

# High-Resolution CMOS Camera

## CSC6M100BMP11 CSC6M100CMP11

### PRODUCT SPECIFICATION

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**TOSHIBA TELI CORPORATION**

D4234238C

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## Restriction For Use

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- Should the equipment be used in the following conditions or environments, give consideration to safety measures and inform us of such usage:
  1. Use of the equipment in the conditions or environment contrary to those specified, or use outdoors.
  2. Use of the equipment in applications expected to cause potential hazard to people or property, which require special safety measures to be adopted.
- This product can be used under diverse operating conditions. Determination of applicability of equipment or devices concerned shall be determined after analysis or testing as necessary by the designer of such equipment or devices, or personal related to the specifications. Such designer or personal shall assure the performance and safety of the equipment or devices.
- This product is not designed or manufactured to be used for control of equipment directly concerned with human life (\*1) or equipment relating to maintenance of public services/functions involving factors of safety (\*2). Therefore, the product shall not be used for such applications.
  - (\*1): Equipment directly concerned with human life refer to:
    - Medical equipment such as life-support systems, equipment for operating theaters.
    - Exhaust control equipment for exhaust gases such as toxic fumes or smoke.
    - Equipment mandatory to be installed by various laws and regulations such as the Fire Act or Building Standard Law.
    - Equipment related to the above.
  - (\*2): Equipment relating to maintenance of public service/functions involving factors of safety refer to:
    - Traffic control systems for air transportation, railways, roads, or marine transportation.
    - Equipment for nuclear power generation.
    - Equipment related to the above.

Although sufficient check is performed about translation of these specifications, we will apply a Japanese sentence, if a doubt should occur.

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## Exemption Clauses

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- TELI assumes no responsibility or liability for damage arising from fire, earthquake, an act by a third party or other accidents, or intentional or careless error or misuse by the user, or use under abnormal conditions.
- TELI assumes no responsibility or liability for incidental damages (e.g., loss of business profits or interruption of business) arising from use of or inability to use the camera equipment.
- TELI assumes no responsibility or liability in the case damages or losses are caused by failure to observe the information contained in the operation manual and specifications and interface specifications.
- TELI assumes no responsibility or liability in the case damages or losses are caused by use contrary to the instructions in this operation manual and specifications and interface specifications.
- TELI assumes no responsibility or liability in the case damages or losses are caused by malfunction or other problems resulting from use of equipment or software that is not specified.
- TELI assumes no responsibility or liability in the case damages or losses are caused by repair or modification conducted by the customer or any unauthorized third party (such as an unauthorized service representative).
- Expenses we bear on this product shall be limited to the individual price of the product.
- TELI does NOT guarantee the items that are not described in the specification.

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## Notes on using this product

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- Handle carefully

Do not drop the equipment or allow it to be subject to strong impact or vibration, as such action may cause malfunctions. Further, do not damage the connection cable, since this may cause wire breakage.

- Environmental operating conditions

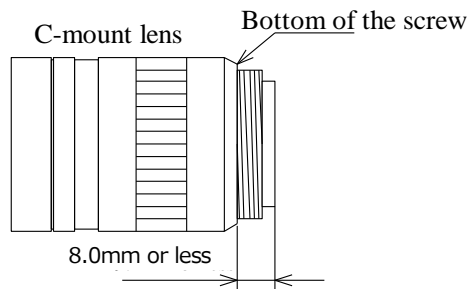
Do not use the product in locations where the ambient temperature or humidity exceeds the specifications.

Otherwise, image quality may be degraded or internal components may be adversely affected. In particular, do not use the product in areas exposed to direct sunlight. Moreover, during shooting under high temperatures, vertical stripes or white spots (noise) may be produced, depending on the subject or camera conditions (such as increased gain).

However, such phenomena are not malfunctions.

- Regarding a lens mount

Install a next lens; Dimension of protrusion from flange is equal to or less than 8.0 mm. If a lens does not stand to this condition, it might not be installed to this camera.



- Check a combination with the lens

Depending on the lens and lighting you use, an image is reflected as a ghost in the imaging area. However, this is not because of a fault of the camera.

In addition, depending on the lens you use, the performance of the camera may not be brought out fully due to deterioration in resolution and brightness in the peripheral area, aberration and others.

Be sure to check a combination with the camera by using the lens and lightning you actually use.

When installing a lens in the camera, make sure carefully that it is not tilted.

In addition, use a mounting screw free from defects and dirt. Otherwise, the camera may be unable to be removed.

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## Notes on using this product

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- Avoid intensive light

Do NOT expose the camera's image-pickup-plane to sunlight or other intense light directly. If the part of CMOS sensor is exposed to spot-intensive light, you might get a picture problem like blooming and/or smear. Under the comparison at the same video output level, the shorter the exposure time setting, the more smear is generated.

- Do not expose the camera's image-pickup-plane to sunlight or other intense light directly. Its inner CMOS sensor might be damaged.

- Occurrence of moire

If you shoot thin stripe patterns, moire patterns (interference fringes) may appear. This is not a malfunction.

- Occurrence of noise on the screen

If an intense magnetic or electromagnetic field is generated near the camera or connection cable, noise may be generated on the screen. If this occurs, move the camera or the cable.

- Handling of the protective cap

If the camera is not in use, attach the lens cap to the camera to protect the image pickup surface.

- If the equipment is not to be used for a long duration

Turn off power to the camera for safety.

- Maintenance

Turn off power to the equipment and wipe it with a dry cloth.

If it becomes severely contaminated, gently wipe the affected areas with a soft cloth dampened with diluted neutral detergent. Never use alcohol, benzene, thinner, or other chemicals because such chemicals may damage or discolor the paint and indications.

If the image pickup surface becomes dusty, contaminated, or scratched, consult your sales representative.

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## CAUTIONS ON USE

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- When disposing of the camera

Wastes of this product should be separated and discarded in compliance with the various national and local ordinances.

This camera is showing the following symbol to body due to EU environmental regulation (Waste Electrical and Electronic Equipment (WEEE)). However this symbol is applied to only an EU member state.



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## Phenomena specific to CMOS sensor

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- Defective pixels

A CMOS image sensor is composed of photo sensor pixels in a square grid array. Due to the characteristics of CMOS image sensors, over- or under-driving of the pixels results in temporary white or black areas (as if these are noises) appearing on the screen. This phenomenon, which is not a defect is exacerbated under higher temperatures and long exposure times.

- Image shading

The brightness of the upper part of the screen may be different from that of the lower part. Note that this is a characteristic of a CMOS image sensor and is not a fault.

This phenomenon is generated when the shutter speed is fast.

We recommend that the shutter speed of the camera should be slower than 1/100s to reduce the effect by this phenomenon

- Shutter artifact

Although the level difference of several lines of an image arises in the upper part of a screen at the time of shutter-off mode, note that this is a characteristic of a CMOS image sensor and is not a fault.

## **1. Overview**

This CMOS camera is a High-resolution CMOS camera employing the CMOS sensor which has 6.55Mega pixels readout system.

## **2. Features**

(1) High speed output at High-resolution pixel.

The TOSHIBA TELI's proprietary 1.1 type 6.55Mega pixels High-resolution CMOS sensor outputs the entire 6.55Mega pixels in a speed as high as 85fps (standard) or 99fps (max.).

(2) WOI (Window Of Interest)

WOI (Window Of Interest) of a partial readout function optimized to diversified high-speed image processing is available.

It supports a variable frame rate to increase the frame rate by specifying an address in horizontal and vertical directions and reading an arbitrary area.

(3) Global shutter

As it employs a global electronic shutter similar to a CCD image sensor, clear images of even fast-moving object are obtainable with less blur.

(4) Random trigger shutter

Photo images can be imported in any timing by inputting external trigger signals.

(5) CameraLink interface

Image output and camera control interfaces employ the CameraLink standard.

The dual SDR connector supporting CameraLink Full-Configuration outputs the entire 6.55Mega pixels at high speed.

(6) Binning

The binning readout function can output the entire pixels for valid area formatted 1,280(H) x 1,280(V) or 640(H) x 640(V) pixels without changing the original camera view by reading 2(H) x 2(V) or 4(H) x 4(V) pixels as one pixel.





