OMRON

PoCL Camera Link
Monochrome / Color CMOS Camera

STC-APB503PCL (5.0M / Monochrome)
STC-APC503PCL (5.0M / Color)

Product Specifications and User's Guide

OMRON SENTECH CO., LTD.

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Precautions for safe use

Please read carefully this “Precautions for safe use” before use the camera. Then the camera uses correctly with agreeing with below notes.

In this “Precautions for safe use”, notes divides into “Warning” and “Caution” to use the camera safety and prevent to harm and damage.

⚠ Warning	This shows, assumption for possibility of serious accident leading death or serious injury if ignore this note and camera uses incorrectly.
⚠ Caution	This shows, assumption for possibility of bear the damage or physical damage if ignore this note and camera uses incorrectly.

About Graphic symbols

This symbol shows general prohibition.

This symbol shows completion or instruction.

[Environment / condition]

⚠ Warning	
Do not use flammable or explosiveness atmospheres. This will cause of personal injury or fire.	Do not use for “safety for human body” related usage. This camera is designed for use “do not harm human body immediately” if by any chance the camera has malfunction.
⚠ Caution	
Use and store under specified environmental conditions (Vibration, shock, temperature, humidity) in the specifications for this camera. This will cause of fire or damage the camera.	

[Installation and cable wiring]

⚠ Warning	
Do not use with out of power voltage range that is specified in the specifications for this camera. This will cause of fire, electrification or malfunction.	Do not wrong wiring. This will cause of fire or malfunction.

⚠ Caution	
Do not grounding DC power (+) of all devices that are connect to the camera. The camera housing is connecting to 0 V line of camera inside circuit. There is a risk of short circuit between camera inside ciurcuit and frame ground. This will cause of malfunction.	It is necessary to wiring and mounting that is specified in the specifications for this camera. This will cause of fire or malfunction.
It is necessary to wiring with turn off the camera This will cause of electrification or malfunction.	
Do not use Camera Link un-supported cable and board. There is a risk of malfunction if the camera connects with wrong environment and turn on the camera.	

[Usage instruction]

⚠ Warning	
Do not touch the terminal and PCB board While turn on the camera. This will cause of electrification or accident caused by malfunction.	Do not put combustibles near the camera. This will cause of fire.
Do not use without usage that is specified in the specifications for this camera. This will cause of personal injury or malfunction.	Do not push metals including screw driver into radiation holes. This will cause of electrification or malfunction.
⚠ Caution	
Do not push contamination into opening of the camera. This will cause of electrification or malfunction.	Do not block the radiation holes. This will cause of fire due to increase the camera inside temperature.

[Maintenance]

⚠ Caution	
Do not disassemble or repair the camera. This will cause of fire, electrification or malfunction.	It is turn off the camera when maintaining or inspecting the camera. This will cause of electrification.

[Disposal]

⚠ Caution	
It is necessary to dispose as industrial waste.	

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1 Product Precautions

Do not give shock to the camera.
Do not haul or damage the camera cable.
Do not wrap the camera with any material while using the camera. This will cause the internal camera temperature to increase.
When the camera moving or using the place that temperature difference is extreme, countermeasure for dew condensation (heat removal / cold removal) is necessary.
While the camera is not using, keep the lens cap on the camera to prevent dust or contamination from getting in the sensor or filter and scratching or damaging it.
Do not keep the camera under the following conditions.
- In wet, moist, high humidity or dusty place
- Under direct sunlight
- In extreme high or low temperature place
- Near an object that releases a strong magnetic or electric filed
- Place with strong vibrations

Apply the power that satisfies the specified in specifications for the camera.
The defective pixels may appear due to the sensor characteristics.
Use below recommend materials (or equivalent materials) to clean the surface of glass.
- Air dust: Non Freon air duster (NAKABAYASHI Co., LTD.)
- Alcohol: Propan-2-ol (SAN'EI KAKO Co., LTD.)
- Non-woven: nikowipe clean room (NKB)

Use a soft cloth to clean the camera.

2 Warranty

■Warranty period

One year after delivery (However, the camera had malfunction with camera uses correctly)
In below case for a fee even within warranty period.

- The malfunction caused by incorrect usage, incorrect modify or repair.
- The malfunction caused by external shock including the camera dropping after delivery the camera.
- The malfunction caused by fire, earthquake, flood disaster, thunderbolt struck, other natural disaster or wrong voltage.

■Warranty coverage

Exchange or repair the malfunction camera if the malfunction is occurred by our responsibility.
"Warranty" mean is warranty for the delivered camera itself. Please accept the induction damage by the camera malfunction is not included.

3 Specifications

3.1 Electronic Specifications

Model Number			STC-APB503PCL	STC-APC503PCL
Image Sensor			1/2.5" 5M Progressive Monochrome CMOS (Aptina: MT9P031)	1/2.5" 5M Progressive Color CMOS (Aptina: MT9P031)
Shutter Type			Rolling / Global reset	
Active Picture Elements			2,592 (H) x 1,944 (V)	
Cell Size			2.2 (H) x 2.2 (V) µm	
Sync System			External trigger (Hardware, Software) / **Free run**	
Frame Rate (Full resolution) (*1)	3TAP / 2TAP		**13.95 fps**	
ADC bit width			12bits	
Image Format			**8bits** / 10bits / 12bits output	
Camera Link Output Type (*2)			Base Configuration	
Camera Link TAP Configuration			**3TAP** / 2TAP	
Camera Link Clock Speed (*3)	3TAP / 2TAP		**48 / 32** MHz	
Noise Level (*4)	8bits output		Less than 4.5 digits (Gain 0 dB)	
	10bits output		Less than 18 digits (Gain 0 dB)	
	12bits output		Less than 64 digits (Gain 0 dB)	
Sensitivity (*5)			430 Lux	960 Lux
Exposure Time	Edge preset trigger / Free run		32 µseconds to 16.777 seconds **(Default: 32 µseconds)**	
	Pulse width trigger		42 µseconds to	
Gain	Analog Gain		0 dB to 24 dB **(Default: 0 dB)**	
	Digital Gain		CMOS: 0 to 24 dB , FPGA: 0 to 9.5 dB	
Black Level (*4)	8bits output		0 to 63 digits	
	10bits output		0 to 255 digits	
	12bits output		0 to 512 digits	
White Balance Gain			N/A	0 (Black level) to x4 **(Default: x1)**
ROI	Size	Horizontal	0 to 2,751 pixels **(Default: 2,592)**	
		Vertical	0 to 2,005 lines **(Default: 1,944)**	
	Position	Horizontal	0 to 2,750 pixels	
		Vertical	0 to 2,004 lines	
Multi ROI				
Gamma				
Binning				
Decimation				
Image Flip				
Defective Pixel Correction				
Auto Image Control	Auto Exposure			
	Auto Gain			
	Auto White Balance			

Default: **Bold**

Model Number		STC-APB503PCL	STC-APC503PCL
Operational Mode		Edge preset Trigger / Pulse width Trigger / **Free run**	
User Setting Storage		Support	
Input / Output		4 IOs	
Power	Input Voltage	12 Vdc +/- 10 % (Support PoCL)	
	Consumption	Less than 1.2 W	

Default: **Bold**

Precautions

(*1) The selected video output bit does not make any influence for the maximum frame rate.

(*2) Camera Link data output formats (TAP configuration and output bits) are listed in below table:

	3TAP	2TAP
8bits	Base configuration	Base configuration
10bits	N/A	Base configuration
12bits	N/A	Base configuration

(*3) Please select the optimum Camera Link clock speed if the long length Camera Link cable is required.

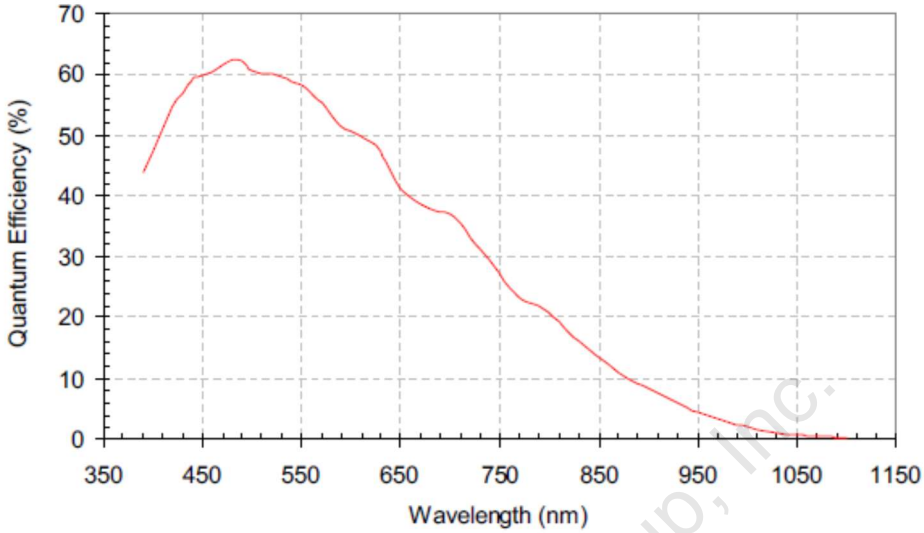
(*4) Selected TAP configuration does not make any influence for the nose level and black level.

