BC Series
CMOS Camera

Instruction Manual

Model
Mono Camera : BC302LMG / BC505LMG
Color Camera : BC505LMCG / BC505LMCF

Thank you for purchasing our product.
Before using this CMOS camera, Please read through this instruction manual carefully in order to use this product correctly and safely.
After reading, keep this instruction manual handy so that you can refer to, whenever you need it.

Toshiba Teli Corporation

Information contained in this document is subject to change without prior notice.

Standard name might be trade mark of each company.

D4272607A

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

Contents

Safety Precautions

Before using this product, read these safety precautions carefully. Important information is shown in this Instruction Manual to protect users from bodily injuries and property damages, and to enable them to use the product safely and correctly.

Please be sure to thoroughly understand the meanings of the following signs and symbols before reading the main text that follow, and observe the instructions given herein.

[Definition of Safety Signs]

Safety Signs	Description
 WARNING	Indicates a potentially hazardous situation that may result in death or serious injury (*1) in the event of improper handling.
 CAUTION	Indicates a potentially hazardous situation that may result in light to moderate injuries (*2) or only in property damage (*3)in the event of improper handling.

Notes *1:“Serious injury” refers to cases of loss of eyesight, wounds, burns (high or low temperature), electric shock, broken bones, poisoning, etc., which leave after-effects or which require hospitalization or a long period of outpatient treatment of cure.

*2: "Light to moderate injuries" refers to injuries, burns, electric shock etc. that do not require hospitalization or long-term treatment.

*3: "Property damage" refers to cases of extensive damage involving damage to buildings, equipment, farm animals, pet animals and other belongings.

[Explanation of Safety Symbols]

Safety Symbols	Description
 PROHIBITED	This sign indicates **PROHIBITION** (Do not). The content of prohibition is shown by a picture or words beside the symbol.
 MANDATORY	This sign indicates **MANDATORY ACTION** (You are required to do). The content of action is shown by a picture or words beside the symbol.

General Handing

⚠WARNING

Unplug

- **Stop operation immediately when any abnormality or defect occurs.**
  If abnormal conditions are present, such as smoke, a burning smell, ingress of water or foreign matter, or if the equipment is dropped or malfunctions, fire or electric shock may result.
  Be always sure to disconnect the power cable from the wall socket at once and contact your dealer.

Do not get wet

- **Do not use the equipment in locations subject to water splashes.**
  Otherwise, fire or electric shock may result.

Never pull apart

- **Do not disassemble, repair, or modify the equipment.**
  Otherwise, fire or electric shock may result.
  For internal repair, inspection, or cleaning, contact your sales representative.

Avoid

- **Do not place anything on the equipment.**
  If metallic objects, liquid, or other foreign matter enters the equipment, fire or electric shock may result.

Avoid

- **Do not install the equipment in an unstable or inclined location or locations subject to vibration or impact.**
  Otherwise, the equipment may topple over and cause personal injury.

Do not touch

- **During an electrical storm, do not touch the power cable and the connection cable.**
  Otherwise, an electric shock may result.

Instruction

- **Use the specified voltage.**
  Use of an unspecified voltage may result in fire or electric shock.

Avoid

- **Do not be handled roughly, damaged, fabricated, bent forcefully, pulled, twisted, bundled, placed under heavy objects or heated the power cable and the connection cable.**
  Otherwise, fire or electric shock may result.

⚠ CAUTION


Instruction

- **Observe the following when installing the equipment:**
  ·Do not cover the equipment with a cloth, etc.
  ·Do not place the equipment in a narrow location where heat is likely to accumulate.
  Otherwise, heat will accumulate inside the equipment, possibly resulting in a fire.


Avoid

- **Do not place the equipment in locations subject to high moisture, oil fumes, steam, or dust.**
  Otherwise, fire or electric shock may result.


Avoid

- **Do not install the equipment in locations exposed to direct sunlight or humidity.**
  Otherwise, the internal temperature of the equipment will rise, which may cause a fire.


Instruction

- **Use only specified the power cable and the connection cables.**
  Otherwise, fire or electric shock may result.


Avoid

- **Do not give strong impact against the equipment.**
  It may cause the trouble.


Instruction

- **When performing connection, turn off power.**
  When connecting the power cable and the connection cable, turn off the equipment power.
  Otherwise, fire or electric shock may result.


Avoid

- **Do not expose its camera head to any intensive light (such as direct sunlight).**
  Otherwise, its inner image pickup device might get damaged.


Avoid

- **Avoid short-circuiting signal output.**
  Otherwise, a malfunction may occur.


Avoid

- **Avoid giving a strong shock against the camera body.**
  It might cause a breakdown or damage. If your camera is used in a system where its camera connector is subjected to strong repetitive shocks, its camera connector is possible to break down. If you intend to use your camera in such a situation, if possible, bundle and fix a camera cable in the place near the camera, and do not transmit a shock to the camera connector.


Instruction

- **Contact your sales representative to request periodic inspection and cleaning (every approx five years).**
  Accumulation of dust inside the equipment may result in fire or electric shock.
  For inspection and cleaning costs, contact your sales representative.

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.

- In the case damage or losses are caused by natural disasters, such as an earthquake and thunder, fire, or other acts of God, acts by a third party, deliberate or accidental misuse by the user, or 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 unintended use of equipment or software etc. that are 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 out of the guarantee.

- The case of damages or losses which are caused by incorrect connection of the cable is out of the guarantee.

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

Notes on using this product

● 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.

● 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.

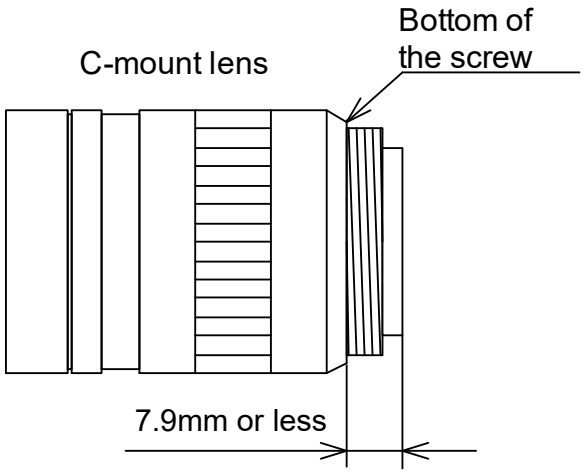
In addition, depending on the lens you use, the performance of the camera may not be brought out fully due to deterioration in resolution and brightness in the peripheral area, aberration and others.

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.

Install a next lens; its dimension of protrusion from bottom of the screw is equal to or less than 7.9mm. If a lens does not stand to this condition, it might not be installed to this camera.



● Mounting to pedestal

When mounting this product to a pedestal, make sure carefully that 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.

● 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 product is marked this symbol to subject to EU Waste Electrical & Electronic Equipment (WEEE) directive.

Following information is only for EU-member states:

The use of the symbol indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. For more detailed information about the take-back and recycling of this product, please contact your supplier where you purchased the product.

	“This symbol is applicable for EU member states only”

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communication.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be require to correct the interference at his own expense.

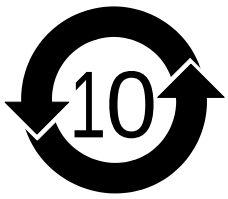
[Phenomena specific to CMOS sensor]

- **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.

 中华人民共和国 环保使用期限	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。 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。 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。 另外，此期限不同于质量/功能的保证期限。 The Mark and Information are applicable for People's Republic of China only.

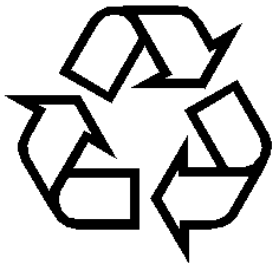
<产品中有毒有害物质或元素的名称及含量>

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

Specifications

Overview

This BC series is an integrated-(one-body)-type camera that adopts a global shutter CMOS sensor.
BC302LM (3M 1/1.8 type, monochrome), BC505LM (5M 2/3 type, monochrome).
Suffix [G] is attached to the monochrome models, suffix [CG] or [CF] are attached to the color models.

Features

● High frame rate and high resolution
Supporting high frame rate, BC302LMG 56fps, BC505LMG / BC505LMCG / BC505LMCF, 36fps.

● 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.

●Camera Link interface (power supply type)
By using a Camera Link-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.

● 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.

● Scalable
Selectable video output area. This mode achieves higher frame rate by reducing vertical output area. And reduces occupied data rate of Gigabit Ethernet by reducing horizontal output area.

● Binning mode
In this mode, pixel data is combined by vertical and horizontal.

● Decimation mode

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

(Decimation mode is supported only in color models)

●Color processing

Color models have built in color processing. The white balance function also works in Bayer output.

● IR-cut filter

Build-in IR-cut filter models are optional for color models.

Suffix [F] is attached to the model name of built-in IR-cut filter model. (e.g. BC505LMCF)

* Suffix [F] is not shown in the common part of specifications.

● Compact and lightweight

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

● EU RoHS & Chinese ROHS

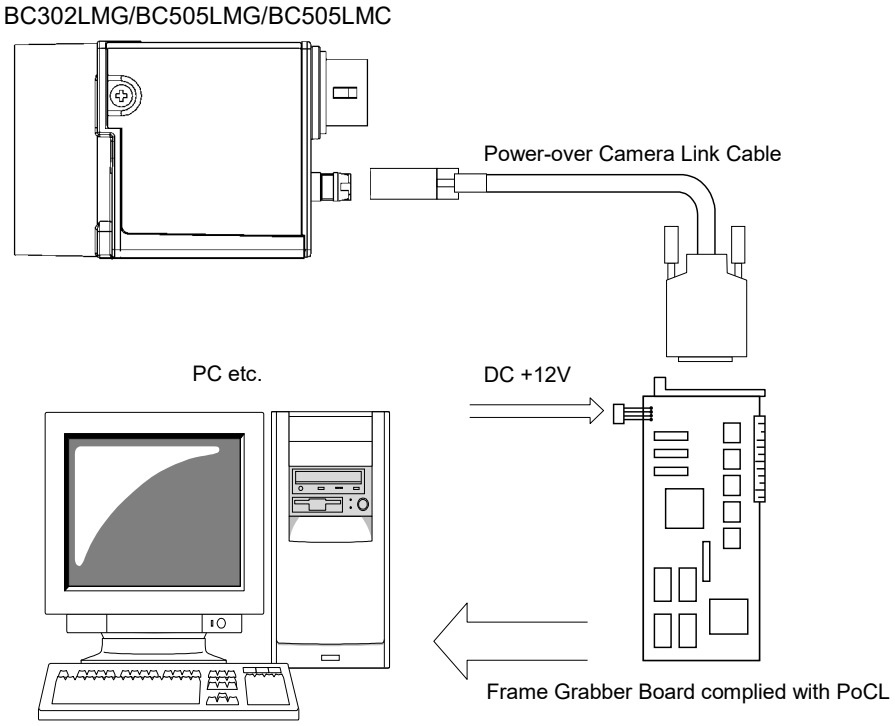
Configuration

The system configuration of this camera series is as follows;
This camera does not include any accessories. Please prepare other equipments separately.

- Camera: This product. (BC series)
- Camera mounting kit CPT8560 (*1): To fix a camera to a tripod; attach this to the bottom of the camera.

*1: Optional part. Contact your dealer / distributor for details of option units.

Connection



Connector Pin Assignment

Please confirm the power supply of the camera cuts when the connector is connected or pulls out. It causes the breakdown etc.

(1) Video output/controlling/power supply connector: (Camera Link Base Configuration) CAMERA LINK

Connector model: HDR-EC26FYTG2+ (Manufactured by Honda Connectors)

Pin No.	I/O	信号名	Pin No.	I/O	信号名
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+ and CC4- are not used.

Bit assignment of camera output

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 port assignment is based on CamraLink standard.