## 5. Specifications

### 5.1. Electrical specifications

\*Factory setting are underlined.

(1) Imager	CMOS image sensor	
•Number of active pixels	2560 (H) x 2560 (V)	
•Pixel size	5 μm (H) x 5 μm (V)	Square-grid array
•Scanning area	12.8 mm(H) x 12.8 mm(V)	
•Optical size	Equivalent to 1.1 type	
•Color filter	RGB bayer	*CSC6M100CMP11
(2) Scanning system	Progressive	
(3) Aspect ratio	1:1	
(4) Synchronization method	Internal synchronization	
(5) Sensitivity	900 lx, F5.6, 3000 K	*CSC6M100BMP11
	2200 lx, F5.6, 5000 K	*CSC6M100CMP11
	*Shutter speed 1/60 s	
(6) Minimum object illuminance	8 lx	*CSC6M100BMP11
	20 lx	*CSC6M100CMP11
	*Reading all pixels, F2.8, shutter speed 1/60 s, max gain, gamma value 16, image level 50%	
(7) Image output	Compliant with CameraLink standard	
•Output mode	<u>Full configuration</u>	<u>8 tap</u>
	Medium configuration	4 tap
	Base configuration	2 tap
•Data format	Y	*CSC6M100BMP11
	RAW (G/R/B/G)	*CSC6M100CMP11
•Data Width	<u>8</u> / 10 / 12 bit switching	*4 / 2 tap
	<u>8</u> / 10 bit switching	*8 tap
•Pixel clock	60 / <u>72</u> / 84 MHz switching	
(8) Scan mode		
•All pixels readout	<u>2560(H) x 2560(V)</u>	Approx. 85 fps@72MHz
•Binning(2x2)	1280(H) x 1280(V)	Approx. 170 fps@72MHz
•Binning(4x4)	640(H) x 640(V)	Approx. 340 fps@72MHz
•WOI/Binning	Depends on the window setting.	
(9) Gain		
•Analog gain	<u>0</u> / +3 / +6 / +9 dB switching	
•Digital gain	<u>0.0</u> to +18.0 dB [180 steps, 1step = Approx. 0.1dB]	

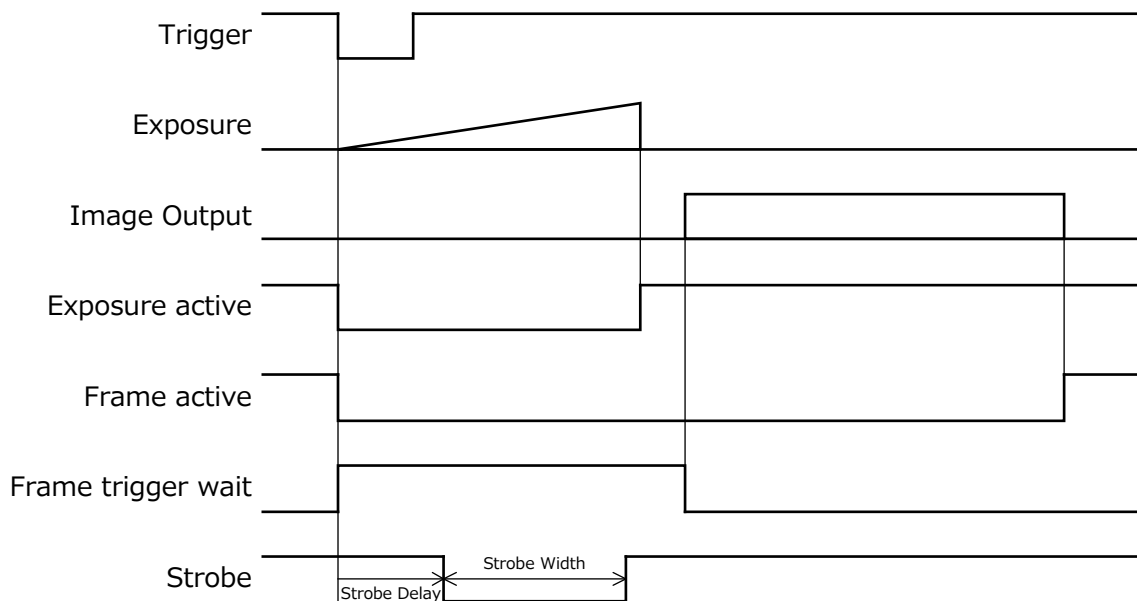


### 5.3. Input/Output signal specifications

- (1) TRIG CameraLink I/F or I/O connector input
  - Signal level LVTTTL (Low Voltage TTL = 3.3V) 1ch
  - Pulse width 10 μsec or more
- (2) GPO I/O connector
  - Signal type Open collector 1ch
  - Signal source

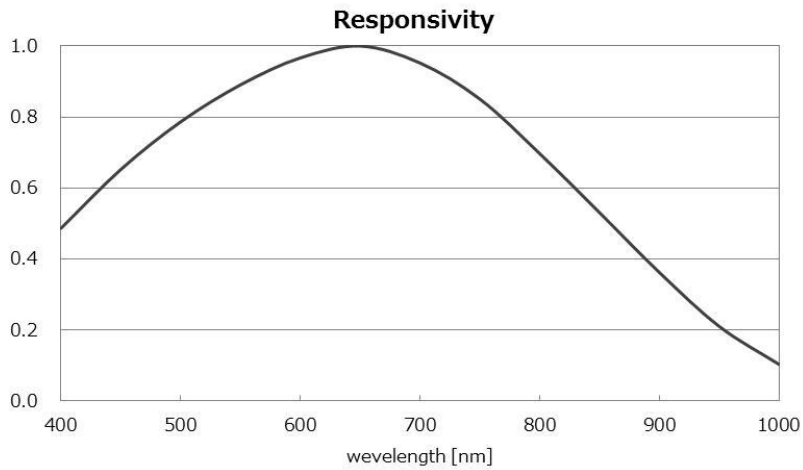
Signal	Explanation
Exposure active	This signal is a period from the start to the end of an exposure.
Frame active	This signal is a period from the start of an exposure to the completion of image transmission.
Frame trigger wait	This signal is that it is a waiting period for a trigger at random trigger shutter. Exposure is started without restrictions of a previous frame when an external trigger is inputted in this period.
Strobe	This is a signal for strobe control. The delaying amount and width from an exposure start can be set up.

•Polarity Positive / Negative

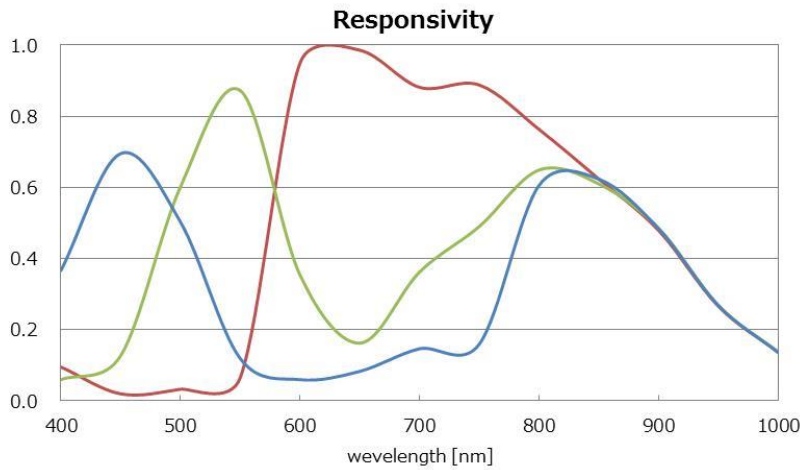




### 5.7. Typical spectral response characteristic



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\*The lens characteristics and light source characteristics are not reflected in table.

### 5.8. Various safety standards

- (1) Electro-Magnetic Compatibility
  - EMI (Electro-Magnetic Interference) : EN61000-6-4
  - EMS (Electro-Magnetic Susceptibility) : EN61000-6-2
- (2) FCC : FCC Part 15 Subpart B class A
- (3) KC (scheduled)

THIS DEVICE HAS COMPLIES WITH PART 15 OF THE FCC RULES.  
OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS:  
(1)THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2)THIS DEVICE  
MUST ACCEPT ANY INTERFERENCE RECEIVED. INCLUDING INTERFERENCE THAT  
MAY CAUSE UNDESIREED OPERATION.

