color)
STC-SBA503POE	(5M Monochrome)

1.1 Features

- CMOS (Rolling Shutter /Global Reset Release)
- GigE Interface
- Support PoE(Power over Ethernet Support)

5M pixel model of cameras are GigE camera on COMS Sensor (Rolling Shutter /Global Reset Release). The maximum allowed frame rate is 14 fps on 5M pixel model (8bit).8,10,12bit RAW output is supported.

1.2 Naming Method

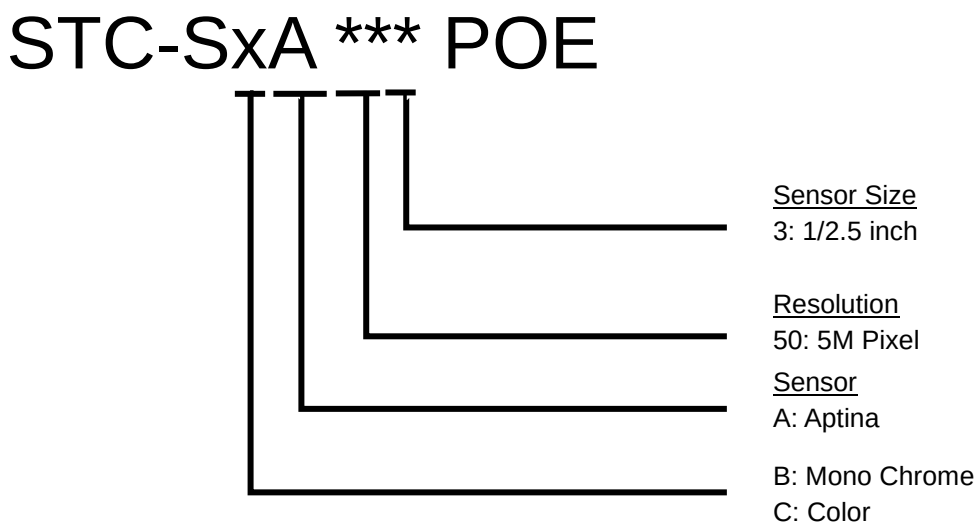


Figure 1: Naming Method

2 Specifications

2.1 Electronic Specifications

2.1.1 STC-SCA503POE / STC-SBA503POE

Model Number		STC-SCA503POE	STC-SBA503POE
Imager		1/2.5″ 5M pixel color CMOS (Aptina:MT9P031I12STC)	1/2.5″ 5M pixel monochrome CMOS (Aptina:MT9P031I12STM)
Active Picture Elements		2592(H) x 1944(V)	
Cell Size		2.2 (H) x 2.2 (V) µm	
Scanning System		Progressive	
Shutter Type		Rolling Shutter / Global Reset Release	
Scan Mode		Full Scan / AOI	
Vertical Frequency (Frame Rate on Full Scan)		QSXGA: 2592 x 1944 : 14fps (6.8835 to 14fps adjustable via the communication) (Frame rate depends on the AOI setting)	
Maximum Frame Rate (Binning or AOI on FullScan)		Vertical 1/2 Binning: 23.3fps, Vertical 1/4Binning: 34.6fps QXGA (2048 x 1536) : 17fps, UXGA (1600 x 1200) : 22fps,SXGA (1280 x 1024) : 26fps, XGA (1024 x 768) : 35fps,SVGA (800 x 600) : 45fps, VGA (640 x 480) : 56fps,Minimum AOI (32 x 32): 366fps	
Video Output Format		Mono8, Mono10, Mono10Packed, Mono12,Mono12Packed BayerGR8, BayerGR10, BayerGR10Packed BayerGR12,, BayerGR12Packed,RGB8Packed	Mono8, Mono10, Mono10Packed, Mono12,Mono12Packed
Noise Level	@ 10bit output	≤ 13 Digit (Gain 0 dB)	≤ 13 Digit (Gain 0 dB)
Minimum Scene Illumination		16 Lux at F1.14Hz	.0.1 Lux at F1.2, 14 Hz
ALC		AE and AGC (ON/OFF) (adjustable via the communication）(**Default: AE OFF, AGC ON**)	
Exposure Time		Preset continuous mode: 32 useconds to 16,777,215m seconds Preset trigger mode: 32 useconds to 16,777,215m seconds TriggerWidth (Pulse width) mode: 32 useconds to Non-limit m seconds	
Gain	Sensor	0 to 18.69 dB (Analog Gain: 0 to 7.51dB, Digital Gain: up to 18.69 dB)	
	DSP	Digital Gain: 0 to 9.51 dB	
Gamma		Gamma 1.0 (Factory default) or unloadable gamma table (**Default:1**)	
AOI Function		AOI (H: 32 to 2592 Pixel / V: 32 to 1944 Line） Unit： H 8 Pixel / V 2 Line	
Binning		H:1/2, V:1/2, 1/4 Note: Sensitivity may increase on Horizontal, Sensitivity may not increase on Vertical	
Decimation(Skipping)		H 1/2, 1/3, 1/4, 1/5, 1/6, 1/7 V 1/2, 1/3, 1/4, 1/5, 1/6, 1/7	
Flip Image		N/A	Horizontal / Vertical / Horizontal-Vertical (configurable via the communication）
Pixel Blemish Correction		Maximum 64points (**Default:ON)**	
White Balance		Auto, Manual, Push to Set White Balance are available. on both raw data and RGB outputs (**Default:OFF**)	N/A
Operational Mode		FreeRun, Edge preset trigger, TriggerWidth (Pulse width) (**Default:OFF**)	
Protocol		IEEE802.3 (1000BASE-T)	
Communication		GigE Vision® 1.2 , GenICam™ 1.4	
I/O		One opt-isolated input and two open collector outputs(+3.3V)	
Power	Input Voltage	+10.8 to +26.4 Vdc (IO Connector) or Power Over Ethernet(IEEE802.3af compliance)	
	Power Consumption	Power Over Ethernet: Less than 3.0 W, +12Vdc: Less than 3.2 W	

Table 1: STC-SCA503POE / STC-SBA503POE

2.2 Spectral Sensitivity Characteristics

2.2.1 STC-SCA503POE

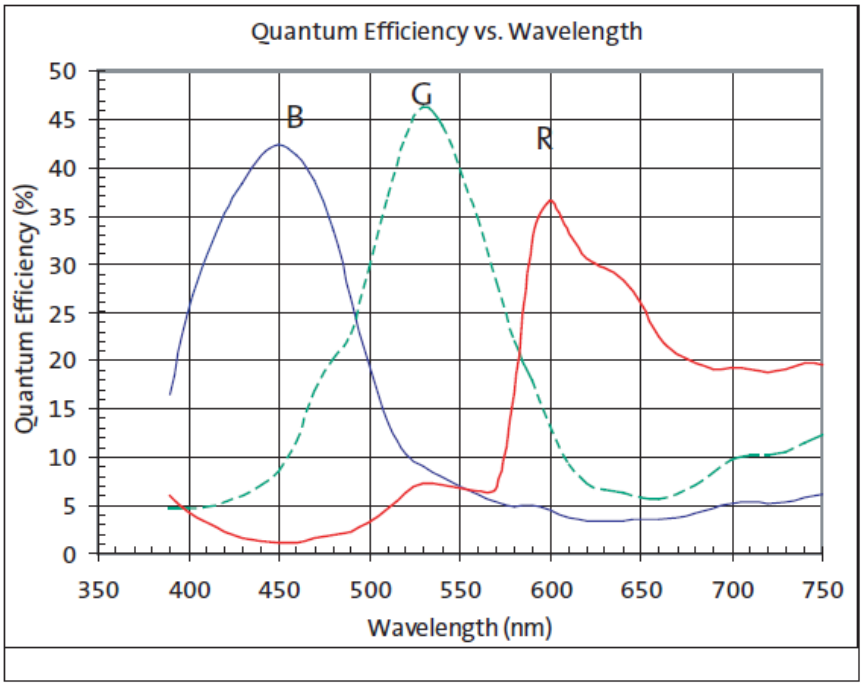


Figure 2: Sensor Spectral Response (Color)

2.2.2 STC-SBA503POE

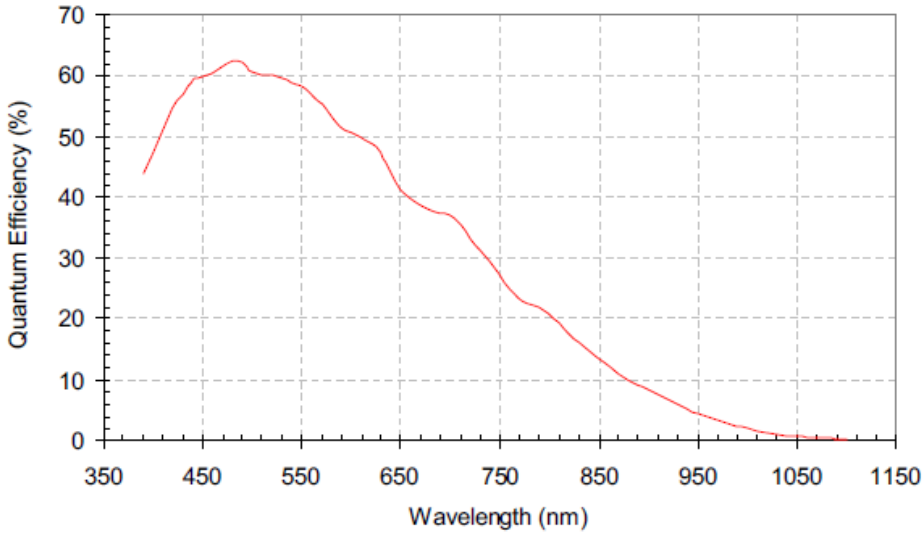


Figure 3: Sensor Spectral Response (Monochrome)

2.3 Mechanical Specifications

Model Number	STC-SCA503POE	STC-SBA503POE
Dimensions	35 (W) x 35 (H) x 53.5(D) mm excluding connectors	
Optical Filter	With IR Cut Filter	No Filter
Optical Center Accuracy	Positional accuracy in H and V directions:: ±0.3 mm Rotational accuracy of H and V: ±1.0 deg	
Material	Aluminum (AC)	
Lens Mount	C mount	
Connectors	RJ45 connector Power- I/O connector: HR10A-7R-6PB (Hirose) or equivalent	
Camera Mount Screws	Two 1/4" Tripod screw holes: (One on each top and bottom plate), Twelve M4 screws holes: (Four on each top and bottom plate, two on each side plate)	
Weight	Approximately 97 g	

Table 2: Mechanical Specifications

2.4 Environmental Specifications

Model Number		STC-SCA503POE, STC-SBA503POE
Operational Temperature	Minimum	Environmental Temperature -5^{0}C
	Maximum	Camera housing temperature (top plate) shall not exceed 65^{0}C (This corresponds to an environmental temperature of approximately 40^{0}C)
Storage temperature		Environmental Temperature: -30^{0}C to 65^{0}C
Vibration		20Hz to 200Hz to 20Hz (5min./cycle), acceleration 10G, XYZ 3 directions 30 min. each)
Shock		Acceleration 38G, half amplitude 6ms, 3 directions 3 times each
Standard Compliancy		EMS: EN61000-6-2, EMI: EN55011
RoHS		RoHS Compliance

Table 3: Environmental Specifications

Note: When the camera is used in surrounding temperatures that exceed 40^{o}C, please make sure that the camera is set up to properly radiate heat (maintaining the camera's top case plate's temperature to be less than 65^{o}C).

Taking these steps will maintain the heat rating of the electronic components of the camera.

3 Connector Specifications

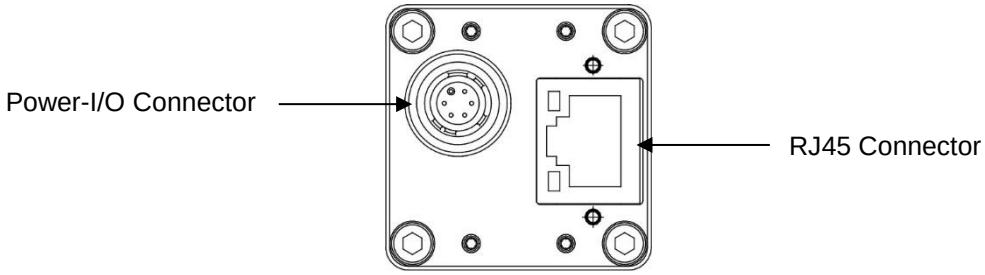


Figure 4: Camera Connector

3.1 RJ45 Connector

This product is PoE compliant. Please supply power (+10.8 to +26.4Vdc) through the power-I/O connector when using a non-PoE-compliant NIC.

Pin Assignment

Pin No.	Signal Name
1	TA+
2	TA-
3	TB+
4	TC+
5	TC-
6	TB-
7	TD+
8	TD-

LED

Green LED	Orange LED	Status
Green Light ON	Orange Light ON	Power ON(1GB NIC)
Green Light OFF	Orange Light OFF	Power ON(100MB NIC)
Green Light ON	Orange Light Blinking	1Gb Transferring
Light OFF	Orange Light Blinking	100 Mb Transferring

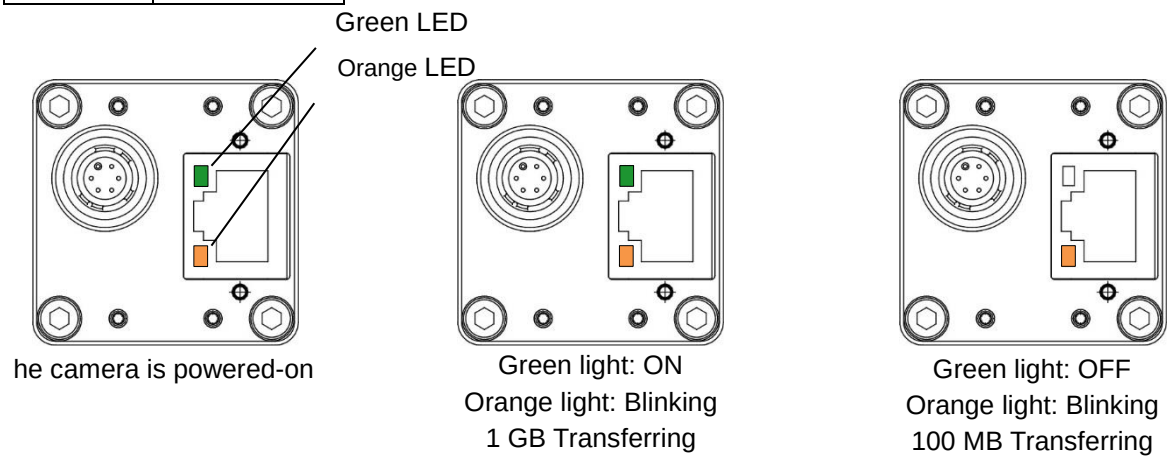


Figure 5: LED Information

Please use a 1GB supported NIC, NetWork Switcher and LAN cable. Check that the NIC and NetWork Switcher being used is "1GB transferring".

3.2 Power and Control Signal Connector

- HR10A-7R-6PB（Hirose）or equivalent
- This connector is for the power supply (12Vdc) and input /output signals.
- Use HR10A-7P-6S (Hirose) or equivalent for the cable side.

Pin No.	Signal Name	IN / OUT	Voltage
1	GND	IN	0V
2	I/O-1	OUT	+3.3V Open Collector
3	I/O-2	OUT	+3.3V Open Collector
4	TRG_In- (Opt. Isolated -)	IN	Low: Smaller than +1.0V High: +3.0 to +26.4V *potential difference between TRG_In- and TRG_In+
5	TRG_In+ (Opt. Isolated +)	IN	
6	POWER IN	IN	+10.8 to +26.4 Vdc

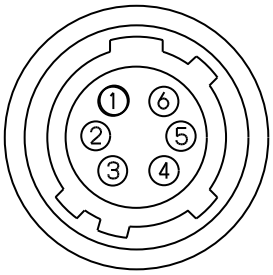


Table 4: Pin Assignment (Power –I/O Connector)

- Output signals can be assigned through the camera setting communication. (Device Code = 00H, Command = F0H and F1H)

Configuration of I/O-1(Pin No.2),I/O-2(Pin No.3)

Output pin can be assigned through register setting or GenICam Command.

Command No.				GenICam command
F0H[3..0]	F1[3]	F0H[7..4]	F1[4]	I/O-1 (Pin No.2) / I/O-2 (Pin No.3)
For I/O-1 (Pin No. 2)		For I/O-2 (Pin No.3)		
0H (initial setting)	-	0H	-	FrameTriggerWait (initial setting for I/O-1)
1H	Set Value	1H	Set Value	UserOutput
2H	-	2H (initial setting)		ExposureActive (initial setting for I/O-2)
3H	-	3H	-	TriggerAuxiliary
4H	-	4H		TriggerInternal
5H	-	5H		SensorReadOut
6H	-	6H		StrobeSignal
7H-FH	-	7H-FH	-	For Test Use Only

Table 5: IO port Command List

※ Note: I/O-1 can be assigned only by F0H[3..0] and F1[3], and I/O-2 can be assigned only by F0H[7..4] and F1[4].

1) FrameTriggerWait

The user can check the camera condition (camera exposure and image output processing by the trigger signal with this FrameTriggerWait signal).
This signal is LOW for the period from the trigger input signal to the image output.

a) High status (3.3V): No processing by the trigger signal. The camera accepts the trigger signal.
b) Low status (0V): The camera is exposed and the image output processes by the trigger signal.

