CMOS Camera
BC Series

BC040M
BC160M

Specifications

Toshiba Teli Corporation

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Standard name might be trade mark of each company.

D4296065A

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RESTRICTION FOR USE

● 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 personnel related to the specifications. Such designer or personnel 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 refers 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 services/functions involving factors of safety refers to.

- Traffic control systems for air transportation, railways, roads, or marine transportation

- Equipment for nuclear power generation

- Equipment related to the above

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CASES FOR INDEMNITY (LIMITED WARRANTY)

We shall be exempted from taking responsibility and held harmless for damage or losses incurred by the user in the following cases.

- Natural disasters, such as an earthquake and thunder, fire or any other act of God; acts by third parties; misuse by the user, whether intentional or accidental; use under extreme operating conditions.
- In the case of indirect, additional, consequential damages (loss of business interests, suspension of business activities) are incurred as result of malfunction or non-function of the equipment, we shall be exempted from responsibility for such damages.
- In the case damage or losses are caused by failure to observe the information contained in the instructions in this instruction manual and specifications.
- In the case damage or losses are caused by use contrary to the instructions in this instruction manual and specifications.
- In the case damage or losses are caused by malfunction or other problems resulting from use of equipment or software that is not specified.
- In the case damage 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.
- The item that is not described in specifications of this product is off the subject of the guarantee.
- The attachment mistake of a cable.

● **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.

If your camera is used in a system where its connector is subjected to strong repetitive shocks, its connector is possible to break down. If you intend to use your camera in such a situation, if possible, bundle and fix a cable in the place near the camera, and do not transmit a shock to the connector.

● **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.

● **Combination of C-mount lens**

Depending on the lens you use, the performance of the camera may not be brought out fully due to the deterioration in resolution and brightness in the peripheral area, occurrence of a ghost, aberration and others. When you check the combination between the lens and camera, be sure to use the lens 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.

As for the C-mount lens used combining this product, the projection distance from bottom of the screw should use 7.9mm or less.
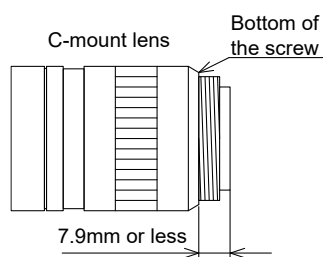
● **Mounting to a pedestal**

When mounting this product to a pedestal, make sure carefully that the lens doesn't touch with the pedestal.

● **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 moiré**

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

USAGE PRECAUTIONS

● **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.

● **Disposal**

When disposing of the camera, it may be necessary to disassemble it into separate parts, in accordance with the laws and regulations of your country and/or municipality concerning environmental contamination.

	"This symbol is applicable for EU member states only"
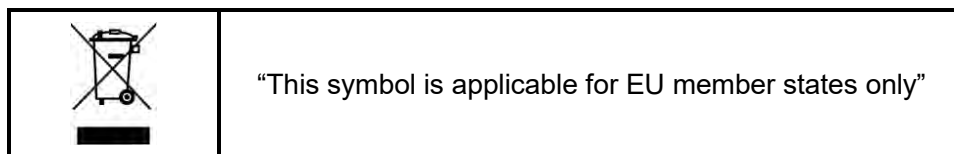
[Phenomena specific to CMOS sensor]

● **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 time.

● **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.

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1   Overview

This BC series is an integrated-(one-body)-type camera that adopts a global shutter CMOS sensor.

These are BC040M (0.4M 1/2.9 type), BC160M (1.6M 1/2.9 type).

It is easy to integrate into industrial equipment.

2   Features

2.1   High frame rate and high resolution

Supporting high frame rate, BC040M 523fps, BC160M 148fps.

2.2   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.

2.3   CameraLink interface (Power over CameraLink)

By using a CameraLink-capable frame grabber board to which power can be supplied, high-speed transfer of captured images to a PC as well as various types of camera control from the PC are allowed. Power can also be supplied to the camera with only one cable.

2.4   IIDC2 Digital Camera Control Specification Ver.1.1.0

This product is based on IIDC2 Digital Camera Control Specification Ver.1.1.0

2.5   Random Trigger Shutter

The Random Trigger Shutter function provides images in any timing by input of an external trigger signal. Trigger control from PC is available as well.

2.6   Scalable

Selectable video output area. This mode achieves higher frame rate by reducing vertical output area.

2.7   Binning

Pixel data is combined by vertical and horizontal.

2.8   Decimation

Camera reads all effective areas at high speed by skipping lines.

2.9   Compact and lightweight

This camera is compact and lightweight; it is easy to integrate into industrial equipment.

3   Configuration

- Camera body   1

  * No application software and manuals are attached to this camera.

4   Optional part

- Camera mounting kit   Model name: CPT8560

  * Contact your dealer / distributor for details of option units.

5　Functions

5.1　Gain

The camera gain can be set manually (MANUAL). Gain is adjustable from 0 to +24dB.

Notes on gain setting:

Setting the gain value too high increases noises. When you adjust the brightness of the image, I ask you to have final image quality checked with your environment.

5.2　Black Level

Black level is adjustable from -25% to +25% as white saturation level is 100%.

5.3　Gamma

Gamma correction curve is adjustable from 0.45 to 1.00.

5.4　LUT (Look Up Table)

Arbitrary curve and binarization are possible by using 12 bit input and 12 bit output LUT.

5.5　Exposure Time

Manual exposure time control are available (MANUAL). Exposure time is adjustable by 14.8μs to 16s. Also, by setting the ShortExposureMode to valid (ON), and high-speed exposure time setting of 1.08μs to 13.31μs is possible.

Notes on ShortExposureMode setting:

- If you use ShortExposureMode, the image quality may deteriorate. Also, the actual exposure time may vary depending on the individual differences and the operating environment (such as the operating temperature).When using the ShortExposureMode, I ask you to have final image quality checked with your environment.
- 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.

5.6 Random Trigger Shutter

5.6.1 Normal Shutter / TriggerMode =OFF

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

For the setting range of the electronic shutter, refer to [6.3 Electronic shutter specification].

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

5.6.2 Random Trigger Shutter / TriggerMode =ON

An image is captured at the desired timing using trigger signal input.

External trigger (Hardware trigger) signal from CameraLink I/F (CC1) and software trigger from control command are available (Fix mode). Operation point of HardwareTrigger is at the edge of trigger signal, and active edge polarity is able to change by register setting (High active / Low active).

Note that Random Trigger Shutter will cause a delay between trigger signal and start of exposure.

- Fix mode (TriggerSequence0)

The exposure time is determined by electronic shutter setting.
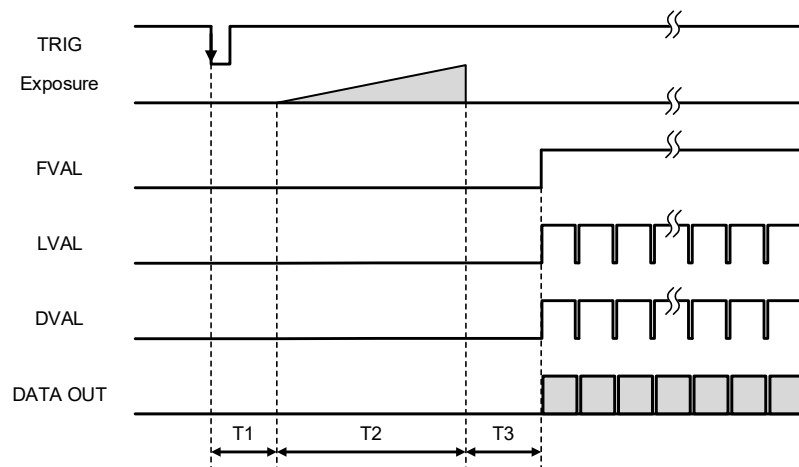
PixelFormat	HighFramerateMode	T1 [µs]		T3 [µs]	
		ShortExposureMode			
		OFF	ON	OFF	ON
Mono8	OFF	12.4	28.6	565.7	566.7
	ON	10.6	26.0	565.1	566.0
Mono10/Mono12	OFF/ON	16.7	34.3	566.4	567.3

* T1 and T3 are typical value

* T2 = electronic shutter setting value

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- Level mode (TriggerSequence1)

The exposure time is determined by the pulse width of the trigger signal.

The pulse width should be 14.8 µs or more. It is not supported when the ShortExposureMode is enable (ON).
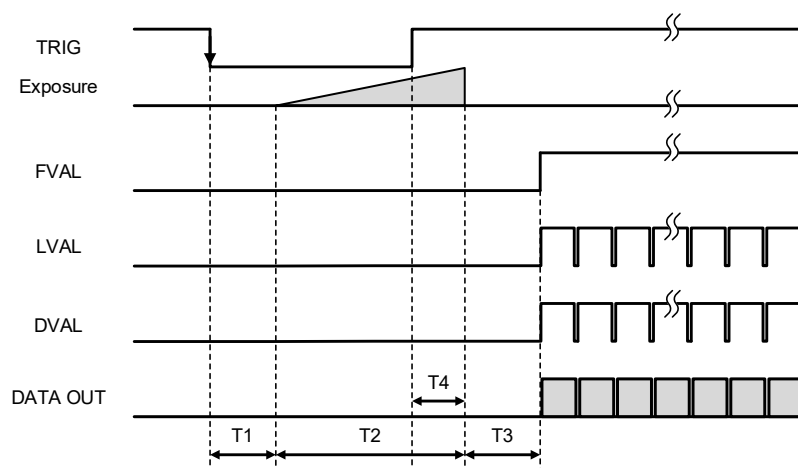
PixelFormat	HighFramerateMode	T1 [µs]	T3 [µs]	T4 [µs]
Mono8	OFF	12.4	565.7	26.8
	ON	10.6	565.1	24.9
Mono10/Mono12	OFF/ON	16.7	566.4	31.0

* T1, T3 and T4 are typical value

* T2 = pulse width setting value

Notes on Random Trigger Shutter mode:

- When the interval of the input trigger signal is extremely short, or when the trigger signal is noisy, there is a possibility of causing the malfunction. In this case, please input a proper trigger signal.