### 5.9. Environmental correspondence

It complies with the following instruction.

- (1) RoHS conformity
- (2) Administrative Measure on the Control of Pollution Caused by Electronic Information Products (Popular name: China RoHS)
  - a) Environmental usage period : refer to 9.2.
  - b) Poisonous substance content table : refer to 9.2.
  - c) Toxic substance content table : refer to 9.2.

### 5.10. Communication specifications

(1) Baud rate 9600 / 19200 / 38400 / 57600 / 115200 bps switchable

\* The re-injection of a camera power supply is required at the time of the change of baud rate.

#### **Note**

Please switch the baud rate within the range which your host supports. If out of range which your host supports and rebooting the camera, you cannot control the camera anymore.

- (2) Start bit 1bit
- (3) Data bit 8bit
- (4) Stop bit 1bit
- (5) Parity None
- (6) Handshake None

### 5.11. Connector pin assignment

\* When connecting a cable to the camera, please turn off the power supply firstly.

(1) Video output/control (Camera Link Full Configuration) B•M/F

•Connector type : SDR 26-PIN connector HDR-EC26FDTG2+(Manufactured by HTK)

Connector name : B

Pin No.	I/O	Signal name	Pin No.	I/O	Signal name
1	-	DC+12V (PoCL)	14	-	GND
2	O	X0-	15	O	X0+
3	O	X1-	16	O	X1+
4	O	X2-	17	O	X2+
5	O	X CLK-	18	O	X CLK+
6	O	X3-	19	O	X3+
7	I	Ser TC+	20	I	Ser TC-
8	O	Ser TFG-	21	O	Ser TFG+
9	I	CC1-	22	I	CC1+
10	I	CC2+	23	I	CC2-
11	I	CC3-	24	I	CC3+
12	I	CC4+	25	I	CC4-
13	-	GND	26	-	DC+12V (PoCL)

Connector name : M/F

Pin No.	I/O	Signal name	Pin No.	I/O	Signal name
1	-	10k $\Omega$ Pull-down (connected 26pin)	14	-	GND
2	O	Y0-	15	O	Y0+
3	O	Y1-	16	O	Y1+
4	O	Y2-	17	O	Y2+
5	O	Y CLK-	18	O	Y CLK+
6	O	Y3-	19	O	Y3+
7	-	100 $\Omega$ terminated(20)	20	-	100 $\Omega$ terminated(7)
8	O	Z0-	21	O	Z0+
9	O	Z1-	22	O	Z1+
10	O	Z2-	23	O	Z2+
11	O	ZCLK-	24	O	ZCLK+
12	O	Z3-	25	O	Z3+
13	-	GND	26	-	10k $\Omega$ Pull-down (connected 1pin)

(2) Power supply connector I/O

- Connector (camera side) : HR10A-7R-6PB(73) (HIROSE ELECTRIC)
- Compatible plug (cable side) : HR10A-7P-6S(73) (HIROSE ELECTRIC)  
or equivalent

Pin No.	I/O	Signal name
1	O	GPO
2	-	GND
3	-	GND
4	I	TRIG
5	-	N.C.
6	-	DC+12V



## 5.12. Camera output bit assignment

Full Configuration				Full Configuration(80bit Configuration)			
Camera Out	8bit			Camera Out	10bit		
DATA OUT1	A[7:0]			DATA OUT1	A[9:0]		
DATA OUT2	B[7:0]			DATA OUT2	B[9:0]		
DATA OUT3	C[7:0]			DATA OUT3	C[9:0]		
DATA OUT4	D[7:0]			DATA OUT4	D[9:0]		
DATA OUT5	E[7:0]			DATA OUT5	E[9:0]		
DATA OUT6	F[7:0]			DATA OUT6	F[9:0]		
DATA OUT7	G[7:0]			DATA OUT7	G[9:0]		
DATA OUT8	H[7:0]			DATA OUT8	H[9:0]		
Port/Bit	8bit	Port/Bit	8bit	Port/Bit	10bit	Port/Bit	10bit
Port A0	A[0]	Port E0	E[0]	Port A0	A[2]	Port F0	F[2]
Port A1	A[1]	Port E1	E[1]	Port A1	A[3]	Port F1	F[3]
Port A2	A[2]	Port E2	E[2]	Port A2	A[4]	Port F2	F[4]
Port A3	A[3]	Port E3	E[3]	Port A3	A[5]	Port F3	F[5]
Port A4	A[4]	Port E4	E[4]	Port A4	A[6]	Port F4	F[6]
Port A5	A[5]	Port E5	E[5]	Port A5	A[7]	Port F5	F[7]
Port A6	A[6]	Port E6	E[6]	Port A6	A[8]	Port F6	F[8]
Port A7	A[7]	Port E7	E[7]	Port A7	A[9]	Port F7	F[9]
Port B0	B[0]	Port F0	F[0]	Port B0	B[2]	Port G0	G[2]
Port B1	B[1]	Port F1	F[1]	Port B1	B[3]	Port G1	G[3]
Port B2	B[2]	Port F2	F[2]	Port B2	B[4]	Port G2	G[4]
Port B3	B[3]	Port F3	F[3]	Port B3	B[5]	Port G3	G[5]
Port B4	B[4]	Port F4	F[4]	Port B4	B[6]	Port G4	G[6]
Port B5	B[5]	Port F5	F[5]	Port B5	B[7]	Port G5	G[7]
Port B6	B[6]	Port F6	F[6]	Port B6	B[8]	Port G6	G[8]
Port B7	B[7]	Port F7	F[7]	Port B7	B[9]	Port G7	G[9]
Port C0	C[0]	Port G0	G[0]	Port C0	C[2]	Port H0	H[2]
Port C1	C[1]	Port G1	G[1]	Port C1	C[3]	Port H1	H[3]
Port C2	C[2]	Port G2	G[2]	Port C2	C[4]	Port H2	H[4]
Port C3	C[3]	Port G3	G[3]	Port C3	C[5]	Port H3	H[5]
Port C4	C[4]	Port G4	G[4]	Port C4	C[6]	Port H4	H[6]
Port C5	C[5]	Port G5	G[5]	Port C5	C[7]	Port H5	H[7]
Port C6	C[6]	Port G6	G[6]	Port C6	C[8]	Port H6	H[8]
Port C7	C[7]	Port G7	G[7]	Port C7	C[9]	Port H7	H[9]
Port D0	D[0]	Port H0	H[0]	Port D0	D[2]	Port I0	A[0]
Port D1	D[1]	Port H1	H[1]	Port D1	D[3]	Port I1	A[1]
Port D2	D[2]	Port H2	H[2]	Port D2	D[4]	Port I2	B[0]
Port D3	D[3]	Port H3	H[3]	Port D3	D[5]	Port I3	B[1]
Port D4	D[4]	Port H4	H[4]	Port D4	D[6]	Port I4	C[0]
Port D5	D[5]	Port H5	H[5]	Port D5	D[7]	Port I5	C[1]
Port D6	D[6]	Port H6	H[6]	Port D6	D[8]	Port I6	D[0]
Port D7	D[7]	Port H7	H[7]	Port D7	D[9]	Port I7	D[1]
				Port E0	E[2]	Port J0	E[0]
				Port E1	E[3]	Port J1	E[1]
				Port E2	E[4]	Port J2	F[0]
				Port E3	E[5]	Port J3	F[1]
				Port E4	E[6]	Port J4	G[0]
				Port E5	E[7]	Port J5	G[1]
				Port E6	E[8]	Port J6	H[0]
				Port E7	E[9]	Port J7	H[1]

\*The allocation of the port conforms to the CameraLink standard.