(2) Signal input/output connector

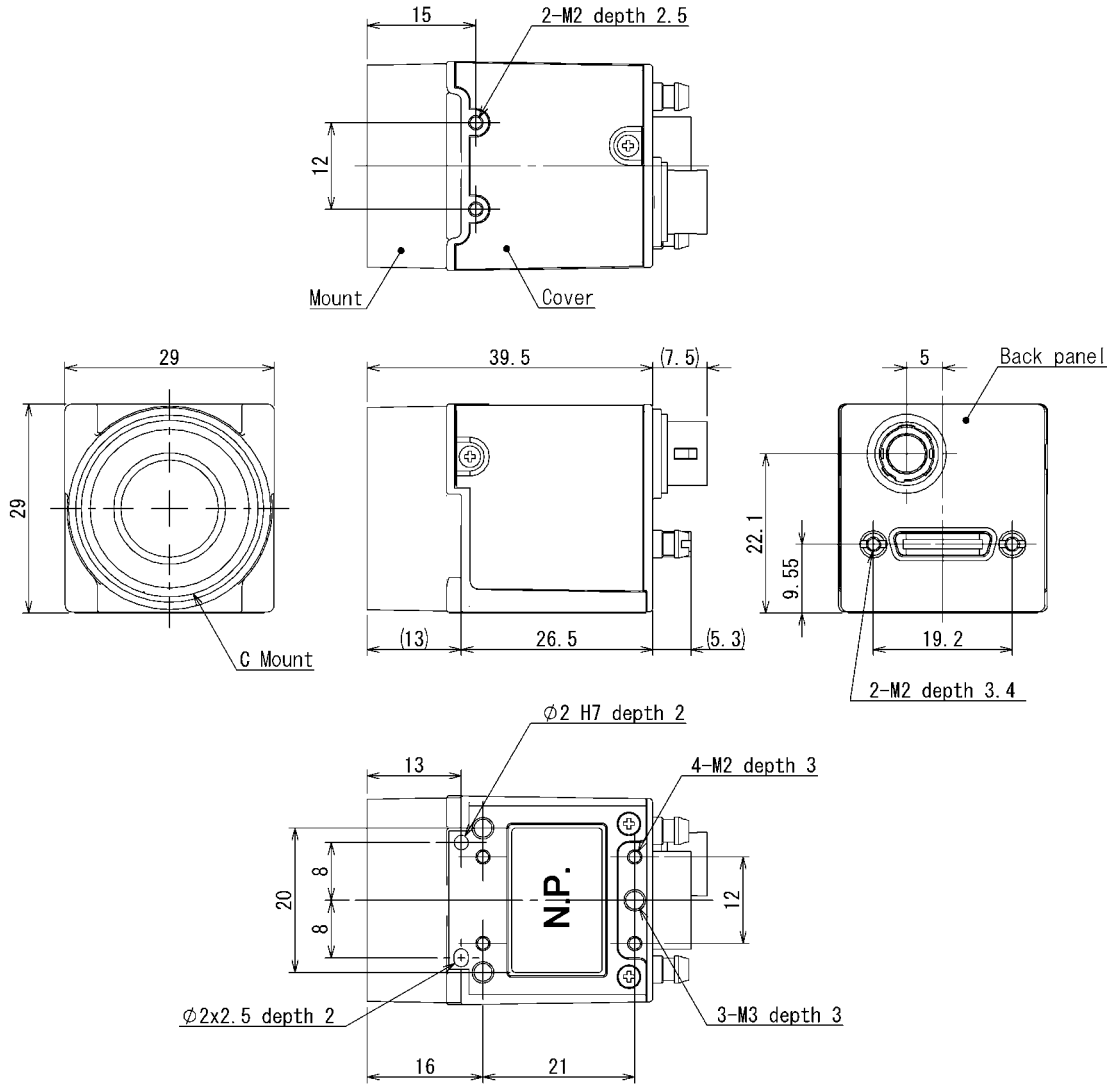
Connector model: HR10A-7R-6PB(73) (Manufactured by HIROSE ELECTRIC CO.)

Conformed Plug model in cable: HR10A-7P-6S(73) (Manufactured by HIROSE ELECTRIC CO.)

* This camera does not include the the conformed connector.

Pin No.	I/O	Signal	Feature
1	O	Line 4	GPIO Output
2	-	IO GND	GPIO_Ground
3	-	GND	Ground
4	I	Line 5	External Trigger Input
5	I/O	Line 6	GPIO_Input / Output
6	-	+12V	DC+12V

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)

General Specifications

Model Name	BC302LMG	BC505LMG
Imager	CMOS image sensor	
Maximum number of Video out pixels (H) x (V)	2048×1536	2448×2048
Optical Size	1/1.8 type	2/3 type
Scanning area (H) x (V) [mm]	7.12×5.33	8.50×7.09
Pixel size (H) x (V) [µm]	3.45×3.45	
Scan method	Progressive	
Electronic shutter method	Global shutter	
Aspect ratio	4:3	6:5
Sensitivity	700lx, F5.6, 1/52s	400lx, F5.6, 1/32.62s
Minimum illuminance(*1)	6lx	3lx
Power supply	DC12 V ± 10% (*it is possible to supply the power to the camera, from Camera Link connector with Power over Camera Link standard or I/O connector)	
Power consumption(*2)	1.8W (Max)	
Interface	CameraLink Base Configuration	
Transmission speed	41.5 / 64 / 83 MHz x 1 / 2 / 3 tap	
Image output format	Mono8 / Mono10 / Mono12	
Maximum Frame rate (*2)	56.13 fps	36.00 fps
Dimaensions	29mm(W) x 29mm(H) x 26.5mm(D) (Not including protrusion)	
Mass	Approximately 45g	
Lens mount	C mount	
Flange back	17.526mm	
Camera body grounding insulation status	Conductive between circuit GND and camera body	

* Underbar is factory default

(*1) F1.4, Gain +24dB, Video level 50%

(*2) at all pixels readout

Model Name	
With AR coated glass	BC505LMCG
With IR cut filter	BC505LMCF
Imager	CMOS image sensor
Maximum number of Video out pixels (H) x (V)	2448×2048
Optical Size	2/3 type
Scanning area (H) x (V) [mm]	8.50×7.09
Pixel size (H) x (V) [µm]	3.45×3.45
Scan method	Progressive
Electronic shutter method	Global shutter
Aspect ratio	6:5
Sensitivity	
With AR coated glass	1150lx, F5.6, 1/32.62s
With IR cut filter	1400lx, F5.6, 1/32.62s
Minimum illuminance(*1)	
With AR coated glass	3lx
With IR cut filter	
Power supply	DC12 V ± 10% (*it is possible to supply the power to the camera, from Camera Link connector with Power over Camera Link standard or I/O connector)
Power consumption(*2)	2.2W (Max)
Interface	CameraLink Base Configuration
Transmission speed	41.5 / 64 / 83 MHz x 1 / 2 / 3 tap
Image output format	Bayer8 / Bayer10 / Bayer12
Maximum Frame rate (*2)	36.00 fps
Dimaensions	29mm(W) x 29mm(H) x 26.5mm(D) (Not including protrusion)
Mass	Approximately 45g
Lens mount	C mount
Flange back	17.526mm
Camera body grounding insulation status	Conductive between circuit GND and camera body

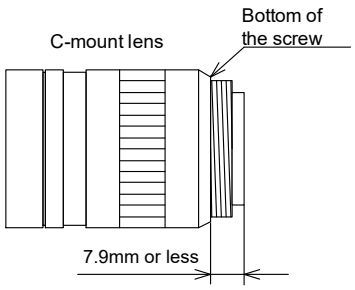
* Underbar is factory default

(*1) F1.4, Gain +24dB, Video level 50%

(*2) at all pixels readout

Notes on 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.
- 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 camera, the projection distance from bottom of the screw should use 7.9mm or less.



I/O Specification

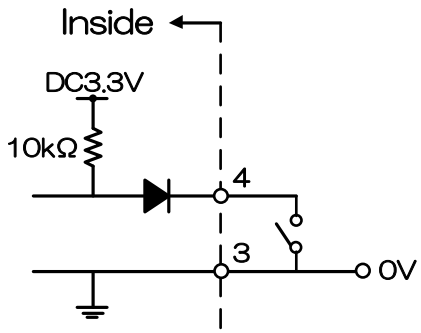
● Signal Specification

● Line4 (GPIO Output, I/O connector, 1pin)

Signal level:	5V CMOS
Maximum current:	+/- 32mA (drive current)
Signal Polarity:	Factory setting: Low active (it is possible switching by camera settings)
Ouput signal:	TIMER0 ACTIVE
	USER OUTPUT
	EXPOSURE ACTIVE
	FRAME ACTIVE
	FRAME TRANSFER
	FRAME TRIGGER WAIT

● Line5 (External Trigger Input, I/O connector, 4pin)

Input circuit:	LVTTL
Signal level:	Low 0 to 0.5V、High 2.0 to 24.0V
Signal Polarity:	Factory setting: Low active (it is possible switching by camera settings)
Pulse width:	50μs (minimum)



Notes of external trigger signal:

- Depending on cable length, kind of cable and input current of trigger input line, external trigger signal may not be accepted by camera.
- Line5 and Line6 have a different input level. Please use input level within the voltage described in this specification.

- Line6 (GPIO In / Out, I/O connector, 5pin)
  - Input signal specification

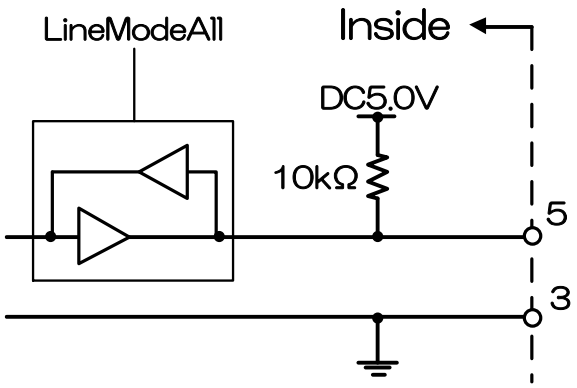
Input circuit:	5V CMOS
Signal level:	Low 0 to 0.5V、High 4.0 to 5.0V
Signal Polarity:	Factory setting: Low active (it is possible switching by camera settings)
Pulse width:	50μs (minimum)

Notes of external trigger signal:

- Depending on cable length, kind of cable and input current of trigger input line, external trigger signal may not be accepted by camera.
- Line5 and Line6 have a different input level. Please use input level within the voltage described in this specification.

  - Output signal specification

Input circuit:	5V CMOS
Maximum current:	+/- 32mA (drive current)
Signal Polarity:	Factory setting: Low active (it is possible switching by camera settings)
Ouput signal:	TIMER0 ACTIVE
	USER OUTPUT
	EXPOSURE ACTIVE
	FRAME ACTIVE
	FRAME TRANSFER
	FRAME TRIGGER WAIT

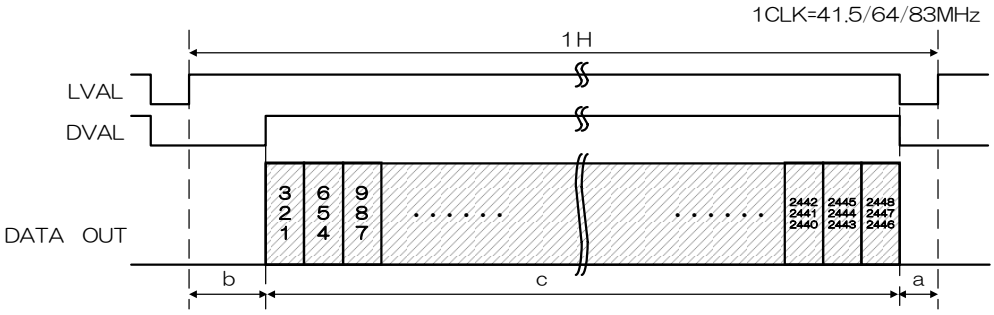


Timing Specification

For getting fastest farmerate, shatter speed ≦ readout time.

(1) Horizontal timing

● All pixel readout (* following timing figure: BC505LMG 3tap)



1CLK=41.5MHz unit: CLK

Model	CameraLink Tap	a	b	c
BC302LMG	1tap	4	8	2048
	2tap			1024
	3tap			683
BC505LMG BC505LMC	1tap			2448
	2tap			1224
	3tap			816

1CLK=64MHz / 83MHz unit: CLK

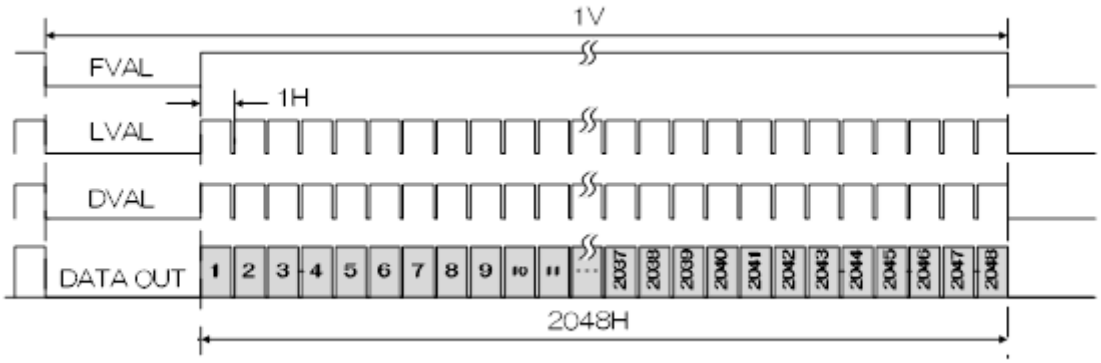
Model	CameraLink Tap	a	b	c
BC302LMG	1tap	4	8	2048
	2tap			1024
	3tap	any		683
BC505LMG BC505LMC	1tap	4		2448
	2tap			1224
	3tap	any		816