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5.7 Sequential Shutter

Sequential Shutter function performs sequential capturing with applying the settings of UserSet that have been made entry in advance. Sequential shutter is valid only in random trigger mode. It is not supported when the ShortExposureMode is enable (ON).
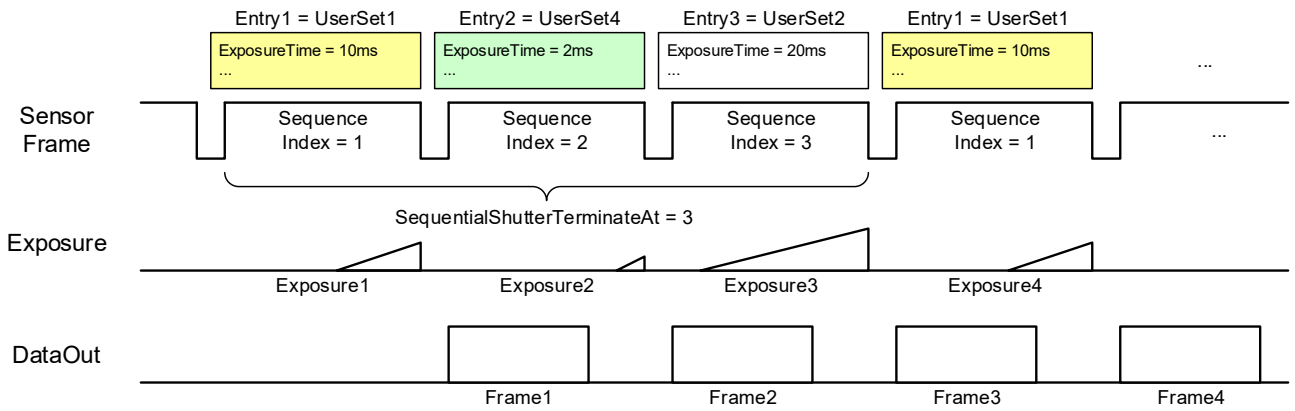
Note on Sequential Shutter:
- In Sequential Shutter mode, window size is unchangeable.

5.8 Trigger Delay

The delay time from the input of the trigger signal to the start of exposure can be set.
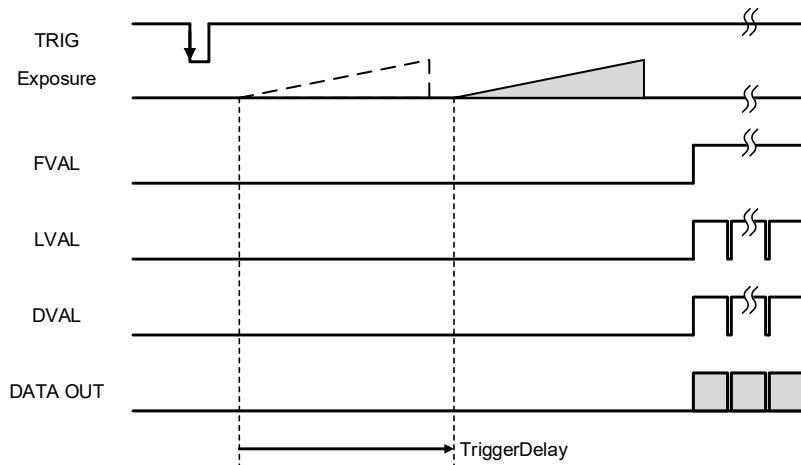
5.9 Scalable mode

Scalable mode is to read out arbitrary area of the image. Only single rectangle is selectable. Concave or convex shape is not selectable.

- Window size: {A + 4*m (H)} * {B + 2*n (V)}

  A, B = minimum unit size

  m, n = integer

  The window size is equal or less than maximum image size.

- Start address: {4 * i (H)} x {2 * j (V)}

  i, j = integer

  The window size is equal or less than maximum image size.

	BC040M	BC160M
Width and OffsetX unit size	4	4
Height and OffsetY unit size	2	2
Minimum unit size (H) * (V)	64 x 64	64 x 64
Maximum unit size (H) * (V)	720 x 540	1440 x 1080
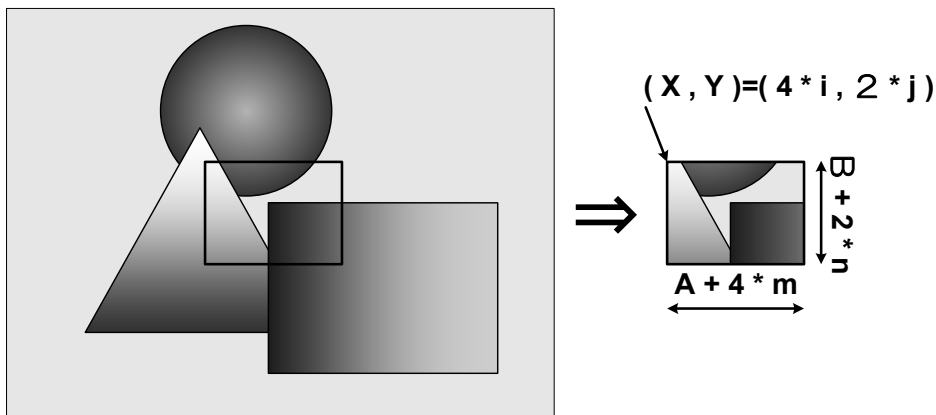
In the scalable mode, camera reads out only necessary area at the normal speed and reads out other area at high speed. The trigger interval can be shorter when the vertical height size is small.

5.10 Binning

In the binning mode, a pixel is added with the neighboring pixel(s).

*Binning and Decimation cannot operate at the same time.

Mono8			Framerate					
			BC040M			BC160M		
Horizontal	Vertical	CLK / TAP	37.5MHz	50MHz	83MHz	37.5MHz	50MHz	83MHz
1	1	1tap	approx.86fps	approx.115fps	approx.191fps	approx.22fps	approx.30fps	approx.50fps
		2tap	approx.170fps	approx.226fps	approx.377fps	approx.45fps	approx.60fps	approx.99fps
		3tap	approx.250fps	approx.333fps	approx.436fps	approx.66fps	approx.89fps	approx.148fps
1	2	1tap	approx.86fps	approx.115fps	approx.191fps	approx.43fps	approx.57fps	approx.96fps
		2tap	approx.170fps	approx.226fps	approx.377fps	approx.86fps	approx.114fps	approx.190fps
		3tap	approx.250fps	approx.333fps	approx.436fps	approx.127fps	approx.170fps	approx.283fps
1	4	1tap	Incompatible			approx.43fps	approx.57fps	approx.96fps
		2tap				approx.86fps	approx.114fps	approx.190fps
		3tap				approx.127fps	approx.170fps	approx.283fps
2	1	1tap	approx.170fps	approx.226fps	approx.502fps	approx.45fps	approx.60fps	approx.99fps
		2tap	approx.328fps	approx.436fps	approx.502fps	approx.88fps	approx.117fps	approx.196fps
		3tap	approx.436fps	approx.436fps	approx.502fps	approx.130fps	approx.173fps	approx.227fps
2	2	1tap	approx.170fps	approx.226fps	approx.502fps	approx.86fps	approx.114fps	approx.190fps
		2tap	approx.328fps	approx.436fps	approx.502fps	approx.168fps	approx.225fps	approx.374fps
		3tap	approx.436fps	approx.436fps	approx.502fps	approx.248fps	approx.331fps	approx.502fps
2	4	1tap	Incompatible			approx.86fps	approx.114fps	approx.190fps
		2tap				approx.168fps	approx.225fps	approx.374fps
		3tap				approx.248fps	approx.331fps	approx.502fps
4	1	1tap	Incompatible			approx.88fps	approx.117fps	approx.196fps
		2tap				approx.170fps	approx.227fps	approx.227fps
		3tap				approx.227fps	approx.227fps	approx.227fps
4	2	1tap	Incompatible			approx.168fps	approx.225fps	approx.374fps
		2tap				approx.326fps	approx.433fps	approx.502fps
		3tap				approx.472fps	approx.502fps	approx.502fps
4	4	1tap	Incompatible			approx.168fps	approx.225fps	approx.374fps
		2tap				approx.326fps	approx.433fps	approx.502fps
		3tap				approx.472fps	approx.502fps	approx.502fps

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5.11 Decimation

Decimation feature reads out all effective areas at high speed by skipping pixels and lines.

　* Decimation and Binning cannot operate at the same time.

