BU Series
CMOS Camera

Instruction Manual

Model
B/W Camera   : BU302MG / BU505MG
Color Camera   : BU302MCG / BU302MCF / BU505MCG / BU505MCF

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.

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

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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.

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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.

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⚠ 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.

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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.

- 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 10 mm. If a lens does not stand to this condition, it might not be installed to this camera.

C-mount lens　Bottom of the screw　10mm or less
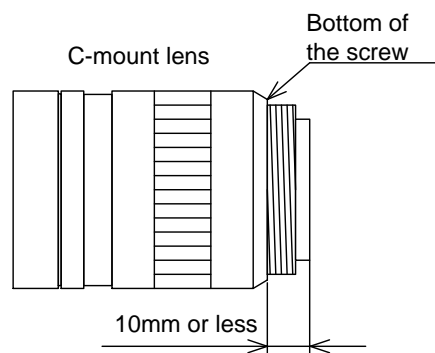
● Mounting to pedestal

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.

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● 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.

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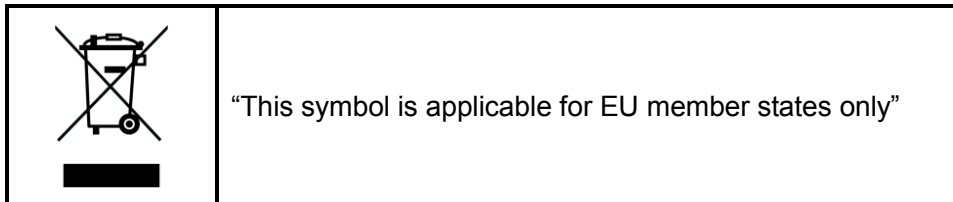
This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC Rules.

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 required 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.
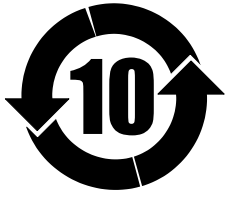
	环保使用期限标识，是根据电子信息产品污染控制管理办法以及，电子信息产品污染控制标识要求(SJ/T11364-2006)、电子信息产品环保使用期限通则，制定的适用于中国境内销售的电子信息产品的标识。 电子信息产品只要按照安全及使用说明内容，正常使用情况下，从生产月期算起，在此期限内，产品中含有的有毒有害物质不致发生外泄或突变，不致对环境造成严重污染或对其人身、财产造成严重损害。 产品正常使用后，要废弃在环保使用年限内或者刚到年限的产品时，请根据国家标准采取适当的方法进行处置。 另外，此期限不同于质量/功能的保证期限。 The Mark and Information are applicable for People's Republic of China only.
中华人民共和国 环保使用期限	

<center>＜产品中有毒有害物质或元素的名称及含量＞</center>

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	×	○	○	○	○	○
○：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(SJ/T11363-2006)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(SJ/T11363-2006) 　This information is applicable for People's Republic of China only.						

<center>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</center>

内部緩衝材料・袋
内部缓冲材料・袋
Internal buffer materials・Bag

箱／箱子／Box
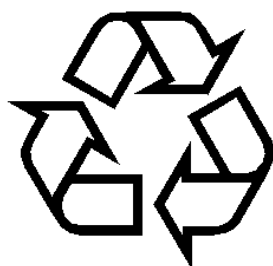
ペーパーボード
纸板
Paper board

PE-LD

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

Installation

Before using this product, you shall install application software to display image and control registers of camera, and IP configuration tool for network setting.

You can download the SDK for our USB camera products (TeliCamSDK) from the Service & Support section of our website.

User registration is necessary to use downloading service. Please make a user registration, or contact your sales representative.

- TOSHIBA TELI CORPORATION Top Page
  http://www.toshiba-teli.co.jp/index.htm

- Service & Support
  https://www.toshiba-teli.co.jp/cgi/ss/en/service.cgi

Please refer to the TeliCamSDK startup guide, about Operation environment, Installation, and Setup.

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

Overview

BU302M/BU505M series is an integrated-(one-body)-type camera that adopts a global shutter CMOS sensor. These are BU302MG (3M type1/1.8) BU505MG (5M type2/3). Suffix [CG] or [CF] are attached to the color models. For video output and camera control, the USB 3.0 interface standard is adopted for high transfer rate, and it is easy to integrate into industrial equipment.

Features

● High frame rate

Supporting high frame rate, BU302MG 120fps, BU505MG 75fps.

● 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.

● USB*3.0 interface

Video output and camera control are performed via the USB 3.0 standard interface. Data transfer is up to 5Gbps (Maximum) that enables to output uncompressed video data at high frame rate.

● USB3 Vision*

This product is based on USB3 Vision Ver.1.0.

● GenICam* Ver 2.3

This product is based on GenICam Generic Interface for Cameras Ver 2.3.

● IIDC2* Digital Camera Control Specification Ver.1.0.0

This product is based on IIDC2 Digital Camera Control Specification Ver.1.0.0.

● e-CON* Connector adoption

   The e-CON connector adoption enables to assemble the cable easily without using special tools.

● 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 USB bus by reducing horizontal output area.

● Binning

   B/W models hove binning. In this mode, pixel data is combined by vertical and horizontal. Vertical binning
 achieves high frame rate.

● Decimation

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

● Color processing

   Color models have built in color processing. There are RGB, BGR, YUV 4:2:2, YUV 4:1:1, Bayer and Mono
 output modes. In addition, it produced an image with restrained false color by adaptive filter interpolating 7 x 7
 pixels.

● 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. BU302MCF)

   * 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

* USB is a unified standard established by USB-IF(USB Implementers Forum).

* USB3 Vision is a unified standard established by AIA (Automated Imaging Association).

* GeniCam is a registered trademark of EMVA (European Machine Vision Association).

* IIDC2 is a unified standard established by JIIA (Japan Industrial Association).

* e-CON (Easy & Economy connector) is a sensor connector that is normalized by the manufacturer of the
    sensor, FA equipment and connector.

Configuration

The system configuration of this camera series is as follows;

This camera has no accessories, please prepare other equipment separately.

● Camera: This product. (BU)

● Camera mounting kit CPTBU (*1): To fix a camera to a tripod; attach this to the bottom of the camera.

● USB3.0 Cable (*2): This cable is used to connect the camera to host PC. Please use a USB3.0 cable of Standard A - Micro B. This product is able to connect a USB cable equipped with screw lock mechanism. Please use it as needed.

● USB3.0 Interface Card (*2): This is the interface card to connect to the camera. Usually this card is installed to expansion slot of PC etc.

● e-CON Cable. (*2): This cable is used to input external trigger signal and output GPIO signal.
We recommend using shielded cable, because there is likely to be affected by the noise depending on the operating environment of the camera.

*1: Optional part. Contact your sales representative for details of option units.

*2: Commercial items.

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Connection

Camera

USB3.0 Cable
← Control Packet   Stream Packet →
(Mirco B)   (Standard A)

e-CON Cable
(e-CON)
1. Line2
2. Line1
3. GND
4. Line0

Camera mounting unit
CPTBU

Interface Card   Host(PC etc.)
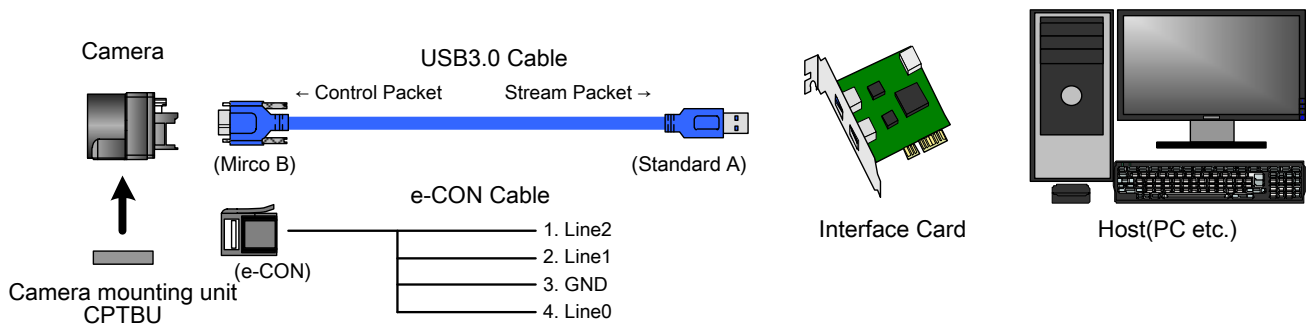
Notes on Connection:

- Please confirm the power supply of the camera off when plugging in or pulling out the I/O Connector. It causes the breakdown.

- If your camera is used in a system where its connectors are subjected to strong repetitive shocks, its connectors are possible to break down. If you use your camera in such a situation, use an USB3.0 cable with a lock screw, and secure the camera cable as close as possible to the camera body for avoid physical shock to the camera connector.

- About e-CON cable: In the case that electric-wire is long or thin, input and output voltage may not satisfy specifications of the camera or your system by voltage drop. Please confirm wires' specifications before use them.

- Lost packets may occur by an electrical characteristic of the transmission line of USB3.0. (USB3.0 Interface Card, USB3.0 Cable, and USB3.0 HUB).

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Connector Pin Assignment

Rear View

1. USB3.0 Interface Connector

Connector model: WMUR-10F6L1PH5N (WIN WIN PRECISION INDUSTRIAL)

Pin No.	I/O	Signal	Function
1	-	VBUS	Power
2	I/O	D-	USB2.0 differential pair
3	I/O	D+	USB2.0 differential pair
4	-	NC	Not connected
5	-	GND	Ground for power return
6	O	SSTX-	SuperSpeed transmitter differential pair
7	O	SSTX+	SuperSpeed transmitter differential pair
8	-	GND_DRAIN	Ground for SuperSpeed signal return
9	I	SSRX-	SuperSpeed receiver differential pair
10	I	SSRX+	SuperSpeed receiver differential pair

2. I/O Connector

Connector (Camera side)   37204-62B3-004PL (Sumitomo 3M) or equivalent
Matching connector (Cable side)   Connectors which conformed to e-CON
     e.g. 37104 series (Sumitomo 3M), RITS 4P series (Tyco)
* Matching connector is not an accessory of this product.
Pin assignment

① ② ↑ TOP ③ ④

*Above figure is connector view from insert side.

Pin No.	I/O	Signal	Function
1	I/O	Line2	GPIO Input / Output
2	O	Line1	GPIO Output
3	-	GND	Ground
6	I	Line0	GPIO Input

Outline Drawing

29

29

Cmount

32.3

(16.3) 16 (10)

18

N.P.