The camera default setting is the input trigger signal is INVALID while at the low status of this signal. When the exposure starts while the image output by the next trigger signal, please change the camera setting (Device code: 00H, Command No. :13H) to accept the trigger signal while the image outputs.
The noise appears on the image when the exposure begins while the image is output. The noise appears on the image when the start exposure while the image is output. In this case, please change the “H reset” for the exposure start mode (Device code: 00H, Command No. : 12H) to change the exposure start point to the next HD timing.

2) UserOutput

The status of the UserOutput signal can change with the “UserOutputValue”.

3) ExposureActive

The user can check the exposure time with the ExposureActive signal.

4) TriggerAuxiliary

The TriggerAuxiliary signal is the input trigger signal.

5) TriggerInternal

The TriggerInternal signal is the input trigger signal with the trigger delay time.

6) SensorReadOut

The SensorReadOut signal is the FVAL signal, which is the image output period of the time.

7) StrobeSignal

The StrobeSignal signal is the strobe control signal.

3.2.1 Equivalent Circuit for the Input Pin of the I/O Connector

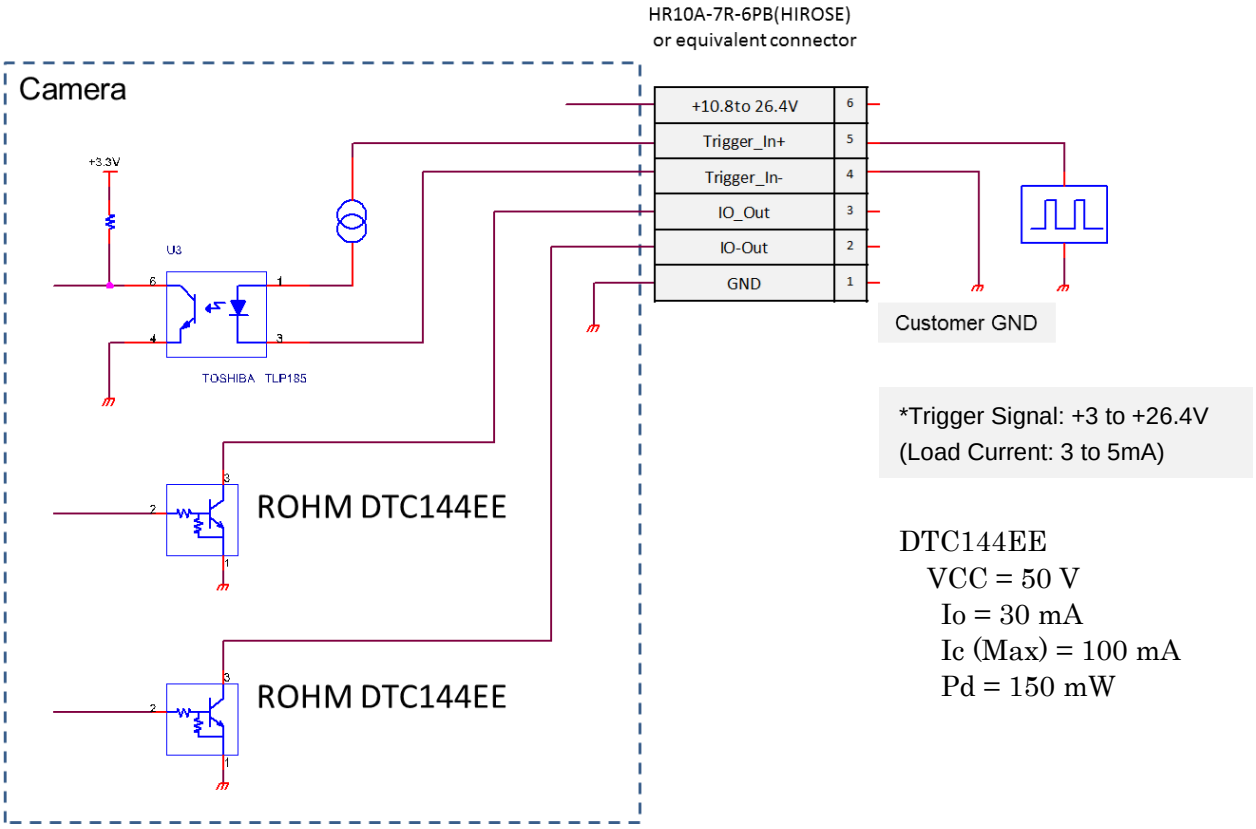
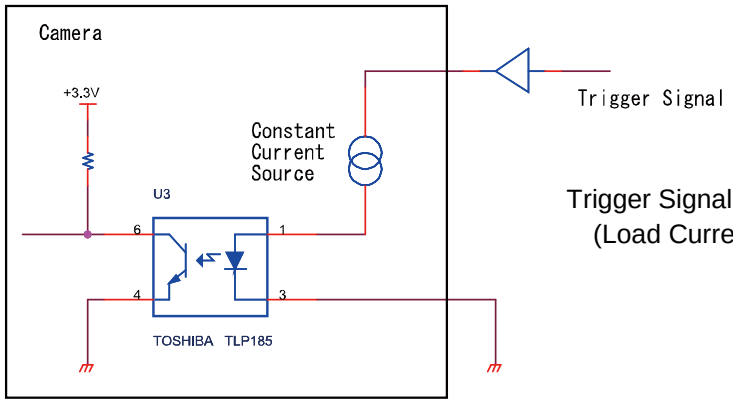


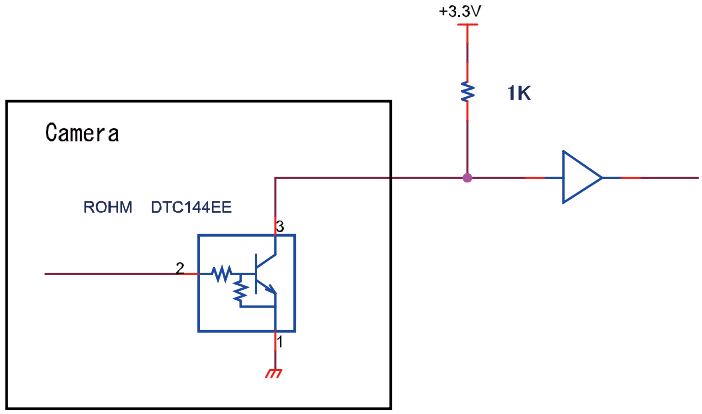
Figure 6: Input / Output Circuit

3.2.2 Typical Input Circuit



Trigger Signal:+3.0 to +26.4V
(Load Current: 3 to 5mA)

3.2.3 Typical Output Circuit

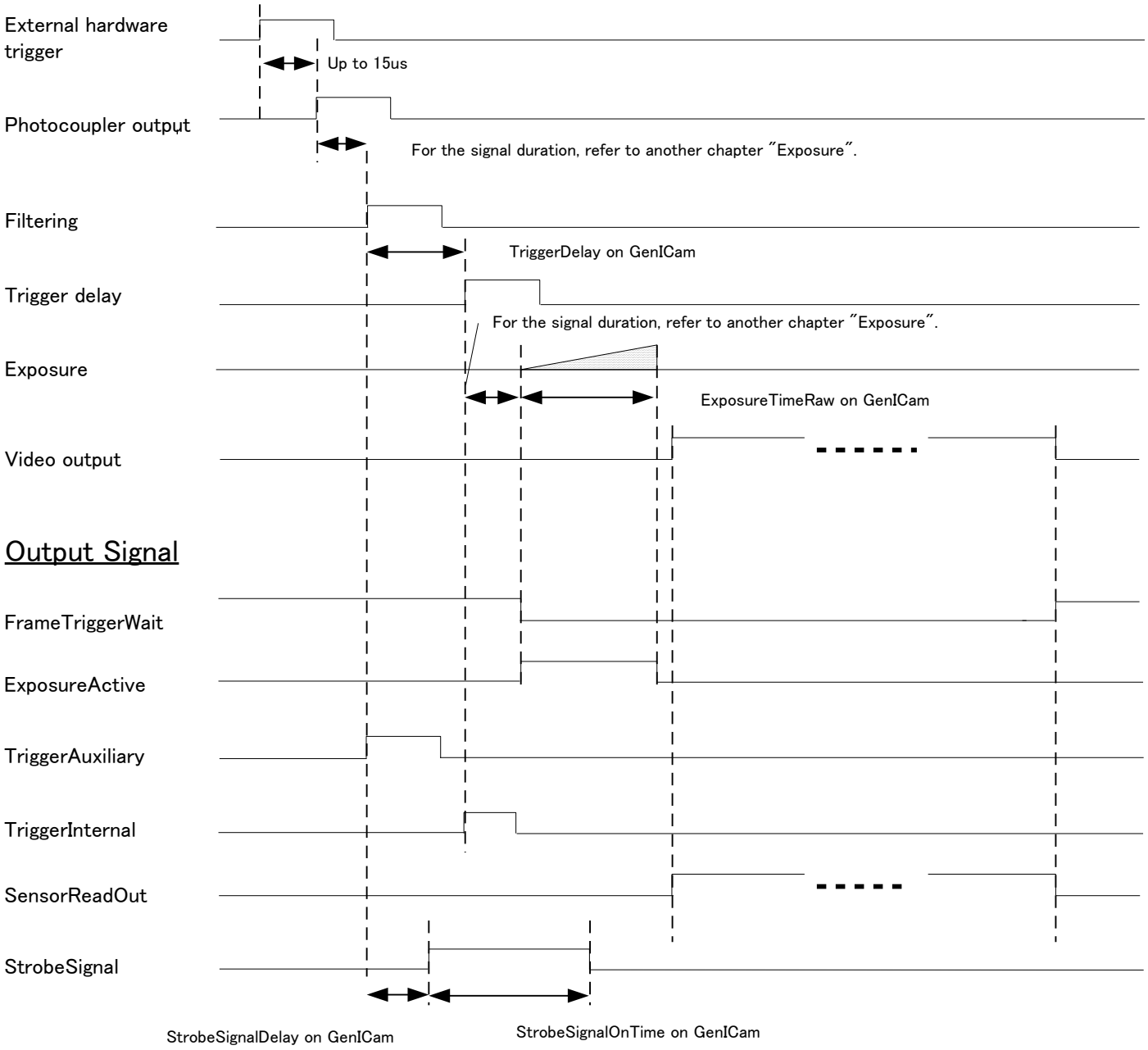


Note;

Value of Vcc and Pull up register can be set within the spec of transistor.

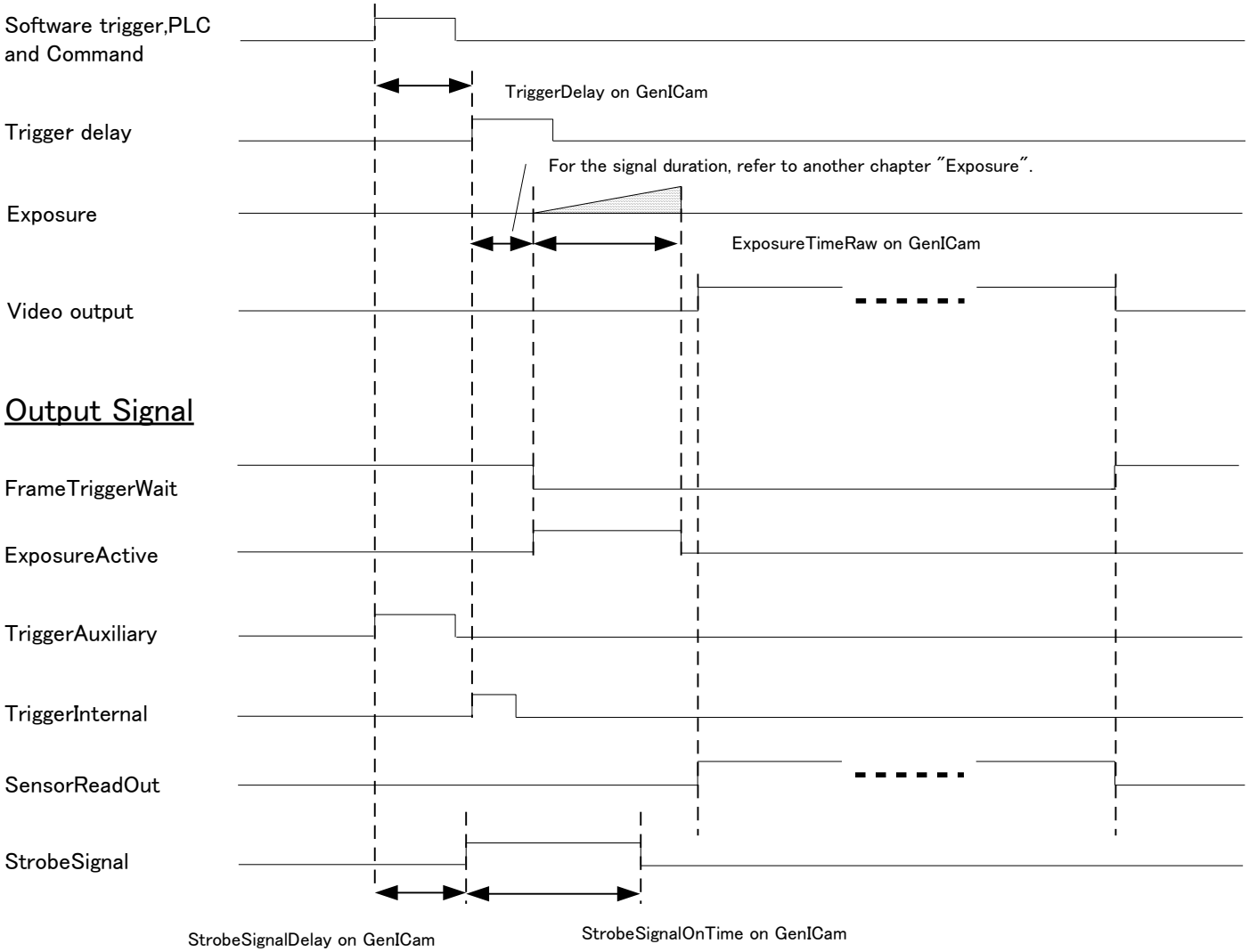
3.2.4 Input and Output Signal Timing (Hardware Trigger)

Case of “External Hardware Trigger”, “Positive Edge Trigger”, “Edge Preset Exposure”,



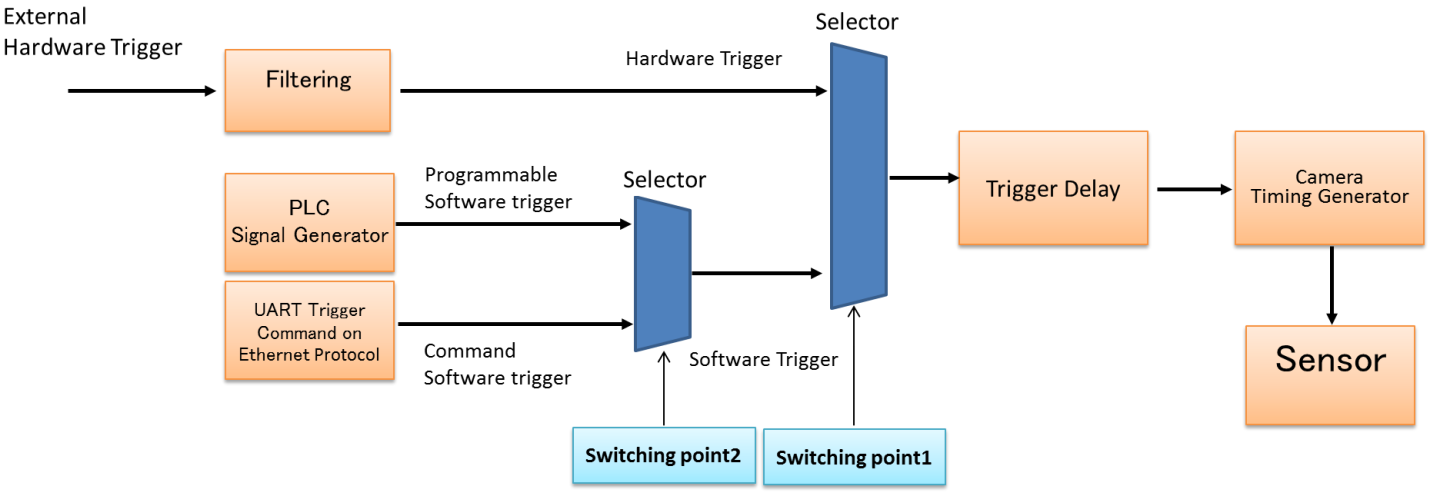
3.2.5 Input and Output Signal Timing (Software Trigger)

Case of “Software Trigger”, “Positive Edge Trigger”, “Edge Preset Exposure”,



3.2.6 Trigger Signal Processing Process

External Hardware Trigger or Software Trigger input the camera's internal process as follows.