Medium Configuration				Base Configuration			
Camera Out	8bit	10bit	12bit	Camera Out	8bit	10bit	12bit
DATA OUT1	A[7:0]	A[9:0]	A[11:0]	DATA OUT1	A[7:0]	A[9:0]	A[11:0]
DATA OUT2	B[7:0]	B[9:0]	B[11:0]	DATA OUT2	B[7:0]	B[9:0]	B[11:0]
DATA OUT3	C[7:0]	C[9:0]	C[11:0]	DATA OUT3	N/A	N/A	N/A
DATA OUT4	D[7:0]	D[9:0]	D[11:0]	DATA OUT4	N/A	N/A	N/A
DATA OUT5	N/A	N/A	N/A	DATA OUT5	N/A	N/A	N/A
DATA OUT6	N/A	N/A	N/A	DATA OUT6	N/A	N/A	N/A
DATA OUT7	N/A	N/A	N/A	DATA OUT7	N/A	N/A	N/A
DATA OUT8	N/A	N/A	N/A	DATA OUT8	N/A	N/A	N/A

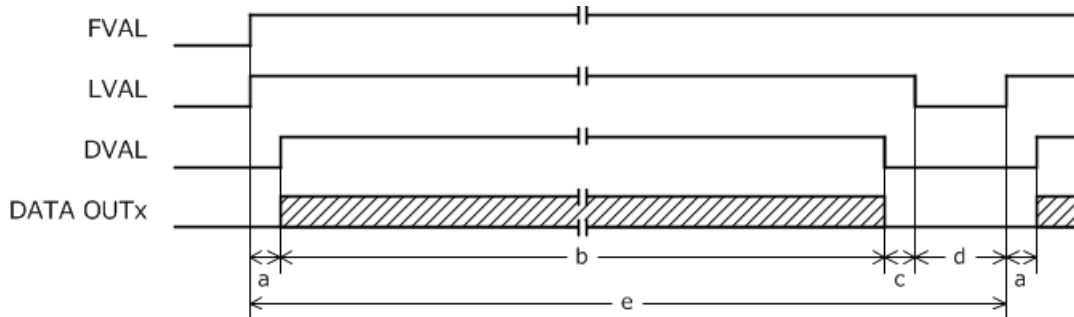
Port/Bit	8bit	10bit	12bit	Port/Bit	8bit	10bit	12bit
Port A0	A[0]	A[0]	A[0]	Port D0	D[0]	D[0]	D[0]
Port A1	A[1]	A[1]	A[1]	Port D1	D[1]	D[1]	D[1]
Port A2	A[2]	A[2]	A[2]	Port D2	D[2]	D[2]	D[2]
Port A3	A[3]	A[3]	A[3]	Port D3	D[3]	D[3]	D[3]
Port A4	A[4]	A[4]	A[4]	Port D4	D[4]	D[4]	D[4]
Port A5	A[5]	A[5]	A[5]	Port D5	D[5]	D[5]	D[5]
Port A6	A[6]	A[6]	A[6]	Port D6	D[6]	D[6]	D[6]
Port A7	A[7]	A[7]	A[7]	Port D7	D[7]	D[7]	D[7]
Port B0	B[0]	A[8]	A[8]	Port E0	n/a	C[0]	C[0]
Port B1	B[1]	A[9]	A[9]	Port E1	n/a	C[1]	C[1]
Port B2	B[2]	n/a	A[10]	Port E2	n/a	C[2]	C[2]
Port B3	B[3]	n/a	A[11]	Port E3	n/a	C[3]	C[3]
Port B4	B[4]	B[8]	B[8]	Port E4	n/a	C[4]	C[4]
Port B5	B[5]	B[9]	B[9]	Port E5	n/a	C[5]	C[5]
Port B6	B[6]	n/a	B[10]	Port E6	n/a	C[6]	C[6]
Port B7	B[7]	n/a	B[11]	Port E7	n/a	C[7]	C[7]
Port C0	C[0]	B[0]	B[0]	Port F0	n/a	C[8]	C[8]
Port C1	C[1]	B[1]	B[1]	Port F1	n/a	C[9]	C[9]
Port C2	C[2]	B[2]	B[2]	Port F2	n/a	n/a	C[10]
Port C3	C[3]	B[3]	B[3]	Port F3	n/a	n/a	C[11]
Port C4	C[4]	B[4]	B[4]	Port F4	n/a	D[8]	D[8]
Port C5	C[5]	B[5]	B[5]	Port F5	n/a	D[9]	D[9]
Port C6	C[6]	B[6]	B[6]	Port F6	n/a	n/a	D[10]
Port C7	C[7]	B[7]	B[7]	Port F7	n/a	n/a	D[11]

\*The allocation of the port conforms to the CameraLink standard.

### 5.13. Timing chart

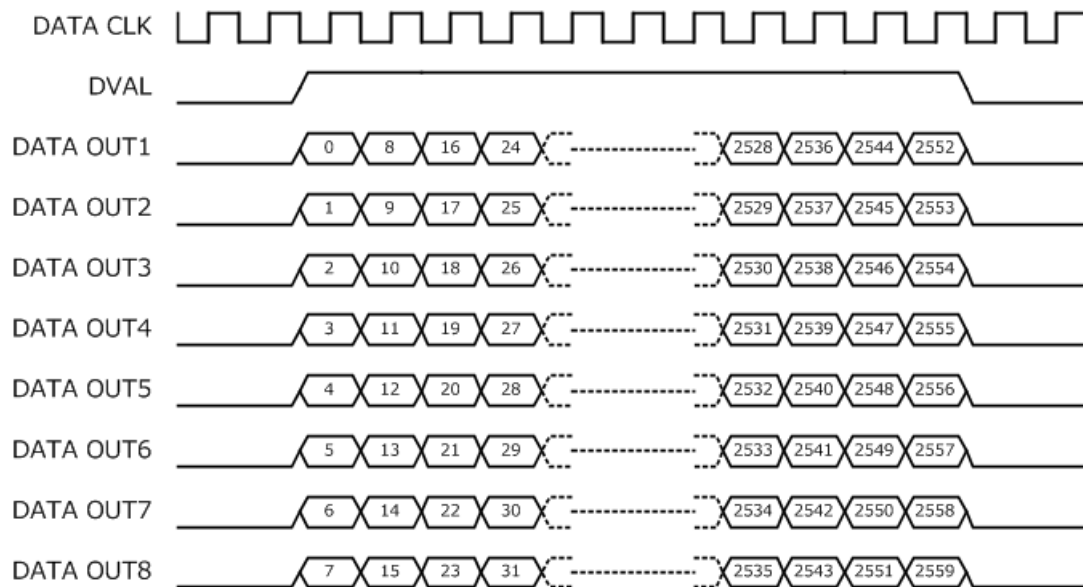
(1) Horizontal timing

•All pixel readout (Full / Medium / Base)



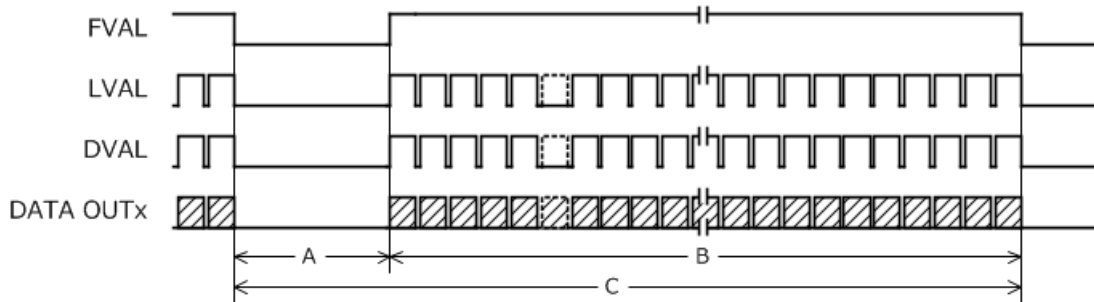
Configuration	a	b	c	d	e
Base	8 clk	1,280 clk	8 clk	24 clk	1,320 clk
Medium	4 clk	640 clk	4 clk	12 clk	660 clk
Full	2 clk	320 clk	2 clk	6 clk	330 clk

•CLK rate (ex. : Full configuration 8tap)



(2) Vertical timing

•All pixel readout (Shutter OFF, Full / Medium / Base)



Configuration	A	B	C
Base	6,624 clk	3,380,496 clk	3,387,120 clk
Medium	3,312 clk	1,690,248 clk	1,693,560 clk
Full	1,656 clk	845,124 clk	846,780 clk

- \* Image output may stop for a horizontal period depending on the start timing of an exposure.
- \* When the shutter speed is shorter than the readout time, those periods are same as the above table.
- \* When the shutter speed is longer than the readout time, the value which is [the shutter speed – the readout time] adds to A and C in the above table.