2-M2
Depth 3.8

4.8 9

20

3-M3
Depth 3

Specification
  Main material : Aluminum die-cast metal
  Processing   : Cation coating (black)

General Specifications

- B/W model

Model Name	BU302MG	BU505MG
Imager	CMOS image sensor	
Number of effective pixels (H) × (V)	2064 x 1544	2464 x 2056
Optical Size	type1/1.8	type2/3
Scanning area (H) × (V)[mm]	7.12 × 5.33	8.50 × 7.09
Pixel size (H) × (V)[μm]	3.45 ×3.45	
Scan method	Progressive	
Electronic shutter method	Global shutter	
Aspect ratio	4 : 3	6 : 5
Sensitivity	3250lx, F5.6, 1/120s	2100lx, F5.6, 1/75s
Minimum illuminance (*1)	7lx	5lx
Power supply	DC +5V±5% (from USB connector)	
Power consumption (*2)	3.2W (maximum)	
Interface	USB 3.0 (Only SuperSpeed is supported)	
Transmission speed	5Gbps (maximum)	
Protocol	USB3 Vision	
Image format	Mono8, Mono10, Mono12	
Number of Video out pixels (H) × (V)	2048 × 1536	2448 × 2048
Maximum Frame rate (*2)		
Mono8	120 fps	75 fps
Mono10, Mono12	63 fps	39 fps
Dimensions	29 mm(W) x 29 mm (H) x 16 mm (D) (Not including protrusion)	
Mass	Approximately 33g	
Lens mount	C-mount	
Flange back	17.526mm	
Camera body grounding: insulation status	Non-Conductive between circuit GND and camera body	

*1 F1.4, Gain: Maximum (+24dB), video level: 50%

*2 at the all pixel readout

- Color model

Model Name			
With optical glass		BU302MCG	BU505MCG
With IR-cut filter		BU302MCF	BU505MCF
Imager		CMOS image sensor	
Number of effective pixels (H) × (V)		2064 x 1544	2464 x 2056
Optical Size		type1/1.8	type2/3
Scanning area (H) × (V)[mm]		7.12 × 5.33	8.50 × 7.09
Pixel size (H) × (V)[µm]		3.45 ×3.45	
Scan method		Progressive	
Electronic shutter method		Global shutter	
Aspect ratio		4 : 3	6 : 5
Sensitivity			
With optical glass		2400lx, F4, 1/120s	3000lx, F5.6, 1/75s
With IR-cut filter		2650lx, F4, 1/120s	3300lx, F5.6, 1/75s
Minimum illuminance (*1)			
With optical glass		10lx	6lx
With IR-cut filter		11lx	7lx
Power supply		DC +5V±5% (from USB connector)	
Power consumption (*2)		4.0W (maximum)	
Interface		USB 3.0 (Only SuperSpeed is supported)	
Transmission speed		5Gbps (maximum)	
Protocol		USB3 Vision	
Image format		RGB, BGR, YUV422, YUV411, Bayer8, Bayer10, Bayer12, Mono8	
Number of Video out pixels (H) × (V)		2048 × 1536	2448 × 2048
Maximum Frame rate (*2)			
Bayer8, Mono8		120 fps	75 fps
YUV411		84 fps	52 fps
YUV422		63 fps	39 fps
Bayer10, Bayer12		63 fps	39 fps
RGB, BGR		42 fps	26 fps
Dimensions		29 mm(W) x 29 mm (H) x 16 mm (D) (Not including protrusion)	
Mass		Approximately 33g	
Lens mount		C-mount	
Flange back		17.526mm	
Camera body grounding: insulation status		Non-Conductive between circuit GND and camera body	

*1 F1.4, Gain: Maximum (+24dB), video level: 50%   *2 at the all pixel 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 10mm or less.

C-mount lens

Bottom of the screw

10mm or less
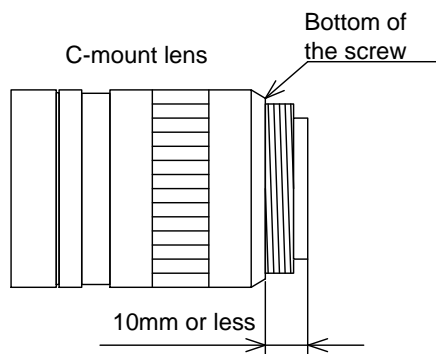
LED Status

Camera state	Lamp indication
No power	Off
Link detection in progress	Fast flash green (ON:20ms, OFF:60ms)
Connection Error	Flash alternate red / green
SuperSpeed connected, but no data being transferred	Flash green (ON: 200ms, OFF: 800ms)
SuperSpeed connected, waiting for trigger	Flash orange (ON: 200ms, OFF: 800ms)
Data being transferred	Fast flash green (ON:60ms, OFF:20ms)
Error during data transfer	Solid Red (Time period: 500ms)
Stand-by	Super slow flash orange (ON:200ms, OFF: 2800ms)

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I/O Specification

● Signal Specification

  - Line0 (GPIO Input, I/O connector : 4 pin)

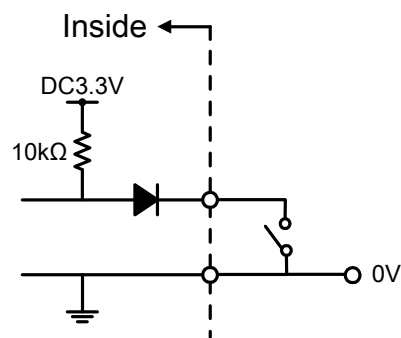   Input Circuit   : LVTTL

        Level   : Low 0 ~ 0.5V, High 2.0 ~ 24.0V

        Polarity   : High active / Low active (initial factory setting: Low active)

        Pulse Width   : Minimum 50μs

        Input circuit diagram


> **Notes of external trigger signal:**
>
>   Depending on cable length, cable kinds and input current of trigger input line, Random Trigger Shutter operation may not satisfy timing specification or camera may not receive EXT_TRIG signal. Please confirm it before use.
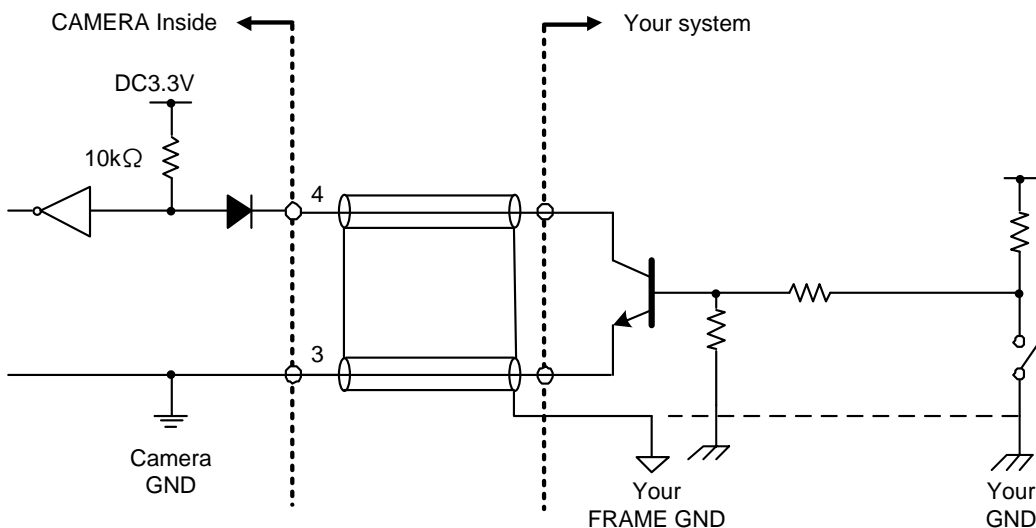
> **Notes of input level:**
>
>   Line0 and Line2 have different input level. Please use input level within the voltage described in this specification.

● External trigger input recommended circuit

- Isolated I/F
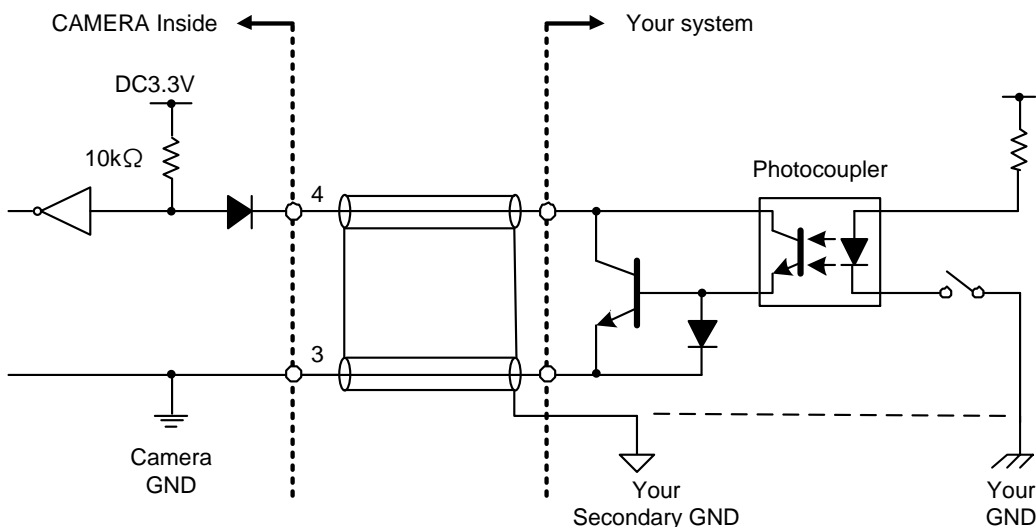
- Non-Isolated I/F

Notes of trigger input cable:

- The recognition of the trigger signal depends on the length, characteristic or driving current of the cable. Therefore

  please confirm your system about those conditions.

- Pin 3 is signal ground. It isn't conducted with camera frame.

  Using shield cable, terminal processing of the shield is referred as above.

- Please confirm the EMC adaptability in whole of your system.

- Line2 (GPIO Input / Output, initial factory setting: Input, I/O connector : 1 pin)

   - Input signal specification

      Level   : Low 0 ~ 0.5V, High 4.0 ~ 5.0V

      Polarity   : High active / Low active (initial factory setting: Low active)

      Pulse Width   : Minimum 50μs

Notes of external trigger signal:

Depending on cable length, cable kinds and input current of trigger input line, Random Trigger Shutter operation may not

satisfy timing specification or camera may not receive EXT_TRIG signal. Please confirm it before use.

Notes of input level:

Line0 and Line2 have different input level. Please use input level within the voltage described in this specification.

- Output signal specification

      Output Circuit   : 5V CMOS

      Maximum Current: +/-32mA

      Polarity   : High active / Low active (initial factory setting: Low active)

      Signal Source   : TIMER0 ACTIVE

                          USER OUTPUT

                          EXPOSURE ACTIVE

                          FRAME ACTIVE

                          FRAME TRANSFER

                          FRAME TRIGGER WAIT

   Input / Output circuit diagram

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

- Line1 (GPIO Output, I/O connector : 2 pin)

  Output Circuit : 5V CMOS

  Maximum Current: +/-32mA

  Polarity   : High active / Low active (initial factory setting: Low active)

  Signal Source : TIMER0 ACTIVE
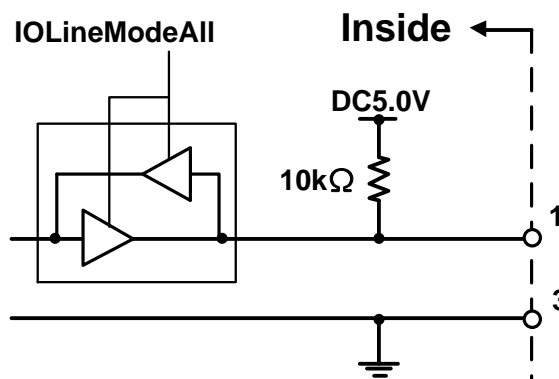
         USER OUTPUT

   EXPOSURE ACTIVE

         FRAME ACTIVE

         FRAME TRANSFER

         FRAME TRIGGER WAIT
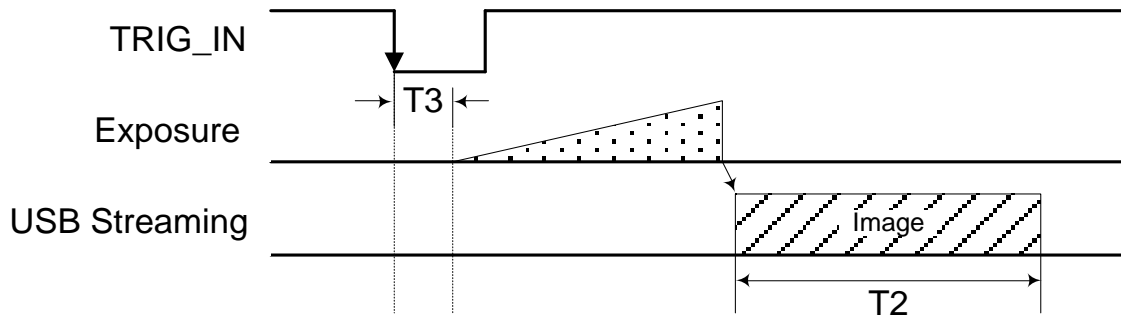
Timing Specification

Image data outputs are transferred with USB bulk transfer. Timing numerical value below is described by absolute prerequisite that camera can use transmission band without restriction of other device. When there is other device on the same bus, the value described below is not guaranteed.