Mono8			Framerate					
			BC040M			BC160M		
Horizontal	Vertical	CLK \ TAP	37.5MHz	50MHz	83MHz	37.5MHz	50MHz	83MHz
1	1	1tap	approx.86fps	approx.115fps	approx.191fps	approx.22fps	approx.30fps	approx.50fps
		2tap	approx.170fps	approx.226fps	approx.377fps	approx.45fps	approx.60fps	approx.99fps
		3tap	approx.250fps	approx.333fps	approx.436fps	approx.66fps	approx.89fps	approx.148fps
1	2	1tap	approx.86fps	approx.115fps	approx.191fps	approx.22fps	approx.30fps	approx.50fps
		2tap	approx.170fps	approx.226fps	approx.377fps	approx.45fps	approx.60fps	approx.99fps
		3tap	approx.250fps	approx.333fps	approx.436fps	approx.66fps	approx.89fps	approx.148fps
1	4	1tap	Incompatible			approx.22fps	approx.30fps	approx.50fps
		2tap				approx.45fps	approx.60fps	approx.99fps
		3tap				approx.66fps	approx.89fps	approx.148fps
2	1	1tap	approx.170fps	approx.226fps	approx.377fps	approx.45fps	approx.60fps	approx.99fps
		2tap	approx.328fps	approx.436fps	approx.436fps	approx.88fps	approx.117fps	approx.196fps
		3tap	approx.436fps	approx.436fps	approx.436fps	approx.130fps	approx.173fps	approx.227fps
2	2	1tap	approx.170fps	approx.226fps	approx.377fps	approx.86fps	approx.114fps	approx.190fps
		2tap	approx.328fps	approx.436fps	approx.436fps	approx.168fps	approx.225fps	approx.374fps
		3tap	approx.436fps	approx.436fps	approx.436fps	approx.248fps	approx.331fps	approx.502fps
2	4	1tap	Incompatible			approx.86fps	approx.114fps	approx.190fps
		2tap				approx.168fps	approx.225fps	approx.374fps
		3tap				approx.248fps	approx.331fps	approx.502fps
4	1	1tap	Incompatible			approx.88fps	approx.117fps	approx.196fps
		2tap				approx.170fps	approx.227fps	approx.227fps
		3tap				approx.227fps	approx.227fps	approx.227fps
4	2	1tap	Incompatible			approx.168fps	approx.225fps	approx.374fps
		2tap				approx.326fps	approx.433fps	approx.502fps
		3tap				approx.472fps	approx.502fps	approx.502fps
4	4	1tap	Incompatible			approx.168fps	approx.225fps	approx.374fps
		2tap				approx.326fps	approx.433fps	approx.502fps
		3tap				approx.472fps	approx.502fps	approx.502fps

5.12 Reverse

Image can be flipped in horizontal and/or vertical direction.
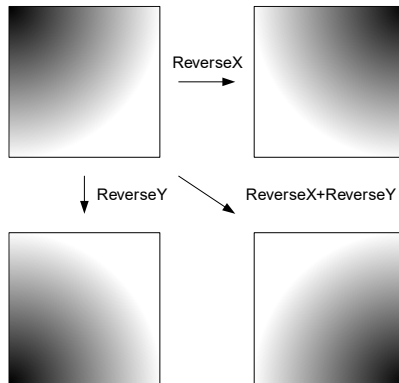
5.13 Defect Pixel Correction

Defect Pixel Correction is available up to 256 pixels.

5.14 CameraLink CLK

You can change the output CLK frequency of the CameraLink.

The frequency can be selected from 37.5 / 50/83 MHz.

5.15 CameraLink Tap

You can change the number of output taps of the CameraLink.

It is possible to choose from 1 / 2 / 3 tap.

5.16 PixelFormat

You can change the output data width of the CameraLink.

It is possible to choose from 8 / 10 / 12 bit.

5.17 HighFramerateMode

BC040M has HighFramerateMode. You can improve the frame rate by using HighFramerateMode.

Note on HighFramerateMode:

- If you use HighFramerateMode, improves frame rate and sensitivity by about 4 times, but image quality may deteriorate. Also, the actual exposure time may vary depending on the individual differences and the operating environment (such as the operating temperature).When using the HighFramerateMode, I ask you to have final image quality checked with your environment.

5.18 User Free Memory

A free memory area is available to read and write arbitrary data for user. Individual numbers can be assigned when multiple BC cameras are connected.

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5.19 User Set

You are able to save a user setting to the non-volatile memory of the camera.

There are 15 user memory channels for user setting.

By using user memory, you are able to restore frequent used settings at the time of next start-up.

The following table is the list of registers applied to UserSetSave.

Category	Register	Category	Register
TransportlayerControl	CameraLink Tap	TriggerControl	TriggerMode
	CameraLink CLK		TriggerSequence
ImageFormatControl	OffsetX		TriggerSource
	Width		TriggerDelay
	OffsetY	ExposureControl	ExposureTimeControl
	Height		ExposureTime
	BinningHorizontal		ShortExposureMode
	BinningVertical	DigitalIOControl	LineInverterAll
	DecimationHorizontal	AnalogControl	Gain
	DecimationVertical		BlackLevel
	ReverseX		Gamma
	ReverseY	LUTControl	LUTEnable
	PixelSize	UserSetControl	UserSetDefault
	TestPattern	SequentialShutterControl	SequentialShutterEnable(*)
AcquisitionControl	AcquisitionFrameRateControl		SequentialShutterTerminateAt(*)
	AcquisitionFrameRate		SequentialShutterEntry(*)
	AcquisitionFrameIntervalControl	DPCControl	DPCEnable(*)
	AcquisitionFrameInterval		DPCNumber(*)
	HighFramerateMode		DPCEntryX(*)
			DPCEntryY(*)

(*) DPC and SequentialShutter entries are stored to a single channel. Entries are shared with all channels.

5.20 Test Pattern

Following test patterns are available

- Black   : All pixels 0 LSB (@ 8-bit)

- White   : All pixels 255 LSB (@ 8-bit)

- Grey A   : All pixels 170 LSB (10101010_B) (@ 8-bit)

- Grey B   : All pixels 85 LSB (01010101_B) (@ 8-bit)

- Horizontal ramp waveform

- Vertical ramp waveform

- Grey scale

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6 Specifications

6.1 Electrical specification

Model Name		BC040M	BC160M
Imager		CMOS image sensor	
Maximum number of Video out pixels (H) x (V)		720×540	1440×1080
Scanning area (H) x (V) [mm]		5.02×3.82 (1/2.9 type)	5.00×3.75 (1/2.9 type)
Pixel size (H) x (V) [μm]		6.90×6.90	3.45×3.45
Scan method		Progressive	
Electronic shutter method		Global shutter	
Aspect ratio		4:3	
Sensitivity		2700lx, F11, 1/125s	2600lx, F11, 1/77s
Minimum illuminance		F1.4, Gain +24dB, Video level 50%	
		2lx	2lx
Gain		MANUAL	
Setting range		0 to +24dB (factory setting : 0dB)	
Black Level		-25 to 25% (factory setting : 0% [0LSB@8bit])	
Gamma		γ=1.0 to 0.45 (factory setting : γ=1.0)	
LUT		Input 12 bit, Output 12 bit	
User Setting Memory		15 channels	
User Free Memory		64 Byte	
Test Pattern		Black, White, Grey A, Grey B Horizontal ramp waveform, Vertical ramp waveform, Grey scale (factory setting : OFF)	
Power supply	PoCL	DC+12V ±10% (From CameraLink connector)	
Power consumption(*1)	PoCL	1.6W(max)	1.7W(max)

(*1) at all pixels readout

6.2 Internal sync signal specification

Model Name	BC040M	BC160M
Driving frequency	37.5 / <u>50</u> / 83 MHz	
Horizontal sync frequency	Depending on the settings of CameraLink CLK and CameraLink Tap	
Vertical sync frequency	Electronic shutter setting value $\leqq$ Frame rate	
37.5MHz：1 / 2 / 3 tap	86.63 / 170.13 / 250.67 Hz	22.74 / 45.07 / 66.99 Hz
50MHz：<u>1</u> / 2 / 3 tap	<u>115.43</u> / 226.54 / 333.57 Hz	<u>30.31</u> / 60.05 / 89.23 Hz
83MHz：1 / 2 / 3 tap	191.98 / 377.13 / 436.74 Hz	50.36 / 99.88 / 148.26 Hz

6.3 Electronic shutter specification

Model Name	BC040M	BC160M
Exposure time	MANUAL	
<u>ShortExposureMode=OFF</u>	14.8µs to 16s	
	8000µs (factory setting)	32000µs (factory setting)
ShortExposureMode=ON	1.08µs to 13.31s	

6.4 Random Trigger Shutter specification

Trigger Mode	<u>External trigger</u>, Software trigger (Fix mode only)
External trigger	CameraLink connector (CC1)
Software trigger	GenCP / Legacy Command control
Exposure time	<u>Fix mode</u>, Level mode
Fix mode	The exposure time depends on the electronic shutter setting
Level mode	The exposure time depends on External trigger width
Sequential Shutter	16 entry (max)
Trigger Delay	0 to 2000000µs (factory setting: 0µs)