Horizontal sync frequency=1H unit：KHz

Model	CameraLink Tap	Clk frequency (1CLK)		
		41.5MHz	64MHz	83MHz
BC302LMG	1tap	20.15	31.20	40.30
	2tap	40.07	62.04	80.14
	3tap	59.73	any	any
BC505LMG BC505LMC	1tap	16.87	26.13	33.75
	2tap	33.59	52.01	67.17
	3tap	50.14	any	any

(2) Vertical timing

● All pixel readout (* following timing figure: BC505LMG 3tap)



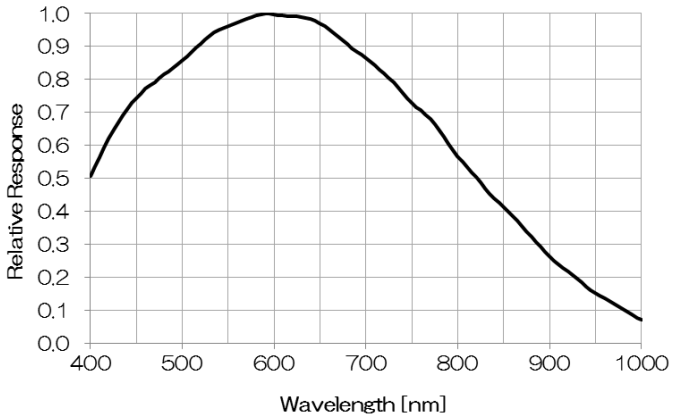
Vertical sync frequency=1V unit：Hz

Model	CameraLink Tap	Clk frequency (1CLK)		
		41.5MHz	64MHz	83MHz
BC302LMG	1tap	13.00	20.00	26.00
	2tap	26.00	40.33	52.00
	3tap	39.00	56.13	56.13
BC505LMG BC505LMC	1tap	8.15	12.54	16.31
	2tap	16.31	25.30	32.63
	3tap	24.47	36.00	36.00

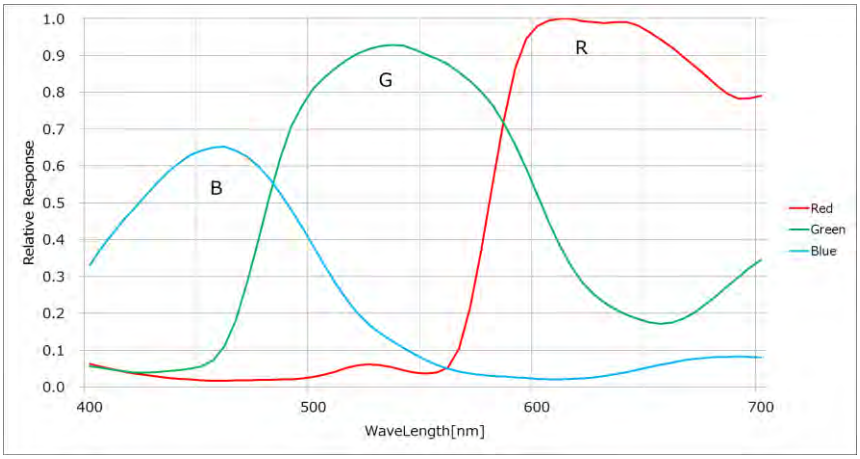
Typical Spectral Response

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

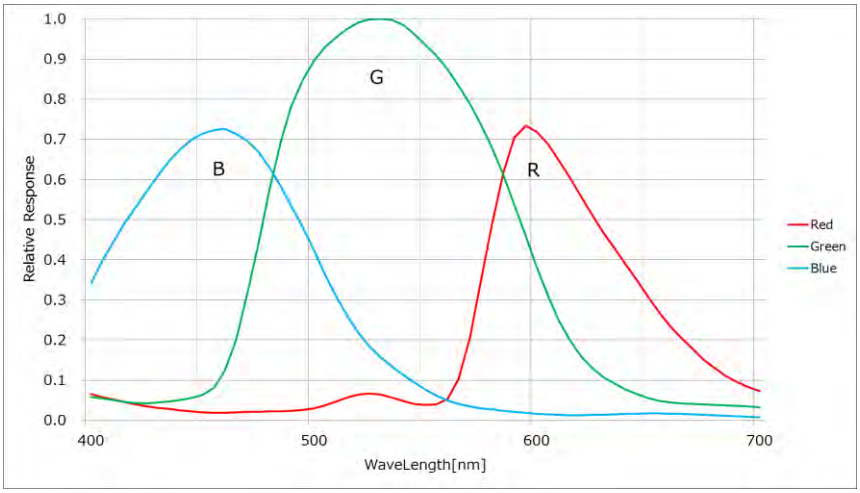
< BC302LMG / BC505LMG >



< BC505LMCG >



< BC505LMCF >



Operating Ambient Conditions

● Ambient conditions

< BC302LMG / BC505LMG>

- Operating Assurance

Temperature:	-5°C ~ 45°C,
Humidity:	10% ~ 90% (no condensation)

- Storage Assurance

Temperature:	-20°C ~ 60°C
Humidity:	90% or less (no condensation)

< BC505LMCG / BC505LMCF>

- Operating Assurance

Temperature:	-5°C ~ 45°C,
	Camera housing temperature is less than 65 °C.
Humidity:	10% ~ 90% (no condensation)

- Storage Assurance

Temperature:	-20°C ~ 60°C
Humidity:	90% or less (no condensation)

● EMC Conditions

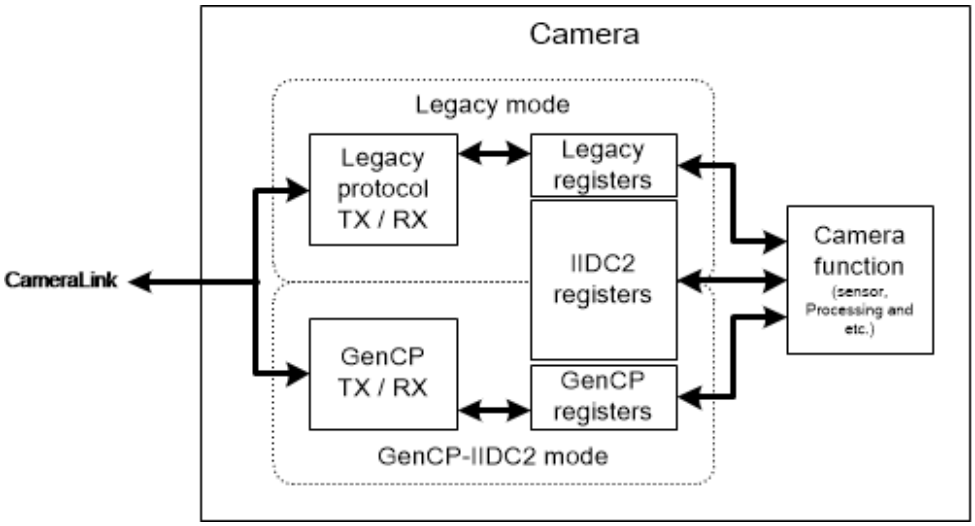
- EMI (Electro-Magnetic Interference):	EN61000-6-4
	FCC Part 15 Subpart B Class A
	KN32
- EMS (Electro-Magnetic Susceptibility):	EN61000-6-2
	KN35

Command Commnucation 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.



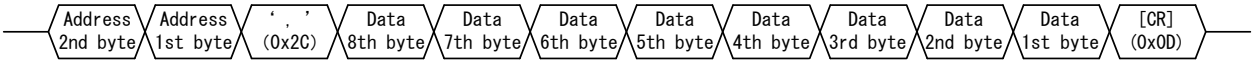
Legacy Protocol

This 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.

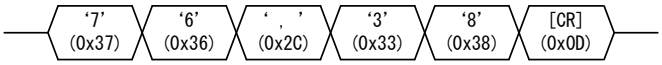
(1) Writing to the register

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)

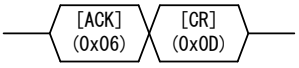


For example, to write data 0x38 to address 0x76, send a command, as follows:

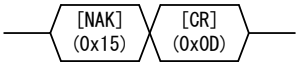


The camera responds to the write command with No Error (ACK) or Error (NAK), as follows:

No Error (ACK):

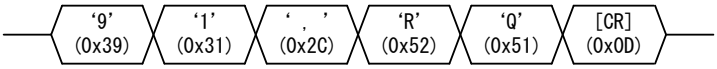


Error (NAK):

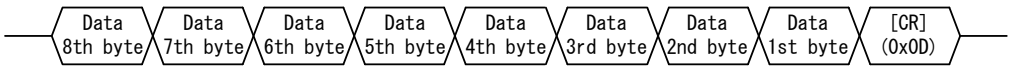


(2) Reading the register

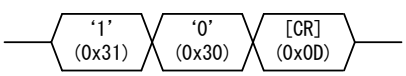
To read data from a register, send ', (comma)', 'R', 'Q' and [CR] code following the address. For example, to read data in address 0x91, send a command, as follows:



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:

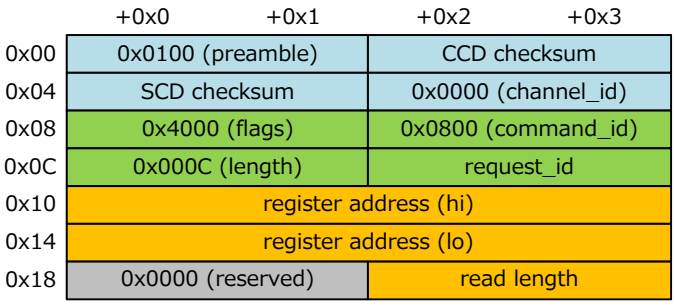


GenCP

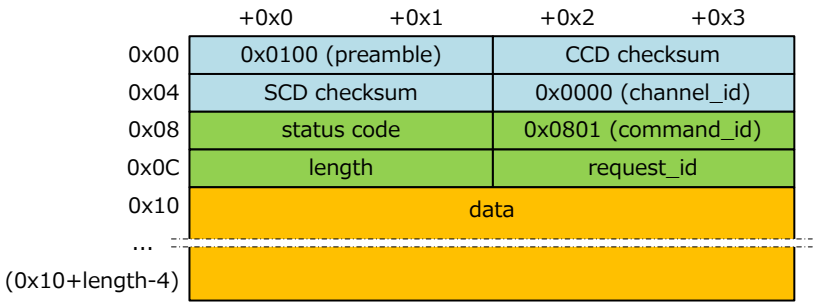
The communication to camera is archived by using the communication packet specificated GenCP. Please see GenCP specifications.

The following figure shows the packet structure:

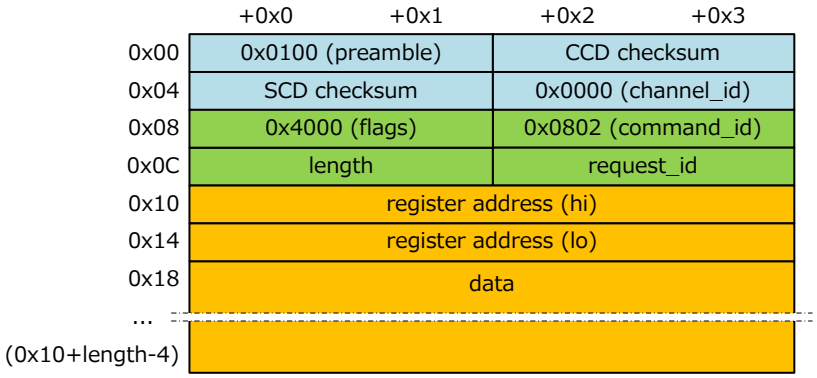
● READMEM_CMD



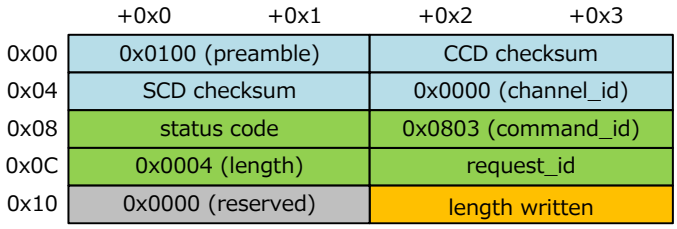
● READMEM_ACK



● WRITEMEM_CMD



● WRITEMEM_ACK



Register Map

IIDC2 Address

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

Register address	Read Write	AC (*)	Memory Save	Color	Default	Register name	Description
0x0020 005C	R	—	—	—	0x0	ApplyImageFormat	0x0:No error, 0x10:Scalable setting error
0x0020 105C	R/W	○	—	—	0x2	CameraLink Tap	0x1:1tap、0x2:2Tap、0x3:3Tap
0x0020 107C	R/W	○	—	—	0x53	CameraLink CLK	0x29:41.5178MHz、0x40:64.2826MHz、0x53:83.0357MHz
0x0020 2094	R/W	○	○	—	0x0	offsetX	Scalable: Horizontal offset (in pixels) from the origin to the region of interest. 3M:0x0 (0) ～ 0x7C0 (1984) OffsetX setting unit: 4 5M/5MC:0x0 (0) ～ 0x950 (2384) OffsetX setting unit: 4
0x0020 2098	R/W	○	○	—	3M:0x800 5M/5MC:0x990	Width	Scalable: Width 3M:0x40 (64) ～ 0x800 (2048) Width setting unit: 4 5M/5MC:0x40 (64) ～ 0x990 (2448) Width setting unit: 4
0x0020 209C	R/W	○	○	—	0x0	offsetY	Scalable: Vertical offset (in pixels) from the origin to the region of interest. 3M:0x0 (0) ～ 0x5C0 (1472) OffsetY setting unit: 2 5M/5MC:0x0 (0) ～ 0x7C0 (1984) OffsetY setting unit: 2
0x0020 20A0	R/W	○	○	—	3M:0x600 5M/5MC:0x800	Height	Scalable: Height 3M:0x40 (64) ～ 0x600 (1536) Height setting unit: 2 5M/5MC:0x40 (64) ～ 0x800 (2048) 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	○	○	○	3M:0x340000 5M/5MC:0x20A0A0	Acquisition FrameRate	Framerate *AcquisitionFrameRate / 65536[fps]
0x0020 30C8	R/W	—	—	—	0x0	Aqcuisition FrameIntervalControl	0x0:NoSpecify Take priority ExposureTime setting. 0x1:Manual Take priority AcquisitionFrameInterval setting.
0x0020 30DC	R/W	—	—	—	3M:0xB0101 5M/5MC:0x11899B	Acquisition FrameInterval	Interval 式: AcquisitionFrameInterval / 37500000[sec]
0x0020 4028	R/W	—	○	○	0x1	ExposureTimeControl	0x1:Manual、0x2:Auto
0x0020 403C	R/W	○	○	—	3M:0xA4CB8 5M/5MC:0x112A88	ExposureTime	Exposure Time *ExposureTime / 37500000 [sec] 0x465 (30usec) ～ 0x23C34600 (16sec)
0x0020 405C	R/W	○	○	—	0x0	BlackLevel	0xFFFFFEFF (-25%) ～ 0x100(+25%)
0x0020 4068	R/W	—	○	○	0x1	GainControl	0x1:Manual、0x2:Auto
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 40BC	R/W	○	○	—	0x0	Sharpness	Min:0(OFF) Max:7(Max) (Only B/W models)
0x0020 5068	R/W	—	○	○	0x1	WhiteBalanceControl	0x1:Manual、0x2:Auto、0x3:OnePush
0x0020 507C	R/W	—	○	○	0x10000	WhiteBalanceR	0x10000 (1 times) ～ 0x7FFFF (8 times)
0x0020 509C	R/W	—	○	○	0x10000	WhiteBalanceB	0x10000 (1 times) ～ 0x7FFFF (8 times)
0x0020 603C	R/W	○	○	—	0x0	LUT Enable	0x0:OFF、0x1:ON
0x0030 0000 0x0030 0004 ↓ 0x0030 3FF8 0x0030 3FFC	R/W	○	—	—	0x0	LUTValue[0] LUTValue[1] ↓ LUTValue[4094] LUTValue[4095]	Min:0x0、MAX:0xFFF

Register address	Read Write	AC (*)	Memory Save	Color	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, 0x6:Bulk mode
0x0020 707C	R/W	○	○	—	0x0	TriggerSource	Selects a trigger source of random trigger shutter. 0x0:Line0(CC1)、0x5:Line5(I/O connector 4pin) 0x6:Line6(I/O connector 5pin)、0x40:Software
0x0020 709C	R/W	○	○	—	0x0	Trigger AdditionalParameter	Sets the number of frames to exposure in Bulk mode. 0x0 (0) ～0xFF (255)
0x0020 70BC	R/W	○	○	—	0x0	TriggerDelay	Sets the delay from trigger detection to exposure start. 式: TriggerDelay / 37500000 [sec] 0x0(0sec) ～ 0x47868C0(2sec)
0x0020 70DC	W	—	—	—	—	SoftwareTrigger	0x8:Execute SoftwareTrigger
0x0020 213C	R/W	○	○	—	0x1	Binning Horizontal	Min:1、Max:2
0x0020 215C	R/W	○	○	○	0x1	Binning Vertical	Min:1、Max:2
0x0020_217C	R/W	○	○	○	0x1	Decimation Horizontal	Min:1、Max:2
0x0020_219C	R/W	○	○	○	0x1	Decimation Veritical	Min:1、Max:2
0x0020 20DC	R	—	○	—	0x69	PixelCoding	3M/5M:0x0:Mono 5MC:0x60:BayerGR、0x63:BayerRG、 0x66:BayerGB、0x69:BayerBG
0x0020 20FC	R/W	—	○	—	0x08	PixelSize	0x8:Bpp8、0xA:Bpp10、0xC:Bpp12
0x0020 40DC	R/W	—	○	○	0x0	ALCExposureValue	Sets a correction value for a convergence value. convergence value =84×2^（ALCExposureValue/10） Min:0xFFFFFFEC、Max:0xF
0x0020_429C	R/W	—	○	○	0x465	ALCExposureTimeMin	Sets minimum value of ExposureTime in ALC. *ALCExposureTimeMin / 37500000 [sec] 0x465 (30usec) ～ 0x23C34600 (16sec)
0x0020_42BC	R/W	—	○	○	0x23c3460	ALCExposureTimeMax	Sets maximum value of ExposureTime in ALC. *ALCExposureTimeMin / 37500000 [sec] 0x465 (30usec) ～ 0x23C34600 (16sec)
0x0020_42DC	R/W	—	○	○	0x0	ALCGainMin	Sets minimum value of Gain in ALC. 0x0 (0dB) ～ 0xF0 (24dB)
0x0020_42FC	R/W	—	○	○	0xF0	ALCGainMax	Sets maximum value of Gain in ALC. 0x0 (0dB) ～ 0xF0 (24dB)
0x0021_F37C	R/W	—	○	○	0x64	ALCPhotometric AreaSize	Sets photometric area size for measuring luminance 0x1 (1%) ～ 0x64 (100%)
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, 0x08:Load, 0x09:Save, 0x7F:Erase
0x0021 F2FC	R/W	—	○	—	0x1	UserSetDefault	Selects a channel of user setting when camera powers up. 0x0:Default 0x01:UserSet1 ～ 0x15:UserSet15

Register address	Read Write	AC (*)	Memory Save	Color	Default	Register name	Description
0x0020 90BC	R/W	—	○	—	0x4	LineSelector	Selects the Line of I/O connector. 0x4:Line4(I/O connector 1pin) 0x6:Line6(I/O connector 5pin)
0x0020 90DC	R/W	—	○	—	0x0	LineSource	Selects the source of the output signal. 0x0:OFF 0x20:UserOutput 0x40:Timer0Active 0x63:AcquisitionActive 0x6A:FrameTriggerWait 0x6B:FrameActive 0x73:FrameTransferActive 0x7B:ExposureActive
0x0020 9030	R/W	—	○	—	0x10	LineModeAll	Selects the Input / Output of each Line. [0bit～3bit 目]: fixed "0" [4bit 目]: fixed "1" [5bit 目]: fixed "0" [6bit 目]:"0"input, "1"output ⇒ correspond to Line6(I/O connector 5pin)
0x0020 9050	R/W	—	○	—	0x0	LineInverterAll	Selects the inversion of I/O lines. "0"negative, "1" positive [0bit]: correspond to Line0(CC1) [1bit～3bit]: fixed "0" [4bit]: correspond to Line4(I/O connecotor 1pin) [5bit]: correspond to Line5(I/O connecotor 4pin) [6bit]: correspond to Line6(I/O connecotor 5pin)
0x0020 9070	R	—	—	—	0x7F	LineStatusAll	Returns the current status of all I/O lines. [0bit]: correspond to Line0(CC1) [1bit～3bit]: fixed "0" [4bit]: correspond to Line4(I/O connecotor 1pin) [5bit]: correspond to Line5(I/O connecotor 4pin) [6bit]: correspond to Line6(I/O connecotor 5pin)
0x0020 9090	R/W	—	○	—	0x0	UserOutputValueAll	Sets the user output value of each Line. [4bit 目]: correspond to Line4(I/O connecotor 1pin) [6bit 目]: correspond to Line6(I/O connecotor 5pin)
0x0021 F27C	R/W	—	○	—	0x7C	TimerTriggerSource	Selects the source of Timer0Active pulse to start. 0x0:OFF Timer disabled. 0x20:Line Start timer from Line0(CC1) or Line5 (I/O connector 4pin) input. 0x68:FrameTrigger Start timer from trigger input. 0x7C:ExposureStart Start timer from exposure start.
0x0020 A05C	R/W	—	○	—	0x0	TimerDelay	Min:0x0 Max:0x47868A0(2sec)
0x0020 A07C	R/W	—	○	—	0x0	TimerDuration	Min:0x0 Max:0x47868A0(2sec)
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(B/W model only） 0x7:ColorBar(Color model only） 0x8:GreyVerticalRamp

Register address	Read Write	AC (*)	Memory save	Color	Default	Register name	Description
0x0021 F29C	R/W	—	○	—	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					0x0	DPCValue [X_1]	Sets the X coordinate of defective pixel (1st) 3M:0x0(0)～0X7FF(2047) 5M/5MC:0x0(0)～0X98F(2447)
0x0040 0004						DPCValue [Y_1]	Sets the Y coordinate of defective pixel (1st) 3M:0x0(0)～0X5FF(1535) 5M/5MC:0x0(0)～0X7FF(2047)
0x0040 0008						DPCValue [X_2]	Sets the X coordinate of defective pixel (2nd) 3M:0x0(0)～0X7FF(2047) 5M/5MC:0x0(0)～0X98F(2447)
0x0040 000C						DPCValue [Y_2]	Sets the Y coordinate of defective pixel (2nd) 3M:0x0(0)～0X5FF(1535) 5M/5MC:0x0(0)～0X7FF(2047)
↓						↓	↓
0x0040 07F8						DPCValue [X_{255}]	Sets the X coordinate of defective pixel (255th) 3M:0x0(0)～0X7FF(2047) 5M/5MC:0x0(0)～0X98F(2447)
0x0040 07FC						DPCValue [Y_{255}]	Sets the Y coordinate of defective pixel (255th) 3M:0x0(0)～0X5FF(1535) 5M/5MC:0x0(0)～0X7FF(2047)
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、Max:0x10
0x0050 0040	R/W	—	○	—	0x1	SS Entry 0	Sets the UserSet number to register to the first sequence. Min:0x1、Max:0xF
0x0050 0044						SS Entry 1	
0x0050 0048						SS Entry 2	
0x0050 004C						SS Entry 3	
↓						↓	
0x0050 0078						SS Entry 15	

*3M:BC302LMG、5M:BC505LMG、5MC:BC505LMC

*If [Color] marked “○”, the feature is supported only color model.

*AC: In relation to Acquisition Command (address:0x002 0303C) : If [AC] marked “○”, the register is set to following procedure.
Stop image output (0x00) → register setting / write command → Start image output (0x08)

GenCP Address

The following address is possible to access by GenCP only.

Register address	Read Write	Memory save	Default	Register name	Description
0x0000 0000	R.O.	—	—	GenCP Version	0x0001 0000(GenCP Ver.1.0 を示す)
0x0000 0004 | 0x0000 0043	R.O.	—	—	Manufacture Name	Toshiba-Teli
0x0000 0044 | 0x0000 0083	R.O	—	—	Model Name	ex.)BC505LMG
0x0000 0084 | 0x0000 00C3	R.O	—	—	Family Name	BC-Series
0x0000 00C4 | 0x0000 0103	R.O	—	—	Device Version	Cameara version　ex) 3.3.8
0x0000 0104 | 0x0000 0143	R.O	—	—	Manufacture Info	ex) 5.0M 2/3 B/W
0x0000 0144 | 0x0000 0183	R.O	—	—	Serial Number	ex) 0100001
0x0000 0184 | 0x0000 0193	R/W	○	Null string	User Define Name	User-programmable device identifier.
0x0000 01F0 | 0x0000 01F7	R.O	—	0x00	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	—	0x00	Current Baudrate	Set baudrate. 0x00:auto recognition, 0x01:9600bps, 0x10:115200bps, 0x80:921600bps