Switching Trigger can be done through register access or GenICam commands

Switching point 1 : Switch to Hardware Trigger and Software Trigger

Register: 12H.5=0
Register: 12H.5=1

TriggerSource=Software on GenICam
TriggerSource=Hardware on GenICam

Switching point 2 : Switch to PLC programmable Software trigger and command software trigger

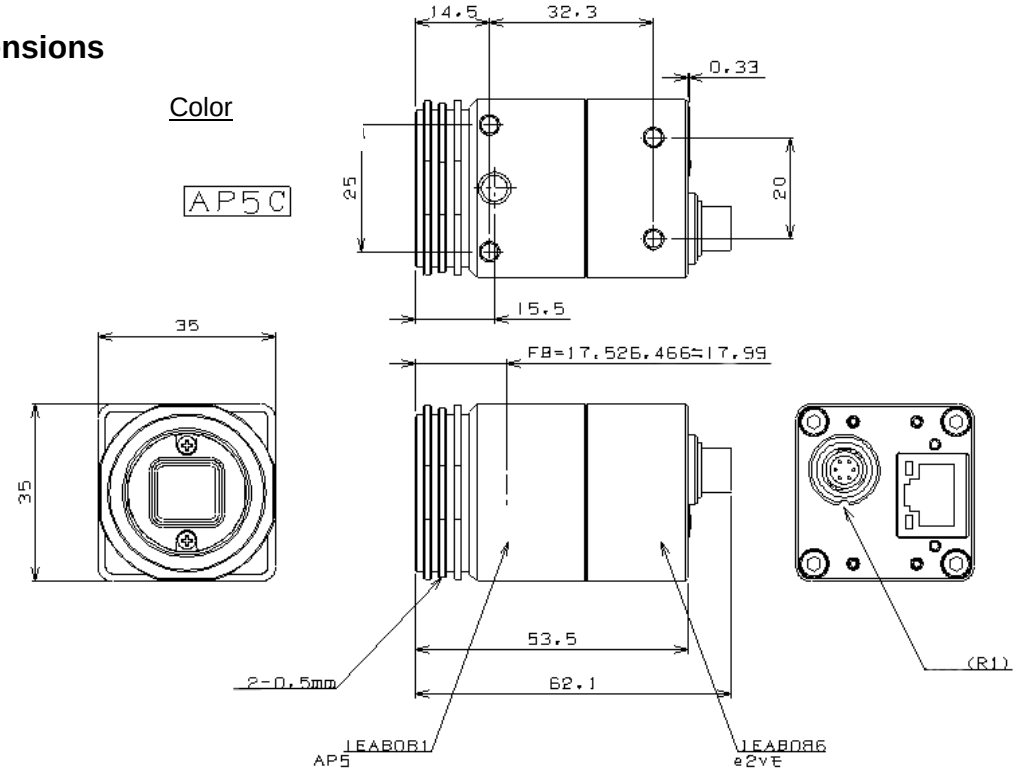
Register: 16H.7-6=00
Register: 16H.7-6=10

GenICam の TriggerSoftwareSource=PLC
GenICam の TriggerSoftwareSource =Command

4 Dimensions

Color

AP5C



Monochrome

AP5M

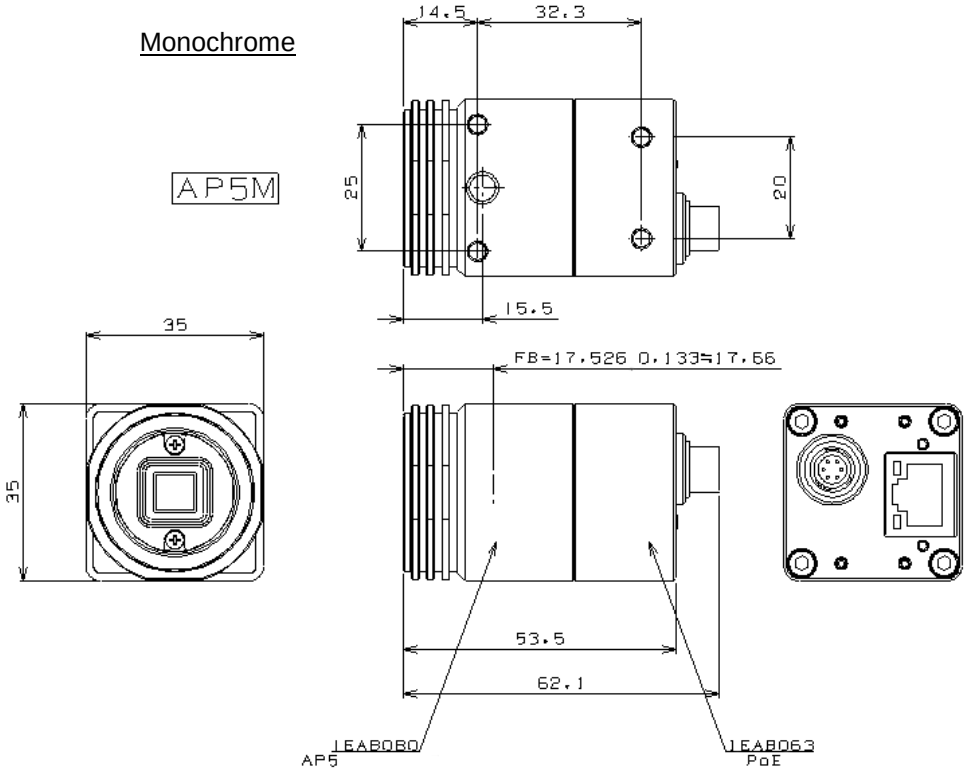


Figure 7: Mechanical Dimensions

5 Camera Output Timing Charts

5.1 Horizontal Timing

[Summary]

Output video image has 2 formats as shown below:

Mono/Bayer Output Mode (Default)

Bayer/Monochrome horizontal 2592 pixels data is output, this is a default setting.

RGB Output Mode(RGB8Packed)

RGB video data for each pixel is outputted. Frame rate would be slower than Mono/Bayer Output Mode for data transfer rate of each pixel is larger than Mono.

[Procedure]

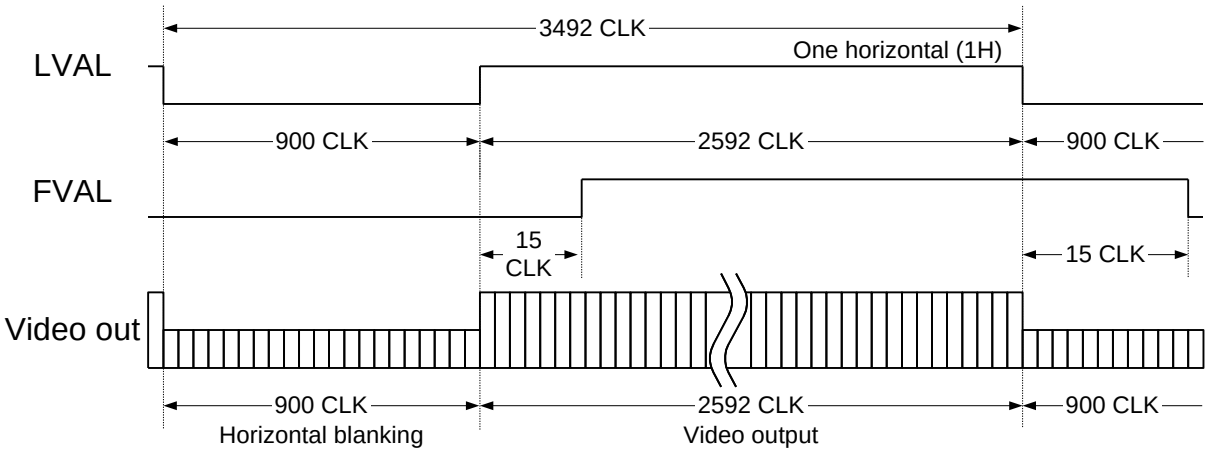
Step	GigEPlayer Category	GenIcam Parameter	Mono/Bayer Output Mode Value(Default)	RGB Output Mode (RGB8Packed) Value
1	ImageFormatControl	SensorDigitizationTaps	2	1

For further information on GenIcam commands, please refer to the Section ”7.5GenICam Command / Camera Command Reference Table”.

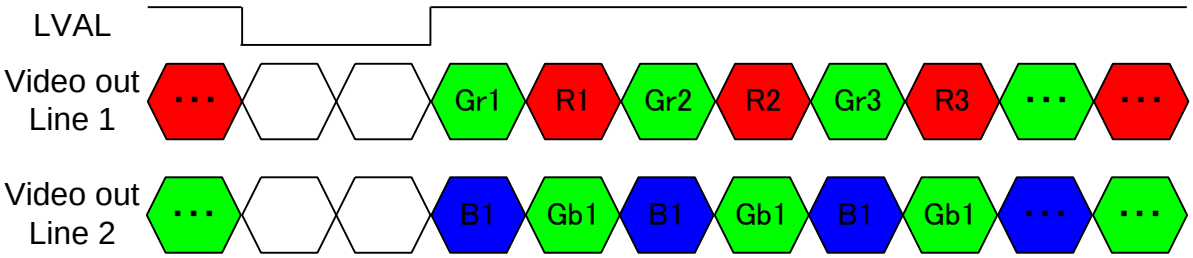
5.2 Horizontal Timing

5.2.1 Horizontal Timing(STC-SCA503POE,STC-SBA503POE)

1 CLK = 10.4167 nseconds(STC-SBA503POE, STC-SCA503POE on Bayer)
1 CLK = 19.3939 nseconds(STC-SCA503POE on RGB)



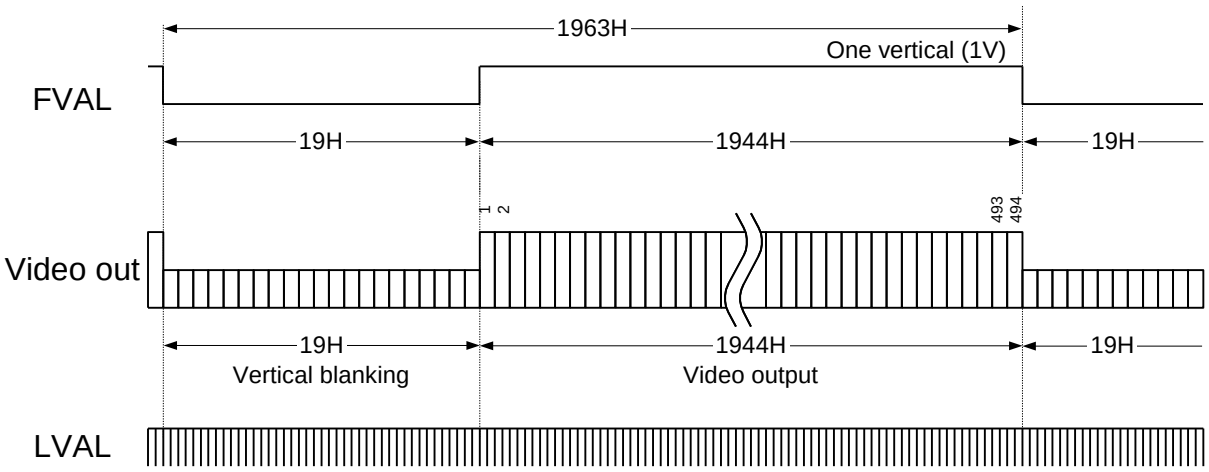
5.2.2 Color Bayer Order (This information is only for STC-SCA503POE)



5.3 Vertical Timing

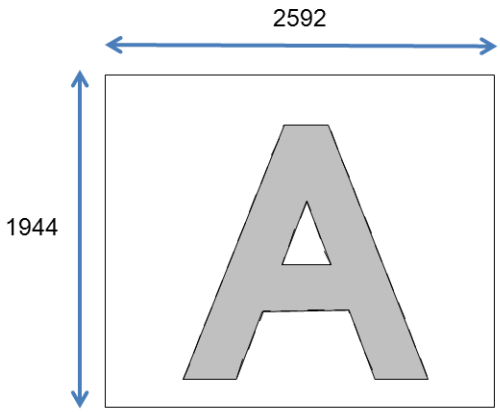
5.3.1 Full Scanning(STC-SCA503POE,STC-SBA503POE)

STC-SBA503POE/STC-SCA503POE of Bayer:
1 H = 36.3750 μseconds, 14 fps
STC-SCA503POE of RGB:
1 H = 67.7236 μseconds, 7.5 fps



5.3.2 Binning Mode

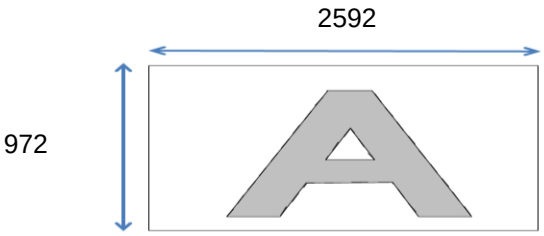
Binning OFF: BinningVertical = 1, BinningHorizontal = 1
A full resolution (2592x1944) images are output. The default frame rate is 14fps



Binning Vertical 1/2: BinningVertical = 2, BinningHorizontal = 1

The width is full resolution, and approximately 1/2 of the height of the "Normal" image is output (2592x972). The image becomes the center portion of the "Binning" image. The Binning's frame rate is about **23**fps

*Note: Sensitivity may not increase on Vertical.



Binning Vertical 1/4: BinningVertical = 4, BinningHorizontal = 1

The width is full resolution, and approximately 1/4 of the height of the "Normal" image is output (2592x486). The image becomes the center portion of the "Binning" image. The Binning's frame rate is about 35fps

*Note: Sensitivity may not increase on Vertical.

Horizontal Binnig

Added the beside pixel value are outputted on horizontal direction.

*Note:Sensitivity may increase on Horizontal.

Resolution	FPS	Setting
1296 x 1944	About 23	BinningVertical = 1, BinningHorizontal = 2

5.3.3 Decimation(Skipping)

Vertical Decimation(Skipping)

Decimated vertical line images are output.

Resolution	FPS	Setting
2592 x 972	About 28	DecimationVertical = 2
2592 x 648	About 42	DecimationVertical = 3
2592 x 486	About 55	DecimationVertical = 4
2592 x 388	About 69	DecimationVertical = 5
2592 x 324	About 82	DecimationVertical = 6
2592 x 276	About 96	DecimationVertical = 7

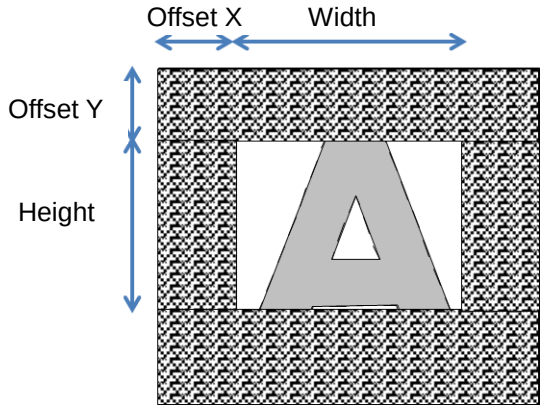
Horizontal Decimation(Skipping)
Decimated horizontal pixels are output.

Resolution	FPS	Setting
1296 x 1944	About 22	DecimationHorizontal = 2
864 x 1944	About 28	DecimationHorizontal = 3
648 x 1944	About 32	DecimationHorizontal = 4
512 x 1944	About 35	DecimationHorizontal = 5
432 x 1944	About 37	DecimationHorizontal = 6
368 x 1944	About 39	DecimationHorizontal = 7

*Note1: When Horizontal/Vertical Binning are selected,capable Decimation(Skipping) numbers exist.
e.g.)
BinningHorizontal = 2 => DecimationHorizontal = 2 #1,3,4,5,6,7 cannot be selected
BinningVertical = 2 => DecimationVertical = 2 #1,3,4,5,6,7 cannot be selected

5.3.4 AOI

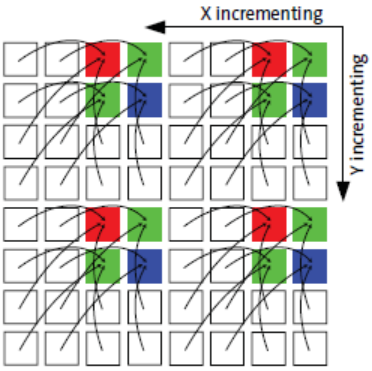
You can set your desired width and height to extract only the desired portion of the image. Use "Offset X" to set the horizontal cutoff starting point. The setting range is 0 to 2560. Use "Width" to set the number of pixels for the horizontal cutoff. The setting range is 32 to 2592. Use "Offset Y" to set the vertical cutoff starting line. The setting range is 0 to 1912. 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 2 lines in the vertical direction, and 8 pixels in the horizontal directions. The frame rate changes according to the image size.



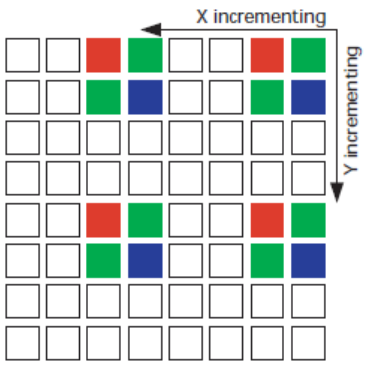
It is possible to set the binning (*1), Decimation (*2), or both for the extracted image. Use "Binning/ Decimation H" and "Binning/ Decimation V" to set the combination of binning and decimation in the horizontal and vertical directions.

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: vertical binning can be set to 1/2 and 1/4.and horizontal binning can be set to 1/2. 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.
*2: For Decimation, 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.