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6.5　Interface specification

Interface	CameraLink Version 1.2 conformity
Output mode	Base configuration　1 / 2 / 3 Tap
Camera control	
Legacy mode	Our proprietary communication protocol
Baud rate	9600 bps
Start bit	1 bit
Data bit	8 bit
Stop bit	1 bit
Parity bit	None
Handshake	None
GenCP-IIDC2 mode	Communication protocol formulated by EMVA
Baud rate	9600 / 115200 / 921600 bps
Start bit	1 bit
Data bit	8 bit
Stop bit	1 bit
Parity bit	None
Handshake	None

6.6　Image output format

* <u>Underbar</u> is factory default

Model			BC040M	BC160M
Image output format			<u>Mono8</u>, Mono10[*1], Mono12[*1]	
Maximum Frame rate (at all pixels readout)	Mono8[*2]	HighFramerateMode=OFF	436 fps	148 fps
		HighFramerateMode=ON	523 fps	Incompatible
	Mono10[*3], Mono12[*3]		320 fps	99 fps

　(*1) 3tap is not supported

　(*2) 83MHz / 3tap setting

　(*3) 83MHz / 2tap setting

6.7 Machine external specification

Dimensions	29 mm(W) x 29 mm (H) x 26.5 mm (D) (Not including protrusion)
Mass	Approximately 33g
Lens mount	C mount
Flange back	17.526mm
Camera body grounding insulation status	Conductive between circuit GND and camera body

6.8 Operation Ambient conditions

Operation assurance	Temperature: -5°C to +45 °C Humidity: 90% or less (no condensation)
Storage assurance	Temperature: -20°C to +60 °C Humidity: 95% or less (no condensation)
EMC condition	EMI (Electro-Magnetic interference) : EN61000-6-4 FCC Part 15 Subpart B Class A KN32 EMS (Electro-Magnetic susceptibility) : EN61000-6-2 KN35

6.9 Connector pin assignment

Video output / Controlling / Power supply connector (CameraLink Base Configuration)		
Connector type	HDR-EC26FYTG2+ (Manufactured by Honda Connectors)	

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

Pin No.	I/O	Signal name	Pin No.	Pin No.	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- (TRIG)	22	I	CC1+ (TRIG)
10	I	CC2+	23	I	CC2
11	I	CC3-	24	I	CC3+
12	I	CC4+	25	I	CC4-
13	-	GND	26	-	DC+12V (PoCL)

*CC2+, CC2-, CC3+, CC3-, CC4+, CC4- : Not used

## 6.10 Bit assignment of camera output

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

Port / Bit	8bit	10bit	12bit	Port / Bit	8bit	10bit	12bit	Port / Bit	8bit	10bit	12bit
Port A0	A[0]	A[0]	A[0]	Port B0	B[0]	A[8]	A[8]	Port C0	n/a	B[0]	B[0]
Port A1	A[1]	A[1]	A[1]	Port B1	B[1]	A[9]	A[9]	Port C1	n/a	B[1]	B[1]
Port A2	A[2]	A[2]	A[2]	Port B2	B[2]	n/a	A[10]	Port C2	n/a	B[2]	B[2]
Port A3	A[3]	A[3]	A[3]	Port B3	B[3]	n/a	A[11]	Port C3	n/a	B[3]	B[3]
Port A4	A[4]	A[4]	A[4]	Port B4	B[4]	B[8]	B[8]	Port C4	n/a	B[4]	B[4]
Port A5	A[5]	A[5]	A[5]	Port B5	B[5]	B[9]	B[9]	Port C5	n/a	B[5]	B[5]
Port A6	A[6]	A[6]	A[6]	Port B6	B[6]	n/a	B[10]	Port C6	n/a	B[6]	B[6]
Port A7	A[7]	A[7]	A[7]	Port B7	B[7]	n/a	B[11]	Port C7	n/a	B[7]	B[7]

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

6.11 Typical spectral response

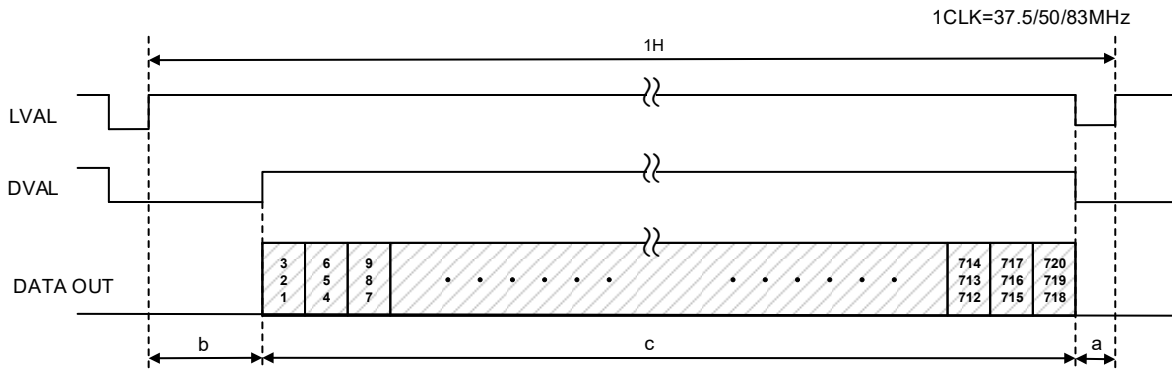The lens characteristics and light source characteristics is not reflected in table.

< BC040M / BC160M >

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http://www.toshiba-teli.co.jp/en/
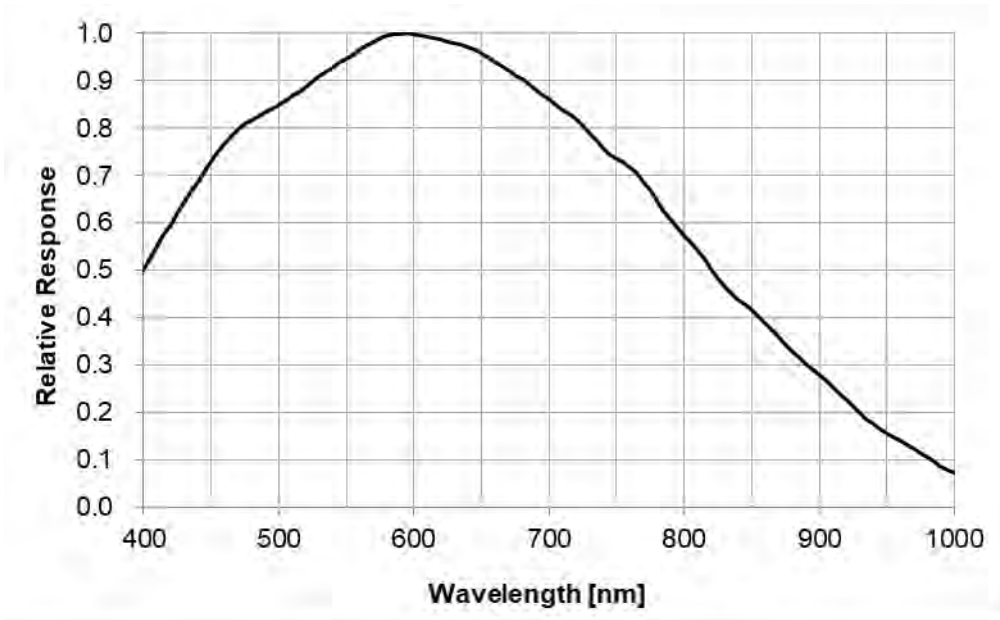
7 Timing chart

For getting fastest framerate, Electronic shutter $\leqq$ readout time.

7.1 Horizontal timing : at all pixels readout (following timing figure : BC040M 3tap)

1CLK=37.5/50/83MHz

1 CLK=37.5MHz/50MHz　　　　　　　　　　　　　　　　　unit：CLK

Model name	CameraLink tap	a	b	c
BC040M	1tap	4	10	720
	2tap			360
	3tap			240
BC160M	1tap	4	10	1440
	2tap			720
	3tap			480

1 CLK=83MHz　　　　　　　　　　　　　　　　　　　　　unit：CLK

Model name	CameraLink tap	a	b	c
BC040M	1tap	4	10	720
	2tap			360
	3tap	69～73		240
BC160M	1tap	4	10	1440
	2tap			720
	3tap			480

Horizontal sync frequency=1H　　　　　　　　　　　　　　unit：KHz

Model name	CameraLink tap	CLK frequency (1CLK)		
		37.5MHz	50MHz	83MHz
BC040M	1tap	51.09	68.12	113.08
	2tap	100.27	133.69	221.93
	3tap	147.64	196.85	258.57
BC160M	1tap	25.79	34.39	57.08
	2tap	51.09	68.12	113.08
	3tap	75.91	101.21	168.02