(*5) The sensitivity is measured the light source illumination for 100 % white under below conditions:

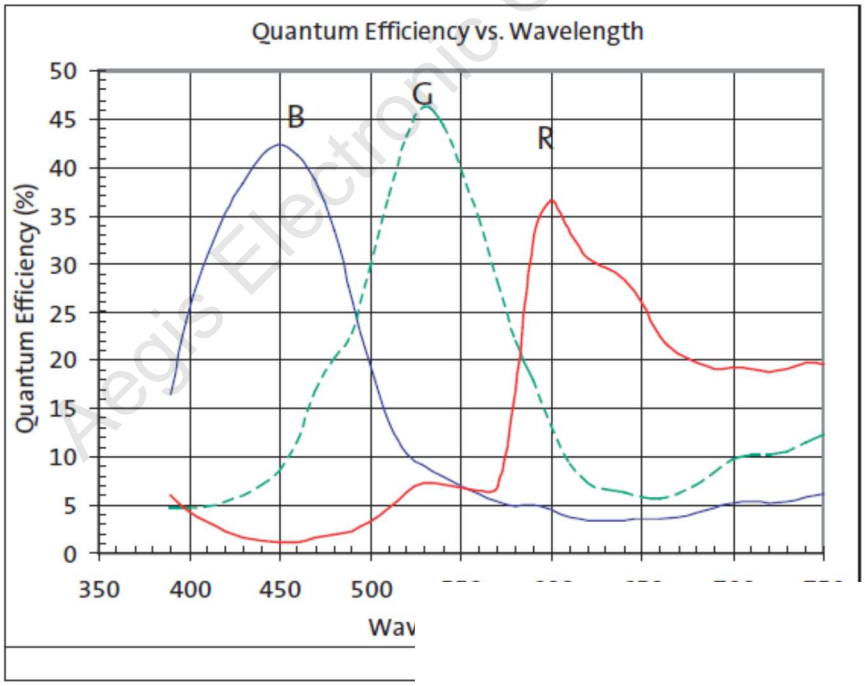
Camera Setting		Environment	
Parameter	Setting	Parameter	Setting
Gain Up	0 dB	Light Source	Light Box (White)
AGC	Off	Color temperature	5,100K
White Balance	Optimum	Lens	
Electrical Shutter	1/30 seconds	F on Lens	F5.6
Black Level	Optimum	Target Luminance	IM-600 (Topcon)
Gamma	Factory Setting		

3.2 Spectral Sensitivity Characteristics

3.2.1 STC-APB503PCL



3.2.2 STC-APC503PCL



3.3 Mechanical Specifications

Model Number	STC-APB503PCL	STC-APC503PCL
Dimensions	28 (W) x 28 (H) x 40 (D) mm (*1)	
Optical Filter	No Optical Cut Filter	
Optical Center Accuracy	Positional accuracy in Horizontal and Vertical directions: +/- 0.3 mm Rotational accuracy of Horizontal and Vertical: +/- 1.5 deg.	
Material	Aluminum alloy (AC)	
Lens Mount (*2)	C Mount	
Interface Connectors	Camera Link Connector: SDR x 1 Power-I/O Connector: HR10A-7R-6PB (Hirose) or equivalent	
Camera Mounting	M2 screw holes (Three on top and both side, Four on bottom plates) M4 screws holes (Tow on top and both side, Four on bottom plates)	
Weight	Approximately 36 g	

(*1) Excluding connectors

3.4 Environmental Specifications

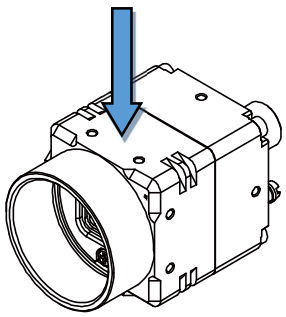
Model Number	STC-APB503PCL	STC-APC503PCL
Operational Temperature / Humidity	Environmental Temperature: 0 to +45 deg. C (Camera housing temperature shall not exceed +64 deg. C) (*1) Environmental Humidity: 0 to 85 %RH (No condensation)	
Storage Temperature / Humidity	Environmental Temperature: -20 to +65 deg. C, Environmental Humidity: 0 to 80 %RH (No condensation)	
Vibration	20 Hz to 200 Hz to 20 Hz (5 min. / cycle), acceleration 10 G, XYZ 3 directions 30 min. each	
Shock	Acceleration 38 G, half amplitude 6 ms, XYZ 3 directions 3 times each	
Standard Compliancy	EMS: EN61000-6-2, EMI: EN55011	
RoHS	RoHS Compliant	

(*1) Please insure the camera is installed with the appropriate heat dissipation to keep the camera housing temperature (top plate) is less than 64 deg. C when the camera using the ambient temperature is exceeded 45 deg. C.
If the camera has a mounted lens and a tripod with an aluminum plate, this could decrease the camera housing temperature for the heat dissipation.

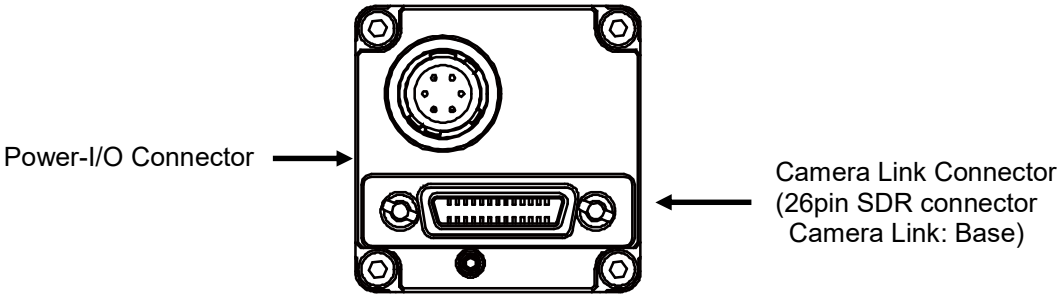
Taking these steps will maintain the heat rating of the electronic components of the camera.

Upper side of camera

Measuring point



3.5 Common Specification



3.5.1 Camera Link Connector

SDR (3M) or equivalent
This camera is PoCL supported Camera Link camera.
The Camera Link frame grabber board is supplied the power to the camera through the Camera Link cable and connectors if the frame grabber board and the cable are applicable for the PoCL.

Pin Assignment

Pin No.	Signal Name	Pin No.	Signal Name
1	+12V	14	GND
2	X0-	15	X0+
3	X1-	16	X1+
4	X2-	17	X2+
5	Xclk-	18	Xclk+
6	X3-	19	X3+
7	SerTC+	20	SerTC-
8	SerTFG-	21	SerTFG+
9	CC1-(TRG)	22	CC1+(TRG)
10	CC2+	23	CC2-
11	CC3-	24	CC3+
12	CC4+	25	CC4-
13	GND	26	+12V

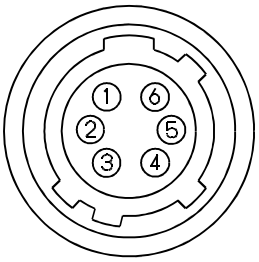
3.5.2 Power-I/O Connector

HR10A-7R-6PB (Hirose) or equivalent connector x 1

This connector is for DC12V power input and the input and output signals.
Please use HR10A-7P-6S (Hirose) or equivalent connector for the connecting cable.

Pin assignment

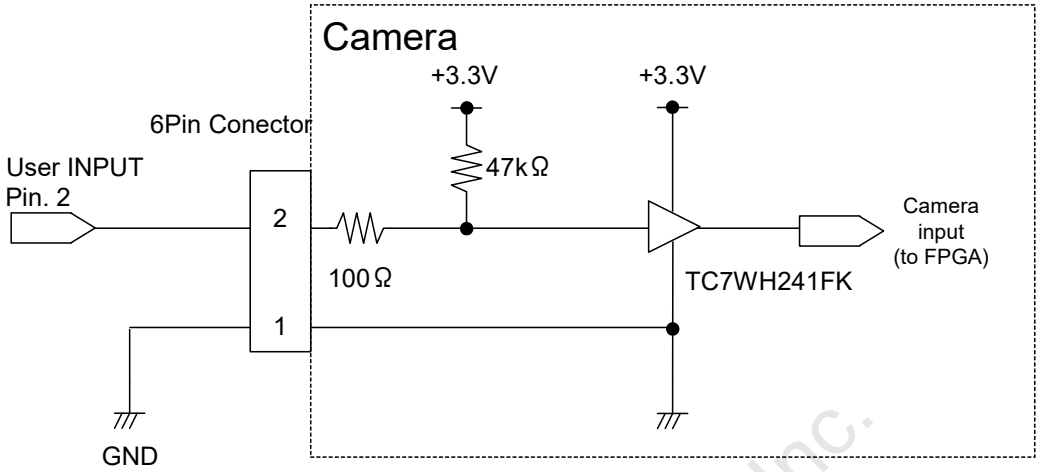
Pin No.	Signal Name	IN / OUT	Voltage		Consumption
			Low voltage	High voltage	
1	GND	IN	0V		
2	Trigger	IN	0 to +0.99 V	+2.3 to +3.6 V	5 µA (typ.) (*1)
3	FVAL	OUT	0 V	+3.3 V	10 mA (Max.) (*2)
4	LVAL	OUT	0 V	+3.3 V	10 mA (Max.) (*2)
5	Trigger Filter	OUT	0 V	+3.3 V	10 mA (Max.) (*2)
6	DC12V	IN	+12 V		



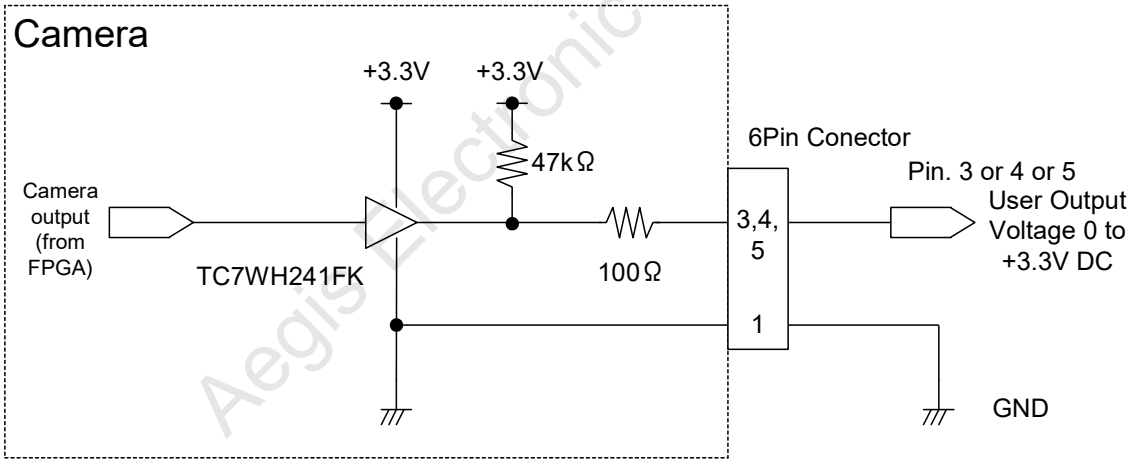
The trigger signal input connector is selectable from below two connectors by the camera control command.
Camera Link connector: CC1
Power-I/O connector: 2pin

(*1) The power consumption when the high voltage trigger signal input to the input port.
(*2) The power consumption for the output port has to be managed less than 10 mA.