*3M:BC302LMG、5M:BC505LMG / BC505LMC

Legacy Address

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

Register address	Read Write	Memory save	Default	Register name	Description
0x00 | 0x0F	R.O.	—	—	Manufacture Name (ASCII)	Toshiba-Teli
0x10 | 0x1F	R.O.	—	—	Model Name (ASCII)	Ex.)BC505LMG
0x20 | 0x2F	R.O.	—	—	Family Name (ASCII)	BC-Series
0x30 | 0x3F	R.O.	—	—	Serial Number (ASCII)	Ex.)0100001
0x48 | 0x4F	R.O.	—	—	Camera version (ASCII)	Ex.)3.3.8
0x60 | 0x67	R.O.	—	—	Register map version (ASCII)	Ex.)01.01
0x69	R.O.	—	—	Status	Status after control camera feature.
0x6A	R.O.	—	—	Expanded status	Expanded status after control camera feature.
0x6C	R/W	—	—	Memory bank	Sets the memory channel of UserSet. 0x0:Default、0x1:UserSet1 ～ 0xF:UserSet15
0x6D	W.O.	—	—	Memory save	0x01: Save user settings.
0x6E	W.O.	—	—	Memory load	0x01: Load user settings from selected memory bank.
0x70	R/W	○	0x00	Setup	0xFFFFFFEFF (-25%) ～ 0x100(+25%)
0x76	R/W	○	0x00	Gain	0x00(0dB:default)～0xF0(24dB)
0x80	R.O.	—	3M:0x34 5M:0x20	Frame rate	All pixels readout: Calcurated from [CameralinkCLK / Cameralink Tap]. Scalable: Calcurated from number of ouput lines.
0x82	R.O.	—	3M:0x800 5M:0x990	Horizontal resolution	All pixels readout: 3M:0x800 (2048), 5M:0x990 (2448) Scalable: 3M:0x40 (64)～0x800 (2048), 5M:0x40 (64)～0x990 (2448)
0x84	R.O.	—	3M:0x600 5M:0x800	Vertical resolution	All pixels readout: 3M:0x600 (1536), 5M:0x800 (2048) Scalable: 3M:0x40 (64)～0x600 (1536), 5M:0x40 (64)～0x800 (2448)
0x87	R/W	○	0x08	Output bit	0x8:8bit, 0xA:10bit,0xC:12bit
0x88	R/W	○	0x00	Test pattern	0x0:Off,0x1:Black, 0x2:White, 0x3:GreyA, 0x4:GreyB, 0x5:GreyHorzontalRamp, 0x6:GreyScale, 0x7: Colorbar, 0x8:GreyVerticalRamp
0x89	R/W	○	0x01	Defective pixel correction	0x0:OFF, 0x01:ON
0x8A	R/W	○	0x00	ReverseX	0x0:OFF、0x01:ON
0x8B	R/W	○	0x00	ReverseY	0x0:OFF、0x01:ON
0x90	R/W	○	0x00	Scan mode	0x0:normal (default)、0x1:Scalable
0x91	R/W	○	0x00	Shutter mode	0x0:Normal shutter(default)、0x1:Random trigger shutter
0x92	R/W	○	0x00	Random trigger mode	0x0:FIX mode (default)、0x1:pulse width mode 0x6:bulk mode
0x93	R/W	○	0x00	Trigger polarity	0x0:negative(default)、0x1:positive
0x94	R/W	○	0x00	Frame number in Bulk mode	Sets number of output frame in bulk mode. 0x00～0xFF
0xA0	R/W	○	3M:0x34 5M:0x20	Shutter speed denominator	0x01(1)～0x8235(33333)
0xA4	R/W	○	0x01	Shutter speed numerator	0x01(1)～0x10(16)

Register Address	Read Write	Memory save	Default	Register name	Description
0xC0	W.O.	—	—	Update scalable	0x01: Update registers related to scalable.
0xC4	R/W	○	0x0	Offset Y	3M:0x0 (0)～0x5C0 (1472)　OffsetY setting unit 2 5M:0x0 (0)～0x7C0 (1984)　OffsetY setting unit 2
0xC8	R/W	○	3M:0x600 5M:0x800	Height	3M:0x40 (64)～0x600 (1536)　Height setting unit 2 5M:0x40 (64)～0x800 (2048)　Height setting unit 2
0xCC	R/W	○	0x0	Offset X	3M:0x0 (0)～0x7C0 (1984)　OffsetX setting unit 4 5M:0x0 (0)～0x950 (2384)　OffsetX setting unit 4
0xD0	R/W	○	3M:0x800 5M:0x990	Width	3M:0x40 (64)～0x800 (2048)　Width setting unit 4 5M:0x40 (64)～0x990 (2448)　Width setting unit 4
0xD8	R/W	—	0x00	User area : address	Sets address of user area 0x0～0x0F(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	0x01: 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. 0x01, 0x04, 0x08, 0x10(16)
0xF0	R/W	—	0x00	SequentialShutter Enable	0x0:OFF、0x01:ON
0xF1	R/W	—	0x01	SequentialShutter TerminateAt	Sets the number of Tables to repeat the sequence. 0x01 ～ 0x04
0xF3	R/W	—	0x01	SequentialShutter Entry1	Sets the UserSet number to register to the first sequence. 0x01 ～ 0x04
0xF4	R/W	—	0x01	SequentialShutter Entry2	Sets the UserSet number to register to the 2nd sequence. 0x01 ～ 0x04
0xF5	R/W	—	0x01	SequentialShutter Entry3	Sets the UserSet number to register to the 3rd sequence. 0x01 ～ 0x04
0xF6	R/W	—	0x01	SequentialShutter Entry4	Sets the UserSet number to register to the 4th sequence. 0x01 ～ 0x04
0xF7	W.O.	—	—	SequenceMemory Load	0x1: Load the parameters from the memory specified [Memory bank] register.
0xF8	W.O.	—	—	SequenceMemory Save	0x01: Save the parameters from the memory specified [Memory bank] register. If camera teruned off, the data in memory for SS is erased.

※3M:BC302LMG、5M:BC505LMG/ BC505LMC

R/W　Read / Write

R.O.　Read only

W.O.　Write only

N.A.　Not Accessible

Functions

This section introduces standard functions. BC series provide following functions.

Category	Function	
TransportLayerControl	CameraLink Tap	CameraLink tap control
	CameraLink CLK	CameraLink clk control
	Baudrate	Baudrate control
DeviceControl	DeviceControl	Device information
ImageFormatControl	Scalable	Scalable control
	Binning	Binning control
	Decimation	Decimation control
	Reverse	Image flip
	PixelFormat	Pixel format selection
	TestPattern	Test pattern control
AcquisitionControl	AcquisitionControl	Image stream start / stop
	TriggerControl	Trigger control
	ExposureTimeControl	Exposure time control
DigitalIOControl	DigitalIOControl	GPIO signal control
CounterAndTimerControl	TimerControl	Timer0Active signal control
AnalogControl	Gain	Gain control
	BlackLevel	Black level control
	Gamma	Gamma correction
	Sharpness	Sharpness control
	BalanceRatio	White balance control
ALCControl	ALCControl	ALC control
LUTControl	LUTControl	LUT control
SequentialShutterControl	SequentialShutterControl	Sequential shutter control
DPCControl	DPCControl	Defect pixel correction control
UserSetControl	UserSetControl	Load / Save user setting

Features supported by each model are as follows.

Function	BC302LMG	BC505LMG	BC505LMC
TransportLayerControl	○	○	○
DeviceControl	○	○	○
Scalable	○	○	○
Binning	○	○	○
Decimation	○	○	○
Reverse	○	○	○
PixelFormat	○	○	○
TestPattern	○	○	○
AcquisitionControl	○	○	○
TriggerControl	○	○	○
ExposureTimeControl	○	○	○
DigitalIOControl	○	○	○
TimerControl	○	○	○
Gain	○	○	○
BlackLevel	○	○	○
Gamma	○	○	○
Sharpness	○	○	—
BalanceRatio	—	—	○
ALCControl	○	○	○
ALCExposureMin	—	—	○
ALCExposureMax	—	—	○
ALCGainMin	—	—	○
ALCGainMax	—	—	○
LUTControl	○	○	○
SequentialShutterControl	○	○	○
DPCControl	○	○	○
UserSetControl	○	○	○

TransportLayerControl

Registers of this category provides the function related to control the number of taps and clk frequency of CameraLink interface.

● **IIDC2 Register**

Register Address	Read Write	Memory Save	Default	Register name	Description
0x0020 105C	R/W	○	0x2	CameraLink Tap	0x1:1Tap、0x2:2Tap、0x3:3Tap
0x0020 107C	R/W	○	0x53	CameraLink CLK	0x29:41.5178MHz、0x40:64.2826MHz、0x53:83.0357MHz

● **Note**

Before write to CameraLink Tap (0x0020 205C) or CameraLink CLK (0x0020 107C), stop image output (Write to 0x00 to AcquistionCommand (0x0020 303C)). After change setting of CameraLink Tap / CameraLink CLK, restart image output (Write to 0x08 to AcquistionCommand (0x0020 303C)).

DeviceControl

Registers of this category provide various information of the camera.

The address is different by using of communication protocol.

● Registers

GenCP

Register Address	Read Write	Memory Save	Default	Register name	Description
0x0000 0004 | 0x0000 0043	R.O.	-	-	Manufacture Name (ASCII)	Toshiba-Teli
0x0000 0044 | 0x0000 0083	R.O	-	-	Model Name (ASCII)	ex) BC505LMG
0x0000 0084 | 0x0000 00C3	R.O	-	-	Family Name (ASCII)	BC-Series
0x0000 00C4 | 0x0000 0103	R.O	-	-	Device Version (ASCII)	Camera version ex)3.3.8
0x0000 0104 | 0x0000 0143	R.O	-	-	Manufacture Info (ASCII)	ex) 5.0M 2.3 B/W
0x0000 0144 | 0x0000 0183	R.O	-	-	Serial Number (ASCII)	ex) 0100001
0x0000 0184 | 0x0000 0193	R/W	○	Null string	User Define Name	User-programmable device identifier.

Legacy protocol

Register Address	Read Write	Memory Save	Default	Register name	Description
0x00 | 0x0F	R.O.	-	-	Manufacture Name (ASCII)	Toshiba-Teli
0x10 | 0x1F	R.O.	-	-	Model Name (ASCII)	Ex.) BC505LMG
0x20 | 0x2F	R.O.	-	-	Family Name (ASCII)	BC-Series
0x30 | 0x3F	R.O.	-	-	Serial Number (ASCII)	Ex.) 0100001
0x48 | 0x4F	R.O.	-	-	Camera version (ASCII)	Ex.) 3.3.8
0x60 | 0x67	R.O.	-	-	Register map version (ASCII)	Ex.) 01.01
0xD8	R/W	-	0x00	User area : address	Sets address of user area 0x0～0x0F(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	0x01: 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. 0x01, 0x04, 0x08, 0x10(16)

Scalable

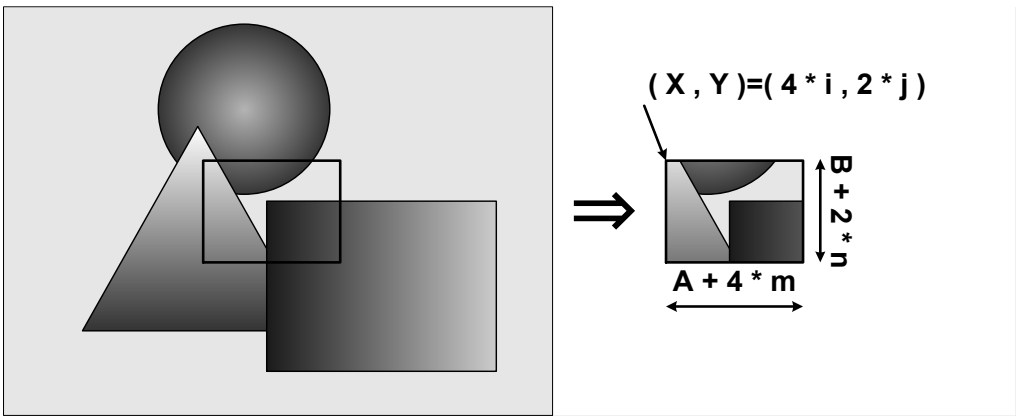
Scalable function reads out the region of interest (ROI) of the sensor.

If height size is set small, it is possible to increase the frame rate.

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 x i (H)} x {2 x j (V)}
  i, j = integer
  The window size is equal or less than maximum image size.

Model Name	BC302LMG	BC505LMG	BC505LMC
Width/OffsetX setting unit	4	4	4
Height/OffsetY setting unit	2	2	2
Minimum unit size (H)×(V)	64×64	64×64	64×64
Maximum unit size (H)×(V)	2048×1536	2448×2048	2448×2048

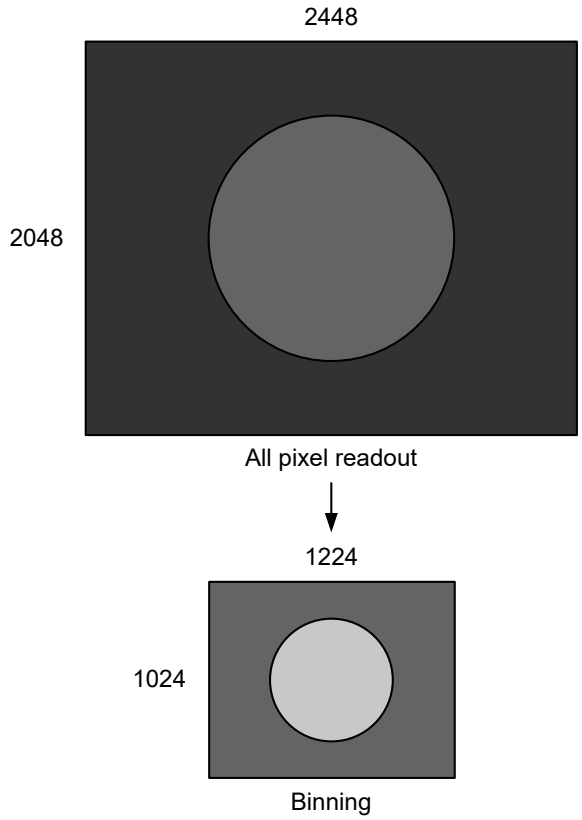


Scalable

Binning

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

This increases the sensitivity of the image. It's alike scalable, the frame rate can be faster and interface bandwidth occupation decrease.