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7.2 Vertical timing : at all pixels readout (following timing figure : BC040M 3tap)
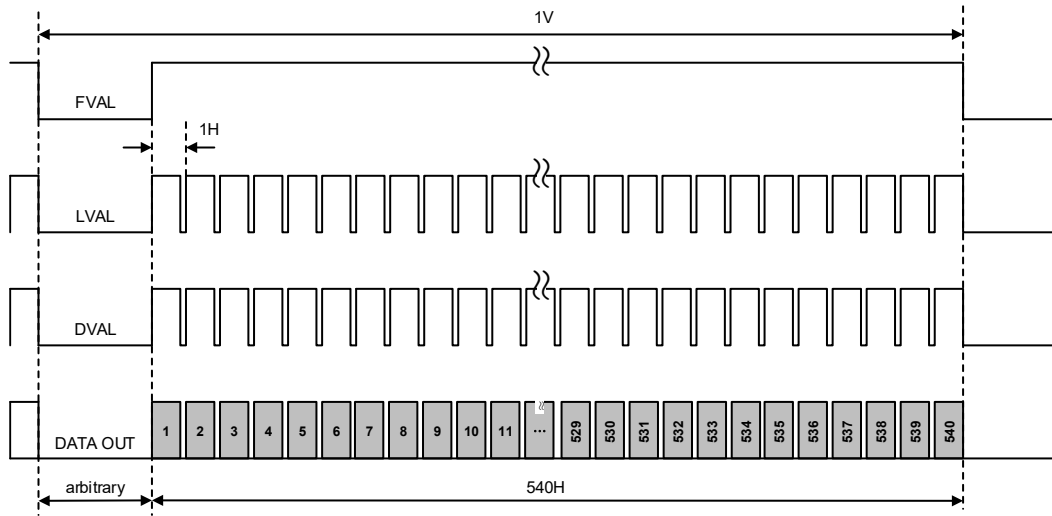
Vertical sync frequency=1V   Unit：Hz

Model name	CameraLink tap	PixelFormat	CLK frequency (1CLK)		
			37.5MHz	50MHz	83MHz
BC040M	1tap	Mono8	86.63	115.43	191.98
		Mono10/Mono12	86.63	115.43	191.98
	2tap	Mono8	170.13	226.54	377.13
		Mono10/Mono12	170.13	226.54	320.13
	3tap	Mono8	250.67	333.57	436.74
BC160M	1tap	Mono8	22.74	30.31	50.36
		Mono10/Mono12	22.74	30.31	50.36
	2tap	Mono8	45.07	60.05	99.88
		Mono10/Mono12	45.07	60.05	99.88
	3tap	Mono8	66.99	89.23	148.26

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8   Communication Protocol

BC series has Legacy protocol and GenCP as command communication protocol.

The switching of communication protocol is recognized automatically from received packet. The PC application can communication to camera without switching operation of communication protocol. For Legacy protocol and GenCP, BC series has multiple register for control of camera feature.

The accessing to IIDC2 registers is possible by using Legacy protocol and GenCP. The accessing to Legacy registers is possible by using only Legacy protocol. The accessing to GenCP registers is possible by using only GenCP.
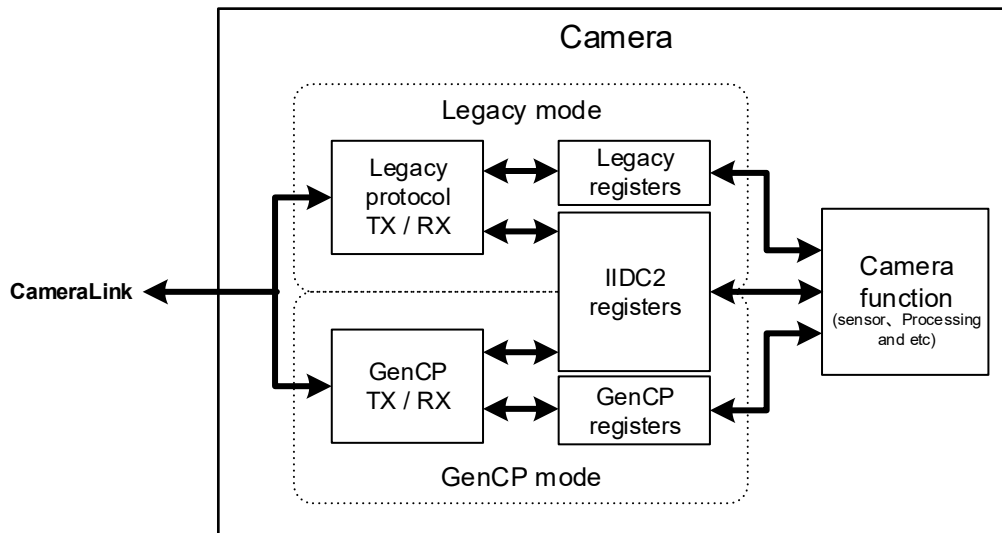
Teli-Legacy protocol, Teli-Legacy register

The protocol and register are adopted on the CSC series in our previous product.

They are available in this camera for ease to the CSC series customers.

GenCP

This is a communication protocol including transaction flow and packet structure, which is standardized by the European Machine Vision Association (EMVA). It is used for CameraLink, USB 3.0 and various interfaces.

You can find this specification as following web page (As of July, 2019).

http://www.emva.org/

IIDC2

This is a register mapping of machine vision cameras, which is standardized by Japan Industrial Imaging Association (JIIA). Because it is not included transport layer, IIDC2 can be used on various interfaces.

You can find this specification as following web page (As of July, 2019).

http://jiia.org/
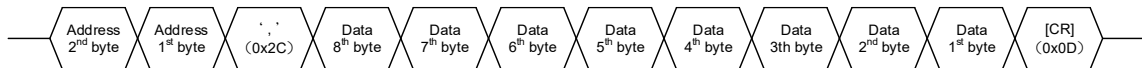
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8.1 Legacy protocol

This 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.
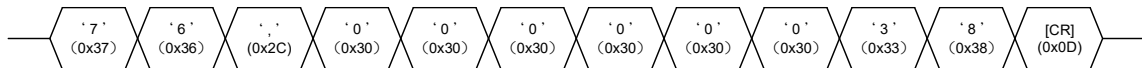
All ASCII alphabetic characters are uppercase.

8.1.1 Writing to the register

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

| Address 2nd byte | Address 1st byte | ',' (0x2C) | Data 8th byte | Data 7th byte | Data 6th byte | Data 5th byte | Data 4th byte | Data 3th byte | Data 2nd byte | Data 1st byte | [CR] (0x0D) |

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

| '7' (0x37) | '6' (0x36) | ',' (0x2C) | '0' (0x30) | '0' (0x30) | '0' (0x30) | '0' (0x30) | '0' (0x30) | '0' (0x30) | '3' (0x33) | '8' (0x38) | [CR] (0x0D) |

When the address and data are 2 bytes or more, the above register writing can be omitted in the following format because it is applied from the upper digit.

| '7' (0x37) | '6' (0x36) | ',' (0x2C) | '3' (0x33) | '8' (0x38) | [CR] (0x0D) |
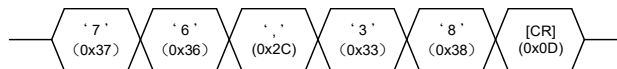
The camera responds to the write command with No Error (ACK) or Error (NAK), as follows.

No Error (ACK)

| [ACK] (0x06) | [CR] (0x0D) |

Error (NAK)

| [NACK] (0x15) | [CR] (0x0D) |
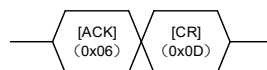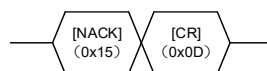
*Setting scalable is reflected by writing the "Scalable update" register.

8.1.2 Reading the 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.

| '9' (0x39) | '1' (0x31) | ',' (0x2C) | 'R' (0x52) | 'Q' (0x51) | [CR] (0x0D) |
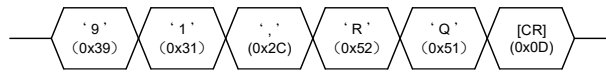
The camera responds to the read request, as follows (Data's max-length is 8 bytes).

| Data 8th byte | Data 7th byte | Data 6th byte | Data 5th byte | Data 4th byte | Data 3rd byte | Data 2nd byte | Data 1st byte | [CR] (0x0D) |

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.

| '1' (0x31) | '0' (0x30) | [CR] (0x0D) |

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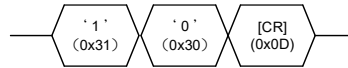
8.2 GenCP

Communicates with the camera, by the packet that is defined by GenCP.

Communication flow control, packet structure and others, refer to the specifications of GenCP.

For packets to be used, refer to below.

8.2.1 READMEM_CMD

	+0x0	+0x1	+0x2	+0x3
0x00	0x0100 (preamble)		CCD checksum	
0x04	SCD checksum		0x0000 (channel_id)	
0x08	0x4000 (flags)		0x0800 (command_id)	
0x0C	0x000C (length)		request_id	
0x10	register address (hi)			
0x14	register address (lo)			
0x18	0x0000 (reserved)		read length	

8.2.2 READMEM_ACK

	+0x0	+0x1	+0x2	+0x3
0x00	0x0100 (preamble)		CCD checksum	
0x04	SCD checksum		0x0000 (channel_id)	
0x08	status code		0x0801 (command_id)	
0x0C	length		request_id	
0x10	data			
...				
(0x10+length-4)				

8.2.3 WRITEMEM_CMD

	+0x0	+0x1	+0x2	+0x3
0x00	0x0100 (preamble)		CCD checksum	
0x04	SCD checksum		0x0000 (channel_id)	
0x08	0x4000 (flags)		0x0802 (command_id)	
0x0C	length		request_id	
0x10	register address (hi)			
0x14	register address (lo)			
0x18	data			
...				
(0x10+length-4)				

8.2.4 WRITEMEM_ACK

	+0x0	+0x1	+0x2	+0x3
0x00	0x0100 (preamble)		CCD checksum	
0x04	SCD checksum		0x0000 (channel_id)	
0x08	status code		0x0803 (command_id)	
0x0C	0x0004 (length)		request_id	
0x10	0x0000 (reserved)		length written	

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8.3　How to calculate GenCP checksum

The specified field is cut out in 2 byte units, and the one's complement sum is taken to be one's complement.