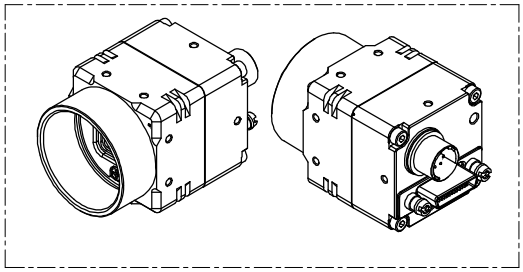
3.5.3 Input signal circuit

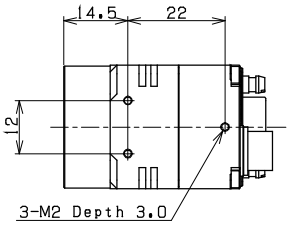


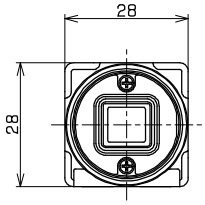
3.5.4 Output signal circuit

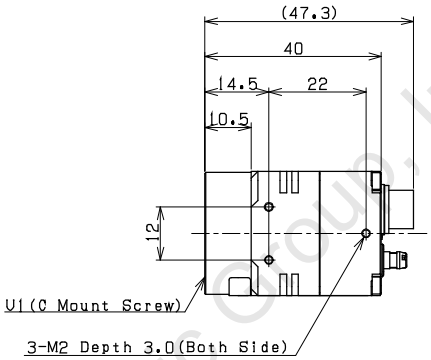


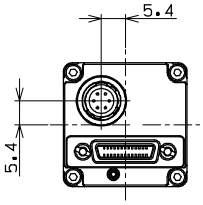
4 Dimensions

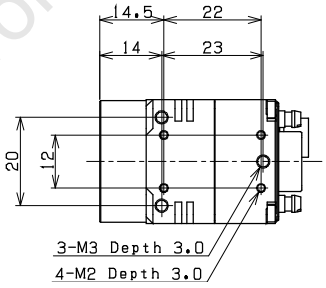








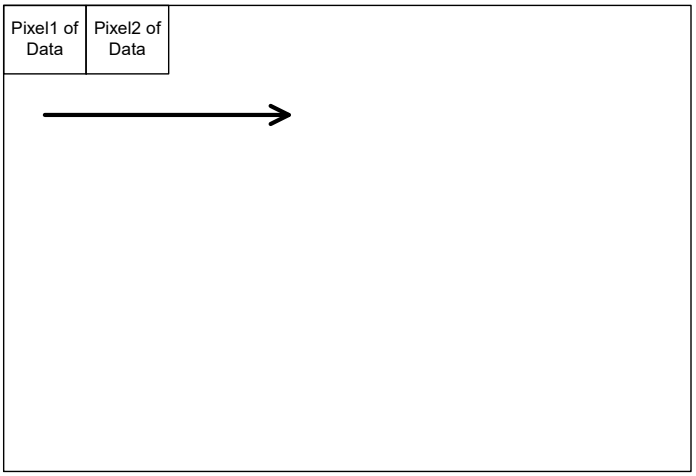




Unit: mm

5 Sensor Information

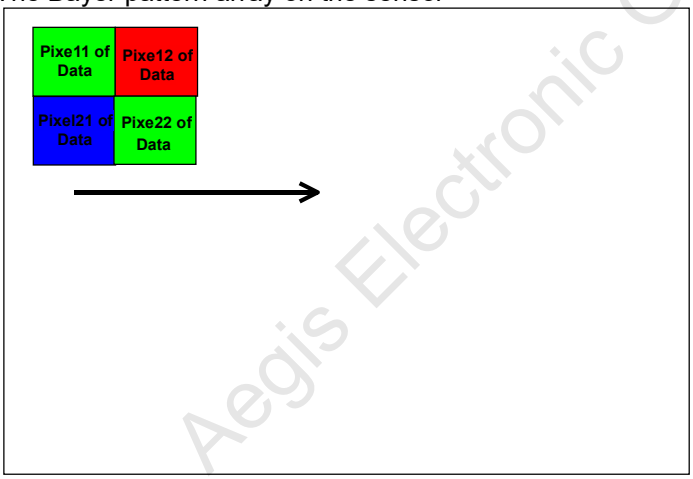
STC-APB503PCL (Monochrome)



Pixel (n) of Data: nth pixel being transferred

STC-APC503PCL (Color)

The Bayer pattern array on the sensor



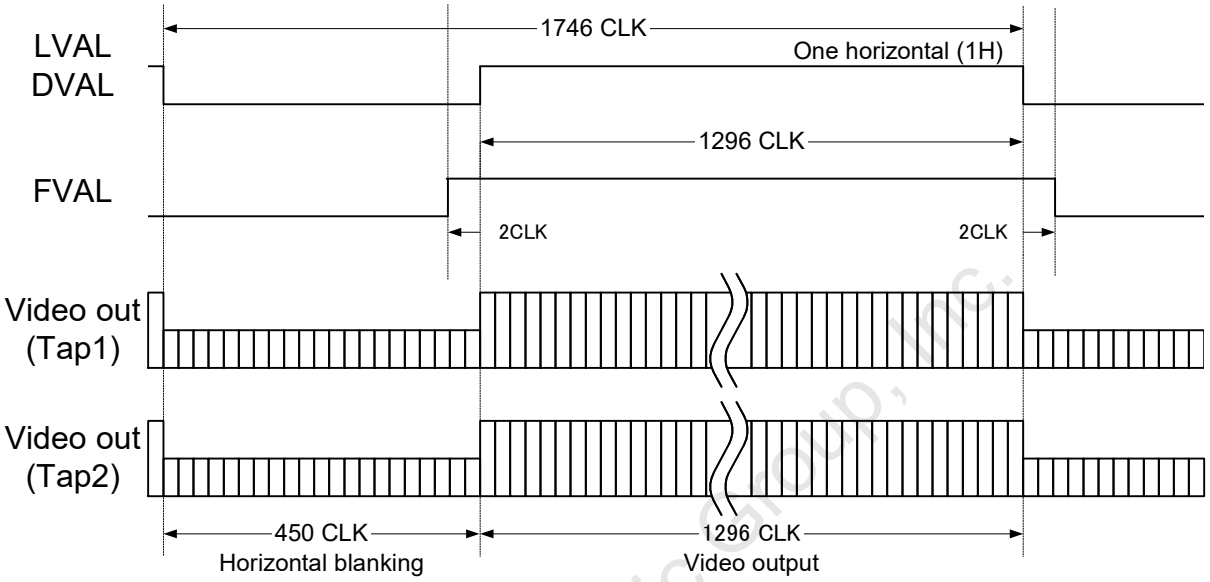
Pixel (m, n) of Data: nth pixel of the mth line being transferred

6 Camera output timing Charts

6.1 Horizontal timing

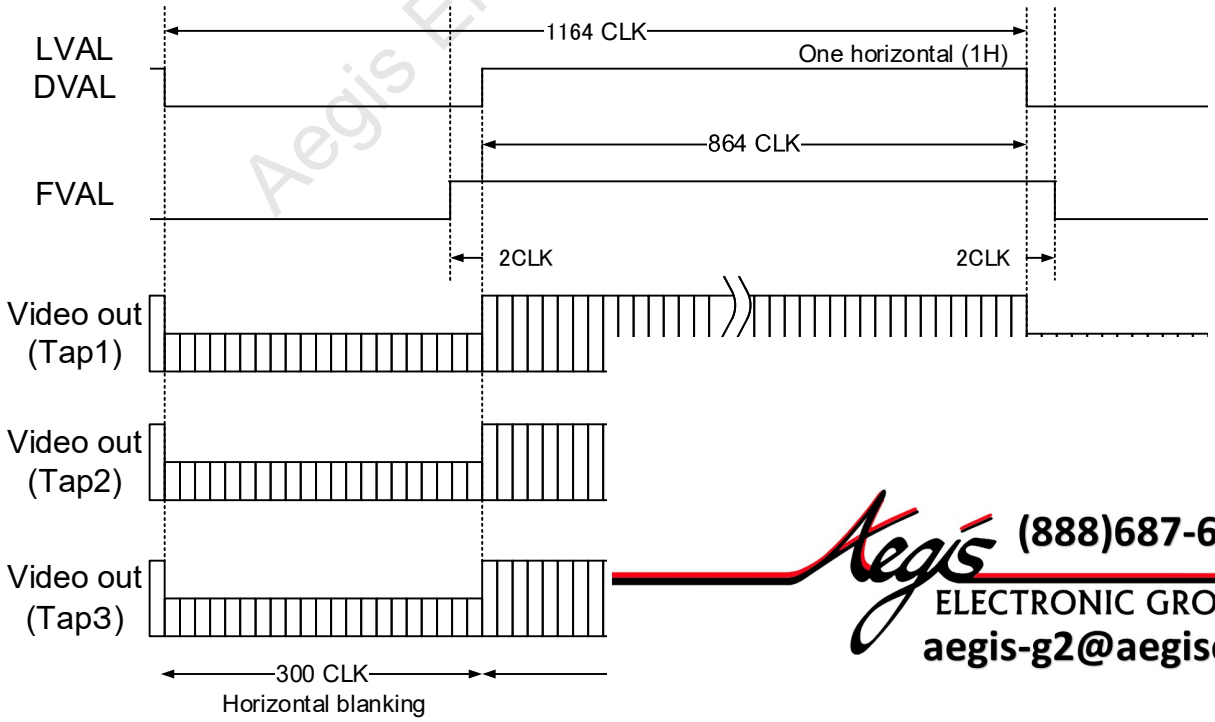
6.1.1 2 TAP (1X2-1Y) / Horizontal 2,592 pixels