## 6. Command Communication Protocol

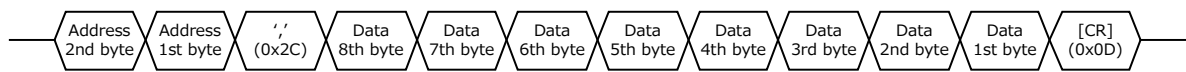
The command communication protocol is the TELI standard method (method in which parameters are set in the registers in the camera).

In command send/receive operation, hexadecimal address and data are converted to ASCII data.

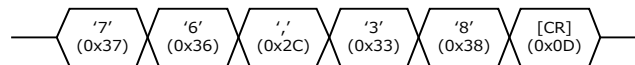
All ASCII alphabetic characters used are uppercase characters.

### (1) Write to register

To write data in a register, send a command, as follows. (Address' max-length is 2 bytes, and Data's max-length is 8 bytes)



For example, to write data 0x38 to address 0x76, send a command, as follows:



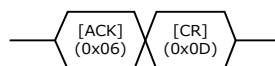
Moreover, because the data size of each address that can be set is decided, the transmission for the width of data to exceed the data size is not accepted.

For instance, five bytes or more cannot be received though it is possible to receive up to four bytes because the data size of address 0xA0 (shutter speed denominator register) is two bytes.

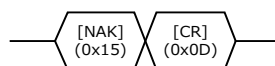
("A0,00001000" cannot be received though "A0,1000" can be received. )

The camera responds to the write command with No Error (ACK) or Error (NAK), as follows:

### No Error (ACK)



### Error (NAK)



\*Because max five kinds of data is needed for the setting about a part of the register that relates to WOI, the setting is reflected by writing the register for "Set value application".

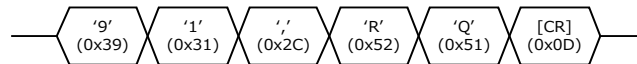
\*The response to the command might become about three seconds by the internal processing of camera.

\*It is not possible to communicate for the exposure period at the random trigger shutter.

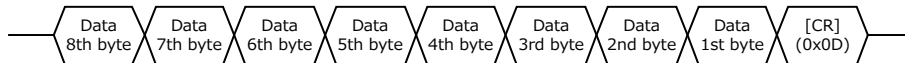
## (2) Read from register

To read data from a register, send ',', (comma)', 'R', 'Q' and [CR] code following the address.

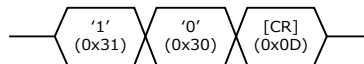
For example, to read data in address 0x91, send a command, as follows:



The camera responds to the read request, as follows (Data's max-length is 8 bytes):



Actually, the camera responds to the read request as minimum data length: For example, to read data 0x10 to address 0x91, the camera responds as follows:



## 7. Register Map

The following accesses are available via the camera link serial interface.

Address	Access	Memory	Register Name	Address	Access	Memory	Register Name
0x00   0x0F	R	-	Manufacture name ASCII format	0xA4	RW	○	Shutter speed numerator
0x10   0x2F	R	-	Model name ASCII format	0xA5   0xB1	N.A.	-	Reserved
0x30   0x3F	R	-	Serial number ASCII format	0xB2	RW	○	MWB red gain
0x40   0x47	R	-	Firmware version ASCII format	0xB3	RW	○	MWB green gain
0x48   0x4F	R	-	FPGA version ASCII format	0xB4	RW	○	MWB blue gain
0x50   0x5F	N.A.	-	Reserved	0xB5	N.A.	-	Reserved
0x60   0x67	R	-	Register map version ASCII format	0xB6	W	-	OPWB execution
0x68	N.A.	-	Reserved	0xB7   0xBF	N.A.	-	Reserved
0x69	R	-	Status	0xC0	W	-	WOI update
0x6A	R	-	Extended status	0xC1	RW	○	WOI area number
0x6B	-	-	Reserved	0xC2	RW	○	WOI horizontal start coordinate
0x6C	R	-	Check memory bank	0xC4	RW	○	WOI vertical start coordinate
0x6D	W	-	Save memory	0xC6	RW	○	WOI horizontal width
0x6E	RW	-	Call memory	0xC8	RW	○	WOI vertical height
0x6F	W	-	Initialize memory	0xCA	RW	-	Control of WOI bank
0x70	RW	○	Setup	0xCB	RW	-	Save/call WOI bank
0x72   0x75	N.A.	-	Reserved	0xCC	RW	○	WOI area effective
0x76	RW	○	Gain	0xD0	RW	-	DP correction data/address
0x77   0x85	N.A.	-	Reserved	0xD2	N.A.	-	Reserved
0x86	RW	-	Output control	0xD3	W	-	DP correction data/save/erase
0x87	RW	○	Number of output bits	0xD4	RW	-	DP correction data/data
0x88	RW	-	Test pattern	0xD8	RW	-	User area/address
0x89	N.A.	-	Reserved	0xDA	RW	-	User area/data
0x8A	RW	○	Gamma	0xDB	W	-	User area/erase
0x8B	RW	○	Defective pixel correction	0xDC	RW	○	User area/number of bytes
0x8C   0x8F	N.A.	-	Reserved	0xDD	N.A.	-	Reserved
0x90	RW	○	Scan mode	0xDE	N.A.	-	Reserved
0x91	RW	○	Shutter mode	0xDF	N.A.	-	Reserved
0x92	RW	○	Random trigger mode	0xE0	W	-	Sequential command
0x93	RW	○	Trigger polarity	0xE1	W	-	FPN correction calibration
0x94	N.A.	-	Reserved	0xE2	RW	○	Trigger source
0x95	N.A.	-	Reserved	0xE3	N.A.	-	Reserved
0x96	RW	○	Binning	0xE4	W	-	LUT data write
0x97	N.A.	-	Reserved	0xE5	W	-	LUT data read
0x98	RW	○	Reverse	0xE6	RW	-	LUT bank select
0x99	RW	○	Number of frame for bulk trigger	0xE7	W	-	LUT data save/erase
0x9A	RW	○	Trigger delay	0xE8	RW	△	Baudrate
0x9C   0x9F	N.A.	-	Reserved	0xE9	RW	△	Output format
0xA0	RW	○	Shutter speed denominator	0xEA	RW	○	GPO setting
				0xEB	RW	○	GPO porality
				0xEC	RW	○	strobe signal delay
				0xEE	RW	○	strobe signal time
				0xF0	RW	△	Pre-gain
				0xF1	RW	△	Pixel clock
				0xF2	N.A.	-	Reserved
				0xF3   0xFF	N.A.	-	Reserved

## **8. Function**

### **8.1. Scan mode**

The image output is output from the camera link connector, and can take the output image by Frame grabber board. The frame rate and the resolution of the output image that this camera corresponds are as follows. (Full configuration, 8tap, 8bit, Shutter OFF)

Output mode	Frame rate			Output size
	@60MHz	@72MHz	@84MHz	
All pixel readout	Approx.70fps	Approx.85fps	Approx.99fps	2560 (H) x 2560 (V)
Binning 2x2	Approx.141fps	Approx.169fps	Approx.197fps	1280 (H) x 1280 (V)
Binning 4x4	Approx.281fps	Approx.337fps	Approx.394fps	640 (H) x 640 (V)
WOI	Depends on the window setting			
Binning WOI	Depends on the window setting			

\*As for the frame that switched the mode when continuously operating, the image of the brightness not intended might be output.

#### 8.1.1. All pixel readout

The camera readouts all pixels (2560(H) × 2560(V) pixels) in approx. 85 fps.

#### 8.1.2. Binning

The camera readouts all effective areas in approx. 170 fps by binning (2x2) for all pixels (2560(H) × 2560(V) pixels). As it readouts adjacent 4 pixels as one pixel, the resolution reduces. However, as the pixel noise is averaged, it can output lower noise than that is produced when it reads all pixels.

#### 8.1.3. WOI

Only arbitrary area can be readout. It can be readout in high speed by skipping unwanted areas.

#### 8.1.4. Binning WOI

It can be readout in higher speed by binning the WOI arbitrary area.