The specification fields are as follows.

	+0x0	+0x1	+0x2	+0x3	
0x00	preamble (0x0100)		CCD checksum (0x2E46)		Prefix
0x04	SCD checksum (0xECCA)		channel_id (0x0000)		
0x08	flags (0x4000)		command_id (0x0802)		CCD (Common Command Data)
0x0C	length (0x000C)		request_id (0x89AB)		
0x10	register address hi (0x00000000)				SCD (Specific Command Data)
0x14	register address lo (0x0020405C)				
0x18	data (0x000000FF)				
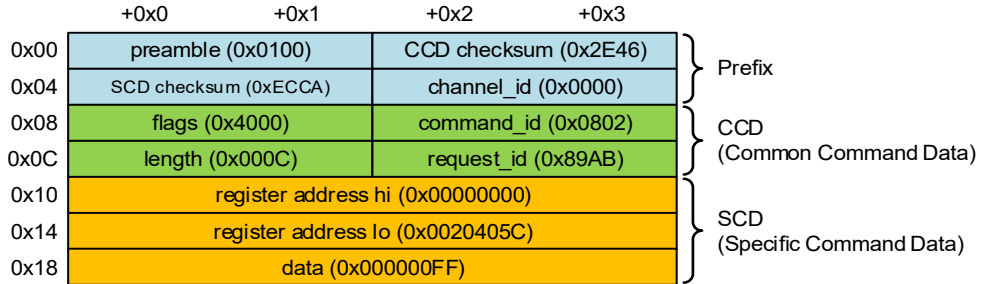
∗CCD checksum 　　　　: channel_id, CCD (In the example, the area of 0x06 to 0x0F)

∗SCD checksum 　　　　: channel_id, CCD, SCD (In the example, the area of 0x06 to 0x1B)

∗The one's complement sum is taken to be one's complement.

　　　　　　　　　　　　: It has the same calculation method as the UPD Checksum of RFC768.

　　　　　　　　　　　　　Please refer to the following about UPD of RFC768.

　　　　　　　　　　　　https://www.ietf.org/rfc/rfc768.txt

8.3.1　CCD checksum in the example

One's complement sum

=0x0000+0x4000+0x0802+0x000C+0x89AB

=0xD1B9

One's complement

=0xFFFF-0xD1B9

=0x2E46

8.3.2　SCD checksum in the example

One's complement sum

=(CCD checksum complement)+0x0000+0x0000+0x0020+0x405C+0x0000+0x00FF

=0xD1B9+0x0000+0x0000+0x0020+0x405C+0x0000+0x00FF

=0x11334

=0x001+0x1334

=0x1335

One's complement

=0xFFFF-0x1335

=0xECCA

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9 Register Map

BC series has GenCP and Legacy protocol as command communication protocol.

9.1 IIDC2 Address

The following address is possible to control by GenCP and Legacy protocol.

Register address	Read Write	AC(*)	Memory Save	Default	Register name	Description
0x0020 005C	R.O.	-	-	0x0	ApplyImageFormat	0x0:No error, 0x10:Scalable setting error
0x0020 105C	R/W	✓	✓	0x1	CameraLink Tap	0x1:1Tap,0x2:2Tap,0x3:3Tap
0x0020 107C	R/W	✓	✓	0x32	CameraLink CLK	0x25:37.5000MHz,0x32:50.0000MHz,0x53:83.0357MHz
0x0020 2094	R/W	✓	✓	0x0	OffsetX	Scalable: Horizontal offset (in pixels) from the origin to the region of interest 0.4M:0x0 (0) ～ 0x290 (656)　　OffsetX setting unit: 4 1.6M:0x0 (0) ～ 0x560 (1376)　　OffsetX setting unit: 4
0x0020 2098	R/W	✓	✓	0.4M:0x2D0 1.6M:0x5A0	Width	Scalable: Width 0.4M:0x40 (64) ～ 0x2D0 (720)　　Width setting unit: 4 1.6M:0x40 (64) ～ 0x5A0 (1440)　　Width setting unit: 4
0x0020 209C	R/W	✓	✓	0x0	OffsetY	Scalable: Vertical offset (in pixels) from the origin to the region of interest. 0.4M:0x0 (0) ～ 0x1DC (476)　　OffsetY setting unit: 2 1.6M:0x0 (0) ～ 0x3F8 (1016)　　OffsetY setting unit: 2
0x0020 20A0	R/W	✓	✓	0.4M:0x21C 1.6M:0x438	Height	Scalable: Height 0.4M:0x40 (64) ～ 0x21C (540)　　Height setting unit:　2 1.6M:0x40 (64) ～ 0x438 (1080)　　Height setting unit:　2
0x0020 303C	R/W	-	-	0x8	Acquisition Command	0x0: Abort image output.　0x1: Stop image output. 0x8: Start image output.
0x0020 30A8	R/W	-	✓	0x0	Acquisition FrameRateControl	0x0:NoSpecify　　Take priority ExposureTime setting. 0x1:Manual　　Take priority AcquisitionFrameRate setting.
0x0020 30BC	R/W	-	✓	0.4M:0x736F31 1.6M:0x12DF8A	Acquisition FrameRate	Framerate *AcquisitionFrameRate / 65536[fps]
0x0020 30C8	R/W	-	✓	0x0	Aqcuisition FrameIntervalControl	0x0:NoSpecify　　Take priority ExposureTime setting. 0x1:Manual　　Take priority AcquisitionFrameRate setting.
0x0020 30DC	R/W	-	✓	0.4M:0x4F4FB 1.6M:0x12DF8A	Acquisition FrameInterval	Interval *AcquisitionFrameInterval / 37500000[sec]
0x0020 4028	R/W	-	✓	0x1	ExposureTimeControl	0x0:NoSpecify　　Take priority AcquisitionFrameRate setting. 0x1:Manual　　Take priority ExposureTime setting.
0x0020 403C	R/W	-	✓	0.4M:0x493E0 1.6M:0x124F80	ExposureTime	ExposureTime ShortExposureMode=OFF: *ExposureTime / 37500000 [sec] 0x22B (14.8usec) ～ 0x23C34600 (16sec) ShortExposureMode=ON: *ExposureTime * 53 / 983850009 [sec] 0x14 (1.1usec) ～ 0xF7 (13.3usec)
0x0020 405C	R/W	-	✓	0x0	BlackLevel	0xFFFFFFEFF (-25%) ～ 0x100(+25%)
0x0020 407C	R/W	-	✓	0x0	Gain	0x0 (0dB) ～ 0xF0 (24dB)
0x0020 409C	R/W	-	✓	0x64	Gamma	Min:0x2D(γ=0.45)　Max:0x64(γ=1.0)
0x0020 439C	R/W	-	✓	0x0	ShortExposureMode	0x0:OFF,0x1:ON
0x0020 603C	R/W	-	✓	0x0	LUT Enable	0x0:OFF,0x1:ON
0x0030 0000 0x0030 0004 ↓ 0x0030 0FFC ↓ 0x0030 3FFC	R/W	-	-	0x0	LUTValue[0] LUTValue[1] ↓ LUTValue[1023] ↓ LUTValue[4095]	Min:0x0,MAX:0xFFF

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Register address	Read Write	AC(*)	Memory Save	Default	Register name	Description
0x0020 703C	R/W	✓	✓	0x0	TriggerMode	0x0:Normal shutter mode 0x1:Random trigger Shutter mode
0x0020 705C	R/W	✓	✓	0x0	TriggerSequence	0x0:Fix mode, 0x1:Level mode
0x0020 707C	R/W	✓	✓	0x0	TriggerSource	Selects a trigger source of random trigger shutter. 0x0:Line0(CC1),0x40:Software
0x0020 70BC	R/W	✓	✓	0x0	TriggerDelay	Sets the delay from trigger detection to exposure start. *TriggerDelay / 37500000 [sec] 0x0(0sec) ～ 0x47868C0(2sec)
0x0020 70DC	W.O.	-	-	—	SoftwareTrigger	0x8:Execute SoftwareTrigger
0x0020 213C	R/W	✓	✓	0x1	Binning Horizontal	0.4M:Min:0x1,Max:0x2 1.6M:Min:0x1,Max:0x4
0x0020 215C	R/W	✓	✓	0x1	Binning Vertical	0.4M:Min:0x1,Max:0x2 1.6M:Min:0x1,Max:0x4
0x0020_217C	R/W	✓	✓	0x1	Decimation Horizontal	0.4M:Min:0x1,Max:0x2 1.6M:Min:0x1,Max:0x4
0x0020_219C	R/W	✓	✓	0x1	Decimation Veritical	0.4M:Min:0x1,Max:0x2 1.6M:Min:0x1,Max:0x4
0x0020 20DC	R.O.	-	-	0x0	PixelCoding	0x0:Mono
0x0020 20FC	R/W	✓	✓	0x8	PixelSize	0x8:Bpp8,0xA:Bpp10,0xC:Bpp12
0x0020 807C	R/W	-	-	0x0	UserSetSelector	Sets the memory channel of UserSet. 0x0:Default,0x1:UserSet1 ～ 0xF:UserSet15
0x0020 809C	R/W	Done : ✓ Load : ✓ Save : - Erase : -		0x0	UserSetCommand	Read / Write the UserSet. 0x0:Done, 0x8:Load, 0x9:Save, 0x7F:Erase
0x0021 F2FC	R/W	-	✓	0x0	UserSetDefault	Selects a channel of user setting when camera powers up. 0x0:Default 0x1:UserSet1 ～ 0x15:UserSet15
0x0020 9050	R/W	-	✓	0x0	LineInverterAll	Selects the inversion of Line0(CC1). 0x0:Negative,0x1:Positive
0x0020 9070	R.O.	-	-	0x1	LineStatusAll	Returns the current status of Line0(CC1).
0x0020 21B0	R/W	✓	✓	0x0	ReverseX	Sets the Reverse Horizontal. 0x0:OFF, 0x1:ON
0x0020 21D0	R/W	✓	✓	0x0	ReverseY	Sets the Reverse Vertical. 0x0:OFF, 0x1:ON
0x0021 F13C	R/W	-	✓	0x0	TestPattern	0x0:OFF 0x1:Black 0x2:White 0x3:GreyA 0x4:GreyB 0x5:GreyHorzontalRamp 0x6:GreyScale 0x8:GreyVerticalRamp
0x0021 F59C	R/W	✓	✓	0x0	HighFramerateMode	Only BC040M model. 0x0:OFF,0x1:ON