1 CLK = 20.83 nseconds



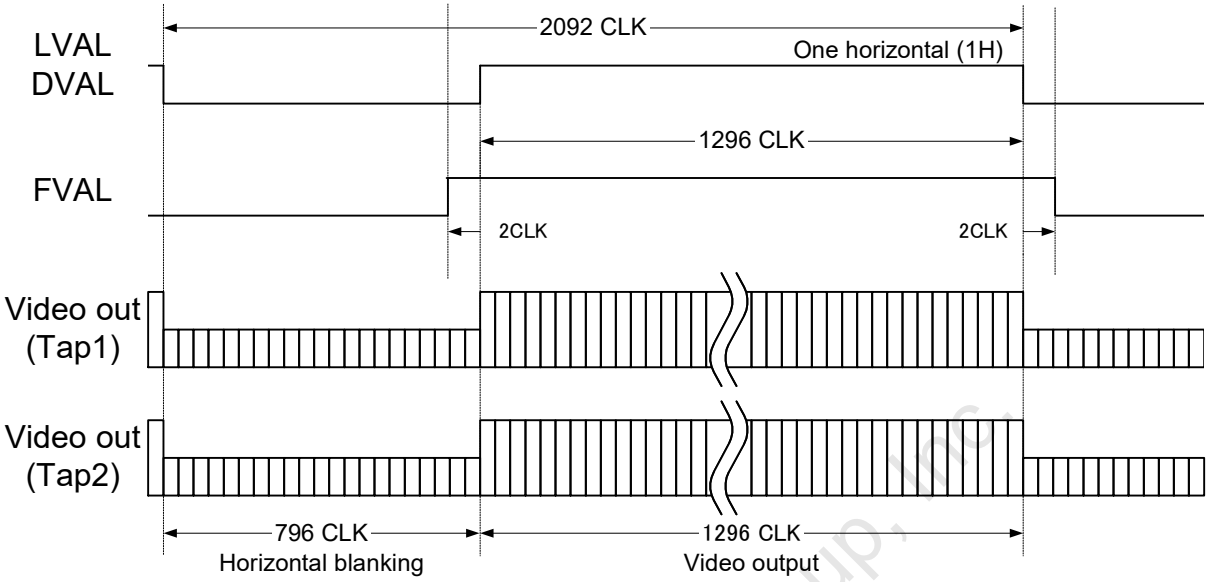
6.1.2 3 TAP (1X3-1Y) / Horizontal 2,592 pixels