## 8.2. Shutter mode

### 8.2.1. Shutter OFF

The shutter speed changes in this mode depending on the frame rate.

Shutter speed is the same as readout time.

### 8.2.2. Normal Shutter

In this mode, the shutter speed can be handled by the value in the register.

Shutter speed can be selected from 1/100,000 sec to 1/5 sec.

If shutter speed is longer than readout time, the frame rate changes according to shutter speed.

### 8.2.3. Random trigger shutter

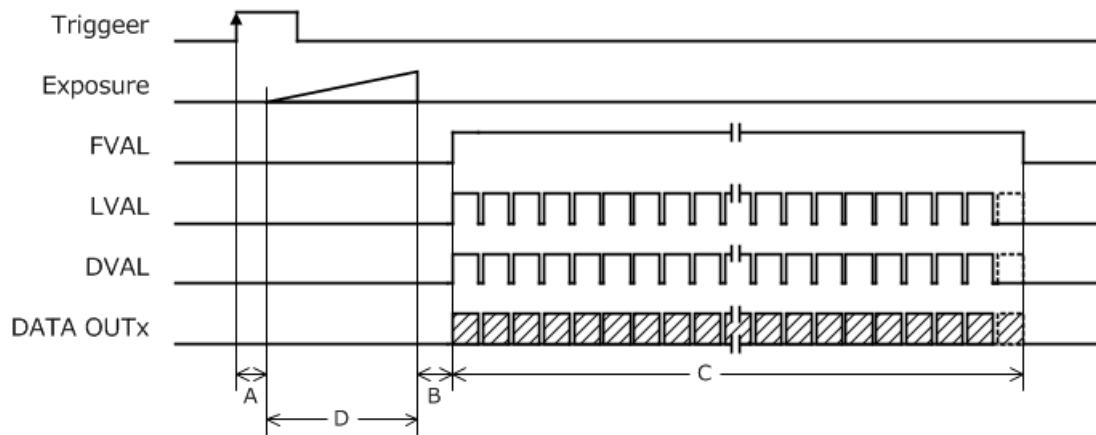
Images can be taken and imported at any timing by inputting an external trigger signal in a random trigger shutter mode.

- External trigger signals can be input from either the camera link I/F CC1 or the I/O connector. However, signals cannot be input at the same time. Fix an unused input to Low.
- It starts exposure at a rising trigger edge when the polarity is set to positive polarity while it starts exposure at a negative-going trigger edge when the polarity is set to negative polarity.
- Random trigger shutter operates in either the fixed mode and the pulse width mode and has different ways to determine the exposure time depending on the mode.
- Starting exposure in a readout time is possible at random trigger shutter, but completion of the exposure in the readout time is not possible. If inputting the triggers continuously, please complete the exposure after the completion of readout for the camera.

1) Fix mode

•The exposure time is determined by the set value of the shutter speed.

\*All pixel readout@72MHz



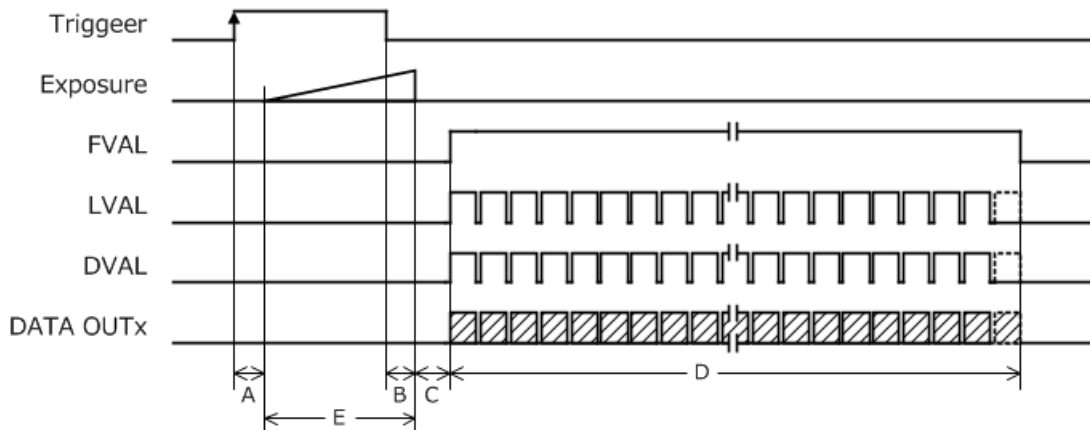
Configuration	A	B	C	D
Base	20.7 us	64.8 us	3,380,496 clk	Reg.value
Medium	11.1 us	33.0 us	1,690,248 clk	Reg.value
Full	6.3 us	17.1 us	845,124 clk	Reg.value

2) Pulse width mode

•The exposure time is determined by the pulse width.

•The pulse width should be more than 10 μsec.

\*All pixel readout@72MHz

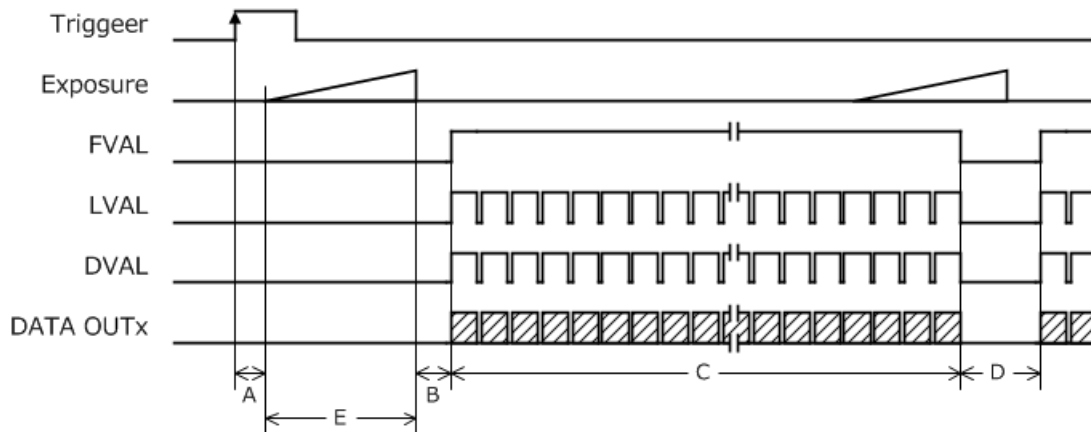


Configuration	A	B	C	D	E
Base	20.7 us	20.7 us	64.8 us	3,380,496 clk	Pulse width
Medium	11.1 us	11.1 us	33.0 us	1,690,248 clk	Pulse width
Full	6.3 us	6.3 us	17.1 us	845,124 clk	Pulse width

### 3) Bulk trigger mode

- The exposure time is determined by the setting value of the shutter speed.
- Outputs specified multiple frames by one trigger input.

\*All pixel readout@72MHz



Configuration	A	B	C	D	E
Base	20.7 us	64.8 us	3,380,496 clk	6,624 clk	Reg.value
Medium	11.1 us	33.0 us	1,690,248 clk	3,312 clk	Reg.value
Full	6.3 us	17.1 us	845,124 clk	1,656 clk	Reg.value

### 8.3. WOI (Window Of Interest)

Only arbitrary areas can be readout by specifying an address in horizontal and vertical directions.

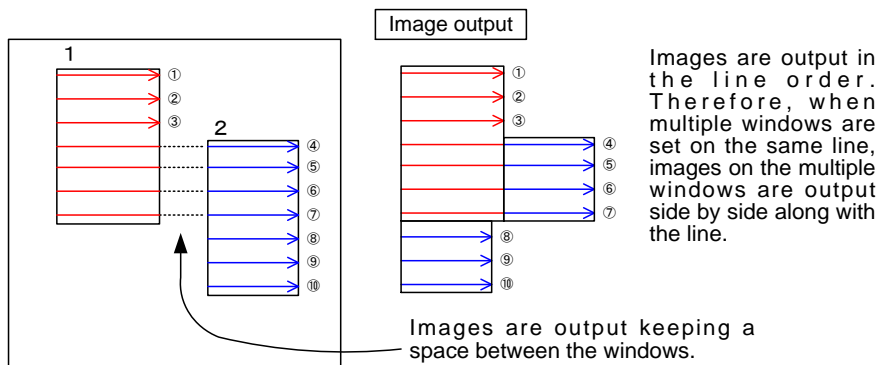
Area setting has the following conditions.