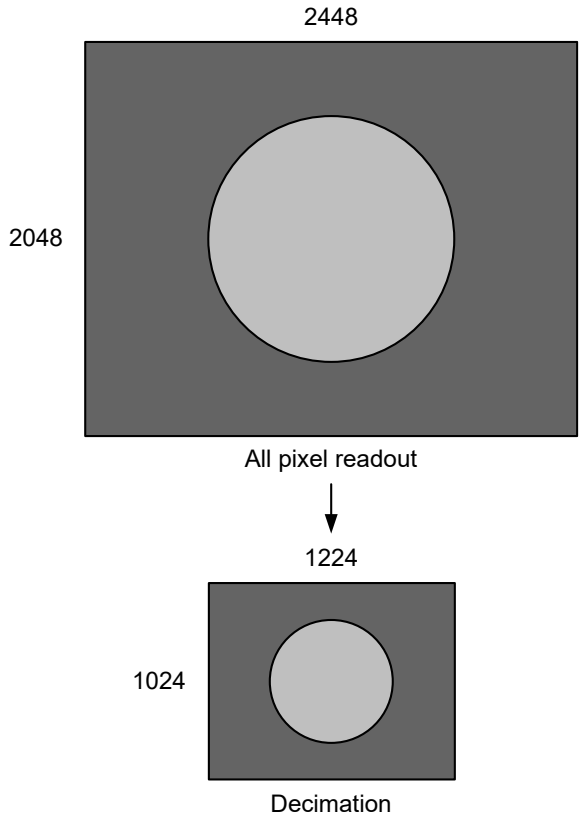
Binning operation (e.g. 5M pixel, 2x2 binning)

- **Note**

Before write to Binning Horizontal (0x0020 213C) or Binning Vertical (0x0020 215C), stop image output (Write to 0x00 to AcquistionCommand (0x0020 303C)). After change setting of Binning Horizontal / Binning Vertical, restart image output (Write to 0x08 to AcquistionCommand (0x0020 303C)).

Decimation

Decimation feature reads out all effective areas at high speed by skipping pixels and lines.
Decimation feature can make frame rate faster, and decrease interface bandwidth occupation.



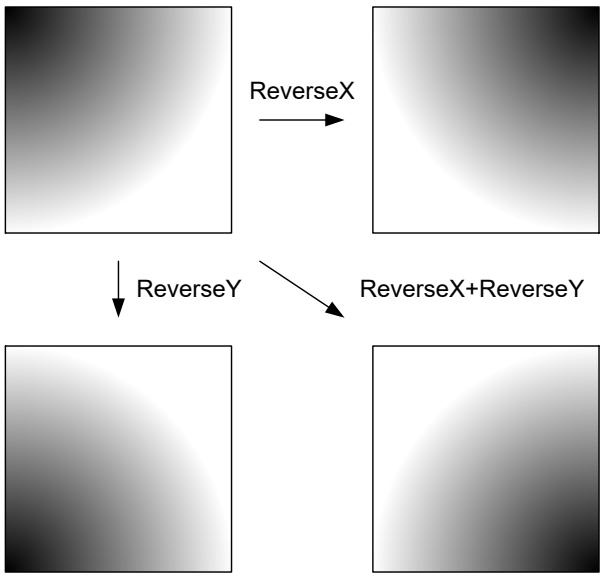
Decimation operation (e.g. 5M pixel, 2x2 decimation)

- **Note**

  Before write to Decimation Horizontal (0x0020 217C) or Decimation Vertical (0x0020 219C), stop image output (Write to 0x00 to AcquistionCommand (0x0020 303C)). After change setting of Decimation Horizontal / Decimation Vertical, restart image output (Write to 0x08 to AcquistionCommand (0x0020 303C)).

Reverse

Reverse function flips image in horizontal and/or vertical direction.



● **Note**

Control by IIDC2 address

Before write to Decimation Horizontal (0x0020 217C) or Decimation Vertical (0x0020 219C), stop image output (Write to 0x00 to AcquistionCommand (0x0020 303C)). After change setting of Decimation Horizontal / Decimation Vertical, restart image output (Write to 0x08 to AcquistionCommand (0x0020 303C)).

Control by Legacy address

The change is applied immedietely by write to ReverseX register (0x8A) or ReverseY register (0x8B).

PixelFormat

Select a pixel format of image stream data.

- **Note**

Control by IIDC2 address

Before write to PixelSize (0x0020 20FC), stop image output (Write to 0x00 to AcquistionCommand (0x0020 303C)). After change setting of PixelSize, restart image output (Write to 0x08 to AcquistionCommand (0x0020 303C)).

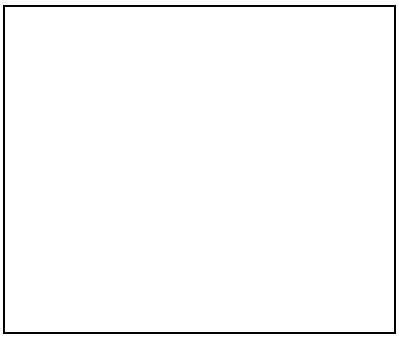
Control by Legacy address

The change is applied immedietely by write to Output bit register (0x87).

TestPattern

Camera supports test pattern data output. Following test patterns are available;

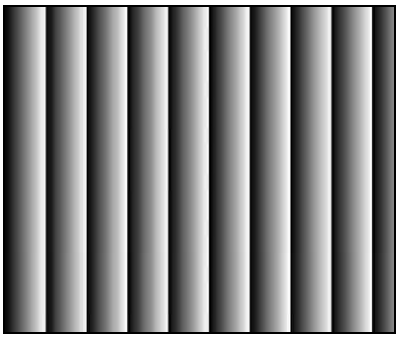
Black



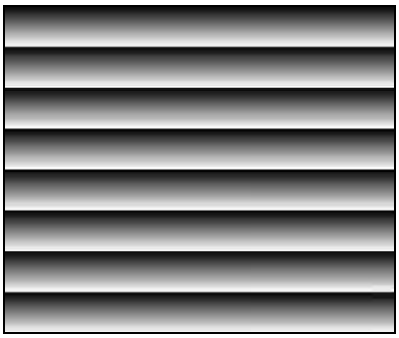
White

GreyA

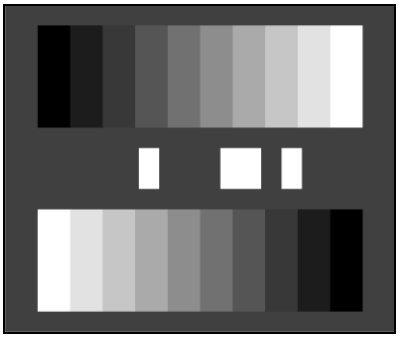
GreyB



GreyHorizontalRamp

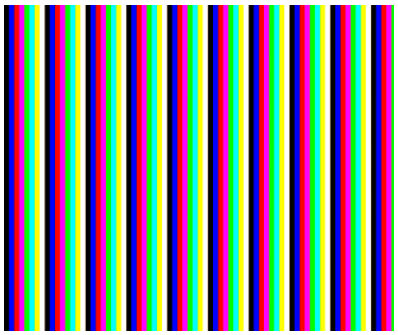


GreyVerticalRamp



GreyScale

(B/W model only)



ColorBar

(Color model only)

AcquisitionControl

AcquisitionControl features are related to image acquisition.
Acquisition frame rate is variable. Maximum acquisition frame rate depends on camera operation mode.
(scalable, CameraLink Tap, CameraLink CLK, etc.)

TriggerControl

TriggerControl features are related to image acquisition using trigger.
This camera series provides two kinds of exposure synchronization.

1. Normal Shutter mode : Free run operation (internal synchronization)
2. Random Trigger Shutter mode : Synchronized with external trigger input

In Random Trigger Shutter mode, two kinds of trigger input are available.

1. Trigger signal via the CC1
2. Trigger signal via the I/O connector

The following table shows the combination of operation mode of this camera series.

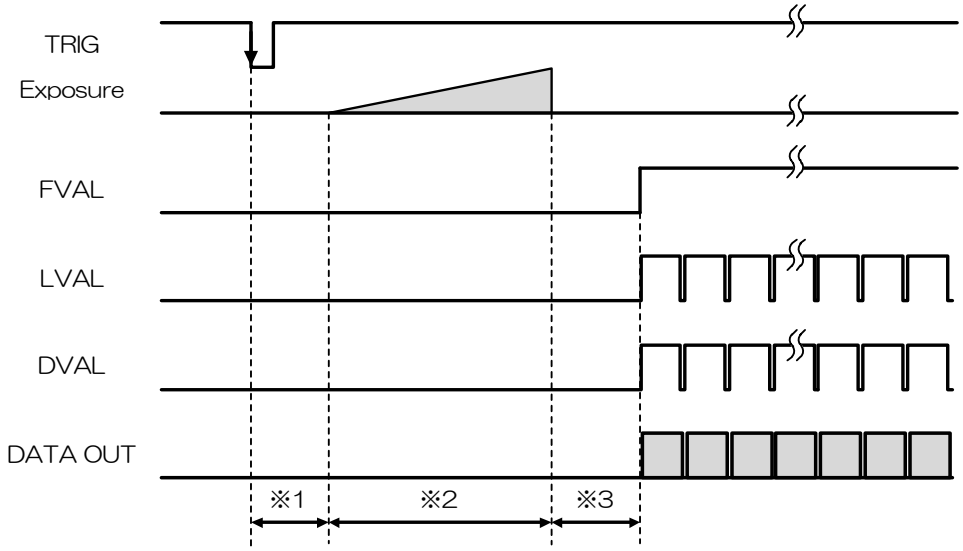
Operation Mode

Trigger Mode	Synchronization	Exposure Control
Normal Shutter mode	Free run	'ExposureTime' register control
Random Trigger Shutter mode	HardwareTrigger	-Edge mode:TriggerSequence0 -Bulk mode:TriggerSequence6 'ExposureTime' register control
		-Level mode:TriggerSequence1 Trigger pulse width control

* The camera operation not mentioned above is not supported.

- Edge mode (TriggerSequence0)

The exposure time is determined by Exposure Time setting.



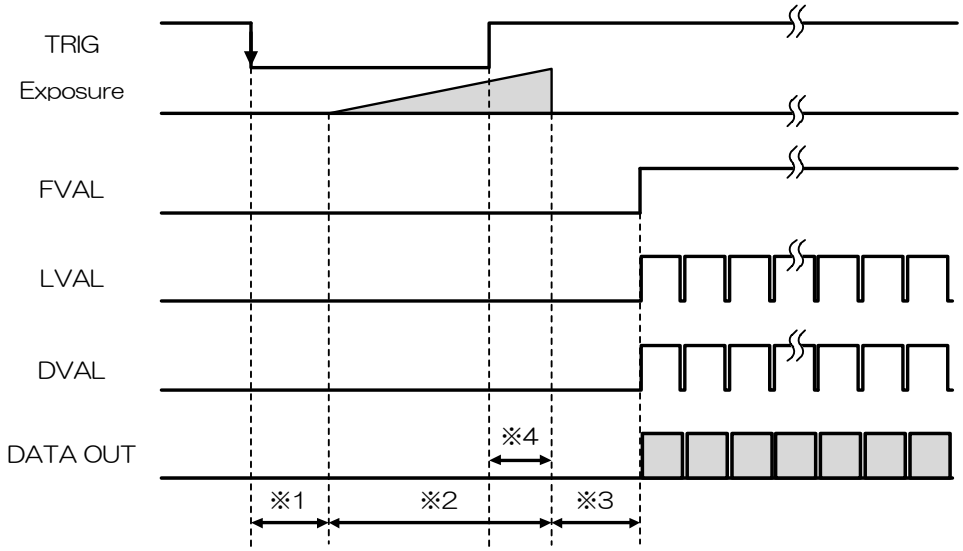
*1 = 40.4 μs

*2 = Setting of shutter speed

*3 = 424.6 μs

- Level mode (TriggerSequence1)

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



*1= 40.4μs

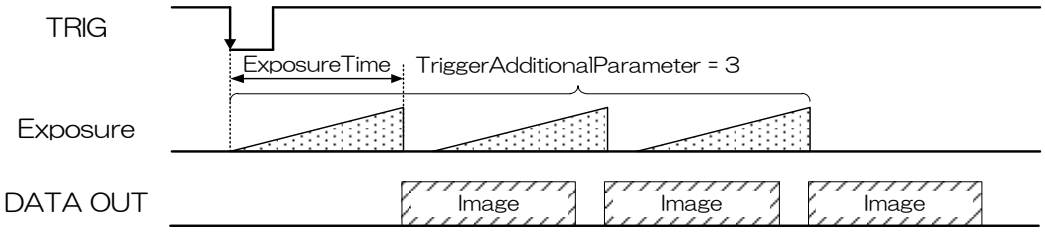
*2= Setting of shutter speed

*3= 424.6μs

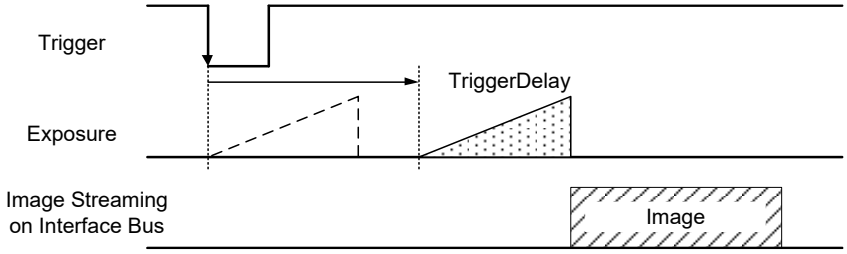
*4= 54.2μs

- Bulk mode (TriggerSequence6)

Camera exposes and transfers multiple frames by a single trigger.