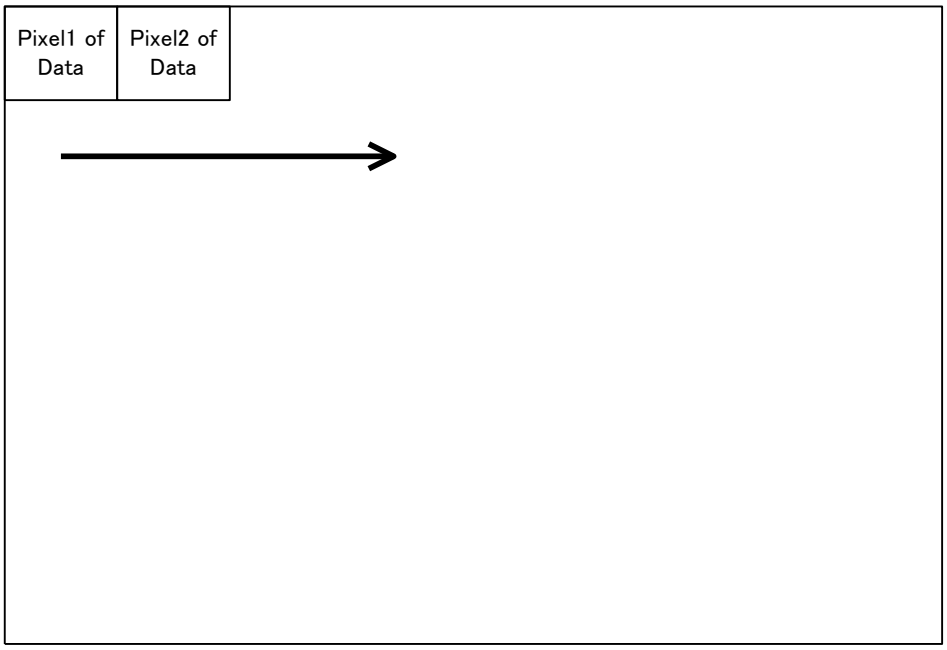
1/2 Horizontal Binning and 1/2 Vertical Binning



1/2 Horizontal Decimation and 1/2 Vertical Decimation

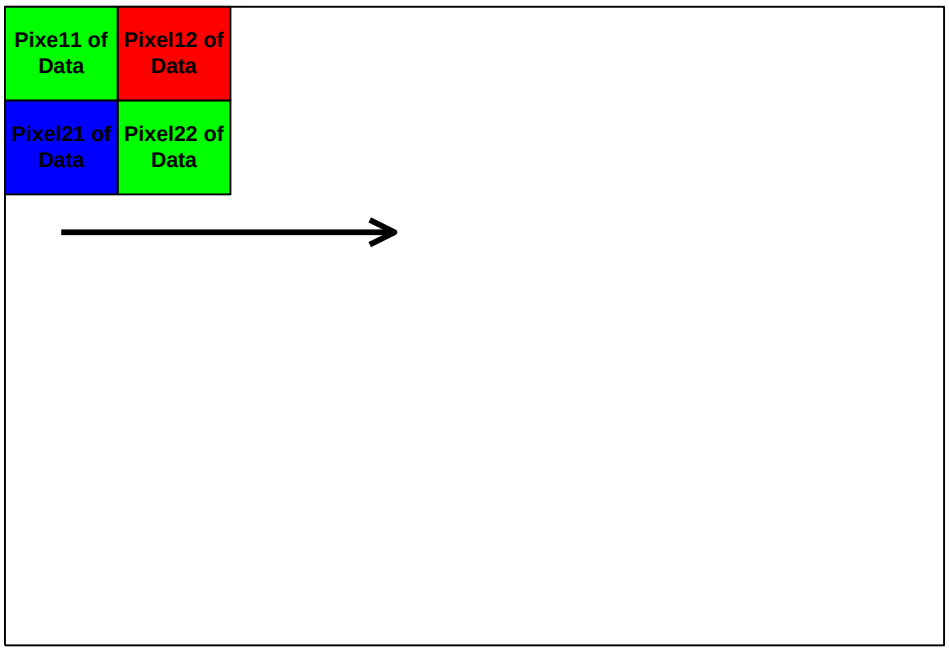
5.4 Pixel Transferring Image

STC- SBA503POE (Monochrome)



Pixel (n) of Data: nth pixel being transferred

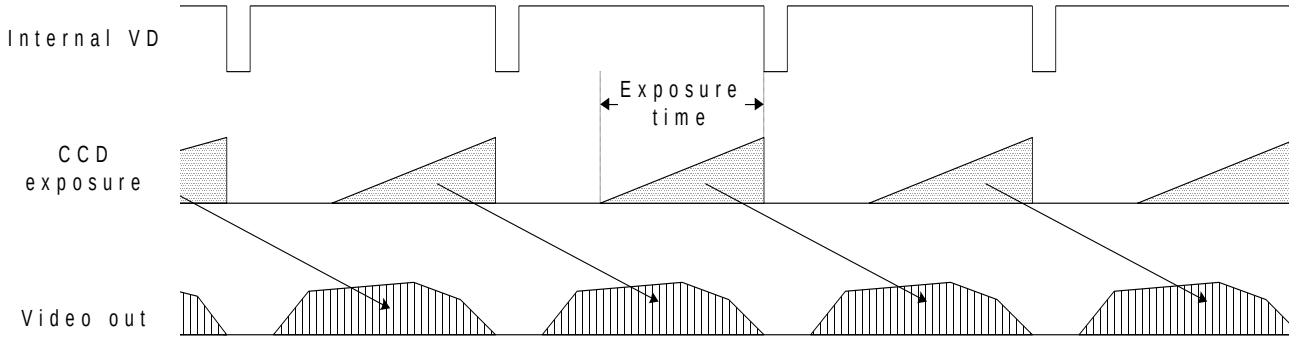
STC- SCA503POE (Color)



Pixel (m,n) of Data: nth pixel of the mth line being transferred

6 Camera Operational Modes

6.1 Normal Mode(triggerMode=Off)

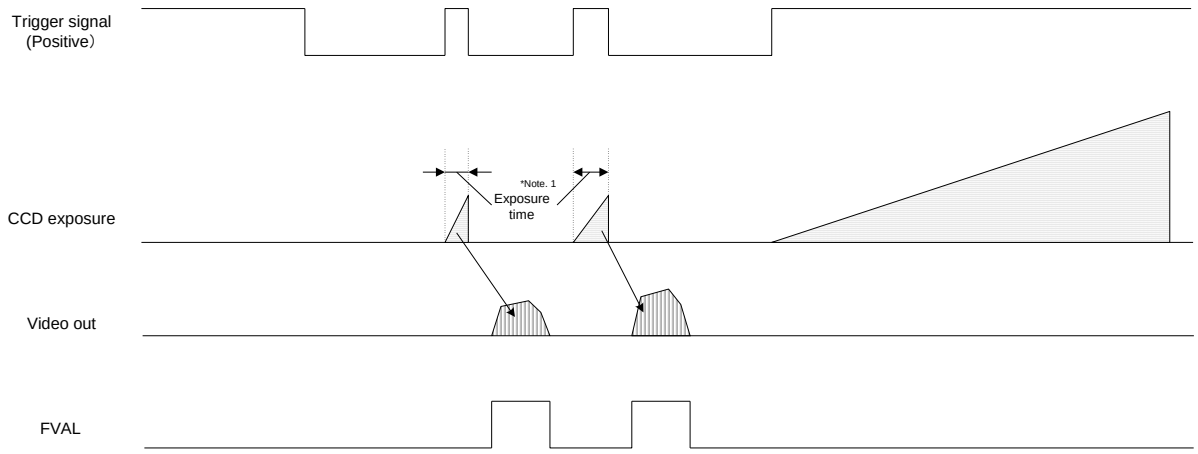


6.2 Pulse width trigger mode(ExposureMode=TriggerWidth)

In this trigger mode with positive polarity, the camera exposure starts at the rising edge of the trigger pulse and stops at the falling edge of the trigger pulse. Therefore, if positive polarity exposure is selected, the exposure periods are the high states of the trigger pulse.

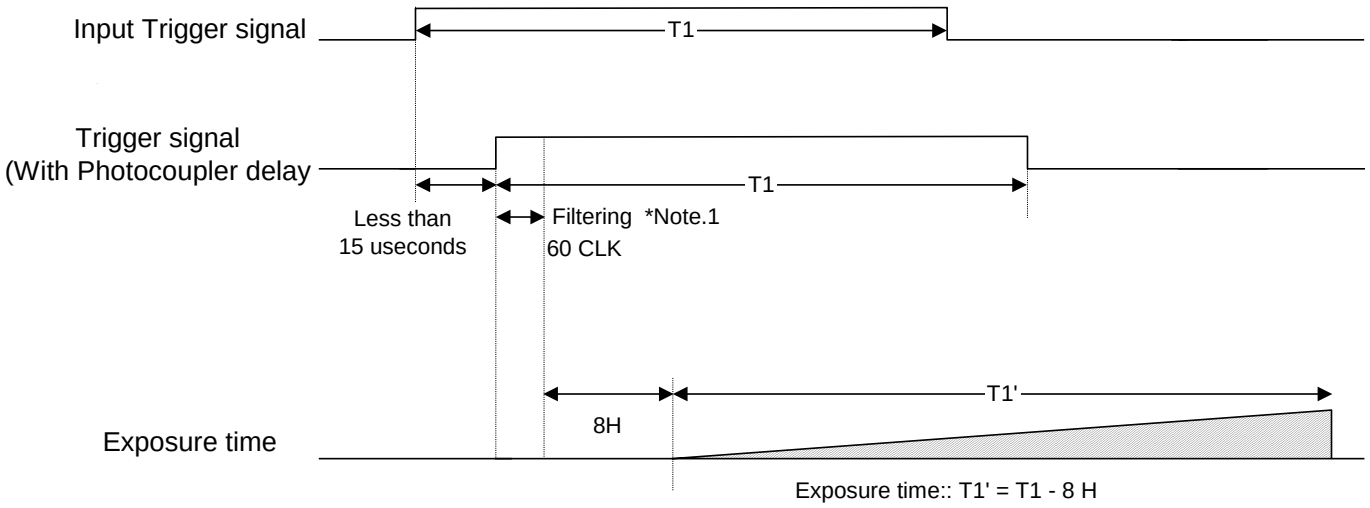
*Note: When set TriggerMode=Off under TriggerMode=On,ExposureMode=TriggerWidth, please set ExposureMode=Timed at first, and after that set TriggerMode=Off.

6.2.1 Timing



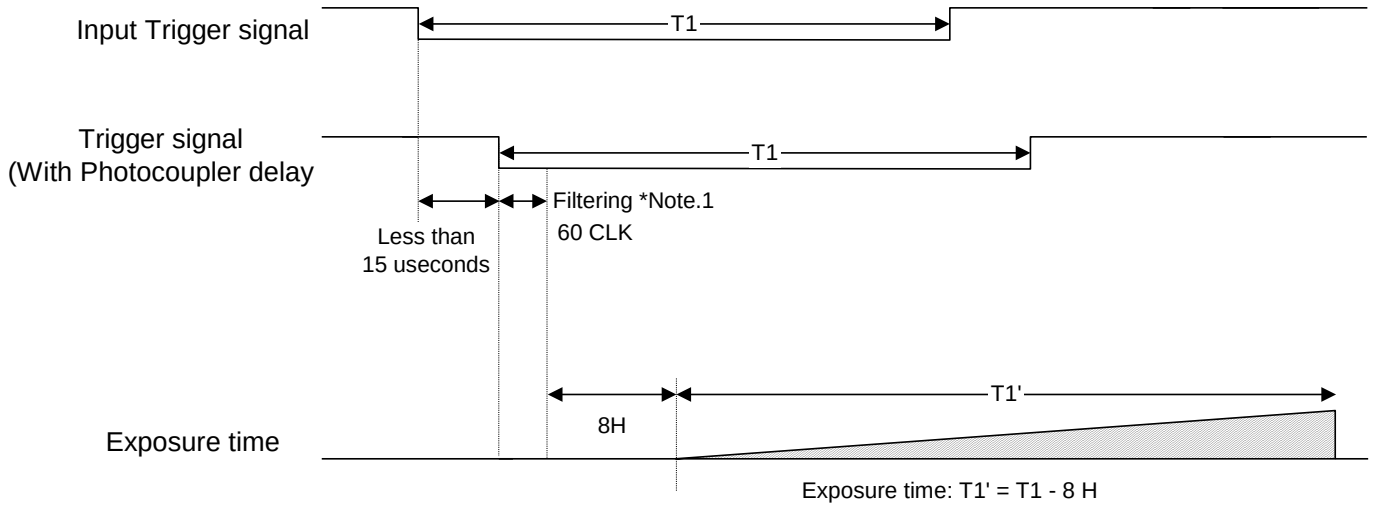
*Note 1: The FVAL signal does not output when the exposure by the trigger signal does not exist.

6.2.2 Exposure Timing with the Positive Polarity Trigger Signal



Note 1: The trigger signal will be removed by the filtering if the pulse width of the input trigger signal is less than 60 CLK. Please input a trigger signal with more than 61 CLK pulse width.
Note 2: The exposure will start 8H after the rising edge of the trigger signal.

6.2.3 Exposure Timing with the Negative Polarity Trigger Signal



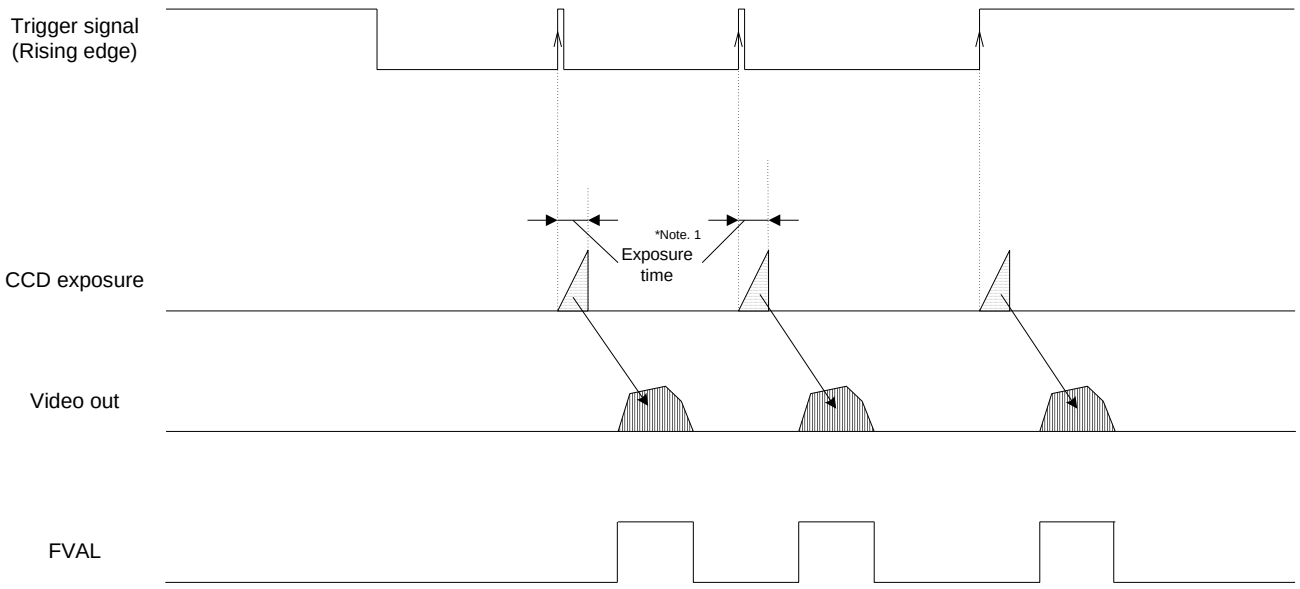
Note 1: The trigger signal will be removed by the filtering if the pulse width of the input trigger signal is less than 60 CLK. Please input a trigger signal with more than 61 CLK pulse width.
Note 2: The exposure will start 8H after the rising edge of the trigger signal.