● In normal shutter mode
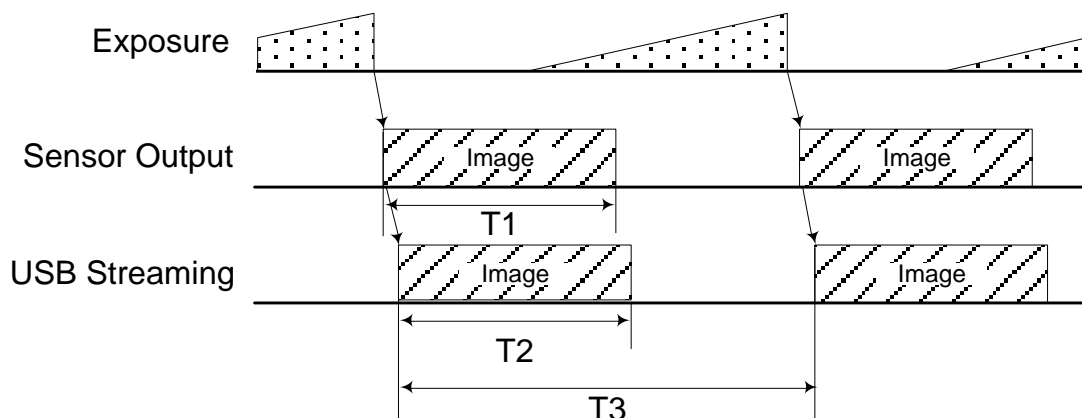
Model Name	format	T1 [ms]	T2 [ms]	T2 [s]
BU302MG	Mono8	8.1	8.1	1/(Frame Rate setting)
	Mono10, Mono12	9.6	9.6	
BU505MG	Mono8	12.9	12.9	
	Mono10, Mono12	15.3	15.3	
BU302MCG	Bayer8, Mono8	8.1	8.1	
	YUV 4:1:1	9.6	11.5	
	YUV 4:2:2		15.3	
	Bayer10, Bayer12		15.3	
	RGB, BGR		23.0	
BU505MCG	Bayer8, Mono8	12.9	12.9	
	YUV 4:1:1	15.3	18.4	
	YUV 4:2:2		24.6	
	Bayer10, Bayer12		24.6	
	RGB, BGR		36.8	

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

● In Random Trigger Shutter mode

TRIG_IN

Exposure

|→| T3 |←|

USB Streaming

Image

T2

Edge mode / Bulk mode (at all pixels readout)

TRIG_IN

|→| T4 |←|

Exposure

|→| T3 |←|

USB Streaming

Image

T2
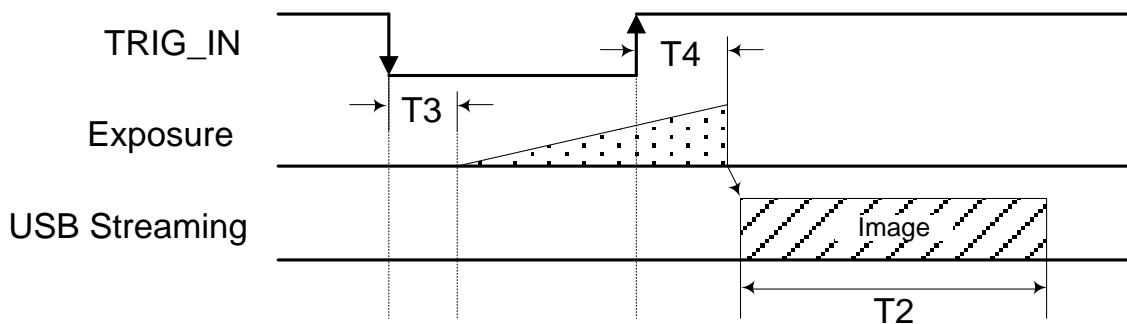
Level mode (at all pixels readout)

Model Name	T3 [µs]	T4 [µs]
BU302MG/MCG	15.8	29.5
BU505MG/MCG	18.8	32.6

* The value of T1 is the same as the value of normal shutter mode.

* T3 and T4 are typical value.

Notes of random trigger shutter mode:

- In the period when FRAME_TRIGGER_WAIT (GPIO signal) is inactive, user must not input external trigger signal to this camera.

- 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.

Typical Spectral Response

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

● BU302MG / BU505MG

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http://www.toshiba-teli.co.jp/en/index.htm
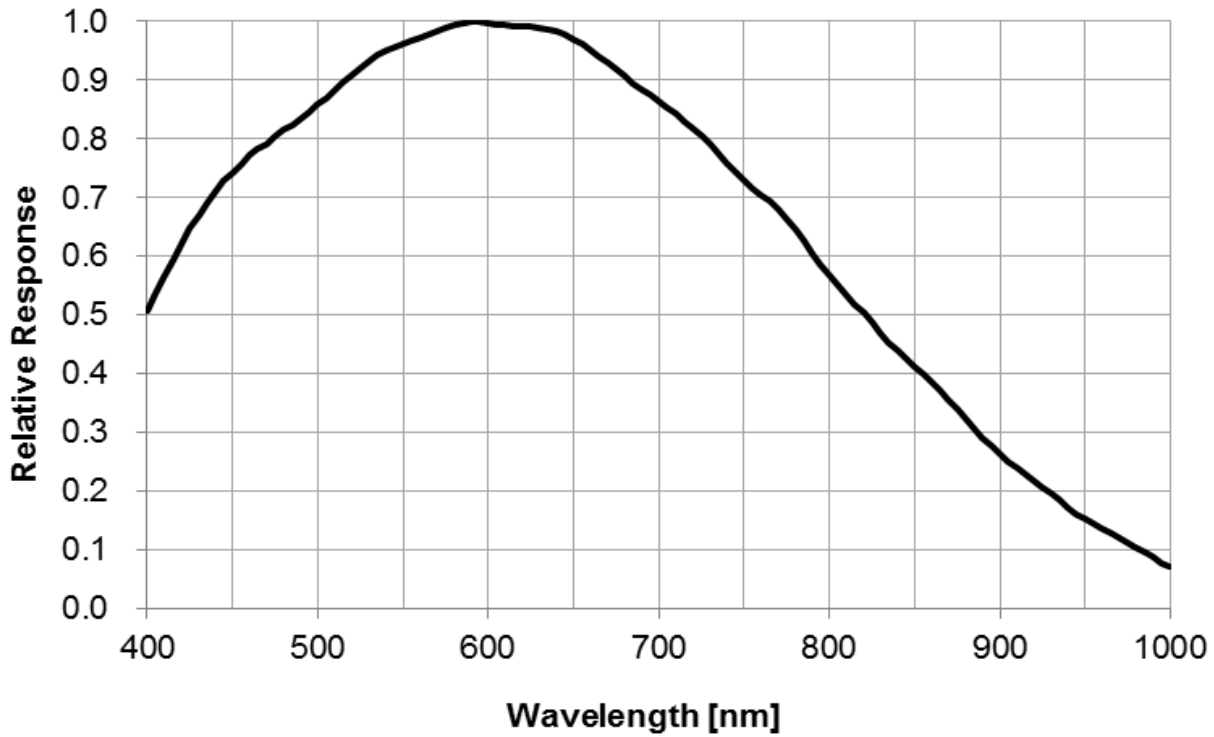
● BU302MCG / BU505MCG