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Register address	Read Write	AC(*)	Memory Save	Default	Register name	Description
0x0021 F29C				0x0	DPCEnable	Sets the activation of DPC (Defective pixel correction) function. 0x0:OFF, 0x1:ON
0x0021 F2BC				0x0	DPCNumber	Sets the number of pixels to correct. 0x0 (0) ～ 0x100 (256)
0x0040 0000					DPCValue [X_1]	Sets the X coordinate of defective pixel (1st) 0.4M:0x0(0)～0X2CF(719) 1.6M:0x0(0)～0X59F(1439)
0x0040 0004					DPCValue [Y_1]	Sets the Y coordinate of defective pixel (1st) 0.4M:0x0(0)～0X21B(539) 1.6M:0x0(0)～0X437(1079)
0x0040 0008	R/W	-	✓		DPCValue [X_2]	Sets the X coordinate of defective pixel (2nd) 0.4M:0x0(0)～0X2CF(719) 1.6M:0x0(0)～0X59F(1439)
0x0040 000C				0x0	DPCValue [Y_2]	Sets the Y coordinate of defective pixel (2nd) 0.4M:0x0(0)～0X21B(539) 1.6M:0x0(0)～0X437(1079)
↓					↓	↓
0x0040 07F8					DPCValue [X_{255}]	Sets the X coordinate of defective pixel (255th) 0.4M:0x0(0)～0X2CF(719) 1.6M:0x0(0)～0X59F(1439)
0x0040 07FC					DPCValue [Y_{255}]	Sets the Y coordinate of defective pixel (255th) 0.4M:0x0(0)～0X21B(539) 1.6M:0x0(0)～0X437(1079)
0x0021 F31C	R/W	-	✓	0x0	SS Enable	Sets the activation of Sequential Shutter (SS) function. 0x0:OFF,0x1:ON
0x0021 F33C	R/W	-	✓	0x1	SS TerminateAt	Sets the number of Tables to repeat the sequence. Min:0x1(1),Max:0x10(16)
0x0050 0040					SS Entry 0	
0x0050 0044					SS Entry 1	
0x0050 0048					SS Entry 2	Sets the UserSet number to register to the first sequence. Min:0x1(1),Max:0xF(15)
0x0050 004C	R/W	-	✓	0x1	SS Entry 3	
↓					↓	
0x0050 0078					SS Entry 15	

 * 0.4M:BC040M, 1.6M:BC160M

 * For registers other than those mentioned above, please refer to the IIDC2 Digital Camera Control Specification Ver.1.0.0.

 *AC: In relation to Acquisition Command (address:0x002 0303C) : If [AC] marked "✓", the register is set to following procedure.

 Stop image output (0x0) → register setting / write command → Start image output (0x08)

    R/W   : Read / Write possible
    R.O.   : Read Only
    W.O.   : Write Only
    N.A.   : Not available

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9.2 GenCP Address

The following address is possible to access by GenCP only.

Register address	Read Write	AC(*)	Memory Save	Default	Register name
0x0000 0000	R.O.	-	-	GenCP Version	0x0001 0000(GenCP Ver.1.0)
0x0000 0004 | 0x0000 0043	R.O.	-	-	Manufacture Name	Toshiba-Teli
0x0000 0044 | 0x0000 0083	R.O	-	-	Model Name	ex)BC040M
0x0000 0084 | 0x0000 00C3	R.O	-	-	Family Name	BC-Series
0x0000 00C4 | 0x0000 0103	R.O	-	-	Device Version	Camera version ex)4.0.2
0x0000 0104 | 0x0000 0143	R.O	-	-	Manufacture Info	ex)0.4M 1/2.9 B/W
0x0000 0144 | 0x0000 0183	R.O	-	-	Serial Number	ex)1000001
0x0000 0184 | 0x0000 0193	R/W	✓	Null string	User Define Name	User-programmable device identifier.
0x0000 01F0 | 0x0000 01F7	R.O	-	0x0	Timestamp	Returns the latched 64-bit value of the timestamp counter.
0x0000 01F8	W.O.	-	-	Timestamp Latch	0x01: Latches the current timestamp counter into timestamp register.
0x0001 0000	R.O	-	0x91	Supported Baudrates	9600/115200/921600 bps
0x0001 0004	R/W	-	0x0	Current Baudrate	Set baudrate. 0x0:auto recognition, 0x1:9600bps, 0x10:115200bps, 0x80:921600bps

* 0.4M:BC040M, 1.6M:BC160M

* For registers other than those mentioned above, please refer to the GenCP Standard Ver.1.0.

R/W ：Read / Write possible

R.O. ：Read Only

W.O. ：Write Only

N.A. ：Not available

9.3 Legacy Address

The following address is possible to access by Legacy protocol only.

Register address	Read Write	AC(*)	Memory Save	Default	Register name
0x00 | 0x0F	R.O.	-	-	Manufacture Name (ASCII)	Toshiba-Teli
0x10 | 0x1F	R.O.	-	-	Model Name (ASCII)	ex)BC040M
0x20 | 0x2F	R.O.	-	-	Family Name (ASCII)	BC-Series
0x30 | 0x3F	R.O.	-	-	Serial Number (ASCII)	ex)1000001
0x48 | 0x4F	R.O.	-	-	Camera version (ASCII)	ex)4.0.2
0x60 | 0x67	R.O.	-	-	Register map version (ASCII)	ex)01.01
0x6C	R/W	-	0x0	Memory bank	Sets the memory channel of UserSet. 0x0:Default,0x1:UserSet1 ～ 0xF:UserSet15
0x6D	W.O.	-	-	Memory save	0x1: Save user settings.
0x6E	W.O.	-	-	Memory load	0x1: Load user settings from selected memory bank.
0x70	R/W	✓	0x0	Setup	0xFFFFFFEFF (-25%) ～ 0x100(+25%)
0x76	R/W	✓	0x0	Gain	0x0(0dB:default)～0xF0(24dB)
0x80	R.O.	-	0.4M:0x71 1.6M:0x1D	Frame rate	All pixels readout: Calcurated from [CameralinkCLK / Cameralink Tap]. Scalable: Calcurated from number of ouput lines.
0x82	R.O.	-	0.4M:0x2D0 1.6M:0x5A0	Horizontal resolution	All pixels readout: 0.4M:0x2D0 (720),1.6M:0x5A0 (1440) Scalable: 0.4M:0x40 (64)～0x2D0 (720),1.6M:0x40 (64)～0x5A0 (1440)
0x84	R.O.	-	0.4M:0x21C 1.6M:0x438	Vertical resolution	All pixels readout: 0.4M:0x21C (540),1.6M:0x438 (1080) Scalable: 0.4M:0x40 (64)～0x21C (540),1.6M:0x40 (64)～0x438 (1080)
0x87	R/W	✓	0x8	Output bit	0x8:8bit,0xA:10bit,0xC:12bit
0x88	R/W	✓	0x0	Test pattern	0x0:Off,0x1:Black,0x2:White,0x3:GreyA,0x4:GreyB, 0x5:GreyHorzontalRamp,0x6:GreyScale,0x8:GreyVerticalRamp
0x89	R/W	✓	0x1	Defective pixel correction	0x0:OFF, 0x1:ON
0x8A	R/W	✓	0x0	ReverseX	0x0:OFF,0x1:ON
0x8B	R/W	✓	0x0	ReverseY	0x0:OFF,0x1:ON
0x90	R/W	✓	0x0	Scan mode	0x0:Normal(default),0x1:Scalable
0x91	R/W	✓	0x0	Shutter mode	0x0:Normal shutter(default),0x1:Random trigger shutter
0x92	R/W	✓	0x0	Random trigger mode	0x0:FIX mode (default),0x1:pulse width mode
0x93	R/W	✓	0x0	Trigger polarity	0x0:Negative(default),0x1:Positive
0xA0	R/W	✓	0.4M:0x7D 1.6M:0x1F	Shutter speed denominator	Only ShortExposureMode=OFF 0x1(1)～0x107EF(67567)
0xA4	R/W	✓	0x1	Shutter speed numerator	Only ShortExposureMode=OFF 0x1(1)～0x10(16)