- 1) Number of windows                    1 to 32
- 2) Setting position                      H: Integral multiple of 16 columns.  
V: Integral multiple of 2 rows.
- 3) Window size                            H: Integral multiple of 16 columns. (minimum size : 16)  
V: Integral multiple of 2 rows. (minimum size : 2)
- 4) Overlapping of windows            Possible
- 5) Others
  - a. Frame rate                            There is no proportional relation between the window area and the frame rate.
  - b. Set values of the coordinate and the size  
Set the coordinate and the size to fit the effective pixel area.  
Values cannot set beyond the effective pixel area.
  - c. Memory                                WOI setting can be saved in memory banks 1- 8.

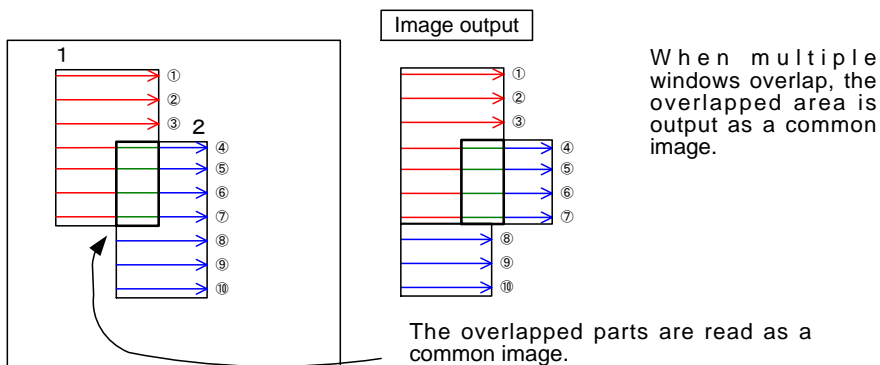
#### 8.3.1 Image output for WOI

Images are outputted per line. Therefore, when multiple windows are set on the same line, images of multiple windows are included in the image output of the line.

- 1) When multiple windows are set on the same line



- 2) When multiple windows overlap



### 8.3.2. About the frame rate at the WOI

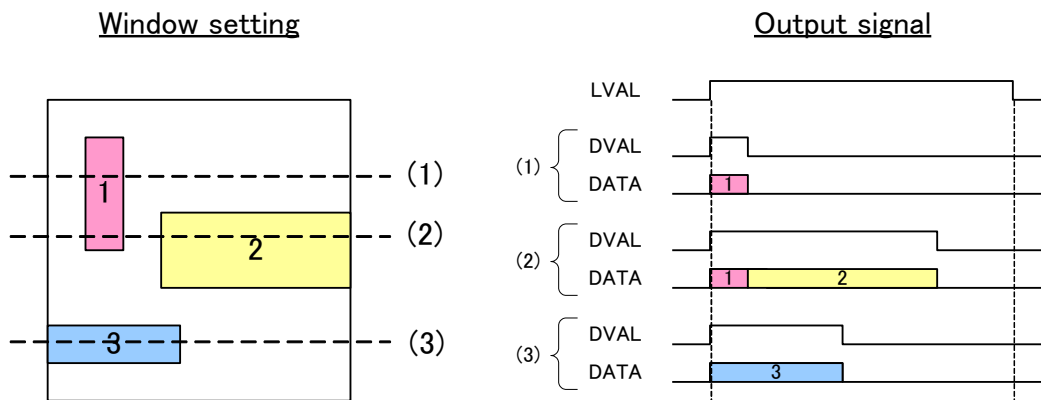
Since output data becomes small by setup of a window, frame rate improves.

However, data volume (window size) is not proportional to a frame rate.

The influence on the frame rate by horizontal and vertical setup has the following features.

#### 1) Horizontal direction

Horizontal rate is fixed by 2560 px (330 CLK). When two or more windows are arranged, the data volume outputted outputs the sum total of the data on the same line. DVAL becomes active only during the period when data is outputted. Even if changing window size, LVAL does not change.



#### 2) Vertical direction

Vertical direction is output only set width.

### 8.3.3. WOI bank

WOI setting value can be saved up to eight patterns at RAM (WOI bank) in a camera. The change of the WOI pattern which uses a WOI bank can be performed at high speed than the operation which calls separate setting and a memory bank.

However, the setting value saved on the WOI bank is lost with the power supply OFF.

### 8.3.4. WOI bank control

How to call a WOI bank can be chosen as either register control or camera link CC control (CC2, 3, 4). In control by camera link CC, a WOI bank can be specified by switching High/Low of CC signal. However, the WOI bank control by CC cannot be used in binning WOI mode.

The relation between CC polarity and a WOI bank is as follows.

CC2	CC3	CC4	WOI bank
L	L	L	1
H	L	L	2
L	H	L	3
H	H	L	4
L	L	H	5
H	L	H	6
L	H	H	7
H	H	H	8

### 8.4. Binning WOI

Using both the WOI and the binning function can output the images in higher speed. Please notice the difference of restrictions for the position or size of window depending each modes.

		WOI	Bining WOI	
			2×2	4×4
Position	H	16 px	32 px	64 px
	V	2 px	4 px	8 px
Size	H	16 px	32 px	64 px
	V	2 px	4 px	8 px
Number of window		1 to 32		
Overlapping of window		Possible		

### 8.5. Pixel clock change

It is possible to switch the frequency of the pixel clock for the CameraLink output, from either 60, 72, or 84 MHz. If switching the frequency of the pixel clock, the frequency of the system clock is also changes.

The re-injection of a camera power supply is required at the time of the change of frequency of the pixel clock.

### 8.6. Output format change

According to a frame grabber board, the change of an image output format is possible. The re-injection of a camera power supply is required at the time of the change of an output format.

Configuration	Taps	Pixel clock	Data width	Frame rate
Full	8	84MHz	8 / 10 bit	Approx.99 fps
		72MHz		Approx.85 fps
		60MHz		Approx.70 fps
Medium	4	84MHz	8 / 10 / 12 bit	Approx.49 fps
		72MHz		Approx.42 fps
		60MHz		Approx.35 fps
Base	2	84MHz		Approx.24 fps
		72MHz		Approx.21 fps
		60MHz		Approx.17 fps

\*Frame rate is the shutter OFF, all pixel readout.

### 8.7. FPN correction

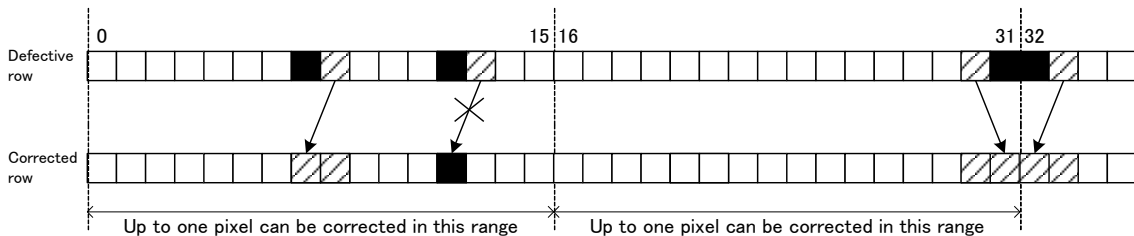
This is a function to correct the FPN(Fixed Pattern Noise)each CMOS sensor has.

When changing some setting, it is possible to correct to an optimized image quality at any time by performing calibration.

### 8.8. Defective pixels correction

This is a function to correct the output of an arbitrary pixel by replacing with the output of the left or right side pixel.

The output of 16×n th pixel is replaced with the left side pixel's for the specified pixel, and the output of the other pixels are replaced with the right side pixel's for the specified pixels.



Setting condition

(1) Maximum pixel numbers: 512 pixels (Factory default: available)

(2) 1 pixel in a series of 16 pixels is correctable, and 8 pixels are correctable in a line.

\* It is possible to set the data for correction, but pixels out of the condition are not corrected.

(3) It is recommended to re-set the coordinate because the image quality changes when using the binning function.

## **8.9. White balance**

It is possible to adjust the white balance according to objects or applications, because the color camera model has the manual white balance and the one-push white balance functions.