1 CLK = 31.25 nseconds



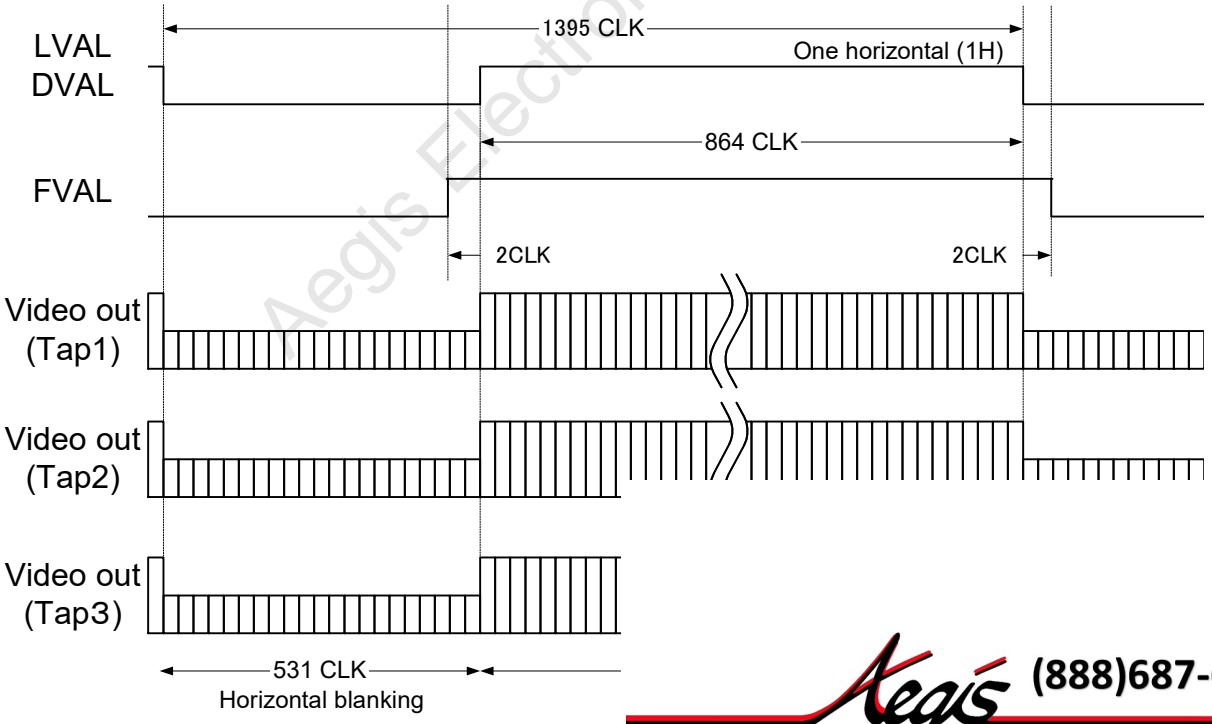
6.1.3 2 TAP (1X2-1Y) / Binning

1 CLK = 20.83 nseconds



6.1.4 3 TAP (1X3-1Y) / Binning

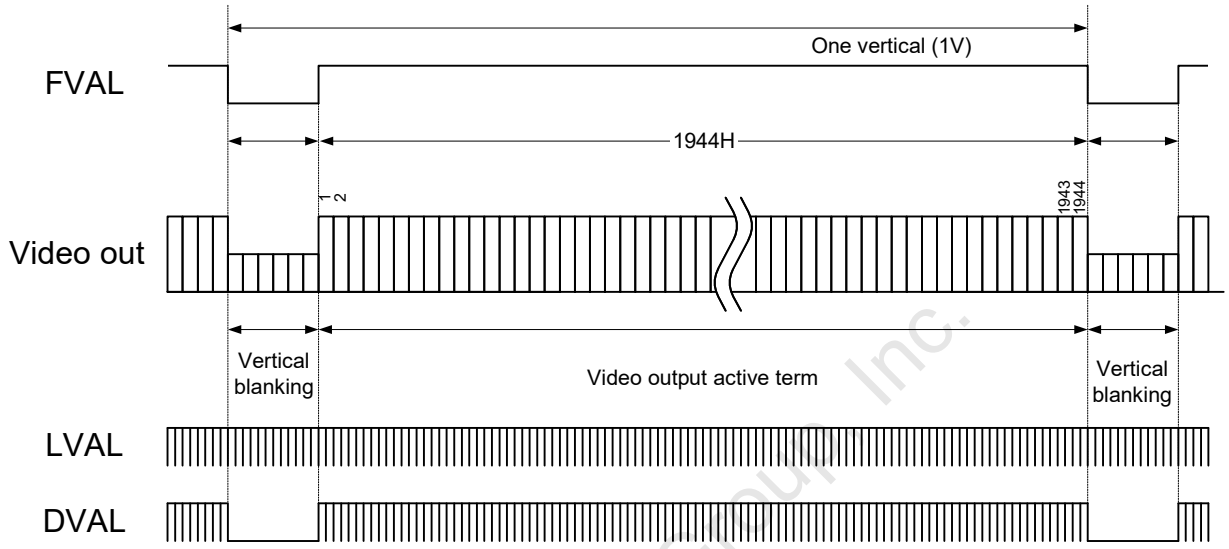
1 CLK = 31.25 nseconds



6.2 Vertical Timing

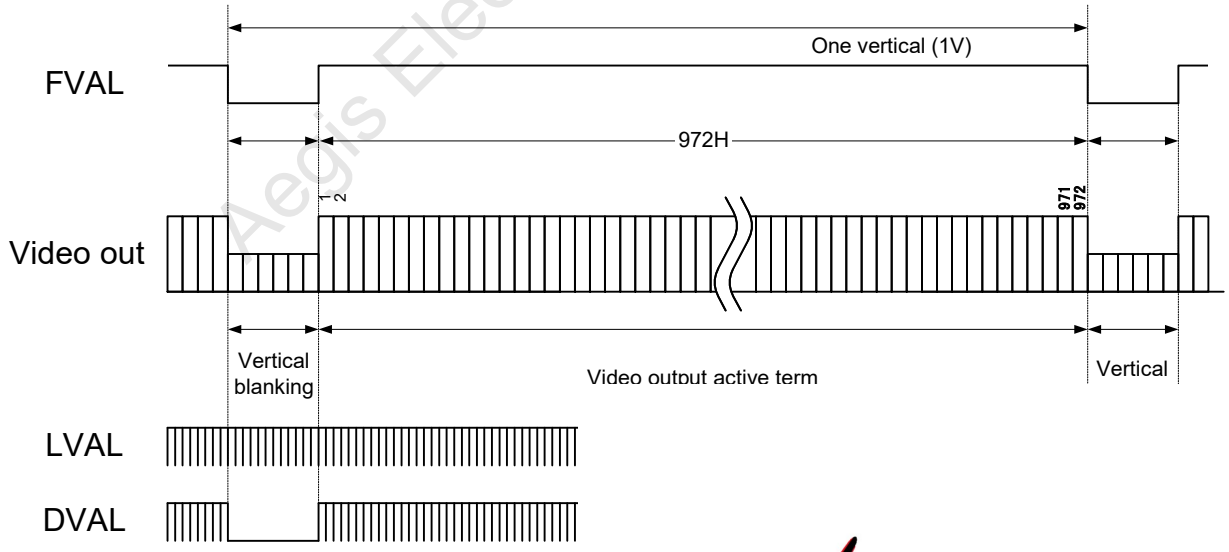
8.1.1 Full scanning

1 H = 36.375 μseconds



8.1.2 Binning

1 H = 43.61 μseconds

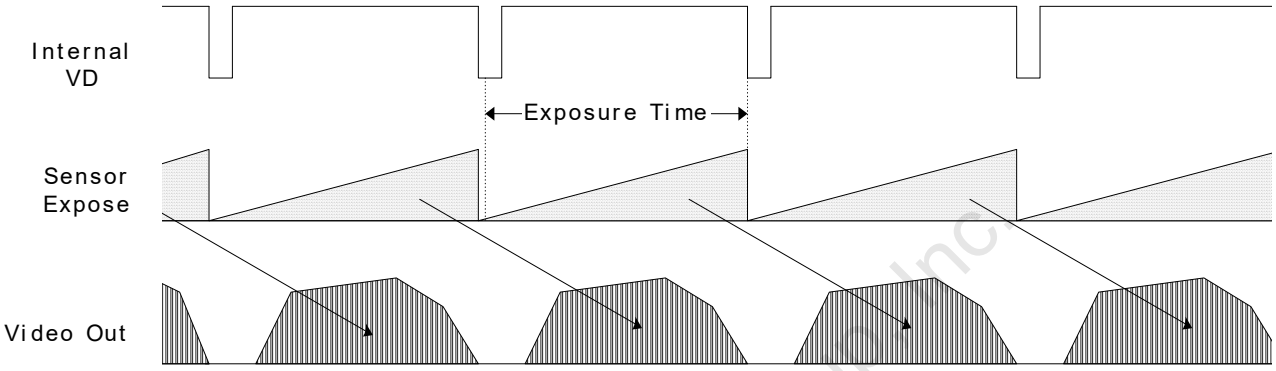


7 Camera Function Mode

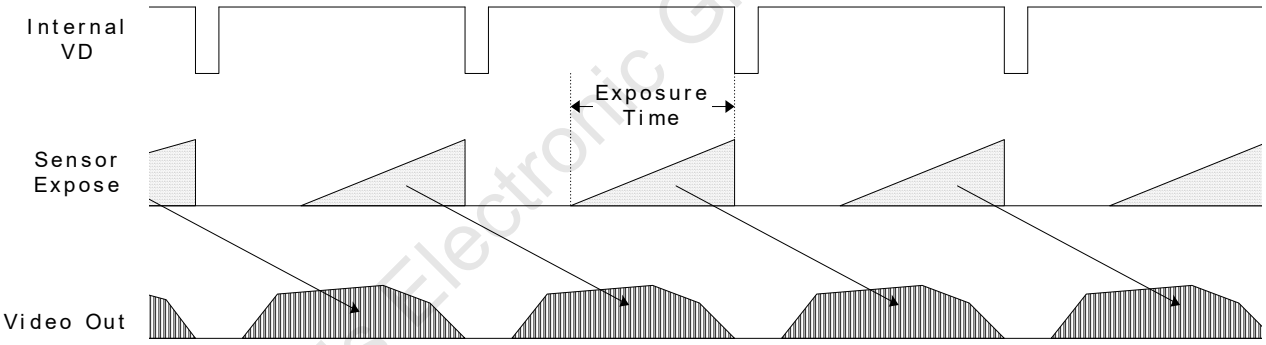
7.1 Free-run / Continuous mode

This mode can be outputted camera video signal continuously.

8.1.3 Full frame exposure



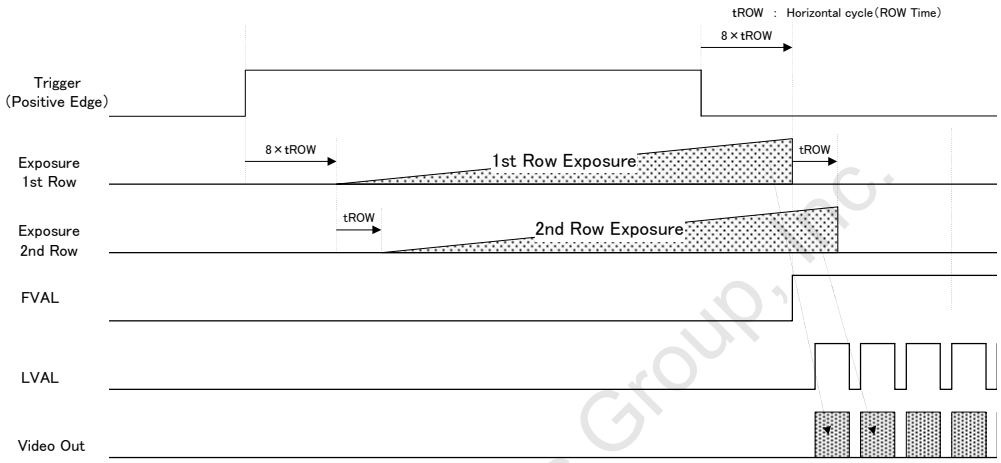
8.1.4 Electronic shutter



8.2 Pulse width trigger mode

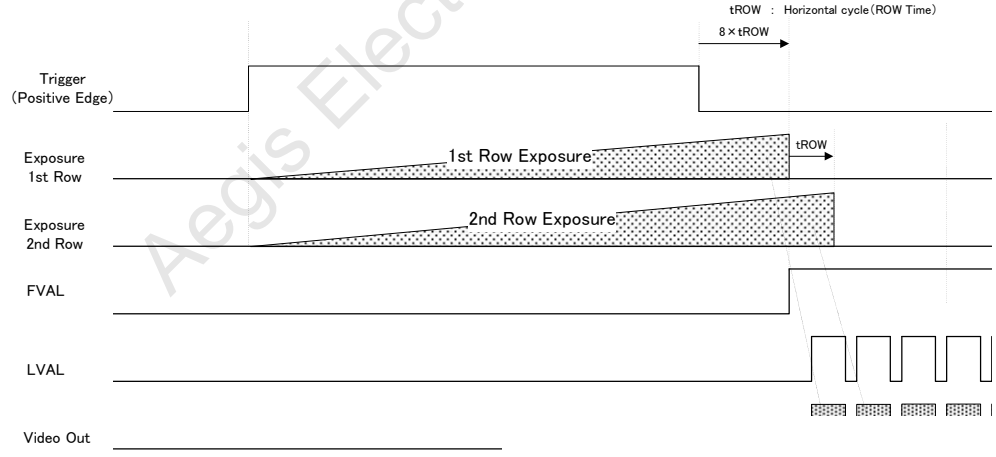
The camera exposure starts by the trigger signal.
In this trigger mode with positive trigger polarity, the camera exposure starts at the rising edge of the trigger signal and stops at the falling edge of the trigger signal.
Therefore, In the case of the exposure positive polarity is selected, the exposure periods (exposure time) are the high states of the trigger signal.