● BU302MCF / BU505MCF

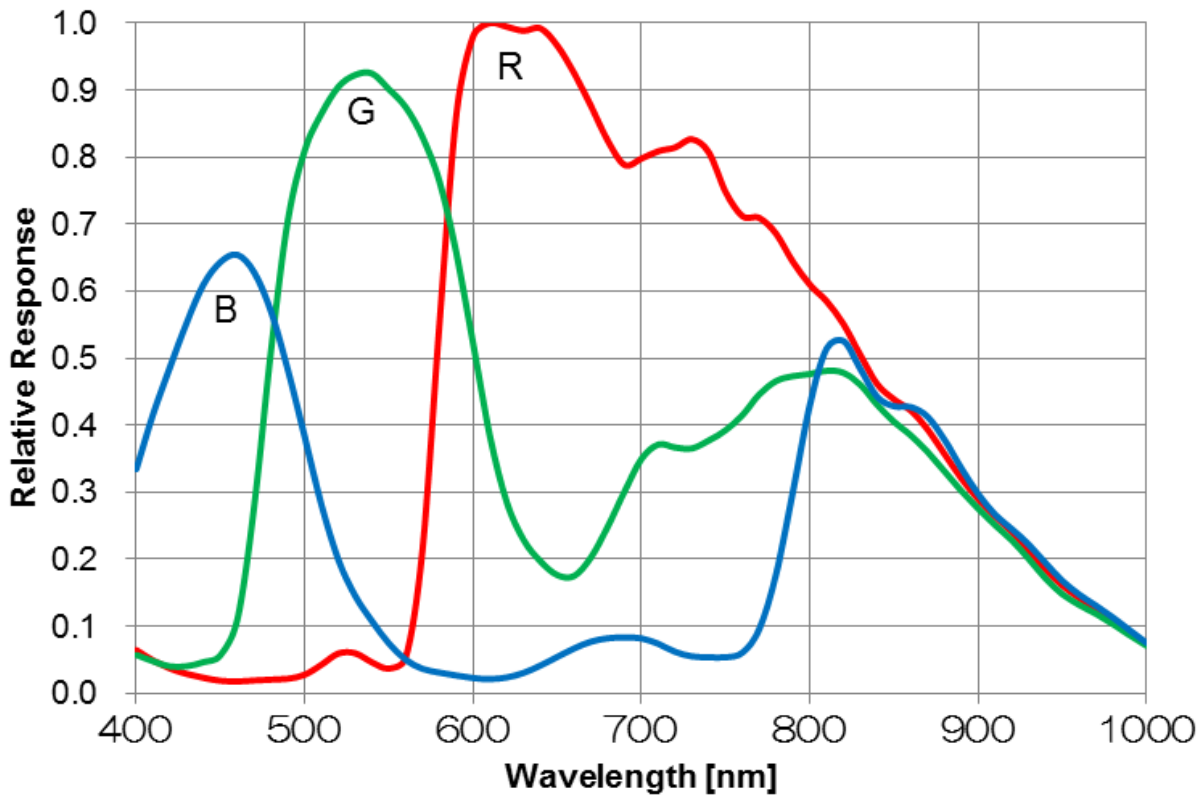D4253386B

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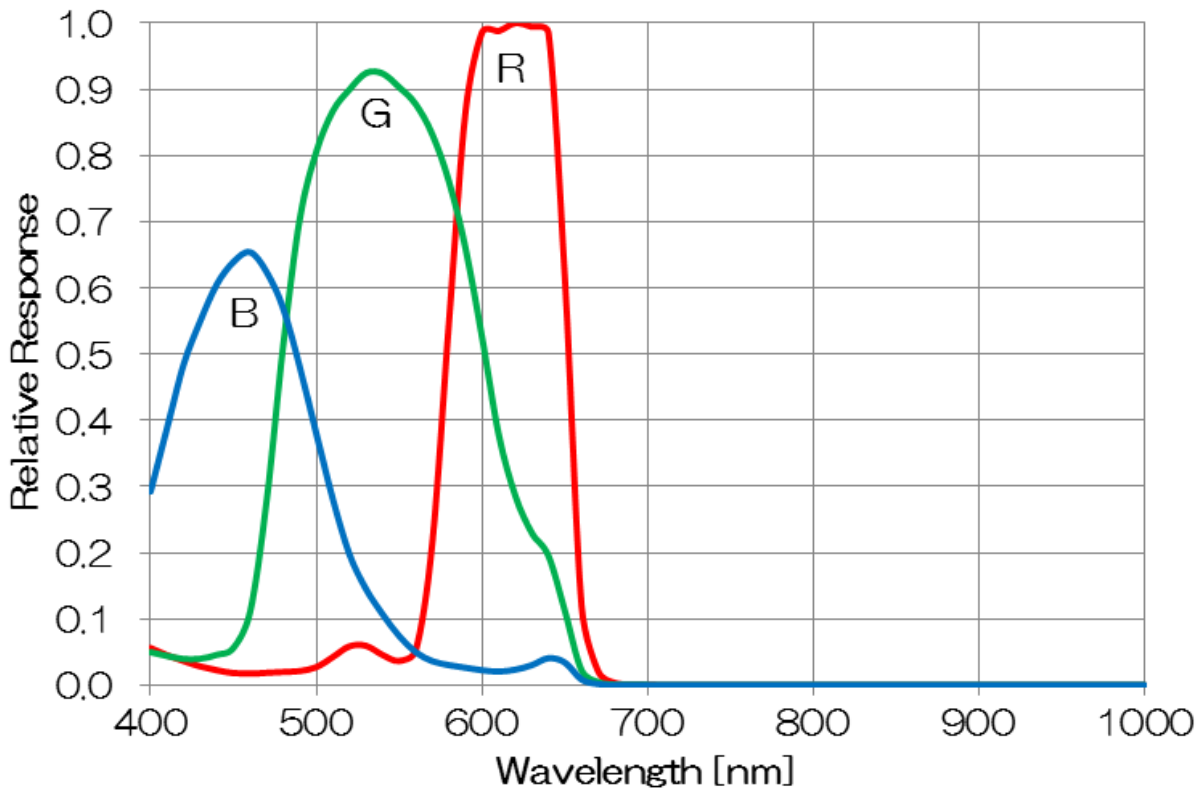
Operating Ambient Conditions

● Ambient conditions

  - Operating Assurance

      Temperature: 0°C to +40°C, Camera housing temperature: less than 50°C

      Humidity: 10% to 90% (no condensation)

  - Storage Assurance

      Temperature: -20°C to +60°C

      Humidity: 90% or less (no condensation)

Notes on Heat Radiation:

The temperature of camera housing must be kept less than 50 °C.

Please provide sufficient heat radiation depending on your installation.

● EMC Conditions

  - EMI (Electro-Magnetic Interference):   EN61000-6-4

                                              FCC Part 15 Subpart B Class A

  - EMS (Electro-Magnetic Susceptibility): EN61000-6-2

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

Notes on Conformity of the EMC:

The adaptability of the safety standard of this camera is assured in the condition of combination with the following parts:

- USB Cable   USB3-KR1-A-MBS-030   (OKI Electric Cable Co., Ltd.)

- e-CON Cable   3.0m, Shield cable   (Fabricated parts)

   Parts:

    - e-CON connector   XN2A-1470   (OMRON Corporation)

    - Shielded wire   UL1533 (AWG28)   (Hitachi cable, Ltd.)

   Connection:
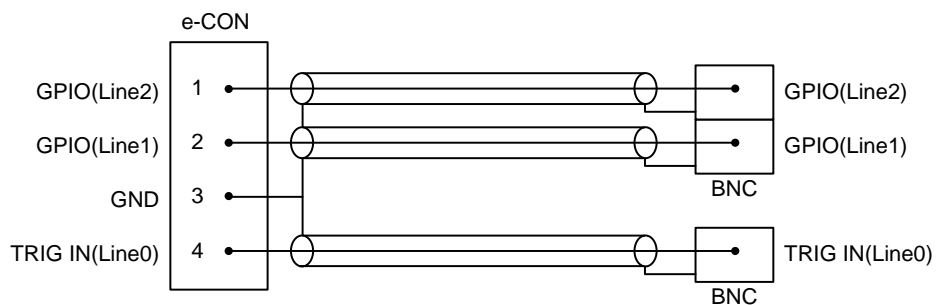
Please confirm the EMC adaptability when it combines with parts other than them.

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

Functions

This section introduces standard functions. BU302M/BU505M series provides following functions.

Category	Function	
USB3 Vision	Bootstrap Registers	USB3 Vision standard registers
DeviceControl	DeviceControl	Device information
ImageFormatControl	ImageFormatSelector	Image format selection
	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
	ImageBuffer	Image buffer control
	TriggerControl	Trigger control
	ExposureControl	Exposure time control
DigitalIOControl	DigitalIOControl	GPIO signal control
CounterAndTimerControl	TimerControl	Timer0Active signal control
AnalogControl	Gain	Gain control
	BlackLevel	Black level control
	Gamma	Gamma correction
	Hue	Hue control
	Saturation	Saturation control
	BalanceRatio	Color gain (R, B)
	BalanceWhiteAuto	Execute auto white balance once
	ColorCorrectionMatrix	Color matrix correction
LUTControl	LUTControl	LUT control
UserSetControl	UserSetControl	Load / Save user setting
EventControl	EventControl	Event packet control
VenderUniqueControl	FrameSynchronization	Frame synchronization control
	LEDIndicatorLuminance	LED luminance control
	AntiGlitch	AntiGlitch control
	AntiChattering	AntiChattering control
DPCControl	DPCControl	Defect pixel correction control
SequentialShutterControl	SequentialShutterControl	Sequential shutter control

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

Features supported by each model are as follows.

Function	BU302MG	BU505MG	BU302MCG	BU505MCG
Bootstrap Registers	○	○	○	○
DeviceControl	○	○	○	○
ImageFormatSelector	○	○	○	○
Scalable	○	○	○	○
Binning	○	○	-	-
Decimation	○	○	○	○
Reverse	○	○	○	○
PixelFormat	○	○	○	○
TestPattern	○	○	○	○
AcquisitionControl	○	○	○	○
ImageBuffer	○	○	○	○
TriggerControl	○	○	○	○
ExposureControl	○	○	○	○
DigitalIOControl	○	○	○	○
TimerControl	○	○	○	○
Gain	○	○	○	○
BlackLevel	○	○	○	○
Gamma	○	○	○	○
Hue	-	-	○	○
Saturation	-	-	○	○
BalanceRatio	-	-	○	○
BalanceWhiteAuto	-	-	○	○
ColorCorrectionMatrix	-	-	○	○
LUTControl	○	○	○	○
UserSetControl	○	○	○	○
EventControl	○	○	○	○
FrameSynchronization	○	○	○	○
LEDIndicatorLuminance	○	○	○	○
AntiGlitch	○	○	○	○
AntiChattering	○	○	○	○
DPCControl	○	○	○	○
SequentialShutterControl	○	○	○	○

Details of each feature are described in following pages.

Bootstrap Registers

This camera is based on USB3 Vision.

Please refer to USB3 Vision specification for details about Bootstrap Registers defined in USB3 Vision.

AIA (Automated Imaging Association) USB3 Vision Homepage.

http://www.visiononline.org/vision-standards-details.cfm?type=11

Followings are commonly used registers.

● Registers

USB3 Vision ABRM			
Register	Visibility	Access	Description
UserDefinedName	Expert	R/W	Store user's arbitrary string in non-volatile memory.

USB3 Vision SIRM			
Register	Visibility	Access	Description
StreamEnable	-	R/W	Open and close the stream channel.

USB3 Vision EIRM			
Register	Visibility	Access	Description
EventEnable	Expert	R/W	Activate event notification function. Please refer to EventControl section as well.
TriggerEventTest	Expert	W	Issue test event packet.

● Note

When opening and closing the stream channel, it is required to control StreamEnable plus SDK setups on your application. Please refer to the TeliCamSDK for details.

DeviceControl

Registers of this category provide various information of the camera. And you can set the free user ID to the camera.

● Registers

Register	Visibility	Access	Description
DeviceReset	Expert	W	Resets the device.
DeviceVendorName	Beginner	R	Returns the vendor name.
DeviceModelName	Beginner	R	Returns the model name.
DeviceManufacturerInfo	Beginner	R	Returns the manufacturer information.
DeviceVersion	Beginner	R	Returns the device version.
DeviceID	Beginner	R	Returns the device ID (serial number).

ImageFormatControl

Registers of this category are related to image format control.

● Registers

Register	Visibility	Access	Description
ImageFormatSelector	Beginner	R/W	Selects an image format.

● Setting

- Select an image format.

  Set a following value to "ImageFormatSelector" register. Setting value is Enumeration type.

ImageFormatSelector	Function
Format0 (*)	Scalable
Format1	Binning
Format2	Decimation

* initial factory setting

● Note

Changing "ImageFormatSelector" register value is invalid during image stream data output.

Scalable

BU series provides the scalable that can read out defined area of the screen.

In the scalable mode, camera reads out only necessary area at the normal speed and reads out other area at high speed. The frame rate can be faster when the vertical height size is small. However, the frame rate cannot be faster only when the horizontal width size is small.

Only single rectangle is selectable. Concave or convex shape is not selectable.