Operation point of HardwareTrigger is at the edge of trigger signal, and active edge polarity is able to change by register setting. And you can add delay time from trigger edge to exposure start by register setting.



ExposureTimeControl

ExposureTime controls the duration where the image sensor is exposed to light.
This camera series provides two kinds of exposure time control mode.

- Manual : The exposure time is determined by 'ExposureTime' register setting value.
- Auto : The exposure time is adjusted automatically.

● **Note**

• Setting of Exposure control

Set to ExposureTimeControl (0x0020 4028) as following:

ExposureTimeControl	Function
0x1: Manua(l*)	Take procedence ExposureTime setting.
0x2: Auto	Auto exposure control（AE）

• Control of ExposureTime (manual)

Control by IIDC2 address

Sets ExposureTime register (0x0020 403C). The absolution value of ExposureTime is calculated by the following formula:

ExposureTime (abs) = ExposureTime / 37,500,000 [sec]

Control by Legacy address

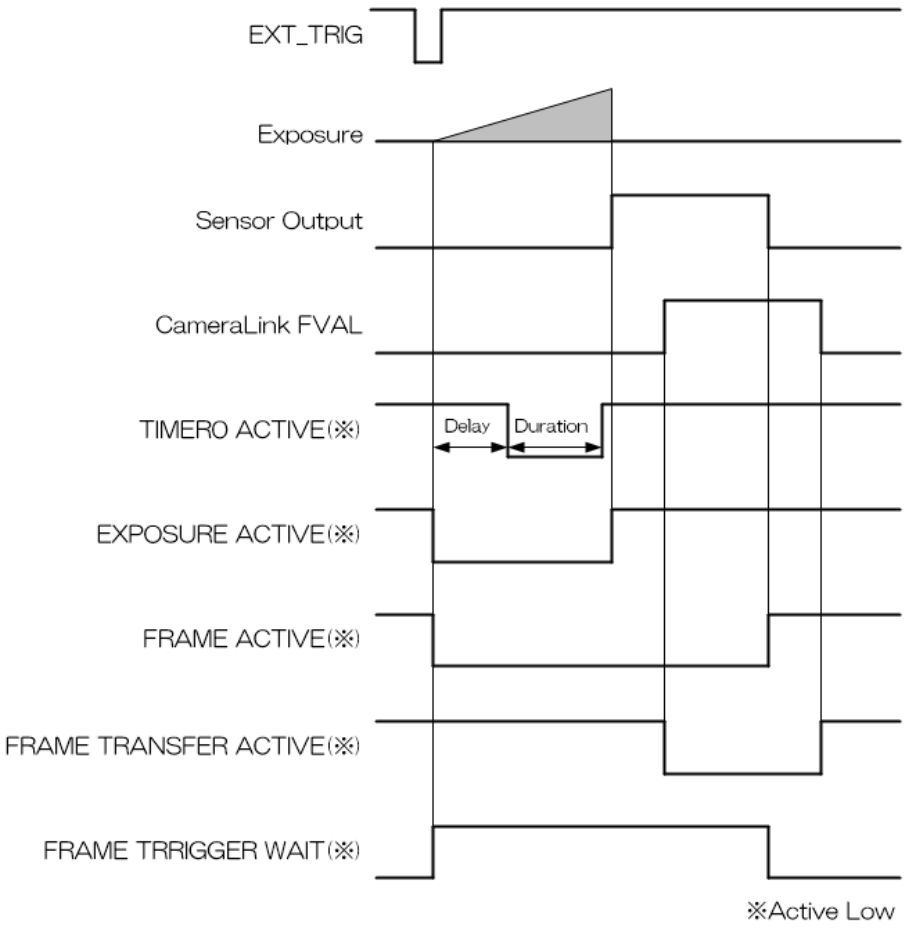
The exposure time is set by a rational number. The absolution value of ExposureTime is calculated by the following formula:

ExposureTime (abs) = Shutter speed numerator / Shutter speed denominator [sec]

DigitalIOControl

This section describes DigitalIOControl features.

This camera provides GPIO output selected by the register setting. And the polarity of the signal is able to switch by the register setting. The following chart shows the specifications of the selectable signals.

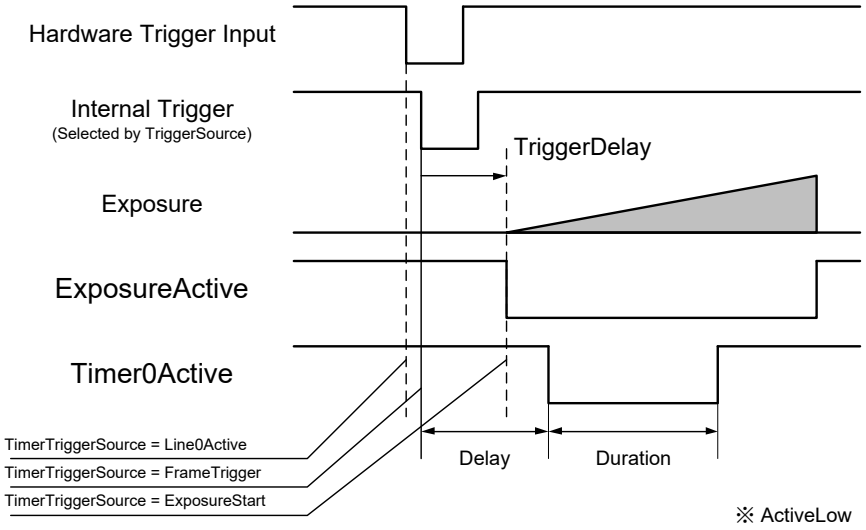


TimerControl

This section describes TimerControl features.

This camera series is able to generate Timer0Active signal beginning from trigger or exposure start signal.

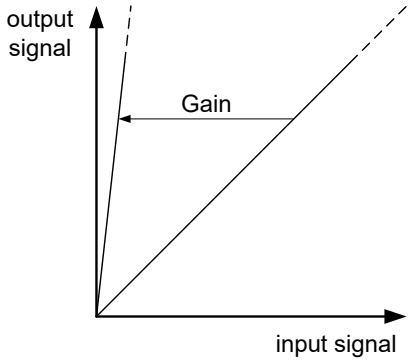
This signal can be used as strobe control signal.



Timer0Active

Gain

This section describes Gain feature. This control adjusts an amplification factor applied to the output signal. Gain feature adjusts manual gain. GainAuto feature adjusts gain automatically.



● **Note**

• Setting of Gain control

Set to GainControl (0x0020 4068) as following:

ExposureTimeControl	Function
0x1: Manua(l*)	Manual Gain setting.
0x2: Auto	Auto gain control（AGC）

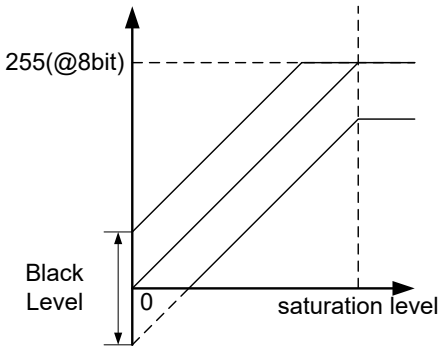
• Control of Gain (manual)

Sets Gain register (0x0020 407C).

For more details information, please see “ALC Control”

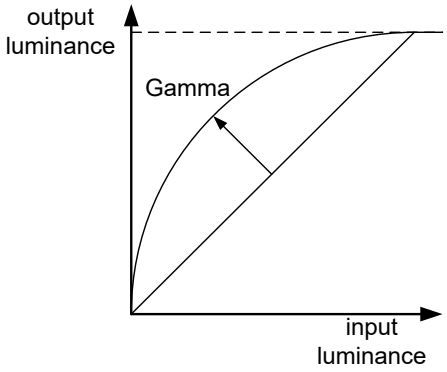
BlackLevel

This section describes BlackLevel feature. This control adjusts the black level applied to the output signal.
It is adjustable from -25% to +25% as white saturation level is 100%.
If BlackLevel is set lower than 0[%], the image level may not be saturated.



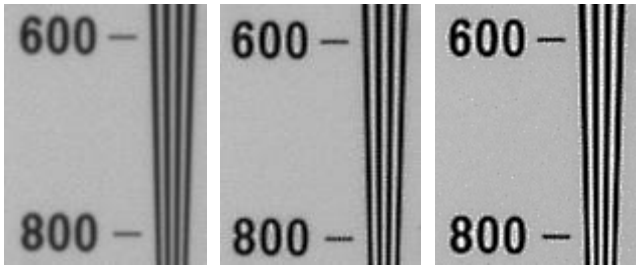
Gamma

This section describes Gamma feature. This control adjusts the gamma correction of pixel intensity.



Sharpness

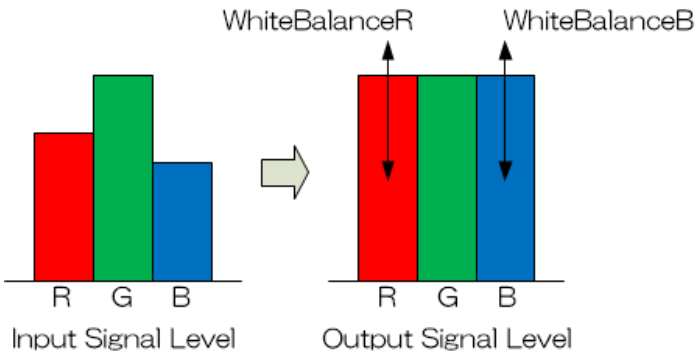
This section describes Sharpness feature. This control enhances the edges of the image.
The edge enhancement will become stronger when the setting value is larger.
This function is available only in Mono models.



Sharpness=0 Sharpness=4 Sharpness=7

BalanceRatio

This section describes BalanceRatio feature (White balance).
BC series has Manual WhiteBalance, One Push WhiteBalance (OPWB) and Auto White Balance (AWB).
In AWB, R-Gain and B-Gain are adjusted automatically. In OPWB, R-Gain and B-Gain are adjusted once from RGB information of current frame.
This function is available only in Color models.



● Note

• Setting of WhiteBalance control

Set to WhiteBalanceControl (0x0020 5068) as following:

WhiteBalanceControl	機能
0x1: Manual(*)	Manual WhiteBalance control
0x2: Auto	Auto WhiteBalance control
0x3: OnePush	One Push WhiteBalance control

• Manual WhiteBalance

In WhiteBalanceControl = Manual setting, set value to WhiteBalanceR (0x0020 507C) or WhiteBalanceB (0x0020 509C).

• Auto WhiteBalance

In WhiteBalanceControl = Auto setting, camera adjust WhiteBalanceR and WhiteBalanceB automatically. AWB is activate in color temperature from 2500K to 6500K.

• One Push WhiteBalance

At WhiteBalanceControl = OnePush set, camera adjust WhiteBalanceR and WhiteBalanceB once.

• ALCPhotometricAreaSize

In WhiteBalanceControl = Auto or OnePush set, the register setting of ALCPhotometricAreaSize is refered as the measuring luminance.