8.2.1 Pulse width trigger mode (Electronic Rolling Shutter [ERS])



8.2.2 Pulse width trigger mode (Global Reset Release [GRR])

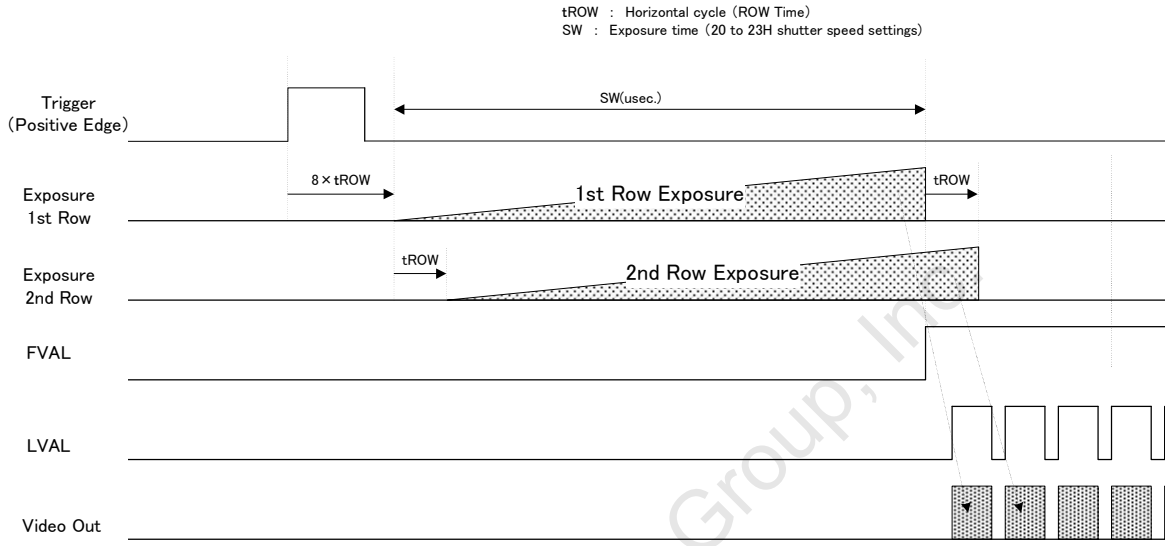
d



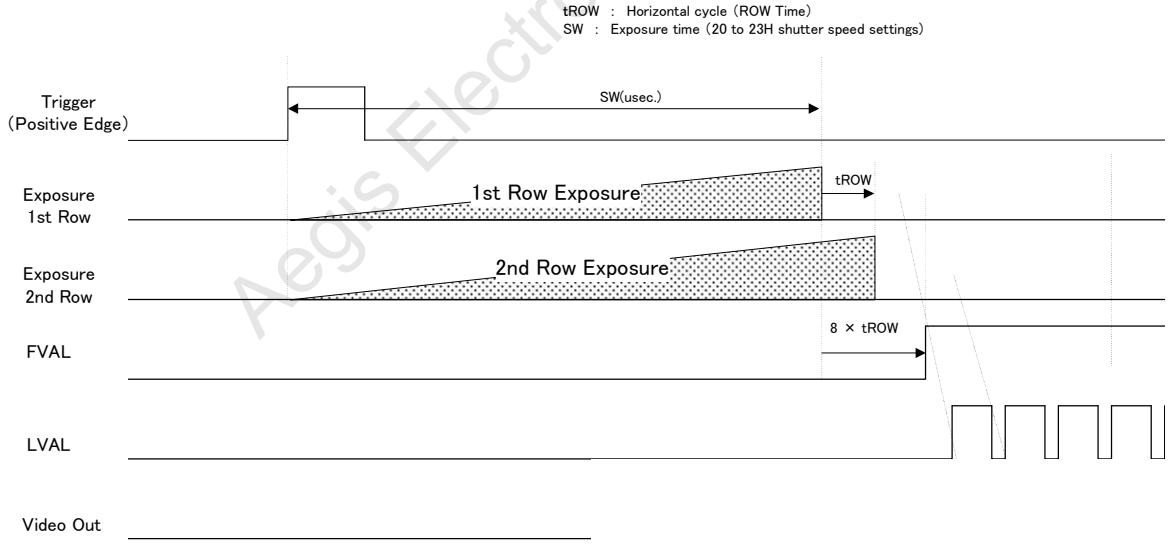
8.3 Edge Preset Trigger mode

The camera exposure starts by the trigger signal.
In this trigger mode with positive trigger polarity, the camera exposure starts at the rising edge of the trigger signal. The exposure time is preset by the “Electrical Shutter” settings.

8.3.1 Edge preset trigger mode (Electronic Rolling Shutter [ERS])



8.3.2 Edge preset trigger mode (Global Reset Release [GRR])



9 Communication Protocol specifications

This camera has a communication function that enables external devises such as a PC, to change the camera settings. Please use “CLCtrl2 (ver. 1.21 or later)” communication software or use the following communication protocol to communicate to the camera.

9.1 Communication method

UART (RS232C standard compliant), Binary communication

9.2 Communication settings

Baud rate	**9,600bps** / 38,400bps / 57,600bps / 115,200bps
Data bit	8bits
Parity	None
Stop bit	1bit
Flow control	None

9.3 Communication format

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

SOF (8bits)	Device code (6bits)	Read / write (1bit)	Page selection (1bit)	Command code (8bits)	Data length (8bits)	Data (Write: Data length) (Read: 1 byte)	EOF (8bits)

B. The receiving data format from the camera is as follows:

a. After sent the read command

SOF (8bits)	Data length (8bits)	Data (Data length byte)	EOF (8bits)

b. After sent the write command

SOF (8bits)	Data length (00H) (8bits)	Receiving code (8bits)	EOF (8bits)

C. Descriptions of the format

SOF	Start of the frame. Sets (or obtains) the value is as “02H” always.
Device code	Sets the device code of the camera. Sets the value is as “000000” always.
Read / Write	Sets “0” when sending read command. Sets “1” when sending write command.
Page selection	Sets “0” when accessing to the register of the camera. Obtains the current data from the register when sending read command. Replaces the data in the register by sending data when sending write command. **The data in the EEPROM does not replace.** Sets “1” when accessing to the EEPROM of the camera. Obtains the data from the EEPROM when sending read command. Replaces the data in the EEPROM by sending data when sending write command. The camera uses the data in the EEPROM when the power on the camera. The camera sends the receiving code as “01H” to the PC after the data in the EEPROM is replaced. The camera rejects any commands while the data in the EEPROM is replacing. (Approximately 5 mseconds / byte)
Command code	Sets the command code. Please refer “The camera control commands” for more details.
Data length	Sets (or obtains) the data length. (unit: byte) For receiving data: The data length is based on the command after sent read command. The data length is “00H” after sent write command. For sending data: The data length is 1 byte when sending read command. The data length is based on the command when sending write command.
Data	Sets (or obtains) the data based on the command.
EOF	End of the frame Sets (or obtains) the value is as “03H” always.
Receiving code	Obtains the result of the sending command. 01H: The command proceeded correctly (ACK) 10H: The command could not process correctly (NAC) 11H: The communication issue

D. Command example

Send the read command to read the 00H addres
02, 00, 00, 01, 00, 03
SOF, (Device code / Read / Register), Comr

The return command
02, 01, 00, 03

9.4 Camera control commands

9.4.1 Camera control commands list

Note. 1: The data unit of each command is 1 byte (8bits).
Note. 2: The data can be saved to the EEPROM if “X” in the “EEPROM” column in the list.
Note. 3: The camera is operating with the data of the EEPROM when the power on the camera.

Command No.	R/W	EEPROM	Function	Default Data	Data Range
00 - 0FH			Reserved	-	-
10H	R/W	X	Camera function mode 1 (8bits: D[7..0])	01H	
11H	R/W	X	Camera function mode 2 (8bits: D[7..0])	08H	
12H	R/W	X	Camera function mode 3 (8bits: D[7..0])	40H	
13H			Reserved	-	-
14H	R/W	X	Communication mode (8bits: D[7..0])	01H	
15 - 1FH			Reserved	-	-
20H	R/W	X	Exposure time of electronic shutter (24bits: D[7..0])	0	0 to 16,777,215
21H	R/W	X	Exposure time of electronic shutter (24bits: D[15..8])		
22H	R/W	X	Exposure time of electronic shutter (24bits: D[23..16])		
23 - 27H			Reserved	-	-
28H	R/W	X	Delay time for trigger signal (8bits: D[7..0])	0	0 to 255
29 - 2FH			Reserved	-	-
30H	R/W	X	Analog gain (8bits: D[7..0])	0	0 to 180
31H	R/W	X	Digital gain (8bits: D[7..0])	0	0 to 240
32H	R/W	X	Offset gain (8bits: D[7..0])	Factory adjusted value	0 to 60
33 - 37H			Reserved	-	-
38H	R/W	X	Clamp level (8bits: D[7..0])	40	0 to 255
39H			Reserved	-	-
3AH	R/W	X	White Balance R gain (15bits: D[7..0]) (*1)	0	0 to 255
3BH	R/W	X	White Balance B gain (15bits: D[7..0]) (*1)	0	0 to 255
3CH	R/W	X	White Balance GR gain (15bits: D[7..0]) (*1)	0	0 to 255
3DH	R/W	X	White Balance GB gain (15bits: D[7..0]) (*1)	0	0 to 255
3EH	R/W	X	Test pattern level (12bits: D[7..0])	1,023	0 to 4,095
3FH	R/W	X	Test pattern level (12bits: D[11..8])		
3E - 77H			Reserved	-	-
78H	R/W	X	Test Pattern (3bits: D[2..0])		
79 - 7FH			Reserved		
80H	R/W	X	EEPROM control (8bits: D[7..0])		
81 - 8FH			Reserved		
90H	R/W	X	Vertical ROI_A Start line (16bits: D		
91H	R/W	X	Vertical ROI_A Start line (16bits: D		
92 - 9FH			Reserved		
A0H	R/W	X	Vertical ROI_A Effective lines (16b		
A1H	R/W	X	Vertical ROI_A Effective lines (16b		
A2 - AFH			Reserved		