- Window size: $\{A + 4 \times m \text{ (H)}\} \times \{B + 2 \times n \text{ (V)}\}$

                    A, B = minimum unit size

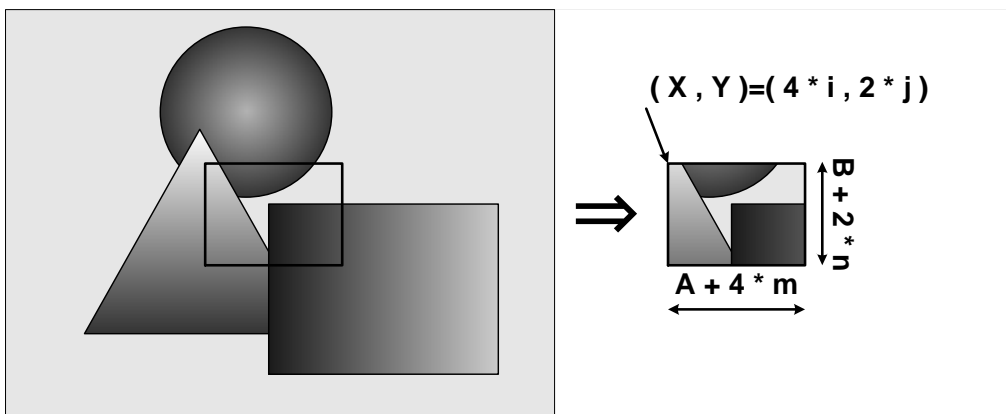   m, n = integer

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

- Start address: $\{4 \times i \text{ (H)}\} \times \{2 \times j \text{ (V)}\}$

                    i, j = integer

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

Scalable

● Registers

Register	Visibility	Access	Description
Width	Beginner	R/W	Sets width (in pixels) of the image data.
Height	Beginner	R/W	Sets Height (in pixels) of the image data.
OffsetX	Beginner	R/W	Sets horizontal offset (in pixels) from the origin to the region of interest.
OffsetY	Beginner	R/W	Sets vertical offset (in pixels) from the origin to the region of interest.

● **Setting**

- Select an image format.

  Select "Fomat0" of "ImageFormatSelector" register.

- Set image size and image start position

  Set the following value to "Width", "Height", "OffsetX", "OffsetY" registers. Setting value is Integer type. "Width", "Height" registers are image size setting. "OffsetX", "OffsetY" registers are image start position setting.

| Model	BU302MG/MCG	BU505MG/MCG
Width/OffsetX unit size	4	4
Height/OffsetY unit size	2	2
Minimum unit size	64 x 64	64 x 64
Maximum unit size (*)	2048 x 1536	2448 x 2048

* initial factory setting

● **Note**

  Changing "Width", "Height", "OffsetX", "OffsetY" register value is invalid during image stream data output.

Binning

B/W models have 2 x 2 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 USB bandwidth occupation decrease.

2448

2048

All pixel readout

1224

1024
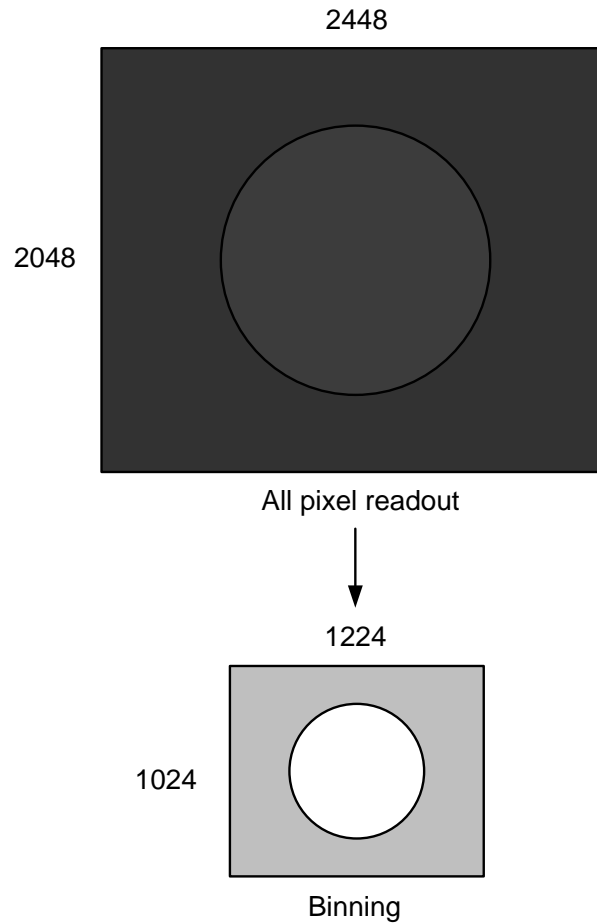
Binning

Binning operation (e.g. BU505MG)

● **Registers**

Register	Visibility	Access	Description
BinningHorizontal	Beginner	R/W	Set horizontal binning.
BinningVertical	Beginner	R/W	Set vertical binning.

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● Setting

- Select an image format.

    Select "Fomat1" of "ImageFormatSelector" register.

- Set binning operation

    Set the "2" to "BinningHorizontal", "BinningVertical" registers. When you set up a value of the one side for horizontal or vertical binning, the other side of the value is set up automatically. Setting value is Integer type.

● Note

Binning is disabled when the camera is running in Scalable mode or Decimation mode.

Scalable and Decimation are disabled when the camera is running in Binning mode.

Changing "BinningHorizontal", "BinningVertical" register value is invalid during image stream data output.

Decimation

Cameras have 2 x 2 decimation, cameras read all effective areas at high speed by skipping lines.

Decimation operation (e.g. BU505MG)

● **Registers**

Register	Visibility	Access	Description
DecimationHorizontal	Biginner	R/W	Set the number of horizontal Decimation line(s).
DecimationVertical	Beginner	R/W	Set the number of vertical Decimation line(s).

● **Setting**

- Select an image format.

  Select "Fomat2" of "ImageFormatSelector" register.

- Set Decimation lines

  Set the "2" to "DecimationHorizontal", "DecimationVertical" registers. When you set up a value of the one side for horizontal or vertical binning, the other side of the value is set up automatically. Setting value is Integer type.

● **Note**

Decimation is disabled when the camera is running in Scalable mode or Binning mode.

Scalable and Binning are disabled when the camera is running in Decimation mode.

Changing "DecimationHorizontal", "DecimationVertical" register value is invalid during image stream data output.

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

Reverse

Image can be flipped in horizontal and/or vertical direction.
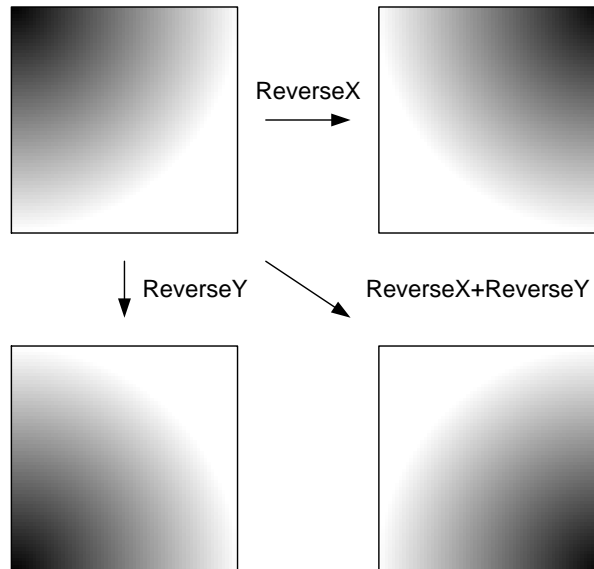
● Registers

Register	Visibility	Access	Description
ReverseX	Expert	R/W	Flip image in horizontal direction.
ReverseY	Expert	R/W	Flip image in vertical direction.

● Setting

- Set image reverse

Set the following value to "ReverseX", "ReverseY" registers. Setting value is Boolean type.

Value	Image reverse
FALSE (*)	Non reverse
TRUE	Reverse

* initial factory setting

● Note

PixelFormat

Select a pixel format of image stream data.

● Registers

Register	Visibility	Access	Description
PixelCoding	Beginner	R/W	Selects a pixel coding.
PixelSize	Beginner	R/W	Selects a bit size of image pixel.
PixelEndian	Beginner	R/W	Selects a pixel endian.
PixelFormat	Beginner	R	Returns a selected pixel format. PixelFormat is conformed to AIA Pixel Format Naming Convention.

● Setting

- Set PixelFormat

PixelFormat is determined by combination of "PixelCoding" and "PixelSize" register. Select a following combination to "PixelCoding" and "PixelSize" register. Setting values are Enumeration type.

B/W model

PixelSize \ PixelCoding	Bpp8	Bpp10	Bpp12
Mono PixelFormat ID	Mono8 (*) 0x01080001	Mono10 0x01100003	Mono12 0x01100005

* initial factory setting

Color model

PixelSize \ PixelCoding	Bpp8	Bpp10	Bpp12	Bpp16	Bpp24 (※)
Mono PixelFormat ID	Mono8 0x01080001	-	-	-	-
BayerBG(*2) PixelFormat ID	BayerBG8 0x0108000B	BayerBG10 Ox0110000F	BayerBG12 0x01100013	-	-
YUV411 PixelFormat ID	-	-	YUV411Packed 0x020C001E	-	-
YUV422 PixelFormat ID	-	-	-	YUV422Packed 0x0210001F	-
RGB PixelFormat ID	-	-	-	-	RGB8 (*1) 0x02180014
BGR PixelFormat ID	-	-	-	-	BGR8 0x02180015

*1 initial factory setting

*2 ReverseX and ReverseY setting are FALSE.

- Set ProcessingMode

In the color model, you can set the ProcessingMode when Bayer output. Valid function varies depending on the setting. Set the following value to "BayerProcessingMode" register. Setting value is Enumeration type.

Register	Visibility	Access	Description
BayerProcessingMode	Expert	R/W	Selects a ProcessingMode.

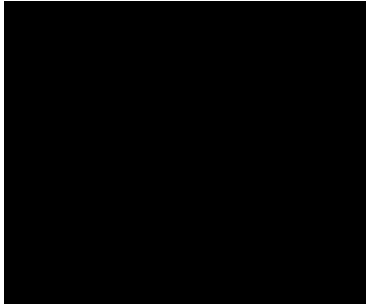| Function	Full (*)	Partial	Raw
Gain	○	○	○
BlackLevel	○	○	-
Gamma	○	○	-
Hue	○	-	-
Saturation	○	-	-
BalanceRatio	○	○	-
ColorCorrectionMatrix	○	-	-
LUTControl	○	○	-
DPCControl	○	○	-

* initial factory setting

● **Note**

Changing "PixelSize" register value is invalid during image stream data output.

TestPattern

BU series supports test pattern data output. Camera provides following Test patterns;
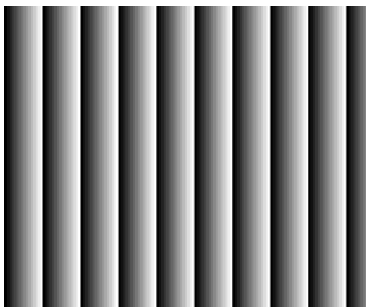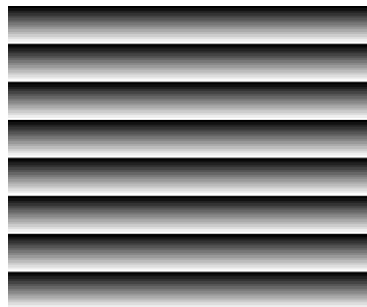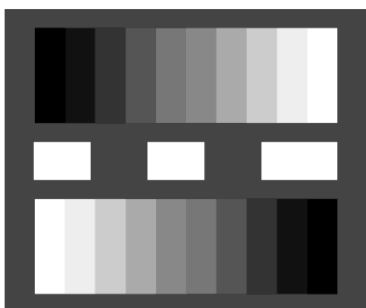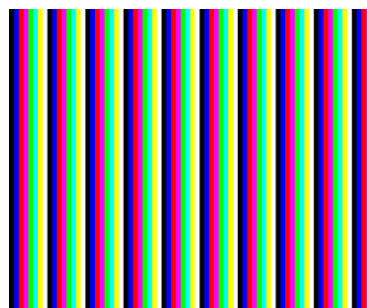
Black

White

GreyA

GreyB

GreyHorizontalRamp

GreyVerticalRamp

GreyScale

(B/W model only)

ColorBar

(Color model only)

Test pattern (e.g. BU505MG/BU505MCG @RGB)

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

● Registers

Register	Visibility	Access	Description
TestPattern	Beginner	R/W	Selects a test pattern.