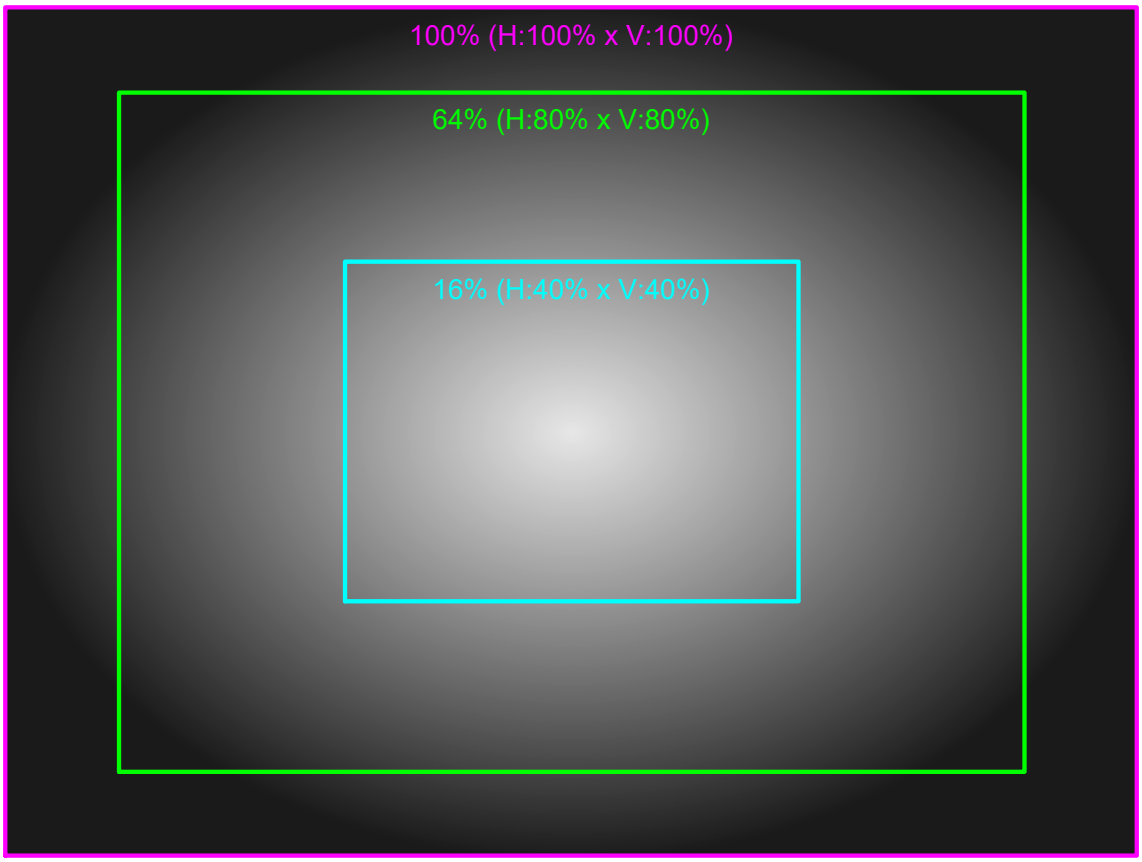
For more details information, please see “ALCControl”.

ALCControl

This section describes ALCControl feature.

This camera series provides some registers to adjust the various parameter of ALC operation.

- ALCPhotometricAreaSize defines photometric area size for measuring luminance.
  This area size is reffered in AE, AGC and AWB.



ALCPhotometricAreaSize (e.g. 100%, 80%, 40%)

- ALCExposureValue defines a correction value for a convergence value.

Final convergence value is determined by the following formula.

$$\text{Final convergence value} = 84(\text{Reference Luminance}) * 2^{(\text{ALCExposureValue}/10)}$$

- ALCExposureTimeMin / ALCExposureTimeMax define the following range of AE operation.

Set the following value to “ALCExposureTimeMin”, “ALCExposureTimeMax” register. AE mode operates at a range of a register value.

You shall set “ExposureTimeMin” < “ExposureTimeMax”.

If you set “ExposureTimeMax” longer than a frame rate period, a frame rate may be slower than the register setting.

The range of register setting depends on camera model, and camera operation mode.

This function is available only in Color models.

AE range	ALCExposureTimeMin	ALCExposureTimeMax
Minimum	as same as maximum value of Manual mode	more than ALCExposureTimeMin
Maximum	less than ALCExposureTimeMax	as same as minimum value of Manual mode

* initial factory setting: ExposureTimeMin = minimum value, ExposureTimeMax = 1 s

- ALCGainMin / ALCEGainMax define the following range of AE operation.

Set the following value to “ALCGainMin”, “ALCGainMax” register. Setting value is Float type. AGC mode operates at a range of a register value.

You shall set “GainMin” < “GainMax”.

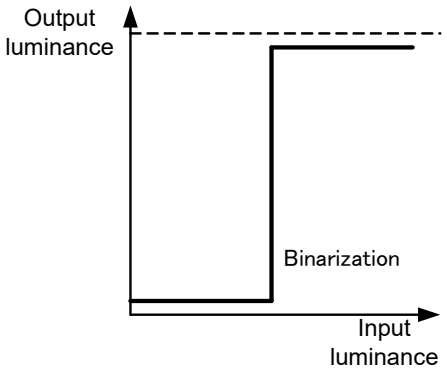
This function is available only in Color models.

AGC range	ALCGainMin	ALCGainMax
Minimum	0.00[dB] (*)	more than ALCGainMin
Maximum	less than ALCGainMax	24.00[dB] (*)

* initial factory setting

LUTControl

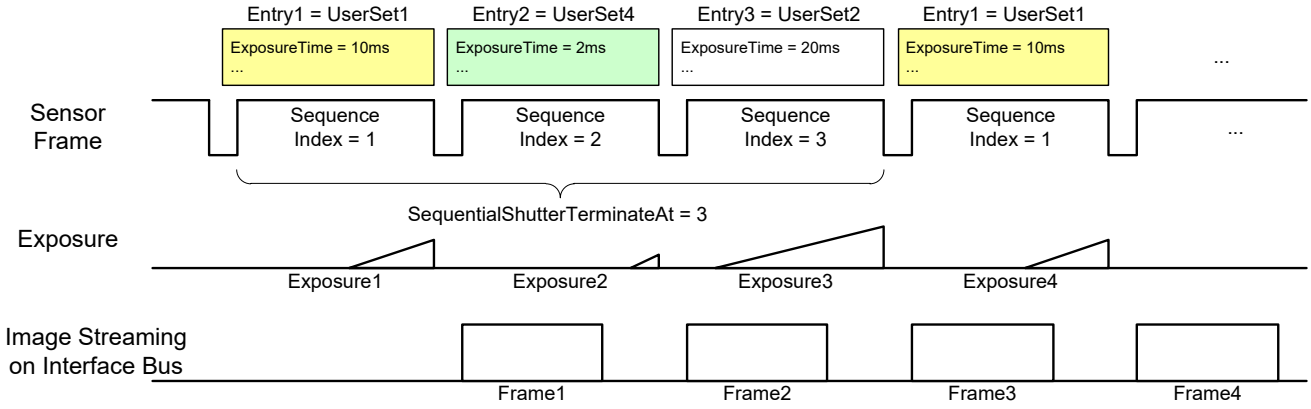
This function allows you to apply the arbitrary LUT(input: 12it, output: 12bit) to the output images.



example of LUT setting

SequentialShutterControl

Sequential Shutter function performs sequential capturing with applying the settings of UserSet that have been made entry in advance.



Sequential Shutter

- **Note**
  - Changing ‘SequentialShutterEnable’, ’SequentialShutterTerminateAt’, ’SequentialShutterIndex’, ‘SequentialShutterEntry’ register value is invalid during image stream data output.
  - The following table is the list of registers applied to “SequentialShutter”.

List of registers to be applied to SequentialShutter

Category	Register
ImageFormatControl	OffsetX
	OffsetY
ExposureControl	ExposureTime
DigitalIOControl	UserOutputValueAll
	LineSource
CounterAndTimerControl	TimerDuration
	TimerDelay

Category	Register
AnalogControl	Gain
	BlackLevel
	Gamma
	Sharpness
	BaLanceRatio
LUTControl	LUTEnable

DPCControl

This DPC (Defective Pixel Correction) function corrects defective pixels from the image sensor. Specifying X and Y coordinates of the defective pixels, the defective pixels are corrected by calculation from the neighboring pixels.

● Note

• On /Off of DPC function

Set value to DPCEnable register.

Setting value	Function
0x0: OFF	Disable
0x1: ON(*)	Enable

*factory default

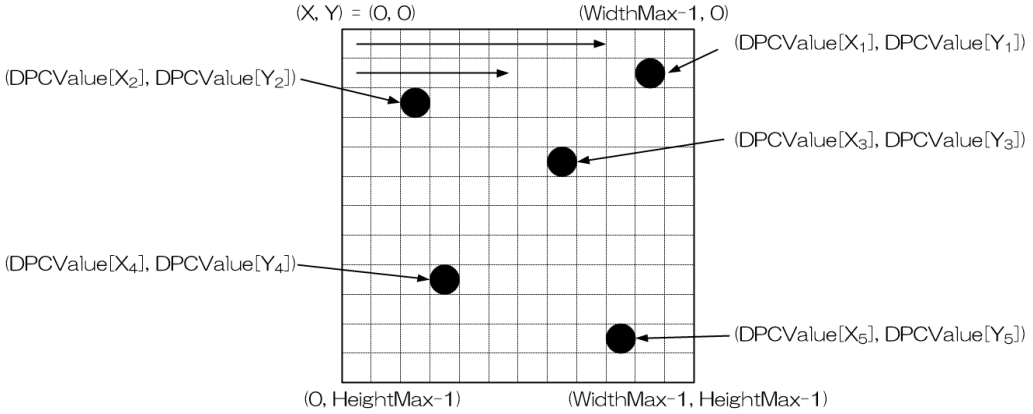
• Setting of DPC coordinate

Set the value to DPCNumber register.

The defective pixels are corrected by calculation from the neighboring pixels by setting to coordinate to DPCValue register. If defective pixel exists plural number, these defective pixels are corrected by set coordinate to another DPCValue register.

• Sort of DPCValue

The settings of coordinate in DPCValue[X_1][Y_1], [X_2][Y_2] … register need to sort that from upper left(0, 0) → upper right (WidthMax-1, 0) → lower left (0, HeightMax-1) → lower right (WidthMax-1, HeightMax-1).



UserSetControl

You are able to save a user setting to the non-volatile or 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.

List of registers to be applied to UserSet

Category	Register name
TransportlayerControl	CameraLink Tap
	CameraLink CLK
ImageFormatControl	Width
	Height
	OffsetX
	OffsetY
	Binning
	Decimation
	Reverse
	PixelFormat
	TestPattern
AcquisitionControl	AcquisitionFrameRateEnable
	AcquisitionFrameRate
	AcquisitionFrameIntervalControl
	AcquisitionFrameInterval
TriggerControl	TriggerMode
	TriggerSequence
	TriggerSource
	TriggerAdditionalParameter
	TriggerDelay
ExposureControl	ExposureTimeControl
	ExposureTime
DigitalIOControl	LineModeAll
	LineInverterAll
	UserOutputValueAll
	LineSelector
	LineSource

Category	Register name
TimerControl	TimerTriggerSource
	TimerDuration
	TimerDelay
AnalogControl	GainControl
	Gain
	BlackLevel
	Gamma
	Sharpness
	WhiteBalanceControl
	WhiteBalanceR
	WhiteBalanceB
ALCControl	ALCPhotometricAreaSize
	ALCExposureValue
	ALCExpusureTimeMin
	ALCExpusureTimeMax
	ALCGainMin
	ALCGainMax
LUTControl	LUTEnable
SequentialShutterControl	SequentialShutterEnable(*)
	SequentialShutterTerminateAt(*)
	SequentialShutterEntry(*)
DPCControl	DPCEnable(*)
	DPCNumber(*)
	DPCEntryX(*)
	DPCEntryY(*)

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

Status / Expanded status

(Legacy protocol only)

If returned [NAK] at sending command to camera, the error status is wrote to status register and expanded status register.

● **Note**

The register value and content are described as follows:

Status (0x69)	Expanded status (0x6A)	Classification	Description
0x00	0x00	No Error	No error
0x02	0x01	General Accessing Error	Accessed to reserve area.
	0x02		Read access to write only register.
	0x03		Write access to read only register.
	0x04		The write value is out of range.

Baudrate

(GenCP Only)

If GenCP used, the baudrate is possible to change.

*In Legacy protocol used, the baudrate is fixed 9600 bps.

Register address	Read Write	Memory Save	Default	Register name	Description
0x0001 0000	R.O.	—	0x91	Supported Baudrates	0x91 (9600, 115200, 921600bps)
0x0001 0004	R/W	—	0x00	Current Baudrate	Current baudrate 0x00:auto recognition 0x01:9600bps, 0x10:115200bps, 0x80:921600bps

Warranty rules

● 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.

● 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

Repair

● Repair methods

Basically, has to return it to our company when the user requests us to repair product.
In the case, exchange to a replacement or an equal function product.

● Repair request methods

On the occasion of a repair request, please return the defective product with the failure situation report sheet to be filled out. The failure situation report sheet is possible to download from homepage of our company.
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.

* Please refer for the inquiry about the software to our homepage or sales personnel.