6.3 Edge Preset Trigger Mode(ExposureMode=Timed)

In this “edge preset trigger mode”, the camera exposure starts at the rising edge of the trigger signal like the “pulse width trigger mode” in the previous sections. However, in this mode, the exposure duration time is based on the preset

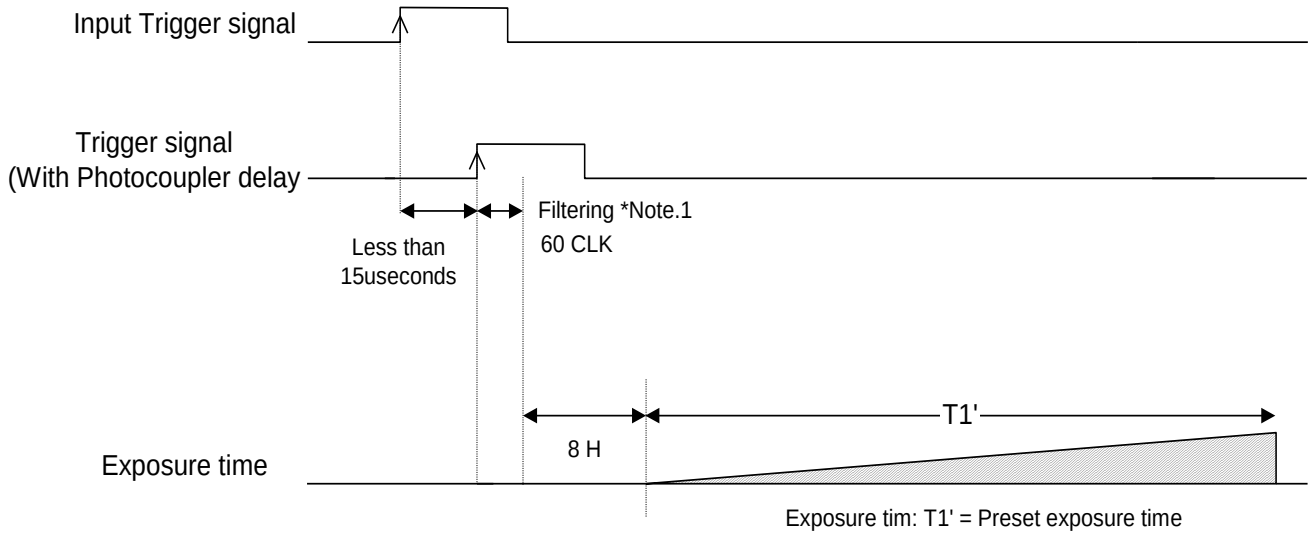
value stored by the by the camera setting communication.

6.3.1 Timing



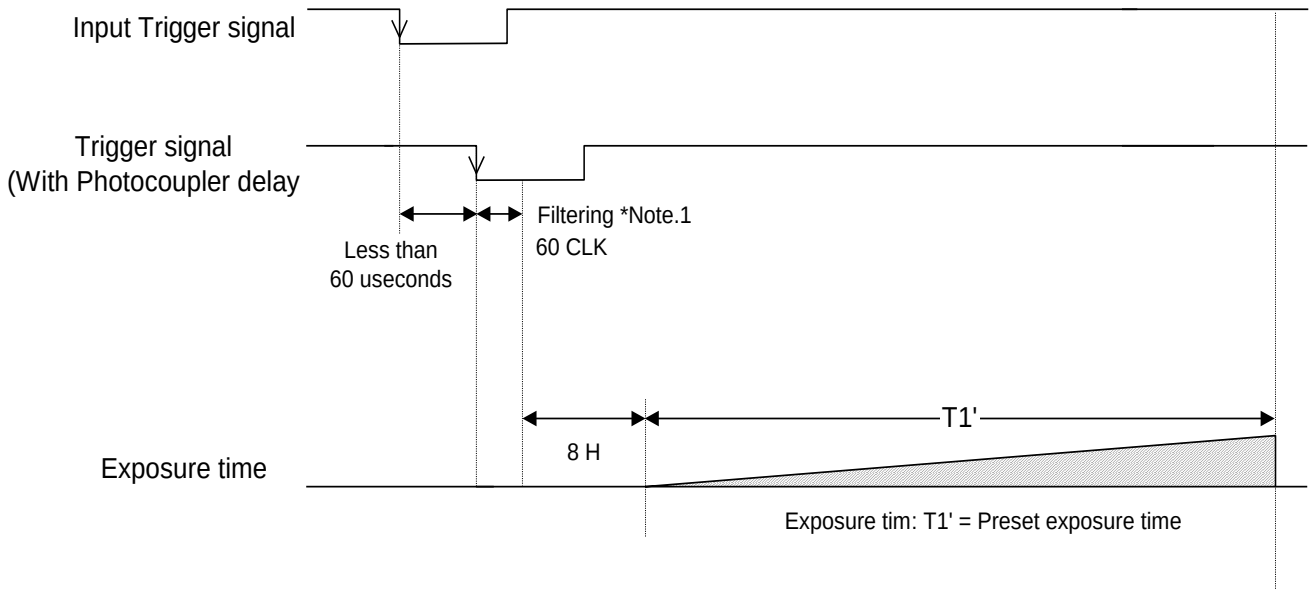
Note 1: The exposure time is set by the preset electronic shutter speed.

6.3.2 Exposure Timing with the Positive Polarity Trigger Signal



Note 1: The trigger signal will be removed by the filtering if the pulse width of the input trigger signal is less than 60 CLK. Please input a trigger signal with more than 61 CLK pulse width.
Note 2: The exposure will start 8H after the rising edge of the trigger signal.

6.3.3 Exposure Timing with the Negative Polarity Trigger signal



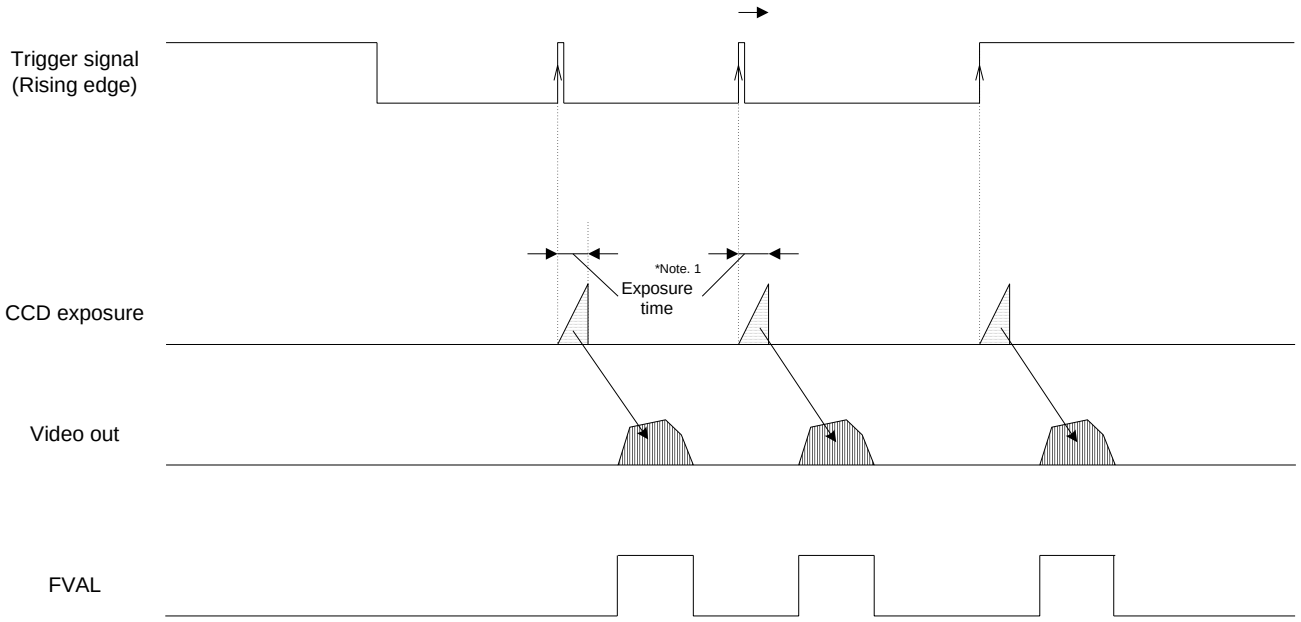
Note 1: The trigger signal will be removed by the filtering if the pulse width of the input trigger signal is less than 60 CLK. Please input a trigger signal with more than 61 CLK pulse width.
Note 2: The exposure will start 8H after the rising edge of the trigger signal.

6.4 Edge Preset Trigger Mode (Trigger Input While the Image Is Out)

In this trigger mode, the camera exposure starts at the rising edge of the trigger pulse.
If trigger signal input is required while the image is out, then it is necessary to disable the trigger signal mask with

the communication.
To avoid generating additional noise on the image, it is necessary to set the “H reset” at the exposure start mode.

6.4.1 Timing

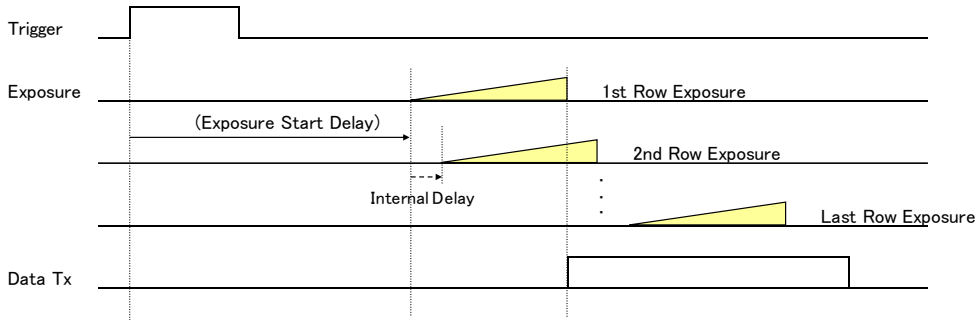


Note 1: The exposure time is set by the preset electronic shutter speed.

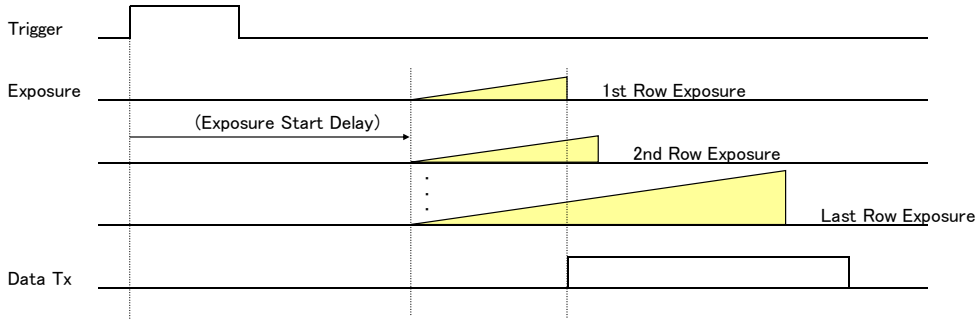
6.5 CMOS Rest Type

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 EdgePreset) Note:This function works on Trigger-mode



*Note1: When changing this CMOS reset type, please set the free-run mode(TriggerMode=Off) at first. If not, image may not come up.

7 Communication Protocol

This camera has a communication function that enables external devises, such as a PC, to control the camera's functions.
Please use the "StCamGigEWare" communication software, or the following communication protocol to communicate to the camera:

7.1 Communication Method

UART (RS232C), binary communication

7.2 Communication Settings

	Settings
Baud Rate	115,200 bps
Data Bit	8 bit
Parity	None
Stop Bit	1 bit
Flow Control	None

7.3 Communication Format

The format for sending data from the PC to the camera is as follows:

SOF	Device Code	Read/Write	Page Selection	Command Code	Data Length	Data	EOF
(8bit)	(6bit)	(1bit)	(1bit)	(8bit)	(8bit)	(R: 1 byte) (W: n bytes)	(8bit)

The format for receiving data from the camera is as follows:

- After the Read command has been sent:

SOF	Data Length	Data	EOF
(8bit)	(8bit)	(n bytes)	(8bit)

- After the Write command has been sent:

SOF	Data Length	Receiving Code	EOF
(8bit)	(8bit) "00"	(1 byte)	(8bit)

The description of the format is as follows:

Name	Descriptions
SOF	Start of Frame. Always set or receive the value as “02H”
Device Code	This indicates the destination of communication. Set “000000” when accessing the camera’s function settings Set “100000” when accessing the camera’s extended function settings. Please refer to the “Camera Command List” and “Description of the Camera Control Commands” for further information.
Read / Write	This specifies “Read” or “Write” to command numbers. Set (or receive) “0” to send the read command. Set (or receive) “1” to send the write command.
Page Selection	This specifies page selection (access selection to registers or EEPROM) of command. Set “0” to access the command register of the camera. Read command: To obtain the current data from the command register. Write command: To set a data into the command register. The previously stored data is replaced by this data. However, the data in the EEPROM is not replaced. Set ”1” to access the EEPROM of the camera. Read command: To read stored data from the EEPROM. Write command: To store data into the EEPROM as default value. The camera returns the receiving code “01H” to the PC after storing data in the EEPROM.
Command Code	This indicates the contents of the data sent or received. Refer to the following page for the details.
Data Length	This indicates the data length (unit: byte). Receiving Frame: The data length is dependent on each read command sent. The data length is defined as “00H” when sending the write command. The data length of error response is defined as “00H”. Sending frame: The data length is 1 byte dummy data when sending the read command, and that data is not referenced. The data length is dependent on each “write command” sent.
Data	This indicates write data or read data according to command type.
EOF	End of Frame. Always set or receive the value as “03H”
Receiving Code	This indicates results of the command sent 01H: OK (ACK), 10H: NG (NAC), 12H: Command number error (Not matching), 13H: Communication frame error (only for Gamma data upload), 14H: Time out error (Two seconds), 15H: Check sum error (only for Gamma data upload), 16H: Data length error (Not matching), 17H: EEPROM write error

【Example Code】Reading the data from the command 00H

- ✧ Command to send: 02H, 00H, 00H, 01H, 00H, 03H

SOF	Device Code	Read/Write	Page Selection	Command Code	Data Length	Data	EOF
(8bit)	(6bit)	(1bit)	(1bit)	(8bit)	(8bit)	(1byte)	(8bit)
02H	**00H**			**00H**	**01H**	**00H**	**03H**

✧ Command to receive upon a successful communication: 02H, 01H, 00H, 03H (assuming the data is 00H)

SOF	Data Length	Data	EOF
(8bit)	(8bit)	(n bytes)	(8bit)
02H	**01H**	**00H**	**03H**

【Sequence for the saving commands to the EEPROM】

Please use the following sequence for saving the commands to the EEPROM.

1) Set “1” to the 80H.0 to enable writing to the EEPROM.

2) Send the save data with the page selection “1”.

3) The camera sends back one of the following receiving codes after writing the EEPROM.
01H: OK
17H: EEPROM write error

4) 80.0H is cleared to “0” automatically after writing the EEPROM.

Note1: The data cannot be saved to the EEPROM when 80H.0 is “0”.

Note2: When saving the consecutive sequence of commands, the above steps, 1) to 4), are necessary only once.

i.e.) saving the commands “10H, 11H, 12H, 13H”, or “22H, 23H, 24H”, etc.

Note3: When saving the non-consecutive sequence of commands, the above steps, 1) to 4), are necessary for the same number of times.

i.e.) saving the commands “10H, 13H, 19H, 1BH” or “20H, 23H, 25H”, etc.

7.4 Camera Control Command

- ✧ **The data unit of the each command is 1 byte (8bit).**
- ✧ **The data can be saved to the EEPROM if there is an "X" in the "Save to EEPROM" column in the following list.**
- ✧ **The camera initializes based on the stored data in the EEPROM when the power is applied.**

7.4.1 Camera Command List (Device Code: 000000)

Device Code = 000000					
Command No.	**R/W**	**Save to EEPROM**	**Function**	**Initial Data**	**Data Range**
00 to 0FH			*reserved*	-	-
10H	R/W	x	*camera function mode 1 (8bit: D[7..0])*	10H	
11H	R/W	x	*camera function mode 2 (8bit: D[7..0])*	08H	
12H	R/W	x	*camera function mode 3 (8bit: D[7..0])*	40H	
13 to 14H			*reserved*	-	
15H	R/W	x	*camera function mode 4 (8bit: D[7..0])*	09H	-
16H	R/W	x	*software trigger mode (8bit: D[7..0])*	80H	
17H	R/W	x	*image data reset (8bit: D[7..0])*	00H	
18H			*reserved*	-	-
19H	R/W	x	*image output format (8bit: D[7..0])*	00H	
1A to 1FH			*reserved*	-	-
20H	R/W	x	*exposure time (us) of the electronic shutter (24bit: D[7..0])*	71113	32 to 16,777,215
21H	R/W	x	*exposure time (us) of the electronic shutter (24bit: D[15..8])*		
22H	R/W	x	*exposure time (us) of the electronic shutter (24bit: D[24..16])*		
23 to 2FH			*reserved*	-	-
30H	R/W	x	*CMOS analog gain and Digital gain (8bit: D[7..0])*	0	0 to 40
31H	R/W	x	*digital gain (8bit: D[7..0])*	00H	0 to 255
32H			*reserved*	-	-
33 to 37H			*reserved*	-	-
38H	R/W	x	*Black level (8bit: D[7..0])*	20H	0 to 31
39 to 3DH			*reserved*	-	-
3EH	R/W	x	*white clip for the test pattern (16bit: D[15..8])*	4,095	0 to 4,095
3FH	R/W	x	*white clip for the test pattern (16bit: D[7..0])*		
40H			*reserved*	-	-
41H	R/W	x	Aptina5M ROW COLUMN Decimation (8bit：D[7..0])		
42 to 4FH			*reserved*	-	-
50H	R/W	x	*trigger delay time (us) (Integer) (24bit: D[7..0])*	0	0 to 2,000,000
51H	R/W	x	*trigger delay time (us) (Integer) (24bit: D[15..8])*		
52H	R/W	x	*trigger delay time (us) (Integer) (24bit: D[23..16])*		
53H	R/W	x	*trigger delay time (us) (Decimal) (8bit: D[7..0])*		
54H	R/W	x	*strobe signal delay time (us) (Integer) (24bit: D[7..0])*	0	0 to 2,000,000
55H	R/W	x	*strobe signal delay time (us) (Integer) (24bit: D[15..8])*		
56H	R/W	x	*strobe signal delay time (us) (Integer) (24bit: D[23..16])*		
57H	R/W	x	*strobe signal delay time (us) (Decimal) (8bit: D[7..0])*		