● Setting

- Select a test pattern output

Set the following value to "TestPattern" register. Setting value is Enumeration type.

The camera generates a test pattern.

TestPattern	Function
Off (*)	Test pattern disable(Normal data output)
Black	All pixel = 0 LSB
White	All pixel = 255 @Mono8
GreyA	All pixel = 170 @Mono8
GreyB	All pixel = 85 @Mono8
GreyHorizontalRamp	Horizontal Ramp
GreyVerticalRamp	Vertical Ramp
GreyScale	Grey scale (B/W model only)
ColorBar	Color bars (Color model only)

* initial factory setting

● Note

AcquisitionControl

Make a setting of image stream and control image stream output.

Camera starts image stream output by receiving AcquisitionStrat command. And there are some registers that require camera to stop image stream output to change values.

Acquisition frame rate is variable. Maximum acquisition frame rate depends on camera operation mode (scalable.)

● **Registers**

Register	Visibility	Access	Description
AcquisitionMode	Beginner	R/W	Selects an acquisition mode.
AcquisitionStart	Beginner	W	Executes the image stream output start.
AcquisitionStop	Beginner	W	Executes the image stream output stop.
AcquisitionAbort	Beginner	W	Executes the image stream output abort.
AcquisitionFrameCount	Beginner	R/W	Sets the number of frames to transfer in MultiFrame mode.
AcquisitionFrameRateControl	Beginner	R/W	Activates frame rate setting.
AcquisitionFrameRate	Beginner	R/W	Sets frame rate of image stream.
AcquisitionFrameIntervalControl	Beginner	R/W	Activates frame interval setting.
AcquisitionFrameInterval	Beginner	R/W	Sets frame interval of image stream.

● **Setting**

- Select an acquisition mode

Set the following value to "AcquisitionMode" register. Setting value is Enumeration type.

AcquisitionMode	Function
Continuous (*)	Continuous image transfer
MultiFrame	Multi frame image transfer

* initial factory setting

- Set the number of frames to transfer (In MultiFrame mode)

Set the number of frames to transfer to "AcquisitionFrameCount". Setting value is Integer type.

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

- Open/Close stream channel (to be ready to receive stream data)

Set "1" to "StreamEnable" in Bootstrap Registers before "AcquisitionStart".

Set "0" to "StreamEnable" in Bootstrap Registers before "AcquisitionStop" or "AcquisitionAbort".

- Start image stream output

The camera starts image stream output by executing "AcquisitionStart" register command.

- Stop image stream output

The camera stops image stream output by executing "AcquisitionStop" register command.

The camera aborts image stream output by executing "AcquisitionAbort" register command.

- Set frame rate

Set the "AcquisitionFrameRateControl" register to "Manual".

And set the following value to "AcquisitionFrameRate" register. Setting value is Float type.

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

"AcquisitionFrameInterval" register is a reciprocal of "AcquisitionFrameRate".

AcquisitionFrameRateControl	Function
NoSpecify (*)	The frame rate is determined by giving priority to ExposureTime setting value.
Manual	The frame rate is determined by giving priority to AcquisitionFrameRate setting value.

* initial factory setting

AcquisitionFrameRate	Value
Minimum	0.5[Hz]
Maximum (*)	Depend on register setting of "Height".

* initial factory setting

● **Note**

Changing "AcquisitionFrameRateControl", "AcquisitionFrameRate", "AcquisitionFrameIntervalControl", "AcquisitionFrameInterval" register value is invalid during image stream data output.

When exposure time setting is longer than frame rate setting, camera operation gives priority to exposure time setting.

When opening and closing the stream channel, it is required to control StreamEnable plus SDK setups on your application. Please refer to the TeliCamSDK for details.

Notes on Frame Drops of Image:

Depends on your PC or USB3.0 interface card configurations, images may not be captured normally (e.g. frame drops may occur). In this case, change to frame rate setting lower.

ImageBuffer

This section describes ImageBuffer control of AcquisitionControl category.

Camera stores images temporarily in image buffer, and read them out in arbitrary timing.

This function is typically used in Random Trigger Shutter mode.

Please refer to TriggerControl section as well.

● **Registers**

Register	Visibility	Access	Description
ImageBufferMode	Beginner	R/W	Selects Image Buffer mode.
ImageBufferFrameCount	Beginner	R	Returns the number of frames stored in the buffer.
ImageBufferRead	Beginner	W	Executes the image buffer read.

● **Setting**

- Activate trigger mode

   Set "On" to "TriggerMode" register, and set "TriggerSoftware" or "Line0", "Line2" to "TriggerSource" register.

- Activate image buffer mode

   Set "On" to "ImageBufferMode" register.

- Open/Close stream channel (to be ready to receive stream data)

   Set "1" to "StreamEnable" in Bootstrap Registers before "ImageBufferRead".

   Set "0" to "StreamEnable" in Bootstrap Registers after completion of image acquisition from image buffer.

- Capture and store images

   Input trigger signals to capture and store images.

   "ImageBufferFrameCount" register shows the number of frames stored in the buffer.

   The maximum number of frames storable depends on the image size. (maximum 64MByte.)

- Set the number of frames to transfer (In ImageBuffer mode)

   Set the number of frames to transfer to "AcquisitionFrameCount". Setting value is Integer type.

- Read images from the buffer

   Read the number of AcquisitionFrameCount image(s) from the buffer by executing "ImageBufferRead" register command (it is equivalent to write value 10 to "AcquisitionCommand" register).

● **Note**

When opening and closing the stream channel, it is required to control StreamEnable plus SDK setups on your application. Please refer to the TeliCamSDK for details.

[Start] button in TeliCamViewer can't deal with "StreamEnable" register alone.

Please substitute procedure "StreamEnable" = 1 to following instructions.

- Push [Start] button ▶ on TeliCamViewer main window.
- Execute [AcquisitionStop] in XML window.

TriggerControl

This section describes trigger control of TriggerControl category for the BU series.

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 I/O connector (HardwareTrigger)
2. Trigger command via the USB interface (SoftwareTrigger)

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

Table. 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
	SoftwareTrigger	-Edge mode:TriggerSequence0 -Bulk mode:TriggerSequence6 "ExposureTime" register control

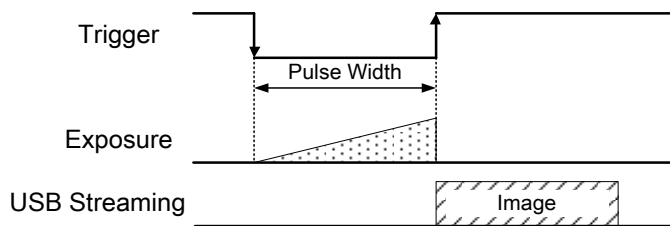* The camera operation not mentioned above is not guaranteed.

- Edge mode (TriggerSequence0)

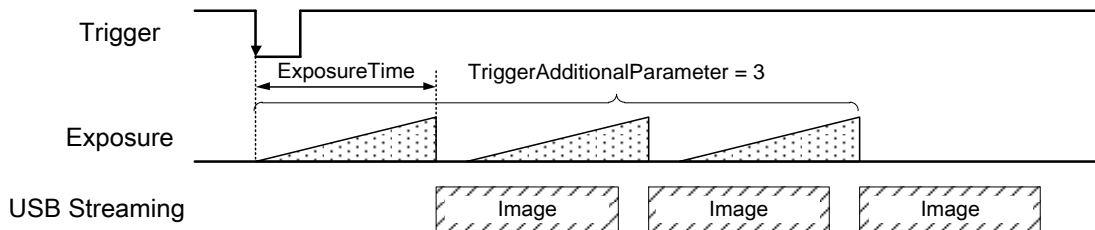The exposure time is determined by Exposure Time setting.
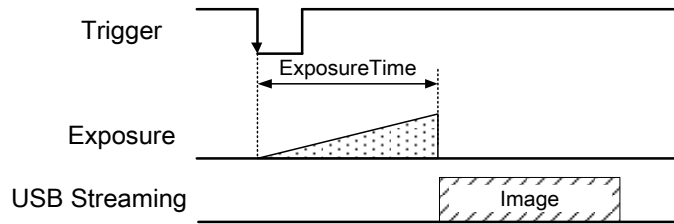
- Level mode (TriggerSequence1)

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

- Bulk mode (TriggerSequence6)

Camera exposes and transfers multiple frames by a single trigger.

Trigger sequence

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.
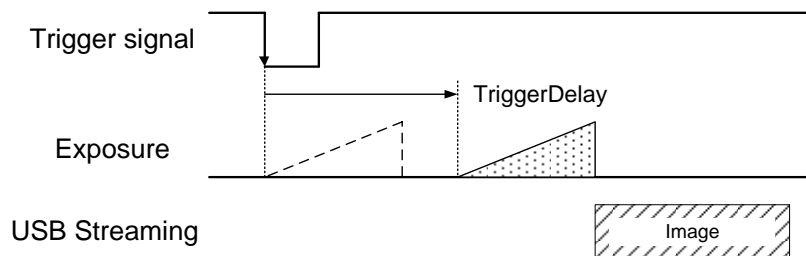
Trigger Delay

Details of Random Trigger Shutter operation, refer to "Timing" of "Specification".

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

● Registers

Register	Visibility	Access	Description
TriggerMode	Beginner	R/W	Selects Random Trigger Shutter mode.
TriggerSequence	Beginner	R/W	Selects trigger sequence.
TriggerSource	Beginner	R/W	Selects trigger source of Random Trigger Shutter.
TriggerAdditionalParameter	Expert	R/W	Sets the number of frames to exposure in Bulk mode.
TriggerDelay	Beginner	R/W	Sets trigger delay.
TriggerSoftware	Beginner	W	Executes software trigger.

● Setting

- Select trigger mode

Set the following value to "TriggerMode" register. Setting value is Enumeration type.

TriggerMode	Function
Off (*)	Normal Shutter Mode
On	Random Trigger Shutter mode

* initial factory setting

- Select trigger sequence

Set the following value to "TriggerSequence" register. Setting value is Enumeration type.

TriggerSequence	Function
TriggerSequence0 (*)	Edge mode
TriggerSequence1	Level mode
TriggerSequence6	Bulk mode

* initial factory setting

In Normal Shutter mode, the exposure time is determined by "ExposureTime" register value regardless of "TriggerSequence" register setting.

- Select trigger source

Set the following value to "TriggerSource" register. Setting value is Enumeration type.

TriggerSource	Function
Line0 (*)	Hardware trigger (I/O connector : 4 pin)
Line2	Hardware trigger (I/O connector : 1 pin)
TriggerSoftware	Software trigger

* initial factory setting

- Set the number of frames to exposure (In Bulk mode)

Set the number of frames to exposure to "TriggerAddtionalParameter". Setting value is Integer type.

TriggerAdditionalParameter	Value
Minimum (*)	0 [frame]
Maximum	255 [frames]

* initial factory setting

- Set trigger delay (HardwareTrigger operation only)

Set the following value to "TriggerDelay" register. Setting value is Float type.