Register address	Read Write	AC(*)	Memory Save	Default	Register name
0xC0	W.O.	-	-	Update scalable	0x1: Update registers related to scalable.
0xC4	R/W	✓	0x0	Offset Y	0.4M:0x0 (0)～0x1DC (476)　OffsetY setting unit 2 0.4M:0x0 (0)～0x3F8 (1016)　OffsetY setting unit 2
0xC8	R/W	✓	0.4M:0x21C 1.6M:0x438	Height	0.4M:0x40 (64)～0x21C (540)　Height setting unit 2 1.6M:0x40 (64)～0x438 (1080)　Height setting unit 2
0xCC	R/W	✓	0x0	Offset X	0.4M:0x0 (0)～0x290 (656)　OffsetX setting unit 4 1.6M:0x0 (0)～0x560 (1376)　OffsetX setting unit 4
0xD0	R/W	✓	0.4M:0x2D0 1.6M:0x5A0	Width	0.4M:0x40 (64)～0x2D0 (720)　Width setting unit 4 1.6M:0x40 (64)～0x5A0 (1440)　Width setting unit 4
0xD8	R/W	-	0x0	User area : address	Sets address of user area. 0x0～0xF(15)
0xDA	R/W	-	-	User area : data	Read /Write data to the specified by [User area : address]. The data length is specified by [User area : byte number].
0xDB	W.O.	-	-	User area : erase	0x1: erase all data in User area.
0xDC	R/W	-	0x10	User area : byte number	Sets the byte number of R/W length of user area. 0x1, 0x4, 0x8, 0x10(16)
0xF0	R/W	✓	0x0	SequentialShutter Enable	0x0:OFF,0x1:ON
0xF1	R/W	✓	0x1	SequentialShutter TerminateAt	Sets the number of Tables to repeat the sequence. 0x1 ～ 0x4
0xF3	R/W	✓	0x1	SequentialShutter Entry1	Sets the UserSet number to register to the first sequence. 0x1 ～ 0x4
0xF4	R/W	✓	0x1	SequentialShutter Entry2	Sets the UserSet number to register to the 2nd sequence. 0x1 ～ 0x4
0xF5	R/W	✓	0x1	SequentialShutter Entry3	Sets the UserSet number to register to the 3rd sequence. 0x1 ～ 0x4
0xF6	R/W	✓	0x1	SequentialShutter Entry4	Sets the UserSet number to register to the 4th sequence. 0x1 ～ 0x4
0xF7	W.O.	-	-	SequenceMemory Load	0x1: Load the parameters from the memory specified [Memory bank] register.
0xF8	W.O.	-	-	SequenceMemory Save	0x1: Save the parameters from the memory specified [Memory bank] register. If camera teruned off, the data in memory for SS is erased.

* 0.4M:BC040M, 1.6M:BC160M

R/W　　　：Read / Write possible

R.O.　　　：Read Only

W.O.　　　：Write Only

N.A.　　　：Not available

10　Warranty rules

10.1 Warranty term

Warranty term is 36 months after your purchase. We may assume the date of the purchase from our shipping date when the date is unidentified.

10.2 Limited Warranty

Free warranty is not applicable for the troubles, damages or losses caused by the cases of the followings, even if it is during the warranty term.

1. Natural exhaust, wear or degradation of a component parts
2. Handling against the instructions and conditions described in the instruction manual
3. Remodeling, adjustment and the part exchange. (including the opening of the enclosure box and the alteration)
4. Using the accessories not included with the product or our non-designated optional articles
5. Damages caused during the transportation or deficiency of the handling such as drop or fall of the products after the products having been transferred to customers, leaving the products to corrosive environment such as sunlight, fire, sand, soil, heat, moisture, or an inappropriate storing method
6. A fire, an earthquake, a flood, a lightning, or other natural disasters, pollution and a short circuit, abnormal voltage, excessive physical pressure, theft, other accident
7. When connected to a product which is not recommended
8. When connected to the power supply which is not suitable
9. Forgery product, products which does not have proper serial number, products of which serial number is forged, damaged or deleted
10. All defects that happened after the expiration for a warranty term

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http://www.toshiba-teli.co.jp/en/

11   Repair

11.1 Repair Methods

Exchange to a replacement or an equal function product.

11.2 Repair request methods

On the occasion of a repair request, please download the "Failure situation report sheet" from our website, fill in the necessary items and return it together with the defective product.

Repair Request Methods

http://www.toshiba-teli.co.jp/en/support/contact/failure_situation.htm

Please read the following instructions carefully.

1. Please return our product alone, taking out of your equipment in case that our product is installed to an equipment

2. We are unable to return the information such as your own serial numbers, control number, the identification seal, if it is attached to the returned products. Please keep record before you return the product.

3. As the data saved in the camera will not be kept after the repair, please take out data before return.

4. We are unable to accept the cancellation after the repair request by the customer's reason.

5. About the repair product shipping expenses, please bear the charges when you return the product to us. We bear the charges to you from us only for a warranty period.

6. We are unable to accept your request of a delivery date and time of the product return, or the delivery method.

7. We are unable to accept a trouble factor investigation, the request of the repair report.

8. We accept a repair of out of warranty product, if it is reparable.

9. The proprietary rights of the repair request products after the exchange repair belong to us.

10. The immunity from responsibility of the product is applied in the repair completion products.

12　Outline Drawing
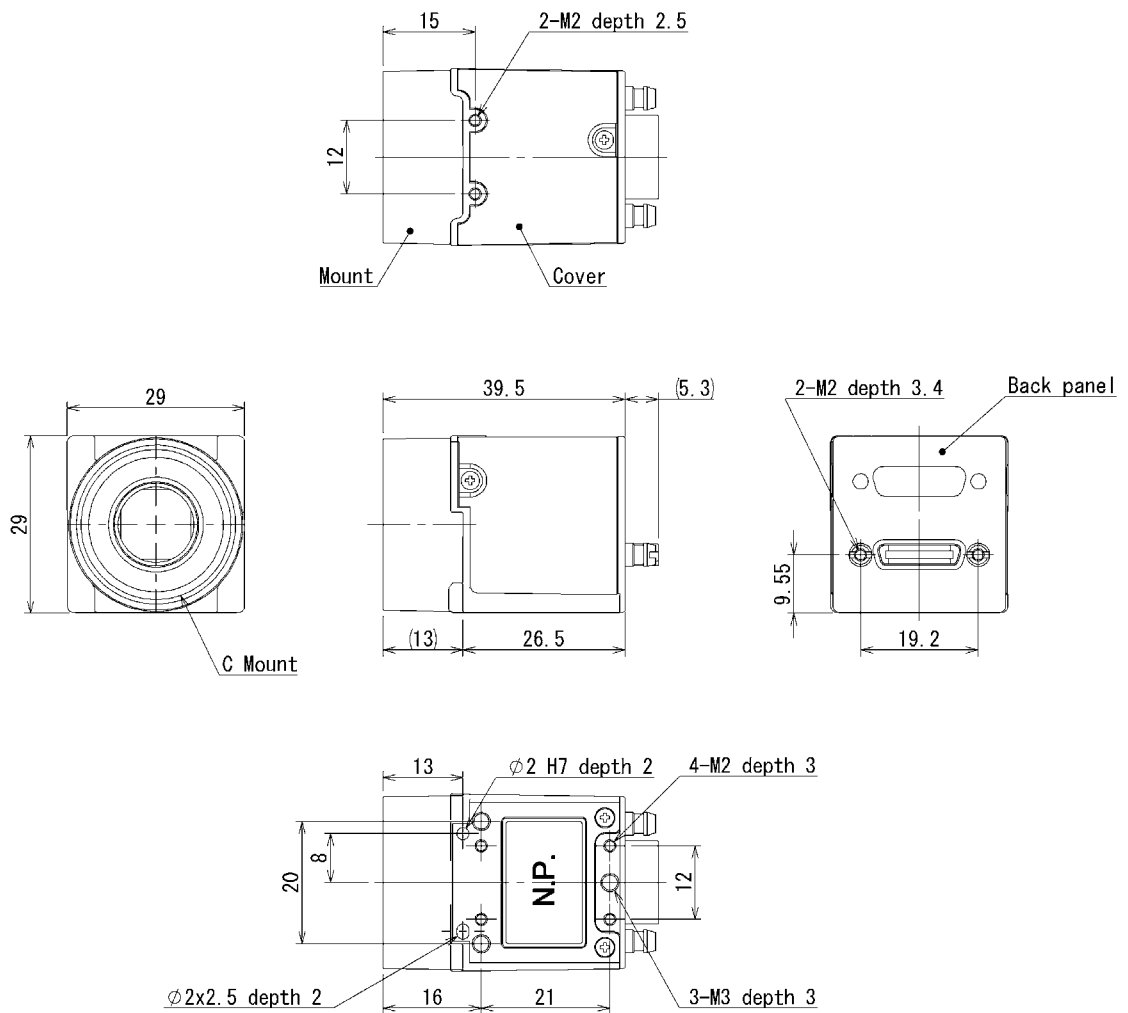

```
Specification
  Main Material
    Mount,Back panel:Aluminium die-cast metal
              Cover:Aerio aluminium
  Processing
    Mount,Back panel:Cationic coating(Black)
              Cover:laser satin print(Black)
```