Device Code = 000000					
Command No.	**R/W**	**Save to EEPROM**	**Function**	**Initial Data**	**Data Range**

58H	R/W	x	*frame rate (Hz) (Integer) (16bit: D[7..0])*	14. 00000	6.88835 to 366
59H	R/W	x	*frame rate (Hz) (Integer) (16bit: D[15..8])*		
5AH	R/W	x	*frame rate (Hz) (Decimal) (24bit: D[7..0])*		
5BH	R/W	x	*frame rate (Hz) (Decimal) (24bit: D[15..8])*		
5CH	R/W	x	*frame rate (Hz) (Decimal) (24bit: D[23..16])*		
5DH	R/W	x	*I/O signal polarity (8bit: D[7..0])*	00H	
5EF			*reserved*	-	-
5FH			*reserved*		
60 to 67H			*reserved*	-	-
68H	R/W	x	*digital clamp (8bit: D[7..0])*	00H	
69H			*reserved*	-	-
6AH	R/W	x	*manual digital clamp (left) (16bit: D[7..0])*	00H	0 to 1,023
6BH	R/W	x	*manual digital clamp (left) (16bit: D[15..8])*		
6CH	R/W	x	*manual digital clamp (right) (16bit: D[7..0])*	00H	0 to 1,023
6DH	R/W	x	*manual digital clamp (right) (16bit: D[15..8])*		
6E-77H			*reserved*	-	-
78H	R/W	x	*test pattern selection (8bit: D[7..0])*	00H	
79H	R/W	x	*image effect selection (8bit: D[7..0])*	00H	
7A to 7FH			*reserved*	-	-
80H	R/W		*EEPROM control (8bit: D[7..0])*	00H	
81 to 8FH			*reserved*	-	-
90H	R/W	x	*strobe signal active time (us) (Integer) (24bit: D[7..0])*	10	0 to 2,000,000
91H	R/W	x	*strobe signal active time (us) (Integer) (24bit: D[15..8])*		
92H	R/W	x	*strobe signal active time (us) (Integer) (24bit: D[23..16])*		
93H	R/W	x	*strobe signal active time (us) (Decimal) (8bit: D[7..0])*		
94 to EFH			*reserved*	-	-
F0H	R/W	x	*signals of the power-/IO connector (8bit: D[7..0])*	20H	
F1H	R/W	x	*user output signal for the power-I/O connector (8bit: D[7..0])*	00H	
F2 to FFH			*reserved*	-	-

7.4.2 Camera Command List (Device Code: 100000)

Device Code = 100000					
Command No.	**R/W**	**Save to EEPROM**	**Function**	**Initial Data**	**Data Range**
00 to 1FH			*reserved*	-	-
20H	R/W	x	*exposure mode (8bit: D[7..0])*	00H	
21H	R/W	x	*AGC maximum limit (8bit: D[7..0])*	40	0 to 40
22H			*reserved*	-	-

23H	R/W	x	*upper limit of the auto electronic shutter (20bit: D[7..0])*	16,777,215	32 to 16,777,215
24H	R/W	x	*upper limit of the auto electronic shutter (20bit: D[15..8])*		
25H	R/W	x	*upper limit of the auto electronic shutter (20bit: D[20..16])*		
26H	R/W	x	*lower limit of the auto electronic shutter (20bit: D[7..0])*	32	32 to 16,777,215
27H	R/W	x	*lower limit of the auto electronic shutter (20bit: D[15..8])*		
28H	R/W	x	*lower limit of the auto electronic shutter (20bit: D[20..16])*		
29H	R/W	x	*weight1 for ALC (8bit: D[7..0])*	11H	D3 to D0: 0 to 15 D7 to D4: 0 to 15
2AH	R/W	x	*weight2 for ALC (8bit: D[7..0])*	11H	
2BH	R/W	x	*weight3 for ALC (8bit: D[7..0])*	1AH	
2CH	R/W	x	*weight4 for ALC (8bit: D[7..0])*	11H	
2DH	R/W	x	*weight5 for ALC (8bit: D[7..0])*	01H	D3 to D0: 0 to 15 D7 to D4: 0
2EH	R/W	x	*target brightness for ALC (8bit: D[7..0])*	128	0 to 255
2FH	R/W	x	*ALC peak-average (8bit: D[7..0])*	0	0 to 255
30H	R/W	x	*vertical_1 position for the ALC weight area (16bit: D[7..0])*	32	0 to 1943
31H	R/W	x	*vertical_1 position for the ALC weight area (16bit: D[15..8])*		
32H	R/W	x	*vertical_2 position for the ALC weight area (16bit: D[7..0])*	680	0 to 1943
33H	R/W	x	*vertical_2 position for the ALC weight area (16bit: D[15..8])*		
34H	R/W	x	*vertical_3 position for the ALC weight area (16bit: D[7..0])*	1264	0 to 1943
35H	R/W	x	*vertical_3 position for the ALC weight area (16bit: D[15..8])*		
36H	R/W	x	*vertical_4 position for the ALC weight area (16bit: D[7..0])*	1912	0 to 1943
37H	R/W	x	*vertical_4 position for the ALC weight area (16bit: D[15..8])*		
38H	R/W	x	*horizontal_1 position for the ALC weight area (16bit: D[7..0])*	36	0 to 2591
39H	R/W	x	*horizontal_1 position for the ALC weight area (16bit: D[15..8])*		
3AH	R/W	x	*horizontal_2 position for the ALC weight area (16bit: D[7..0])*	900	0 to 2591
3BH	R/W	x	*horizontal_2 position for the ALC weight area (16bit: D[15..8])*		
3CH	R/W	x	*horizontal_3 position for the ALC weight area (16bit: D[7..0])*	1692	0 to 2591
3DH	R/W	x	*horizontal_3 position for the ALC weight area (16bit: D[15..8])*		
3EH	R/W	x	*horizontal_4 position for the ALC weight area (16bit: D[7..0])*	2556	0 to 2591
3FH	R/W	x	*horizontal_4 position for the ALC weight area (16bit: D[15..8])*		
40H	R/W	x	*white balance mode (8bit: D[7..0])*	00H	
41H	R/W	x	*preset_1 white balance (Red gain) (8bit: D[7..0])*	0	0 to 255
42H	R/W	x	*preset_1 white balance (Gr gain) (8bit: D[7..0])*	0	0 to 255
43H	R/W	x	*preset_1 white balance (Blue gain) (8bit: D[7..0])*	0	0 to 255
44H	R/W	x	*preset_1 white balance (Gb gain) (8bit: D[7..0])*	0	0 to 255
45H	R/W	x	*preset_2 white balance (Red gain) (8bit: D[7..0])*	0	0 to 255
46H	R/W	x	*preset_2 white balance (Gr gain) (8bit: D[7..0])*	0	0 to 255
47H	R/W	x	*preset_2 white balance (Blue gain) (8bit: D[7..0])*	0	0 to 255
48H	R/W	x	*preset_2 white balance (Gb gain) (8bit: D[7..0])*	0	0 to 255

Device Code = 100000					
Command No.	**R/W**	**Save to EEPROM**	**Function**	**Initial Data**	**Data Range**
49H	R/W	x	*preset_3 white balance (Red gain) (8bit: D[7..0])*	0	0 to 255
4AH	R/W	x	*preset_3 white balance (Gr gain) (8bit: D[7..0])*	0	0 to 255
4BH	R/W	x	*preset_3 white balance (Blue gain) (8bit: D[7..0])*	0	0 to 255
4CH	R/W	x	*preset_3 white balance (Gb gain) (8bit: D[7..0])*	0	0 to 255
4DH			*reserved*	-	-
4EH	R/W	x	*threshold for auto white balance (16bit: D[7..0])*	3072	0 to 4,095
4FH	R/W	x	*threshold for auto white balance (16bit: D[16..8])*		
50H	R/W	x	*Y_offset for AOI (8bit: D[7..0])*	0	0 <= Y <= 1944, where Y = offset + height
51H	R/W	x	*Y_offset for AOI (16bit: D[15..8])*		
52H	R/W	x	*height for AOI (8bit: D[7..0])*	1944	

53H	R/W	x	*height for AOI (16bit: D[15..8])*		
54H	R/W	x	*X_offset for AOI (8bit: D[7..0])*	0	0 <= X <= 2592, where X = offset + width
55H	R/W	x	*X_offset for AOI (16bit: D[15..8])*		
56H	R/W	x	*width for AOI (8bit: D[7..0])*	2592	
57H	R/W	x	*width for AOI (16bit: D[15..8])*		
58H	R/W	x	*vertical_1 position for the white balance area (16bit: D[7..0])*	0	0 to 1942
59H	R/W	x	*vertical_1 position for the white balance area (16bit: D[15..8])*		
5AH	R/W	x	*vertical_2 position for the white balance area (16bit: D[7..0])*	1943	0 to 1943
5BH	R/W	x	*vertical_2 position for the white balance area (16bit: D[15..8])*		
5CH	R/W	x	*horizontal_1 position for the white balance area (16bit: D[7..0])*	0	0 to 2590
5DH	R/W	x	*horizontal_1 position for the white balance area (16bit: D[15..8])*		
5EH	R/W	x	*horizontal_2 position for the white balance area (16bit: D[7..0])*	2591	0 to 2591
5FH	R/W	x	*horizontal_2 position for the white balance area (16bit: D[15..8])*		
60H	R/W	x	*camera mode1 (8bit: D[7..0])*	00H	
61H	R/W	x	*camera mode2 (8bit: D[7..0])*	00H	-
62H	R/W	x	*camera mode3 (8bit: D[7..0])*	80H/81H	
63 to 7FH			*reserved*		
80H	R/W	x	*push set white balance (Red gain) (8bit: D[7..0])*	0	0 to 255
81H	R/W	x	*push set white balance (Gr gain) (8bit: D[7..0])*	0	0 to 255
82H	R/W	x	*push set white balance (Blue gain) (8bit: D[7..0])*	0	0 to 255
83H	R/W	x	*push set white balance (Gb gain) (8bit: D[7..0])*	0	0 to 255
84 to FFH			*reserved*	-	-

7.4.3 Descriptions of the Camera Commands (Device code: 000000);

(The underlined settings are the factory default settings)

<table>
<tr><th>Command No.</th><th>Command Description</th></tr>
<tr><td>10H:
MOD1[7..0]</td><td>[camera function mode 1] Initial data: MOD1[7..0] = 10H
This command sets the camera function mode.
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>

D7: Shutter Type — 0:ERS — 1:GRR
D6: Trigger Polarity — 0: Positive — 1: Negative
D5 to D4: Exposure Mode — 00:ShutterOff(FreeRun) — 01:Edge Preset — 11: Pulse Width(Timed)
D3 to D0: No Function — Always set as “0000”

Note 1: The trigger polarity is automatically set to positive when using the software trigger; the trigger polarity cannot be changed.</td></tr>
<tr><td>11H:
MOD2[7..0]</td><td>[Camera function mode 2] Initial data: MOD2[7..0] = 08H
This command sets the camera function mode.
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>

D7 to D4: No Function — Always set as “0000”

D3: Operational Mode — 0: Trigger Mode — 1: Continuous Mode
D2 to D0: No Function — Always set as “111”

Note 1: The function mode is enabled whenever the “Continuous/Trigger mode (MOD1-D7)” is manual.
Note 2: While the camera is in Trigger Mode, the video will not output without the trigger signal input.</td></tr>
<tr><td>12H:
MOD3[7..0]</td><td>[Camera function mode 3] Initial data: MOD3[7..0] = 40H
This command sets the camera function mode.
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>

D7 to D6 Binning Mode — 00:Binning Mode = Average — 01:Binning Mode = Sum — 10: No Function — 11:No Function
D5: Trigger Signal Type — 0: Software Trigger — 1: Hardware Trigger (from No.5 pin of Power-I/O connector)
D4 to D2: No Function — Always set as “000”
D1 to D0 Mirror Flip — 00:Normal — 01:Horisontal Mirror — 10:Vertical Flip — Another: No Function
Note 1: The trigger polarity is automatically set to positive when using the software trigger; the trigger polarity cannot be changed.</td></tr>
</table>

<table>
<tr><th>Command No.</th><th>Command Description</th></tr>
<tr><td>15H:
MOD4[7..0]</td><td>[Camera function mode 4] Initial data: MOD4[7..0] = 09H
This command sets the camera function mode.
Note: Sensitivity may increase on Horizontal. however may not increase on Vertical.
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>

D7 to D6: No Function — Always set as “00”
D5 to D3: Vertical Binning Mode — 000: No function; 001: Full Scan; 010:Binning x2; 011: No function; 100: Binning x4; Another: Not Use
D2 to D0 Horizontal Binning Mode — 000: No function; 001: Full Scan; 010:Binning x2; 011: No function; 100: No function</td></tr>
<tr><td>16H:
SOFTRG[7..0]</td><td>[Software Trigger Setting] Initial data: SOFTRG[7..0] = 80H
This command sets the source of the software trigger.
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>

D7 to D6: Software trigger source selection — 00: Programming software trigger; 10: Command software trigger (200 useconds pulse width trigger signal); 01, 11: No function (Prohibited settings. Do not set these values)
D5 to D1: No Function — Always set as “00000”
D0: Generate software trigger command — 0: Hold (Low State); 1: Generate command software trigger (200 useconds high state)

Note 1: The software trigger source selection is enabled whenever “Trigger signal type (MOD3-D5)” is the software trigger (set as 0)
Note 2: The “Programming software trigger” is used to set up the pulse duration, trigger signal interval and generate the trigger signal.
Note 3: When selecting “Command software trigger”, it is necessary to generate the software trigger signal with the “Generate command software trigger (SOFTRIG-D0)”.</td></tr>
<tr><td>17H:
IMAGEREST
[7..0]</td><td>[Image Data Reset] Initial data: IMAGEREST[7..0] = 00H
This command resets the Image data (FVAL, LVAL and the image data).
Change from the reset to the image data out after starting the image acquisition.
The image data is not output when resetting the image data.
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>

D7 to D1: No Function — Always set as “0000000”
D0: Image Data Reset — 0: FVAL/LVAL/Image data reset (FVAL, LVAL and the image data are low state data); 1: FVAL/LVAL/Image data out</td></tr>
</table>

<table>
<tr><th>Command No.</th><th>Command Description</th></tr>
<tr><td>19H
FORMAT[7..0]</td><td>[Image output format] initial data:
FORMAT[7..0] = 00H Monochrome:FORMAT[7:0] = 00H, Color:FORMAT[7:0] = 05H
This command sets the output format of the image data.
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>

D7 to D4: No Function Always set as “0000”
D3 to D0: Output format
0000: Mono8
0001: Mono10
0010: Mono10Packed
0011: Mono12
0100: Mono12Packed
0101: BayerGR8
0110: BayerGR10
0111: BayerGR12
1000: BayerGR10Packed
1001: BayerGR12Packed
1010: RGB8Packed

1010 to 1111: No function (Prohibited setting. Do not set these values)</td></tr>
<tr><td>20H:
EXPTM[7..0]
21H:
EXPTM[15..8]
22H:
EXPTM[23..16]</td><td>[Exposure time (useconds) of the electronic shutter]
Initial data: EXPTM[23..0] = 71108, data range: 32 to 16,777,215
This command sets the exposure time for the electronic shutter.

Exposure time = EXPTM[23..0] useconds</td></tr>
<tr><td>30H:
PGA[7..0]</td><td>[CMOS Analog gain] Initial data: PGA [7..0] = 0, data range: 0 to 55
This command sets the CMOS Analog gain and Digital gain(programmable gain)
PGA[7:0] = 0 to 19 : CMOS Analog gain = 20 x log (PGA[7..0] / 8) dB
PGA[7:0] = 20 to 40 : CMOS Analog gain + CMOS Digital = 7.51 dB + 20 x log (1+(PGA[7..0]-19) / 8) dB</td></tr>
<tr><td>31H:
DGB[7..0]</td><td>[Digital gain] Initial data: DGB [7..0] = 0, data range: 0 to 255

Video level = (Input video level – Black level) x (1 + DGB[7..0]/128) + Black Level

* Black Level Black level (The calculated value of the address 38H)</td></tr>
<tr><td>38H
CLAMP[7..0]</td><td>[Clamp Level] Initial data: CLAMP[7..0] = 20H, data range: 0 to 31
This command sets the Clamp level(Black level of clamp).