Adds delay time from trigger edge to exposure start.

TriggerDelay	Value
Minimum (*)	0.00[µs]
Maximum	2000000.00[µs]

* initial factory setting

- Grabs image stream by software trigger

When executes "TriggerSoftware" register command, software trigger command is generated. Camera starts exposure by receiving software trigger command.

● **Note**

In SoftwareTrigger operation, the delay time from "TriggerSoftware" to exposure is not guaranteed.

ExposureTime

BU series is able to adjust exposure time by using electric shutter control.

BU USB series provides two kinds of exposure time control mode.

- Manual : The exposure time is determined by "ExposureTime" register setting value.
- NoSpecify : The exposure time is determined by "AcquisitionFrameRate" register setting value

● Registers

Register	Visibility	Access	Description
ExposureTimeControl	Beginner	R/W	Selects exposure time control mode.
ExposureTime	Beginner	R/W	Sets absolute exposure time.

● Setting

- Select exposure time control mode

    Set the "ExposureTimeControl" register to "Manual".

    Set the following value to "ExposureTime" register. Setting value is Float type.

AcquisitionFrameRateControl	Function
NoSpecify	The frame rate is determined by giving priority to AcquisitionFrameRate setting value.
Manual (*)	The frame rate is determined by giving priority to ExposureTime setting value.

* initial factory setting

| Model	BU302MG/MCG	BU505MG/MCG
ExposureTime (*)	8000 [μs]	13000 [μs]
ExposureTimeMin	30 [μs]	30 [μs]
ExposureTimeMax	16000000 [μs]	16000000 [μs]

* initial factory setting

● Note

DigitalIOControl

This section describes DigitalIOControl category for the BU series.

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.

* ActiveLow

Selectable signals
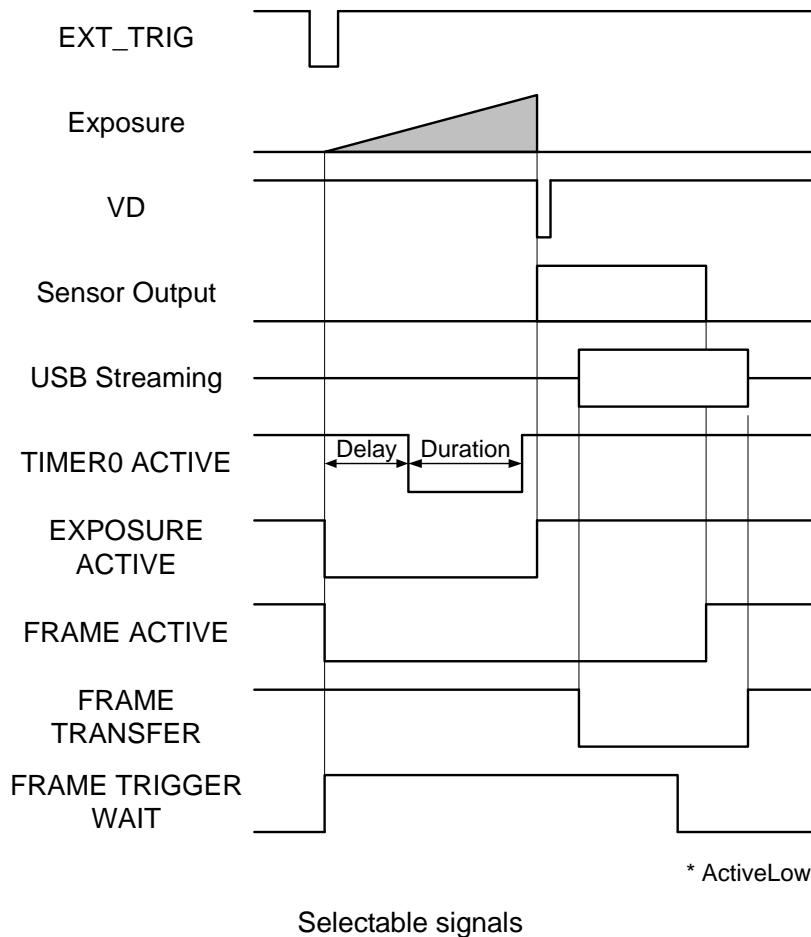
● Registers

Register	Visibility	Access	Description
LineModeAll	Beginner	R/W	Selects the Input / Output of each Line.
LineInverterAll	Beginner	R/W	Selects the polarity of each Line signal.
LineStatusAll	Beginner	R	Returns the status of each Line signal.
UserOutputValueAll	Beginner	R/W	Sets the user output value.
LineSelector	Beginner	R/W	Selects the Line of I/O connector.
LineSource	Beginner	R/W	Selects the source of the output signal.

● Setting

- Select the Input / Output

Set the following value to "LineModeAll" register. Setting value is Integer type.

Each bit corresponds to each Line (bit0=Line0, bit1=Line1).

Line2 is available. Line0 is dedicated input. Line1 is dedicated output.

LineModeAll	I/O connector pin assignment
0 (*)	Input
1	Output

* initial factory setting

- Select the Line of the I/O connector

Set the following value to "LineSelector" register. Select the line to output "LineSource" signal.

Setting value is Enumeration type.

LineSelector	I/O connector pin assignment
Line1 (*)	2 pin: GPIO Output
Line2	1 pin: GPIO Input / Output

* initial factory setting

- Select the source of GPIO output signal

Set the following value to "LineSource" register to change GPIO output signal selected by "LineSelector".

Setting value is Enumeration type.

LineSource	Signal description
Off (*)	No output.
FrameTriggerWait	Indicating waiting a Random Trigger Shutter. An External trigger is input during this period, exposure starts immediately.
FrameActive	Period from exposure start to CMOS transfer completion.
FrameTransfer	Period of transferring image data on USB bus.
ExposureActive	Period from exposure start to exposure end.
UserOutput	Outputs the value set in "UserOutputValueAll".
Timer0Active	This signal can be used as strobe control signal. The delay time and pulse width of this signal are configurable.

* initial factory setting

- Set the UserOutput signal

Set the following value to "UserOutputValueAll" register. Setting value is Integer type.

Each bit corresponds to each Line (bit0=Line0, bit1=Line1).

Line1 and Line2 are available. Line0 is dedicated input.

UserOutputValueAll	Function
0 (*)	Low level output
1	High level output

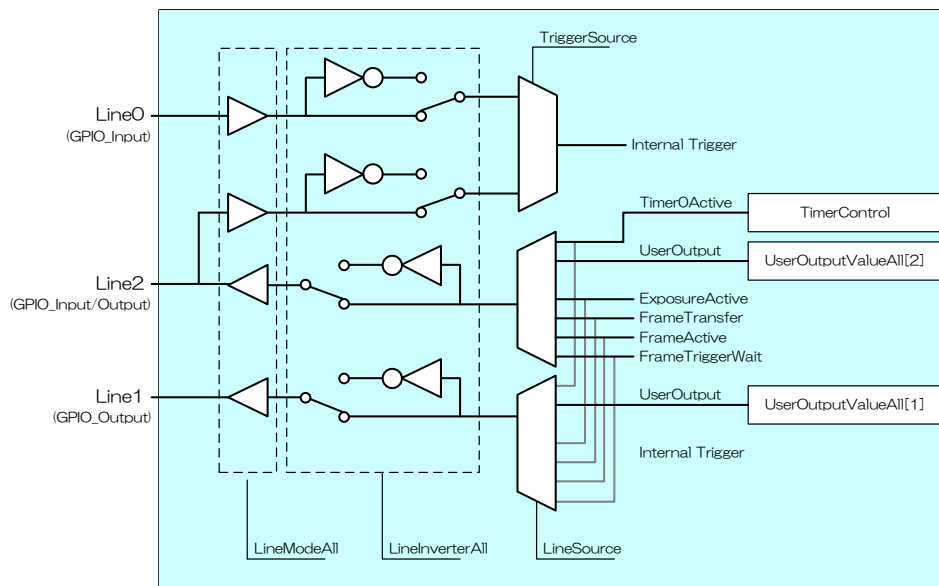<div align="right">* initial factory setting</div>

- Select the polarity of each signal

  Set the following value to "LineInverterAll" register. The setting value is Integer type.

  Each bit corresponds to each Line. All Lines are settable.Inverter is also inserted to UserOutputValue.

LineInverterAll	Function
0 (*)	non inverted
1	inverted

<div align="right">* initial factory setting</div>
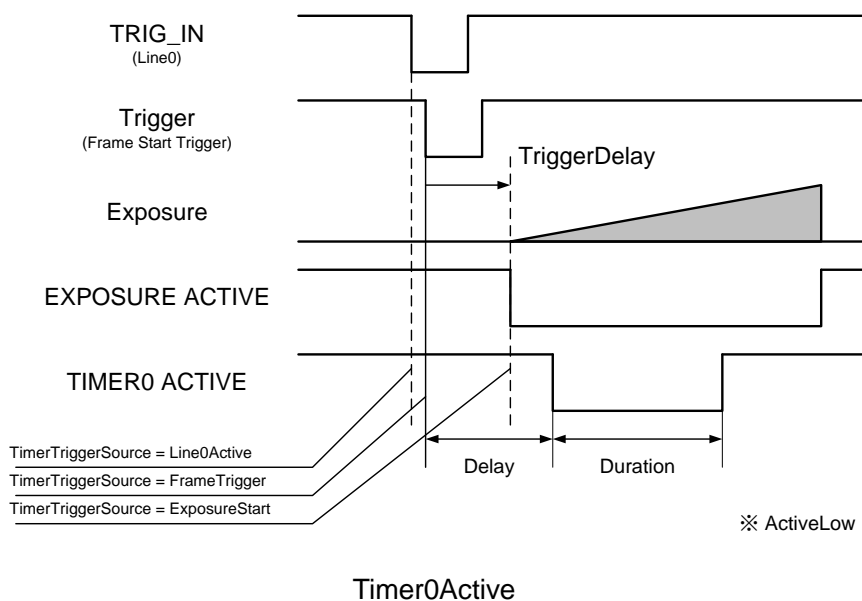

GPIO internal circuit diagram

● **Note**

About the details of Timer0Active signal, refer to "TimerControl" of "Functions".

TimerControl

This section describes TimerControl category for the BU series.

This camera series is able to generate Timer0Active signal, derived from exposure start, by register setting.

This signal can be used as strobe control signal.

Timer0Active

● **Registers**

Register	Visibility	Access	Description
TimerSelector	Beginner	R	Returns the selected timer name.
TimerDuration	Beginner	R/W	Sets the width of Timer0Active signal.
TimerDelay	Beginner	R/W	Sets the delay of Timer0Active signal.
TimerTriggerSource	Beginner	R/W	Selects the source of Timer0Active pulse to start.

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

● **Setting**

- Set the width of Timer0Active pulse

Set the following value to "TimerDuration" register. Setting value is Float type.

TimerDuration	Pulse width
Minimun (*)	0.00[μs]
Maximum	2000000.00[μs]

* initial factory setting

- Set the delay of Timer0Active pulse

Set the following value to "TimerDelay" register. Setting value is Float type.

TimerDelay	Delay value
Minimun (*)	0.00[μs]
Maximum	2000000.00[μs]

* initial factory setting

- Select the source of Timer0Active pulse to start

Select the following value to "TimerTriggerSource" register. Setting value is Enumeration type.