(*1) Only available for the color model

Command No.	R/W	EEPROM	Function	Default Data	Data Range
B0H	R/W	X	Horizontal ROI_A Start pixel (16bits: D[7..0])	16	0 to 2,750
B1H	R/W	X	Horizontal ROI_A Start pixel (16bits: D[15..8])		
B2 - BFH			Reserved	-	-
C0H	R/W	X	Horizontal ROI_A Effective pixels (16bits: D[7..0])	2,592	0 to 2,751
C1H	R/W	X	Horizontal ROI_A Effective pixels (16bits: D[15..8])		
C2 - CFH			Reserved	-	-
D0H	R/W	X	Pixel defect correction control (8bits: D[7..0])	0	
D1H	R/W	X	Pixel defect correction coordinate number (8bits: D[7..0])	0	0 to 255
D2H	R/W	X	Pixel defect X position (Set) (16bits: D[7..0])	0	0 to 2,591
D3H	R/W	X	Pixel defect X position (Set) (16bits: D[15..8])		
D4H	R/W	X	Pixel defect Y position (Set) (16bits: D[7..0])	0	0 to 1,943
D5H	R/W	X	Pixel defect Y position (Set) (16bits: D[15..8])		
D6H	R/W	X	Pixel defect X position (Read) (16bits: D[7..0])	0	-
D7H	R/W	X	Pixel defect X position (Read) (16bits: D[15..8])		
D8H	R/W	X	Pixel defect Y position (Read) (16bits: D[7..0])	0	-
D9H	R/W	X	Pixel defect Y position (Read) (16bits: D[15..8])		
DA - DDH			Reserved	-	-
DEH	R/W	X	Pixel defect correction mode (8bits: D[7..0])	1	
DFH			Reserved	-	-
E0H	R/w	X	Mosaic Gain R gain (8bits: D[7..0])	Factory adjusted value	0 to 255
E1H	R/w	X	Mosaic Gain B gain (8bits: D[7..0])	Factory adjusted value	0 to 255
E2H	R/w	X	Mosaic Gain Gr gain (8bits: D[7..0])	Factory adjusted value	0 to 255
E3H	R/w	X	Mosaic Gain Gb gain (8bits: D[7..0])	Factory adjusted value	0 to 255
E4 - E9H			Reserved	-	-
EAH	R/W	X	White Balance R gain (15bits: D[14..8]) (*1)	16	0 to 127
EBH	R/W	X	White Balance B gain (15bits: D[14..8]) (*1)	16	0 to 127
ECH	R/W	X	White Balance GR gain (15bits: D[14..8]) (*1)	16	0 to 127
EDH	R/W	X	White Balance GB gain (15bits: D[14..8]) (*1)	16	0 to 127
EEH	R/W	X	Camera function mode 6 (8bits: D[7..0])	1	
EFH			Reserved	-	-

(*1) Only available for the color model

9.4.2 Description of the camera control commands (Bank number: 00H)
The underline 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] Default data: MOD1 [7..0] = 01H
Sets the camera function mode.
<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</td><td>Trigger Mode Selection</td><td>0: Auto</td><td>1: Manual</td></tr>
<tr><td>D6</td><td>Trigger Polarity</td><td>0: Positive</td><td>1: Negative</td></tr>
<tr><td>D5</td><td>Trigger Mode</td><td>0: Edge Preset</td><td>1: Pulse Width</td></tr>
<tr><td>D4</td><td>Binning Mode *1</td><td>0: OFF</td><td>1: ON</td></tr>
<tr><td>D3 to D1</td><td>No Function</td><td colspan="2">Always set as “000”</td></tr>
<tr><td>D0</td><td>CMOS Shutter Mode</td><td>0: Rolling (ERS)</td><td>1: Global Reset (GRR)</td></tr>
</table>
*1 Only available for monochrome model (Please sets 0 for color model)</td></tr>
<tr><td>11H:
MOD2 [7..0]</td><td>[Camera function mode 2] Default data: MOD2 [7..0] = 00H
Sets the camera function mode.
<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 D4</td><td>No Function</td><td colspan="2">Always set as “0000”</td></tr>
<tr><td>D3</td><td>Operation Mode</td><td>0: Trigger</td><td>1: Free-run / Continuous</td></tr>
<tr><td>D2 to D0</td><td>No Function</td><td colspan="2">Always set as “000”</td></tr>
</table>
* Note: While the camera is in trigger mode, the image will not output without the trigger signal input.</td></tr>
<tr><td>12H:
MOD3 [7..0]</td><td>[Camera function mode 3] Default data: MOD3 [7..0] = 40H
Sets the camera function mode.
<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>Output Format</td><td>00: 10bits</td><td>01: 8bits</td></tr>
<tr><td></td><td></td><td colspan="2">10 to 11: No Function</td></tr>
<tr><td>D5</td><td>Trigger Input</td><td>0: CC1 on Camera Link</td><td>1: 2pin on power-I/O</td></tr>
<tr><td>D4 to D0</td><td>No Function</td><td colspan="2">Always set as “00000”</td></tr>
</table></td></tr>
<tr><td>14H:
UART [7..0]</td><td>[Communication mode] Default data: UART [7..0] = 01H
Sets the communication mode.
<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 D2</td><td>No Function</td><td colspan="2">Sets always as "000000"</td></tr>
<tr><td>D1 to D0</td><td>Communication Mode</td><td>00: 38,400 bps</td><td>01: 9,600 bps</td></tr>
<tr><td></td><td></td><td>10: 57,600 bps</td><td>11: 115,200 bps</td></tr>
</table></td></tr>
</table>

OMRON

Command No.	Command Description
20H: SVR [7:0] 21H: SVR [15:8] 22H: SVR [23:16]	[Exposure time of electronic shutter] Default data: SVR [23..0] = 0, Data range: 0 to 16,777,215 Sets the preset shutter speed (exposure time) for electronic shutter. Exposure time (shutter speed) = 1 * SVR (µseconds)
28H: DLY [7:0]	[Delay time for trigger signal] Default data: DLY [7..0] = 0, Data range: 0 to 255 Sets the delay time from the trigger signal input to start exposure. Delay time = 2 * DLY [7..0] (µseconds)
30H: PGA[7..0]	[CMOS Gain] Default data: PGA [7..0] = 0, Data range: 0 to 255 Sets analog and digital gain. Value 0 to 55: Gain = 1 + 0.125 * PGA Value 56 to 87: Gain = 8 + 0.25 * (PGA - 56) Value 88 to 119: Gain = 16 + 0.5 * (PGA - 88) Value 120 to 151: Gain = 32 + 1.0 * (PGA - 120) Value 152 to 183: Gain = 64 + 2.0 * (PGA - 152) Value 184 to 215: Gain = 128 + 4.0 * (PGA - 184) Value 216 to 255: Gain = 252
31H: DGB[7..0]	[Digital Gain] Default data: DGB [7..0] = 0 Sets digital gain. Output image level = (input image level – CLAMP [7..0] x 4) x (1 + DGB [7..0] / 128) + CLAMP [7..0] x 4
32H: GOFS[7..0]	[Gain offset] Default data: GOFS [7..0] = Factory adjusted value Sets digital gain. Output image level = (input image level – CLAMP [7..0] x 4) x (1 + DGB [7..0] / 128) + CLAMP [7..0] x 4
38H: CLAMP [7:0]	[Clamp level] Default data: CLAMP [7..0] = 40, Data range: 0 to 255 Sets the 10bits clamp level of the black signal.
3AH: WBR [7:0]	[White Balance R gain] Default data: WBR [14..0] = 4,096, Data range (WBR [7..0]): 0 to 255 Sets the Red gain on Bayer Video level = (Input video level - CLAMP [7..0]) * WBR [14..0] / 4,096 + CLAMP [7..0] WBR [14..0] = 4,096: x1 gain, WBR [14..0] = 8,192: x2 gain, WBR [14..0] = 12,288: x3 gain, WBR [14..0] = 16,384: x4 gain, WBR [14..0] = 20,480: x5 gain, WBR [14..0] = 24,576: x6 gain, WBR [14..0] = 28,672: x7 gain, WBR [14..0] = 32,768: x8 gain *WBR [14..8]: EAH
3BH: WBB [7:0]	[White Balance B gain] Default data: WBB [14..0] = 4,096, Data range (WBB [7..0]): 0 to 255 Sets the Blue gain on Bayer Video level = (Input video level - CLAMP [7..0]) * WBB [14..0] / 4,096 + CLAMP [7..0] WBB [14..0] = 4,096: x1 gain, WBB [14..0] = 8,192: x2 gain, WBB [14..0] = 12,288: x3 gain, WBB [14..0] = 16,384: x4 gain, WBB [14..0] = 20,480: x5 gain, WBB [14..0] = 24,576: x6 gain, WBB [14..0] = 28,672: x7 gain, WBB [14..0] = 32,768: x8 gain *WBB [14..8]: EBH
3CH: WBGR [7:0]	[White Balance GR gain] Default data: WBGR [14..0] = 4,096, Data range (WBGR [7..0]): 0 to 255 Sets the Green gain on Bayer GR line Video level = (Input video level - CLAMP [7..0]) * WBGR [14..0] / 4,096 + CLAMP [7..0] WBGR [14..0] = 4,096: x1 gain, WBGR [14..0] = 8,192: x2 gain, WBGR [14..0] = 12,288: x3 gain, WBGR [14..0] = 16,384: x4 gain, WBGR [14..0] = 20,480: x5 gain, WBGR [14..0] = 24,576: x6 gain, WBGR [14..0] = 28,672: x7 gain, WBGR [14..0] = 32,768: x8 gain *WBGR [14..8]: ECH
3DH: WBGB [7:0]	[White Balance GB gain] Default data: WBGB [14..0] = 4,096, Data range (WBGB [7..0]): 0 to 255 Set the Green gain on Bayer GB line Video level = (Input video level - CLAMP [7..0]) * WBGB [14..0] / 4,096 + CLAMP [7..0] WBGB [14..0] = 4,096: x1 gain, WBGB [14..0] = 8,192: x2 gain, WBGB [14..0] = 12,288: x3 gain, WBGB [14..0] = 16,384: x4 gain, WBGB [14..0] = 20,480: x5 gain, WBGR [14..0] = 24,576: x6 gain, WBGB [14..0] = 28,672: x7 gain, WBGB *WBGB [14..8]: EDH
3EH: W [9..8] 3FH: W [7..0]	[Test Pattern level] Default data: W [9..0] Sets signal output level for “04H, signal c
78H: TESTP [7:0]	[Test Pattern] Default data: TESTP [7..0] Sets the output test pattern. D7 | D6 | D5 | D4 | D3 | D D7 to D3: No Function D2 to D0: Test Pattern