Clamp Level = CLAMP[7..0] x 4</td></tr>
</table>

<table>
<tr><th>Command No.</th><th>Command Description</th></tr>
<tr><td>3EH: WHITE_CLIP[15..8]
3FH: WHITE_CLIP[7..0]</td><td>[White clip level for the white clip test pattern]
Initial data: WHITE_CLIP[15..0] = 4,095; data range: 0 to 4,095

This command sets the white clip level of the white clip test pattern.</td></tr>
<tr><td>41H:
ROW_CLOUMN_SKIP[7:0]</td><td>[Aptina5M ROW COLUMN Decimation] Initial data: ROW_CLOUMN_SKIP[7:0] = 09H
This command sets the Decimation .mode
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>
<table>
<tr><td>D7 to D6</td><td>No Function</td><td>Always set as “00”</td><td></td></tr>
<tr><td>D5 to D3:</td><td>Vertical Decimation</td><td>000: No Function</td><td>001:Ful Scan</td></tr>
<tr><td></td><td></td><td>010: Decimation 1x</td><td>011: Decimation 2x</td></tr>
<tr><td></td><td></td><td>100: Decimation 3x</td><td>101: Decimation 4x</td></tr>
<tr><td></td><td></td><td>110: Decimation 5x</td><td>111: Decimation 6x</td></tr>
<tr><td>D2 to D0:</td><td>Horizontal Decimation</td><td>000: No Function</td><td>001:Ful Scan</td></tr>
<tr><td></td><td></td><td>010: Decimation 1x</td><td>011: Decimation 2x</td></tr>
<tr><td></td><td></td><td>100: Decimation 3x</td><td>101: Decimation 4x</td></tr>
<tr><td></td><td></td><td>110: Decimation 5x</td><td>111: Decimation 6x</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Command No.</th><th>Command Description</th></tr>
<tr><td>50H: DELAY_I[7..0]
51H: DELAY_I[15..8]
52H: DELAY_I[23..16]
53H: DELAY_F[7..0]</td><td>[Delay time (us) for the trigger signal]
Initial data: DELAY_I[23..0] = 0, DELAY_F[7..0] = 0, data range: 0 to 2,000,000
This command sets the delay time that is from the trigger signal input to the start of the exposure as useconds.

Delay time for the trigger signal = (DELAY_I[23..0]). (DELAY_F[7..0]) useconds</td></tr>
<tr><td>54H: STROBEDELAY_I[7..0]
55H: STROBEDELAY_I[15..8]
56H: STROBEDELAY_I[23..16]
57H: STROBEDELAY_F[7..0]</td><td>[Delay time (us) for the strobe signal]
Initial data: STROBEDELAY _I[23..0] = 0, STROBEDELAY _F[7..0] = 0, data range: 0 to 2,000,000

Delay time for the strobe signal = (STROBEDELAY _I[23..0]). (STROBEDELAY _F[7..0]) useconds</td></tr>
<tr><td>58H: FPS_I[7..0]
59H: FPS_I[15..8]
5AH: FPS_F[7..0]
5BH: FPS_F[15..8]
5CH: FPS_F[23..16]</td><td>[Frame rate (Hz)]
Initial data: FPS_I[15..0] = 14, data rage: 6.88835 to 366
Initial data: FPS_F[15..0] = 0, data range: 0 to 99,999
This command sets the frame rate as Hz

Frame rate = (FPS_I[15..0]). (FPS_F[23..0]) Hz
data range of frame rate: 6.88835 to 366 Hz
Maximum frame rate for full resolution: 14 Hz

Note 1: The maximum frame rate depends on the AOI setting</td></tr>
<tr><td>5DH: IOSIGNAL_POL[7..0]</td><td>[I/O signal polarity] Initial data: IOSIGNAL_POL[7..0] = 00H,
This command sets the No.2 pin and No.3 pin of the I/O signal polarity.
D[7..0]
<table><tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr></table>
D7 to D2: No Function Always set as “000000”
D1 No.3 pin (I/O-2) polarity 0: Non-invert 1: Invert
D0: No.2 pin (I/O-1) polarity 0: Non-invert 1: Invert</td></tr>
</table>

<table>
<tr><th>Command No.</th><th>Command Description</th></tr>
<tr><td>78H:
TESTP[7..0]</td><td>[Test Pattern] Initial data: TESTP [7..0] = 00H
This command sets the test pattern video output.
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>

0: Normal Video Image 1: Gray Scale
2: Ramp 3: 100% White
4: White Clip 6: Color Bar
Others: Black</td></tr>
<tr><td>79H:
EFFCT[7..0]</td><td>[Image effect selection] Initial data: EFFCT[7..0] = 00H
This command sets the image effect.
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>

D7: Negative / Positive video selection 0: Positive image 1: Negative image
D6 to D0: Image effect 00H: No effect (Original) 01H: 9bit gradation
02H: 9bit gradation 03H: 7bit gradation
04H: 6bit gradation 05H: 5bit gradation
06H: 4bit gradation 07H: 3bit gradation
08H: 2bit gradation 09H: 1bit gradation
0A to 7FH: No function
(Prohibited settings. Do not set these values)</td></tr>
<tr><td>80H: E2P[7..0]</td><td>[EEPROM control] Initial data: E2P[7..0] = 00H
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>

D7 to D1: No function Always set as “0000000”
D6 to D0: Write control to the EEPROM 0: Prohibited 1: Accept

Note: This bit is cleared to “0” automatically by the internal processes after the execution of the command.</td></tr>
<tr><td>90H:
STROBEON_I[7..0]
91H:
STROBEON_I[15..8]
92H:
STROBEON_I[23..16]
93H:
STROBEON_F[7..0]</td><td>[Active time (us) for the strobe signal]
Initial data: STROBEON _I[23..0] =10, STROBEDELAY _F[7..0] = 0, data range: 0 to 2,000,000

Active time for the strobe signal = (STROBEON _I[23..0]). (STROBEON _F[7..0]) useconds

Active time for the strobe signal is set as below.
0: No strobe signal output
1 to 9: 10 us
Greater than 9: set value</td></tr>
</table>

<table>
<tr><th>Command No.</th><th>Command Description</th></tr>
<tr><td>F0H:
OUTSEL
[7..0]</td><td>[Output signal selection for the power-I/O connector] Initial data: OUTSEL[7..0] = 20H
This command sets the output signal from the power/IO connector.
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>

D7 to D4: Output signal for 3pin of the power/IO connector
0: FrameTriggerWait signal 1: UserOutput signal
2: ExposureActive signal 3: TriggerAuxiliary signal
4: TriggerInternal signal (after mask and delay process)
5: SensorReadOut signal
6 to F: No Function (Prohibited setting. Do not set these values)
D3 to D0: Output signal for 2pin of the power/IO connector
0: FrameTriggerWait signal 1: UserOutput signal
2: ExposureActive signal 3: TriggerAuxiliary signal
4: TriggerInternal signal (after mask and delay process)
5: SensorReadOut signal
6 to F: No Function (Prohibited setting. Do not set these values)
Note: When “UserOutput signal” is selected, set the status of the signal with “UserOutput signal for the power/IO connector (TEST2-D3,4)”.</td></tr>
<tr><td>F1H:
TEST2[7..0]</td><td>[UserOutput signal for the power-I/O connector] Initial data: TEST2[7..0] = 00H
This command sets the status of the UserOutput signal.
D[7..0]
<table>
<tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
</table>

D7 to D5: No function Always set as “000”
D4: UserOutput signal for 3pin of the power/IO connector 0: Low 1: High
D3: UswerOuput signal for 2pin of the power/IO connector 0: Low 1: High
D2 to D0: No function Always set as “000”
Note: The UserOutput signal is enabled whenever “UserOutput signal” is selected at the “Output signal selection (OUTSEL)”.</td></tr>
</table>

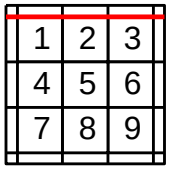
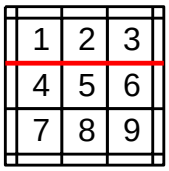
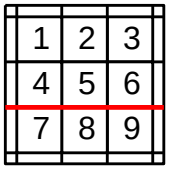
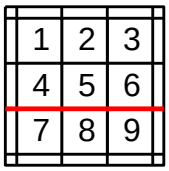
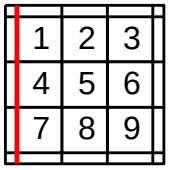
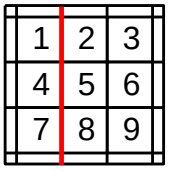
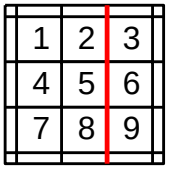
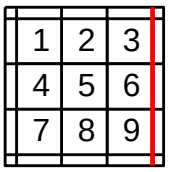
7.4.4 Descriptions of the Camera Commands (Device code: 100000);

(The underlined settings are the factory default settings)

Command No.	Command Description
20H: [7..0]	[Exposure mode] Initial data: 00H This command sets the exposure mode, which is the AGC, the shutter mode and the iris lens control method. D[7..0] D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 D7 to D4: No Function — Always set as "0000" D3: AGC — 0: OFF (Fixed gain) — 1: ON (AGC) D2: Shutter Mode — 0: OFF (Fixed shutter) — 1: ON (Auto shutter) D1: No Function — Always set as "0" D0: No Function — Always set as "0"
21H: [7..0]	[AGC maximum limit] Initial data: 40, data range: 0 to 40 This command sets the maximum limit for the AGC.
23H: [7..0] 24H: [15..8] 25H: [20..16]	[Upper limit of the electronic shutter for auto shutter] Initial data: 16,777,215; data range: 0 to 16,777,215 This command sets the upper limit of the electronic shutter for the auto shutter as usecond.
26H: [7..0] 27H: [15..8] 28H: [20..16]	[Lower limit of the electronic shutter for auto shutter] Initial data: 32; data range: 32 to 16,777,215 This command sets the upper limit of the electronic shutter for the auto shutter as usecond.
29H: [7..0]	[Weight1 for ALC] Initial data: 11H This command sets the weight for ALC weight area 1 and 2. D[7..0] D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 D7 to D4: Weight for ALC weight area 2 — 1 — Range: 0 to 15 D3 to D0: Weight for ALC weight area 1 — 1 — Range: 0 to 15 *Please set the ALC weight area with "30H to 3FH"
2AH: [7..0]	[Weight2 for ALC] Initial data: 11H This command sets the weight for ALC weight area 3 and 4. D[7..0] D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 D7 to D4: Weight for ALC weight area 4 — 1 — Range: 0 to 15 D3 to D0: Weight for ALC weight area 3 — 1 — Range: 0 to 15 *Please set the ALC weight area with "30H to 3FH"

Command No.	Command Description
2BH: [7..0]	[Weight3 for ALC] Initial data: 1AH This command sets the weight for ALC weight area 5 and 6.

	D[7..0] D7 D6 D5 D4 D3 D2 D1 D0 D7 to D4: Weight for ALC weight area 6 1 Range: 0 to 15 D3 to D0: Weight for ALC weight area 5 10 Range: 0 to 15 *Please set the ALC weight area with “30H to 3FH”
2CH: [7..0]	[Weight4 for ALC] Initial data: 11H This command sets the weight for ALC weight area 7 and 8. D[7..0] D7 D6 D5 D4 D3 D2 D1 D0 D7 to D4: Weight for ALC weight area 8 1 Range: 0 to 15 D3 to D0: Weight for ALC weight area 7 1 Range: 0 to 15 *Please set the ALC weight area with “30H to 3FH”
2DH: [7..0]	[Weight5 for ALC] Initial data: 01H This command sets the weight for ALC weight area 9. D[7..0] D7 D6 D5 D4 D3 D2 D1 D0 D7 to D4: No Function Always set as “0000” D3 to D0: Weight for ALC weight area 9 1 Range: 0 to 15 *Please set the ALC weight area with “30H to 3FH”
2EH: [7..0]	[Target Brightness for ALC] Initial data: 128, data range: 0 to 255 This command sets the target brightness for the ALC function (AGC, auto shutter).
2FH: [7..0]	[ALC peak-average] Initial data: 0, data range: 0 to 255 This command sets the control standard for the ALC function (AGC, auto shutter) When set as 0 (Average: 100%, Peak: 0%), the ALC function with the average brightness of the photometry area. When set as 255 (Average: 0%, Peak: 100%), the ALC function with the peak brightness of the photometry area.

Command No.	Command Description
30H: [7..0] 31H: [15..8]	[Vertical_1 position for the ALC weight area] Initial data: 32, data range: 0 to 1943 This command sets the vertical 1 position for the ALC weight area. 
32H: [7..0] 33H: [15..8]	[Vertical_2 position for the ALC weight area] Initial data:680, data range: 0 to 1943 This command sets the vertical 2 position for the ALC weight area. 
34H: [7..0] 35H: [15..8]	[Vertical_3 position for the ALC weight area] Initial data:1264, data range: 0 to 1943 This command sets the vertical 3 position for the ALC weight area. 
36H: [7..0] 37H: [15..8]	[Vertical_4 position for the ALC weight area] Initial data:1912, data range: 0 to 1943 This command sets the vertical 4 position for the ALC weight area. 
38H: [7..0] 39H: [15..8]	[Horizontal_1 position for the ALC weight area] Initial data: 36, data range: 0 to 2591 This command sets the horizontal 1 position for the ALC weight area. 
3AH: [7..0] 3BH: [15..8]	[Horizontal_2 position for the ALC weight area] Initial data: 900, data range: 0 to 2591 This command sets the horizontal 2 position for the ALC weight area. 
3CH: [7..0] 3DH: [15..8]	[Vertical_3 position for the ALC weight area] Initial data:1692, data range: 0 to 2591 This command sets the horizontal 3 position for the ALC weight area. 
3EH: [7..0] 3FH: [15..8]	[Vertical_4 position for the ALC weight area] Initial data: 2556, data range: 0 to 2591 This command sets the horizontal 4 position for the ALC weight area. 

Command No.	Command Description
40H: [7..0]	[White Balance mode] Initial data: 00H This command sets the white balance mode for the color camera.

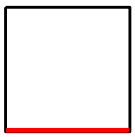
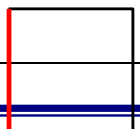
	D[7..0] D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 D7 to D4: No Function — Always set as "0000" D3: Push to set white balance operation — 0: OFF / 1: ON D2 to D0: White balance mode — 000: OFF / 001: Preset 1, / 010: Preset 2 / 011: Preset 3 / 100: Auto white balance / 101: Push to set white balance / 110 to 111: No Function (Prohibited settings. Do not set these values) * When using the push-to-set white balance, set the white balance mode as "Push to set white balance" then change "0" to "1" for the push-to-set white balance operation.
41H: GainR1[7..0]	[Preset_1 white balance (Red gain)] Initial data: 0, data range: 0 to 255 This command sets the Red gain for the preset_1 white balance. Red of the camera output image data = (SENSOR_R – Black Level) x (1+ GainR1[7..0] / 64) + Black Level * SENSOR_R: Red of the Sensor output image data * Black Level: Black level (The calculated value of 38H)
42H: GainGr1[7..0]	[Preset_1 white balance (Gr gain)] Initial data: 0, data range: 0 to 255 This command sets the Gr gain for the preset_1 white balance. Gr of the camera output image data = (Sensor _Gr – BLACK Level) x (1+ GainGr1[7..0] / 64) + BLACK Level * Sensor _Gr: Red of the Sensor output image data * BLACK Level: Black level (The calculated value of 38H)
43H: GainB1[7..0]	[Preset_1 white balance (Blue gain)] Initial data: 0, data range: 0 to 255 This command sets the Blue gain for the preset_1 white balance. Blue of the camera output image data = (Sensor _B – BLACK Level) x (1+ GainB1[7..0] / 64) + BLACK Level * Sensor _B: Blue of the Sensor output image data * BLACK Level: Black level (The calculated value of 38H)
44H: GainGb1[7..0]	[Preset_1 white balance (Gb gain)] Initial data: 0, data range: 0 to 255 This command sets the Gb gain for the preset_1 white balance. Gb of the camera output image data = (Sensor _Gb – BLACK Level) x (1+ GainGb1[7..0] / 64) + BLACK Level * Sensor _Gb: Gb of the Sensor output image data * BLACK Level: Black level (The calculated value of 38H)

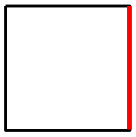
Command No.	**Command Description**
45H: GainR2[7..0]	[Preset_2 white balance (Red gain)] Initial data: 0, data range: 0 to 255 This command sets the Red gain for the preset_1 white balance. Red of the camera output image data = (Sensor _R – BLACK Level) x (1+ GainR2[7..0] / 64) + BLACK Level * Sensor _R: Red of the Sensor output image data * BLACK Level: Black level (The calculated value of 38H)

46H: GainGr2[7..0]	[Preset_2 white balance (Gr gain)] Initial data: 0, data range: 0 to 255 This command sets the Gr gain for the preset_2 white balance. Gr of the camera output image data = (Sensor _Gr – BLACK Level) x (1+ GainGr2[7..0] / 64) + BLACK Level * Sensor _Gr: Red of the Sensor output image data * BLACK Level: Black level (The calculated value of 38H)
47H: GainB2[7..0]	[Preset_2 white balance (Blue gain)] Initial data: 0, data range: 0 to 255 This command sets the Blue gain for the preset_2 white balance. Blue of the camera output image data = (Sensor _B – BLACK Level) x (1+ GainB2[7..0] / 64) + BLACK Level * Sensor _B: Blue of the Sensor output image data * BLACK Level: Black level (The calculated value of 38H)
48H: GainGb2[7..0]	[Preset_2 white balance (Gb gain)] Initial data: 0, data range: 0 to 255 This command sets the Gb gain for the preset_2 white balance. Gb of the camera output image data = (Sensor _Gb – BLACK Level) x (1+ GainGb2[7..0] / 64) + BLACK Level * Sensor _Gb: Gb of the Sensor output image data * BLACK Level: Black level (The calculated value of 38H)
49H: GainR3[7..0]	[Preset_3 white balance (Red gain)] Initial data: 0, data range: 0 to 255 This command sets the Red gain for the preset_3 white balance. Red of the camera output image data = (Sensor _R – BLACK Level) x (1+ GainR3[7..0] / 64) + BLACK Level * Sensor _R: Red of the Sensor output image data * BLACK Level: Black level (The calculated value of 38H)
4AH: GainGr3[7..0]	[Preset_3 white balance (Gr gain)] Initial data: 0, data range: 0 to 255 This command sets the Gr gain for the preset_3 white balance. Gr of the camera output image data = (Sensor _Gr – BLACK Level) x (1+ GainGr3[7..0] / 64) + BLACK Level * Sensor _Gr: Red of the Sensor output image data * BLACK Level: Black level (The calculated value of 38H)