Some lacks of the gray level will be shown when the gain becomes larger, because of the fundamental for the digital-gain.

### 8.9.1 Manual white balance

It is possible to set the R/G/B gain separately.

Setting range: 0 dB~ +12 dB

### 8.9.2 One-push auto white balance

It is adjusted to be the equivalent luminance level between R/G/B pixels of the entire effective area (the entire output window when using WOI) by one-push. But there may be cases where the white balance is not adjusted correctly depending the photo objects or the light sources.

## **8.10. Gamma correction**

Turning ON the gamma correction corrects the linearity of the image. It is possible to set by 16 steps.

## **8.11. LUT (Look-Up Table)**

It is possible to set the values of gamma correction and perform image thresholding using the LUT consisting of 12 bit inputs/ 10bit outputs.

## **8.12. Output control**

The camera output is possible to switch to the sensor image, OFF, or some test patterns.

### 8.12.1. Output of sensor image

The image which entered into the sensor is outputted.

### 8.12.2. Output OFF

The black image of output level "0" is outputted.

In the case of a random trigger shutter, a trigger input is needed although various VALID signals are outputted as they are.



### 8.12.3. Output of test pattern

Some test patterns can be output by cutting the output of the sensor.

It is output by the frame rate matched to each shutter mode and the scanning mode.

However, the test pattern cannot be output in the WOI mode and Binning-WOI mode. It is output for the random trigger shutter by the external trigger signal input.

The shutter speed, the setup, and the gain become invalid.

The FPN correction and pixel defect correction function, etc. become invalid.

The kind of the test pattern that can be output is as follows.

- a. Black
- b. White
- c. Gray (25%) / Gray (75%)
- d. Gray (50%)
- e. Stripe
- f. Grayscale
- g. Ramp
- h. Mix

The test pattern can reverse the brightness and change direction of the pattern (horizontal and vertical) (Part is excluded).

Moreover, it is possible to display it by superimposing the following enhancing patterns.

- a. Line
- b. Center marker
- c. character

### **8.13. Image reverse**

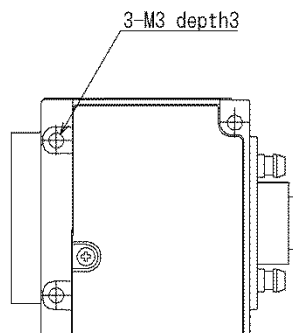
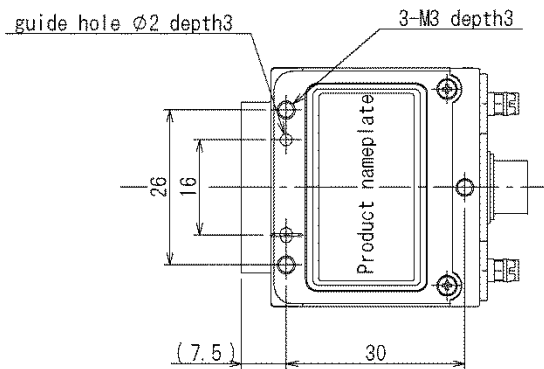
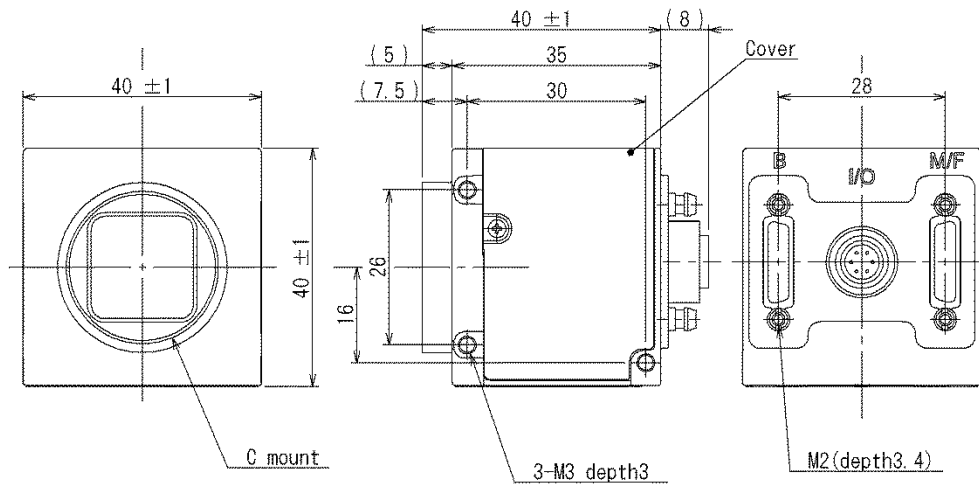
An image output is changed into a mirror, flip, or rotation (180-degree), and can be outputted.

### **8.14. Sequential command**

The time which a response takes can be shortened by transmitting two or more commands at once.


## 9. Appended figure

### 9.1 Dimensional outline drawing



Specification  
 Material: Aluminium die-cast metal  
 (Cover: Aero aluminium)  
 (Nameplate: Polyester film (Silver))  
 Processing: Cationic coating (Black)  
 (Cover: laser satin print (Black))

## 9.2 Administrative Measure on the Control of Pollution Caused by Electronic Information Products (Popular name: China RoHS) Related information

 中华人民共和国 环保使用期限	<p>环保使用期限标识，是根据电子信息产品污染控制管理办法以及，电子信息产品污染控制标识要求(SJ/T11364-2014)、电子信息产品环保使用期限通则，制定的适用于中国境内销售的电子信息产品的标识。</p> <p>电子信息产品只要按照安全及使用说明内容，正常使用情况下，从生产月期算起，在此期限内，产品中含有的有毒有害物质不致发生外泄或突变，不致对环境造成严重污染或对其人身、财产造成严重损害。</p> <p>产品正常使用后，要废弃在环保使用年限内或者刚到年限的产品时，请根据国家标准采取适当的方法进行处置。</p> <p>另外，此期限不同于质量/功能的保证期限。</p> <p>The Mark and Information are applicable for People's Republic of China only.</p>
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### <产品中有毒有害物质或元素的名称及含量>

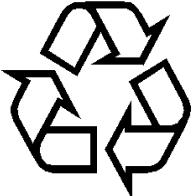

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
相机本体	×	○	○	○	○	○

「本表格依据SJ/T 11364的规定编制」  
 ○：表示该有毒有害物质在该部件所有均质材料中的含量均在电子信息产品中有毒有害物质的限量要求标准规定的限量要求(GB/T26572)以下  
 ×：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出电子信息产品中有毒有害物质的限量要求标准规定的限量要求(GB/T26572)  
 This information is applicable for People's Republic of China only.

### リサイクルに関する情報 (包装物)

#### 有关再利用的信息(包装物)

#### Information on recycling of wrapping composition

箱/箱子/Box    ペーパーボード 纸板 Paper board	内部緩衝材料・袋 内部缓冲材料・袋 Internal buffer materials・Bag    <b>PE-LD</b>
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## **10. Warranty**

The term of a warranty is 3 year after the product delivery.

If by any chance trouble by responsibility of our company occurs before an above period, TELI repairs it free of charge.

During terms of a guarantee, when the trouble cause is the case of below, TELI charges the repair costs.

- (1) Troubles and the damages that causes by misuse, unsuitable repair or remodeling.
- (2) Distribution hazards like drops and vibrations after purchase. Troubles and damages by transportation.
- (3) Troubles and damages by fire, natural calamity (earthquake, storm and flood damage, thunderbolt), damages from salty breeze, gas harm, abnormal voltage.

## **11. Repair**

### **12.1. Condition for repair**

Basically, has to return it to our company when the user requests us to repair product.

Besides that, customer should pay these expenses (travel expenses, camera disassembly technology costs) of both customer and end user. Also customer should pay in themselves costs for return camera to us.

### **12.2. The period of repairing product**

- |                           |                                                                    |
|---------------------------|--------------------------------------------------------------------|
| (1) Repair free of charge | Refer to Clause 10.                                                |
| (2) Charged repair        | We accept a repair of out of guaranty product, if it is reparable. |

Lined writing area consisting of multiple horizontal dashed lines.

## **TOSHIBA TELI CORPORATION**

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