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<table>
<tr><th>Command No.</th><th>Command Description</th></tr>
<tr><td>80H:
E2P [7..0]</td><td>[EEPROM control] Default data: E2P[7:0] = 00H
Controls the data writing to the EEPROM.
<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 D1</td><td>No Function</td><td colspan="2">Always set as “0000000”</td></tr>
<tr><td>D0</td><td>Data writes to the EEPROM</td><td>0: Prohibited</td><td>1: Accept</td></tr>
</table>
Note: This bit is cleared to “0” automatically after the data writes into the EEPROM.</td></tr>
<tr><td>90H:VASA [7..0]
91H:VASA [15..8]</td><td>[Vertical ROI_A Start line] Default data: VASA [15..0] = 54, Data range: 0 to 2,004,
Data adjustable unit: 4 pixels
Sets the start line (vertical) of the ROI.
The actual start line of the ROI = this value (VASA)</td></tr>
<tr><td>A0H:VAHA [7..0]
A1H:VAHA [15..8]</td><td>[Vertical ROI_A Effective lines] Default data: VAHA [15..0] = 1,944, Data range: 0 to 2,005,
Data adjustable unit: 4 lines
Sets the effective lines (image height) of the ROI.</td></tr>
<tr><td>B0H:HASA [7..0]
B1H:HASA [15..8]</td><td>[Horizontal ROI_A Start pixel] Default data: HASA [15..0] = 16, Data range: 0 to 2,750,
Sets the start pixel (horizontal) of the ROI.
The actual start pixel of the ROI = this value (HASA)</td></tr>
<tr><td>C0H:HAWA [7..0]
C1H:HAWA [15..8]</td><td>[Horizontal ROI_A Effective pixels] Default data: HAWA [15..0] = 2,592, Data range: 0 to 2,751,
Sets the effective pixels (image width, DVAL, LVAL) of ROI.</td></tr>
<tr><td>D0H:
DEF_M[7..0]</td><td>[Pixel defect correction control] Default data: PDC0 [7..0] = 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</td><td>Set coordinate of pixel defect position</td><td>0 to 1: Set the coordinate of the pixel defect position
Sets the correspond positions in D2H to D5H registers to the pixel defect coordinate number is assigned in D1H register.
(This bit is cleared to “0” automatically after sets the coordinate of the pixel defect position)</td></tr>
<tr><td>D6</td><td>Load coordinate of pixel defect position</td><td>0 to 1: Read the coordinate of the pixel defect position
Reads the pixel defect coordinate number is assigned in D1H register corresponding position to D6H to D9H registers.
(This bit is cleared to “0” automatically after reads the coordinate of the pixel defect position)</td></tr>
<tr><td>D5</td><td>Save coordinate of defect pixel position into the EEPROM</td><td>0 to 1: Save the coordinate of the pixel defect positions into the EEPROM
All 512 coordinate numbers of the pixel defect position information are saved into the EEPROM.
(This bit is cleared to “0” automatically after saves the coordinate of the pixel defect positions)</td></tr>
<tr><td>D4 to D0</td><td>No Function</td><td>Always set as "00000"</td></tr>
</table></td></tr>
<tr><td>D1H:
PDC1[7..0]</td><td>[Pixel defect correction coordinate number] Default data: PDC1 [7..0] = 0
Sets the coordinate number of the pixel defect correction.
<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 D0</td><td>Pixel defect correction coordinate number</td><td>0 to 255</td></tr>
</table></td></tr>
<tr><td>D2H:
PDC_WX [7..0]
D3H:
PDC_WX [15..8]</td><td>[Pixel defect X position (Set)] Default dat
Sets the X (horizontal) coordinate positic</td></tr>
<tr><td>D4H:
PDC_WY [7..0]
D5H:
PDC_WY [15..8]</td><td>[Pixel defect Y position (Set)] Default dat
Sets the Y (vertical) coordinate position c</td></tr>
</table>

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<table>
<tr><th>Command No.</th><th>Command Description</th></tr>
<tr><td>D6H:
PDC_RX [7..0]
D7H:
PDC_RX [15..8]</td><td>[Pixel defect X position (Read)] Default data: PDC_RX [15..0] = 0
Sets the X (horizontal) coordinate position of the defect pixel for read the position.</td></tr>
<tr><td>D8H:
PDC_RY [7..0]
D9H:
PDC_RY [15..8]</td><td>[Pixel defect Y position (Read)] Default data: PDC_RY [15..0] = 0
Sets the Y (vertical) coordinate position of the defect pixel for read the position.</td></tr>
<tr><td>DEH:
DEF_M [7..0]</td><td>[Pixel defect correction mode] Default data: DEF_M [7..0] = 1
<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 D2</td><td>No Function</td><td colspan="2">Always set as “000000”</td></tr>
<tr><td>D1</td><td>Highlight the corrected pixel</td><td>0: Disable</td><td>1: Enable</td></tr>
<tr><td>D0</td><td>Pixel defect correction</td><td>0: Disable</td><td>1: Enable</td></tr>
</table>
The corrected pixel is appeared with the highlight when “Highlight the corrected pixel” is enabled.</td></tr>
<tr><td>EAH:
WBR [14..8]</td><td>[White Balance R Gain] Default data: WBR [14..0] = 4,096, Data range (WBR [14..8]): 0 to 127
Sets the Red gain on Bayer
Video level = (Input video level - CLAMP [7..0]) * WBR [14..0] / 4,096 + CLAMP [7..0]
WBR [14..0] = 4,096: x1 gain, WBR [14..0] = 8,192: x2 gain, WBR [14..0] = 12,288: x3 gain,
WBR [14..0] = 16,384: x4 gain, WBR [14..0] = 20,480: x5 gain, WBR [14..0] = 24,576: x6 gain,
WBR [14..0] = 28,672: x7 gain, WBR [14..0] = 32,768: x8 gain
*WBR [7:0]: 3AH</td></tr>
<tr><td>EBH:
WBB [14..8]</td><td>[White Balance B Gain] Default data: WBB [14..0] = 4,096, Data range (WBB [14..8]): 0 to 127
Sets the Blue gain on Bayer
Video level = (Input video level - CLAMP [7..0]) * WBB [14..0] / 4,096 + CLAMP [7..0]
WBB [14..0] = 4,096: x1 gain, WBB [14..0] = 8,192: x2 gain, WBB [14..0] = 12,288: x3 gain,
WBB [14..0] = 16,384: x4 gain, WBB [14..0] = 20,480: x5 gain, WBB [14..0] = 24,576: x6 gain,
WBB [14..0] = 28,672: x7 gain, WBB [14..0] = 32,768: x8 gain
*WBB [7:0]: 3BH</td></tr>
<tr><td>ECH:
WBGR [14..8]</td><td>[White Balance GR Gain] Default data: WBGR [14..0] = 4,096, Data range (WBGR [14..8]): 0 to 127
Sets the Green gain on Bayer GR line
Video level = (Input video level - CLAMP [7..0]) * WBGR [14..0] / 4,096 + CLAMP [7..0]
WBGR [14..0] = 4,096: x1 gain, WBGR [14..0] = 8,192: x2 gain, WBGR [14..0] = 12,288: x3 gain,
WBGR [14..0] = 16,384: x4 gain, WBGR [14..0] = 20,480: x5 gain, WBGR [14..0] = 24,576: x6 gain,
WBGR [14..0] = 28,672: x7 gain, WBGR [14..0] = 32,768: x8 gain
*WBGR [7:0]: 3CH</td></tr>
<tr><td>EDH:
WBGB [14..8]</td><td>[White Balance GB Gain] Default data: WBGB [14..0] = 4,096, Data range (WBGB [14..8]): 0 to 127
Sets the Green gain on Bayer GB line
Video level = (Input video level - CLAMP [7..0]) * WBGB [14..0] / 4,096 + CLAMP [7..0]
WBGB [14..0] = 4,096: x1 gain, WBGB [14..0] = 8,192: x2 gain, WBGB [14..0] = 12,288: x3 gain,
WBGB [14..0] = 16,384: x4 gain, WBGB [14..0] = 20,480: x5 gain, WBGB [14..0] = 24,576: x6 gain,
WBGB [14..0] = 28,672: x7 gain, WBGB [14..0] = 32,768: x8 gain
*WBGB [7:0]: 3DH</td></tr>
<tr><td>EEH:
MOD6 [7..0]</td><td>[The camera function mode] Default data: MOD6 [7..0] = 2
Sets the camera TAP number for each setting.
<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 D0</td><td>TAP Configuration</td></tr>
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9.4.3 Command sequence for the data saves to the EEPROM

Please follow the command sequence in below for the data saves to the EEPROM.

1) Sets “1” to command 80H.0 to accept “write control to the EEPROM”.

2) Sends the EEPROM write command with data, which sets “1” for the page selection.

3) The camera sends back one of the below receiving code after the EEPROM write command is proceed.
   01H: Data saves to the EEPROM correctly
   10H: EEPROM write error

4) Command 80H.0 is changed to “0” automatically after the EEPROM write command is proceed.

Note.1) The data does not save into the EEPROM when the command 80H.0 is “0”.

Note.2) The data of the multiple continuous commands can save to the EEPROM by one sets of above sequence (1) to 4)).
   e.g. Multiple continuous command: “10H, 11H, 12H and 13H” or “22H, 23H and 24H”.

Note.3) When save the data of the multiple commands, which is not continuous commands, to the EEPROM, it is necessary to operate the multiple sets of above sequence (1) to 4)).
   e.g. Multiple commands: “10H, 13H, 19H and 1BH” or “20H, 23H and 25H”.

11 Revisions History

Rev	Date	Changes	Note
00	2019/01/28	New Document	
01	2019/02/27	Revised Added trademark information	

Camera Link (including PoCL) is trademark of AIA.
Other company names and product names in this document