Command No.	**Command Description**
4BH: GainB3[7..0]	[Preset_3 white balance (Blue gain)] Initial data: 0, data range: 0 to 255 This command sets the Blue gain for the preset_3 white balance. Blue of the camera output image data = (Sensor _B – BLACK Level) x (1+ GainB3[7..0] / 64) + BLACK Level * Sensor _B: Blue of the Sensor output image data * BLACK Level: Black level (The calculated value of 38H)
4CH: GainGb3[7..0]	[Preset_3 white balance (Gb gain)] Initial data: 0, data range: 0 to 255 This command sets the Gb gain for the preset_3 white balance. Gb of the camera output image data = (Sensor _Gb – BLACK Level) x (1+ GainGb3[7..0] / 64) + BLACK Level

	* Sensor _Gb: Gb of the Sensor output image data * BLACK Level: Black level (The calculated value of 38H)
4EH: [7..0] 4FH: [15..8]	[Bright level threshold fro auto white balance process] Initial data: 0, data range: 0 to 4,095 This command sets the bright level threshold for auto white balance process. Auto white balance process uses the color information of the pixel (the brightness of the pixel that is greater than this value).
50H: [7..0] 51H: [15..8]	[Y_offset for AOI] Initial data: 0, data range:0 ≤ “Y_offset + Height” ≤ 1944 This command sets the Y_offset (the vertical start position of the image for the AOI)
52H: [7..0] 53H: [15..8]	[Height for AOI] Initial data: 1944, data range: 2 ≤ “Y_offset + Height” ≤ 1944 This command sets the height (the vertical size of the image for the AOI)
54H: [7..0] 55H: [15..8]	[X_offset for AOI] Initial data: 0, data range: 8 ≤ “Y_offset + Height” ≤ 2592 This command sets the X_offset (the horizontal start position of the image for the AOI)
56H: [7..0] 57H: [15..8]	[Width for AOI] Initial data: 2592, data range: 8 ≤ “Y_offset + Height” ≤ 2592 This command sets the width (the horizontal size of the image for the AOI)
58H: [7..0] 59H: [15..8]	[Vertical_1 position for the white balance area] Initial data: 0, data range: 0 to 1942 This command sets the vertical 1 position, which is the vertical start position for the white blance area. This area is used for the gain calculation of the auto white balance and the push-to-set white balance. 

Command No.	Command Description
5AH: [7..0] 5BH: [15..8]	[Vertical_2 position for the white balance area] Initial data: 1943, data range: 0 to 1943 This command sets the vertical 2 position, which is the vertical end position for the white blance area. This area is used for calculating the gain of the auto white balance and the push-to-set white balance. 
5CH: [7..0] 5DH: [15..8]	[Horizontal_1 position for the white balance area] Initial data: 0, data range: 0 to 2590 This command sets the horizontal 1 position, which is the vertical end position for the white blance area. This area is used for calculating the gain of the auto white balance and the push-to-set white balance. 

5EH: [7..0] 5FH: [15..8]	[Horizontal_2 position for the white balance area] Initial data: 2591, data range: 0 to 2591 This command sets the horizontal 2 position, which is the vertical end position for the white blance area. This area is used for the calculating the gain of the auto white balance and the push-to-set white balance. 

Command No.	Command Description
60H: [7..0]	[Camera mode 1] Initial data: 00H This command sets the white balance area ON/OFF and the gamma table ON/OFF. D[7..0] D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 D7: Gamma Reload (EEPROM > Register) — 0 -> 1 : Reload Gamma Table after reloaded, automatically 1 ->0 D6 to D5: No function — Always set at "00" D4: White balance area ON/OFF — 0: OFF (Full screen) — 1: ON (setup area) D3 to D1: No function — Always set as "000" D0: Gamma table ON/OFF — 0: OFF (Gamma=1.0) — 1: ON

Command No.	Command Description
80H: GainRP[7..0]	[Push to set white balance (Red gain)] Initial data: 0, data range: 0 to 255 This command sets the Red gain for the Push to set white blance. Red of the camera ouptut image data = (Sensor_R – BLACK Level) x (1 + GainRP[7..0] / 64) + BLACK Level * Sensor _R: Red of the Sensor output image data *BLACK Level: Black level (The calculated value of 38H) * Sensor _Gr: Gr of the Sensor output image data *BLACK Level: Black level (The calculated value of 38H)
81H: GainGrP[7..0]	[Push to set white balance (Gr gain)] Initial data: 0, data range: 0 to 255 This command sets the Gr gain for the Push to set white blance. Gr of the camera ouptut image data = (Sensor_Gr – BLACK Level) x (1 + GainGrP[7..0] / 64) + BLACK Level
82H: GainBR[7..0]	[Push to set white balance (Blue gain)] Initial data: 0, data range: 0 to 255 This command sets the Blue gain for the Push to set white blance. Red of the camera ouptut image data = (Sensor_B – BLACK Level) x (1 + GainBR[7..0] / 64) + BLACK Level * Sensor _B: Blue of the Sensor output image data *BLACK Level: Black level (The calculated value of 38H)
83H: GainGbP[7..0]	[Push to set white balance (Gb gain)] Initial data: 0, data range: 0 to 255 This command sets the Gb gain for the Push to set white balance. Gb of the camera ouptut image data = (Sensor_Gb – BLACK Level) x (1 + GainGbP[7..0] / 64) + BLACK Level * Sensor _Gb: Gb of the Sensor output image data *BLACK Level: Black level (The calculated value of 38H)

7.5 GenICam Command / Camera Command Reference Table

GenICam command	Camera command

	Device	Command	Function
Width	100000	56-57H	Width for AOI (pixel)
Height	100000	52-53H	Height for AOI (pixel)
PixelFormat	000000	19H.0-3	Video out (bit)
OffsetX	100000	54-55H	X offset for AOI (pixel)
OffsetY	100000	50-51H	Y offset for AOI (pixel)
BinningHorizontal	000000	15H.0-2	Horizontal Binning
BinningVertical	000000	15H.3-5	Vertical Binning
BinningMode	100000	15H.6-7	Binning Mode
DecimationHorizontal	000000	41H.0-2	Horizontal Decimation(Skipping)
DecimationVertical	000000	41H.3-5	Vertical Decimation(Skipping)
ExposureMode	000000	10H.5	Trigger mode
ExposureShutterType	000000	10H.7	Electric shutter type
ExposureTime	000000	20-22H	Exposure time (us) of the electronic shutter
ExposureTimeAbs	000000	20-22H	Exposure time (us) of the electronic shutter
ExposureTimeRaw	000000	20-22H	Exposure time (us) of the electronic shutter
ExposureAuto	100000	20H.2	Shutter mode
AcquisitionFrameRate	000000	58-5CH	Frame rate
TriggerDelay	000000	50-53H	The delay time for the trigger signal
TriggerActivation	000000	10H.6	Trigger polarity
TriggerSource	000000	12H.5	Trigger signal type
TriggerSoftware	000000	16H.0	Generate command software trigger
TriggerSoftwareSource	000000	16H.6-7	Software trigger source selection
TriggerMode	000000	11H.3	Function mode
LineSource0	000000	F0H.0-3	Output signal for 2 pin of the power-I/O connector
LineSource1	000000	F0H.4-7	Output signal for 3 pin of the power-I/O connector
UserOutputValue0	000000	F1H.3	UserOutput signal for 2 pin of the power-I/O connector
UserOutputValue1	000000	F1H.4	UserOutput signal for 3 pin of the power-I/O connector
LineInverter0	000000	5DH.0	Output signal polarity for 2 pin of the power-I/O connector
LineInverter1	000000	5DH.1	Output signal polarity for 3 pin of the power-I/O connector
StrobeSignalOnTime	000000	90-93H	Strobe signal active time
StrobeSignalDelay	000000	54-57H	The delay time for the strobe signal (us)

GenICam command	Camera command		
	Device	Command	Function
BalanceWhiteAuto	100000	40H.0-2	White balance mode
BalanceRatio_R_Preset1	100000	41H	Preset1 white balance (Red gain)
BalanceRatio_Gr_Preset1	100000	42H	Preset1 white balance (Gr gain)
BalanceRatio_B_Preset1	100000	43H	Preset1 white balance (Blue gain)

BalanceRatio_Gb_Preset1	100000	44H	Preset1 white balance (Gb gain)
BalanceRatio_R_Preset2	100000	45H	Preset2 white balance (Red gain)
BalanceRatio_Gr_Preset2	100000	46H	Preset2 white balance (Gr gain)
BalanceRatio_B_Preset2	100000	47H	Preset2 white balance (Blue gain)
BalanceRatio_Gb_Preset2	100000	48H	Preset2 white balance (Gb gain)
BalanceRatio_R_Preset3	100000	49H	Preset3 white balance (Red gain)
BalanceRatio_Gr_Preset3	100000	4AH	Preset3 white balance (Gr gain)
BalanceRatio_B_Preset3	100000	4BH	Preset3 white balance (Blue gain)
BalanceRatio_Gb_Preset3	100000	4CH	Preset3 white balance (Gb gain)
BalanceRatio_R_Once	100000	80H	Push to set white balance (Red gain)
BalanceRatio_Gr_Once	100000	81H	Push to set white balance (Gr gain)
BalanceRatio_B_Once	100000	82H	Push to set white balance (Blue gain)
BalanceRatio_Gb_Once	100000	83H	Push to set white balance (Gb gain)
Gain	000000	30H	CMOS Analog gain
GainAbs	000000	30H	CMOS Analog gain
GainRaw	000000	30H	CMOS Analog gain
GainAuto	100000	20H.3	AGC
BlackLevel	000000	38H	Black Level
BlackLevelAbs	000000	38H	Black Level
BlackLevelRaw	000000	38H	Black Level
GammaMode	100000	60H.0	Gamma table ON/OFF
ReloadGammaData	100000	60H.7	Gamma table ON/OFF
Min_ShutterTime	100000	26-28H	The lower limit of the electronic shutter for auto shutter (us)
Max_ShutterTime	100000	23-25H	The upper limit of the electronic shutter for auto shutter (us)
AGCRange	100000	21H	AGC maximum limit
TargetBrightness	100000	2EH	Target brightness for ALC
ALC_Peak_Average	100000	2FH	ALC peak-average

GenICam command	**Camera command**		
	Device	**Command**	**Function**
ALCWeight1	100000	29H.0-3	Weight1 for ALC
ALCWeight2	100000	29H.4-7	Weight2 for ALC
ALCWeight3	100000	2AH.0-3	Weight3 for ALC
ALCWeight4	100000	2AH.4-7	Weight4 for ALC
ALCWeight5	100000	2BH.0-3	Weight5 for ALC
ALCWeight6	100000	2BH.4-7	Weight6 for ALC
ALCWeight7	100000	2CH.0-3	Weight7 for ALC
ALCWeight8	100000	2CH.4-7	Weight8 for ALC
ALCWeight9	100000	2DH.0-3	Weight9 for ALC

ALCWindowV1	100000	30-31H	Vertical1 position for the ALC weight area (pixel)
ALCWindowV2	100000	32-33H	Vertical2 position for the ALC weight area (pixel)
ALCWindowV3	100000	34-35H	Vertical3 position for the ALC weight area (pixel)
ALCWindowV4	100000	36-37H	Vertical4 position for the ALC weight area (pixel)
ALCWindowH1	100000	38-39H	Horizontal1 position for the ALC weight area (pixel)
ALCWindowH2	100000	3A-3BH	Horizontal2 position for the ALC weight area (pixel)
ALCWindowH3	100000	3C-3DH	Horizontal3 position for the ALC weight area (pixel)
ALCWindowH4	100000	3E-3FH	Horizontal4 position for the ALC weight area (pixel)
WB_WindowH1	100000	58-59H	Vertical1 position for the white balance area
WB_WindowH2	100000	5A-5BH	Vertical2 position for the white balance area
WB_WindowV1	100000	5C-5DH	Horizontal1 position for the white balance area
WB_WindowV2	100000	5E-5FH	Horizontal2 position for the white balance area
WB_WindowMode	100000	60H.4	White balance area ON/OFF
YThreshold	100000	4E-4FH	Bright level threshold for auto white balance
ReverseX	000000	12H.0-1	Horizontal Flip
ReverseY	000000	12H.0-1	Vertical Flip
SensorDecimationTaps			Decimation Nmber
DeviceID			Camera Serial Number

Caution:

Width, Height and PixelFormat are effect to the image data size.

Please use GenICam command name command when change these values like below sample code.

In the case to change the Width

```
BOOL SetWidth( PvDevice *pDevice, PvInt64 lValue )
{
    PvGenInteger* lGenInteger = dynamic_cast<PvGenInteger*>( pDevice->GetGenParameters()->Get( "Width" ) );
    PvResult lResult = lGenInteger->SetValue(lValue);
    return lResult.IsOK();
}
```

8 Saving and Loading a User Set data

This camera can save and load the camera parameters. It is included restoring the factory defaults.
There are two kind of data are exist.

Default: The factory defaults data
UserSet1: User accessible data for saving

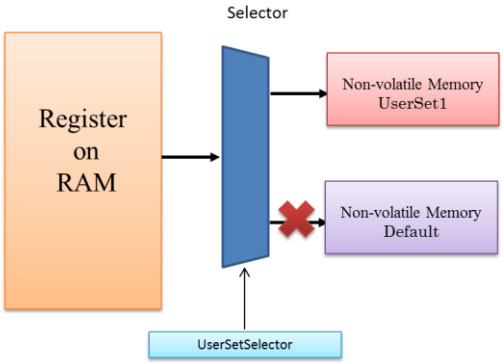
The data is loaded and written into in the register on the RAM of camera.
These functions can be accessed through the parameters (UserSetSelector, UserSetDefaultSelector) and commands (serSetLoad, UserSetSave) on UserSetControl category of GenICam.

For descriptions of the parameters and commands, please see the table below:

UserSetSelector	Select the feature User Set to load, save or configure.
UserSetDefaultSelector	Select the feature User Set to load and make active when the device is reset.
UserSetLoad	Load the User Set specified by UserSetSelector to the device and make it active.
UserSetSave	Save the User Set specified by UserSetSelector to the non-volatile memory if of the device.

8.1.1 When the Camera is Saving the Parameters

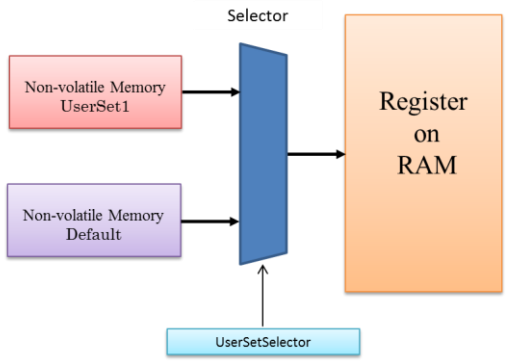
When the camera is saving the parameters (UserSetSave)



When UserSetSave is executed,
The camera data on the register on RAM is saved into the memory that was selected by UserSetSelector.
Caution: UserSetSave does not work with Default on UserSetSelector.

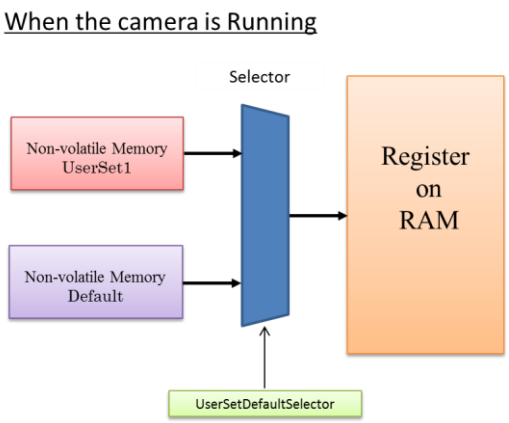
8.1.2 When the Camera is Loading the Parameters

When the camera is loading the parameters (UserSetLoad)



When UserSetLoad is executed,
The camera data on the register on RAM is loaded from the memory that was selected by UserSetSelector.

8.1.3 When the Camera is Running



When the camera is running, The camera data is loading into the register on RAM that was selected by UserSetDefaultSelector.

8.1.4 Camera initialization (Factory Defaults)

In order to recover the factory default settings, please execute the procedure as follows:

1. Execute UserSetLoad, Default is selected on UserSetSelector.
2. Execute UserSet1 is selected on UserSetSelector.

9 Revision History

Rev	Date	Changes	Note
0.03	2014/01/10	● New Document	
0.04	2014/01/17	● Revised Revised some parameters	
0.05	2014/03/20	● Revised Revised Output format Revised Environmental Spec	
0.06	2014/03/24	● Revised Weight, SN ration, Binning on Spec. Added DeviceID on GenIcam command Default value on BlackLevel Deleted 1/4 Horizontal Binning	
1.00	2014/07/18	● New Document	
1.01	2014/07/21	● Updated to English Document	RM

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