TimerTriggerSource	Description
Off	Disables the timer trigger.
Line0Active	Starts when Line0 is active.
ExposureStart (*)	Starts with the reception of the Exposure Start
FrameTrigger	Starts with the reception of the Frame Start Trigger.

* initial factory setting

● **Note**

"TimerTriggerSource" operation is as follows,

Line0Active is available in HardwareTrigger mode, and to be responded at FrameTriggerError.

FrameTrigger is available in both HardwareTrigger and Software Trigger mode, and not to be responded at FrameTriggerError.

ExposureStart is available in both HardwareTrigger and Software Trigger mode, and not to be responded at FrameTriggerError. Timer0Active pulse delays TiggerDelay+TimerDelay[us].

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

Gain

This section describes Gain control of LuminanceControl category of the BU series.

This control adjusts the gain of the image.
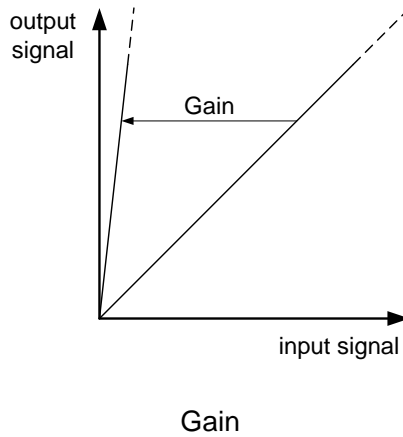
Gain

● **Registers**

Register	Visibility	Access	Description
Gain	Beginner	R/W	Sets the absolute Gain.

● **Setting**
- Set Manual Gain

Set the following value to "Gain" register. Setting value is Float type. This setting value is valid only at Manual Gain mode setting.

Gain	Value
Minimum (*)	0.00 [dB]
Maximum	24.00 [dB]

* initial factory setting

The formula of Gain value is as follows;

$$\text{output signal} = \text{input signal} \times 10^{\frac{\text{Gain}}{20}}$$

● **Note**

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.

http://www.toshiba-teli.co.jp/en/index.htm   D4253386B

BlackLevel

This section describes BlackLevel control of LuminanceControl category of the BU series.

This control adjusts the black level of the image. It is adjustable from -25% to +25% as white saturation level is 100%. However, when BlackLevel is lower than 0[%], the image level may not be saturated.
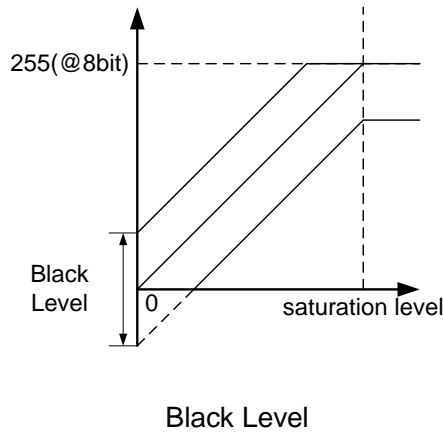
Black Level

● **Registers**

Register	Visibility	Access	Description
BlackLevel	Beginner	R/W	Sets the absolute Black Level.

● **Setting**

- Set Black Level

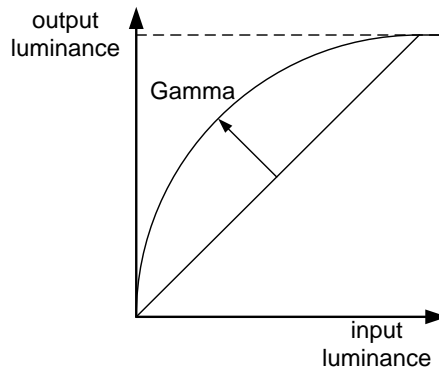Set the following value to "BlackLevel" register. Setting value is Float type.

BlackLevel	Value
Minimum	-25.00[%]
Maximum	+25.00[%]

* initial factory setting = 0.00[%]

● **Note**

Gamma

This section describes Gamma correction of AnalogControl category for the BU series.

This function allows you to apply a gamma correction to the output images.

Gamma correction

● **Registers**

Register	Visibility	Access	Description
Gamma	Beginner	R/W	Sets the Gamma correction.

● **Setting**

- Set Gamma correction

Set the following value to "Gamma" register. Setting value is Float type.

Gamma	Value
Minimum	0.45
Maximum (*)	1.00

* initial factory setting

● **Note**

Hue/Saturation

This section describes Hue/Saturation control of AnalogControl category for the BU series.

Hue control adjusts chroma phase of the image. And Saturation control adjusts chroma gain of the image.

This function is available only in Color models.
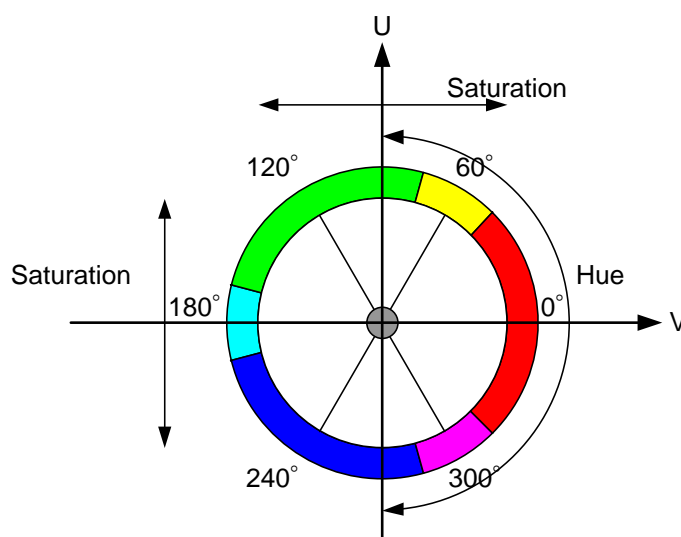
Fig. Hue/Saturation

● **Registers**

Register	Visibility	Access	Description
Hue	Beginner	R/W	Set a chroma phase.
Saturation	Beginner	R/W	Set a chroma gain.

● **Setting**

- Set Hue

    Set the following value to "Hue" register. Setting value is Float type.

Hue	Value
Minimum	-180[°]
Maximum	+180[°]

* initial factory setting = 0[°]

- Set Saturation

Set the following value to "Saturation" register. The value is to be applied to selected saturation component. Setting value is Float type.

Saturation	Value
Minimum	x 0
Maximum	x 2.0

* initial factory setting = x 1.3

● **Note**

Hue/Saturation control is available in following PixelForamt modes.

Bayer8/10/12-Full, RGB8, BGR8, YUV411, YUV422

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

BalanceRatio

This section describes BalanceRatio control of AnalogControl category for the BU series.

This control adjusts the white balance gain of the image.

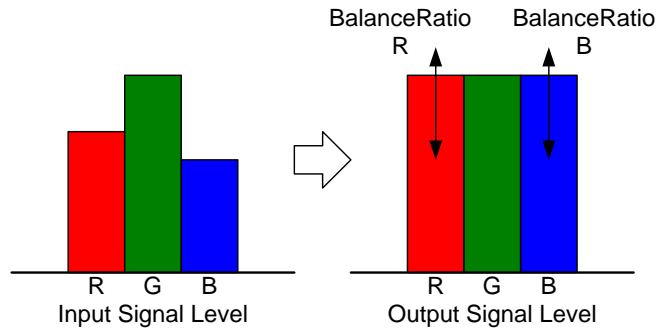This function is available only in Color models.

Fig. BalanceRatio

● **Registers**

Register	Visibility	Access	Description
BalanceRatioSelector	Beginner	R/W	Selects a color component of white balance gain to control.
BalanceRatio	Beginner	R/W	Sets a white balance gain.

● **Setting**

- Select BalanceRatio

Select the color component of white balance gain to control in "BalanceRatioSelector" register.

Setting value is Enumeration type.

BalanceRatioSelector	Function
None (*)	None of component is selected.
Red	BalanceRatio = Red Gain
Blue	BalanceRatio = Blue Gain

* initial factory setting

- Set BalanceRatio

Set the following value to "BalanceRatio" register. The value is to be applied to selected color component. Setting value is Float type.

BalanceRatio	Value
Minimum	x 1.0
Maximum	x 8.0

* initial factory setting value is device-specific

Notes on white balance gain setting:

Too high white balance gain increases noises. After adjusting the white balance of the image, I ask you to have final image quality checked with your environment.

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

BalanceWhiteAuto

Adjust white balance gain automatically.

This function is available only in Color models.

● Registers

Register	Visibility	Access	Description
BalanceWhiteAuto	Beginner	R/W	Adjust white balance gain automatically.

● Setting

- Set BalanceWhiteAuto

Set the following value to "BalanceWhiteAuto" register.

After setting "Once", camera executes auto white balance once. If execution of auto white balance is successful, both R and B gain are applied to BalanceRatio respectively.

BalanceWhiteAuto	Function
Off (*)	No operation
Once	Execute auto white balance once.

* initial factory setting

● Note

BalanceRatio and BalanceWhiteAuto controls are available in following PixelForamt modes.

Bayer8/10/12. RGB8, BGR8, YUV411, YUV422

ColorCorrectionMatrix

This section describes ColorCorrectionMatrix control of AnalogControl category for the BU series.

This control corrects RGB data by using color correction matrix.

This function is available only in Color models.

The relationship between original data (R, G, and B) and corrected data (R', G', and B') are represented in the following formula.

$$\begin{bmatrix} R' \\ G' \\ B' \end{bmatrix} = \begin{bmatrix} 1 & -mask\_rg & -mask\_rb \\ -mask\_gr & 1 & -mask\_gb \\ -mask\_br & -mask\_bg & 1 \end{bmatrix} \begin{bmatrix} R & (G-R) & (B-R) \\ (R-G) & G & (B-G) \\ (R-B) & (G-B) & B \end{bmatrix}$$

$$R' = (1 - mask\_rg - mask\_rb) \cdot R + mask\_rg \cdot G + mask\_rb \cdot B$$
$$G' = mask\_gr \cdot R + (1 - mask\_gr - mask\_gb) \cdot G + mask\_gb \cdot B$$
$$B' = mask\_br \cdot R + mask\_bg \cdot G + (1 - mask\_br - mask\_bg) \cdot B$$

The correspondence of "SelectorI" and "SelectorJ" to color correction matrix element is as follows.

	SelectorJ=R	SelectorJ=G	SelectorJ=B
SelectorI=R		mask_rg	mask_rb
SelectorI=G	mask_gr		mask_gb
SelectorI=B	mask_br	mask_bg	

Fig. Corresponding elements of color correction matrix

● **Registers**

Register	Visibility	Access	Description
ColorCorrectionMatrixSelectorI	Beginner	R/W	Selects a row element of color correction matrix.
ColorCorrectionMatrixSelectorJ	Beginner	R/W	Selects a column element of color correction matrix.
ColorCorrectionMatrix	Beginner	R/W	Sets a coefficient of color correction matrix.

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● Setting

- Select ColorCorrectionMatrix

Select row and column elements of color correction matrix in "ColorCorrectionMatrixSelectorI" and "ColorCorrectionMatrixSelectorJ" register.

ColorCorrectionMatrixSelector	Value
I	R / G / B
J	R / G / B

<div align="right">* initial factory setting = R</div>

- Set ColorCorrectionMatrix

Set a color correction matrix coefficient to the element selected by "SelectorI" and "SelectorJ".

Setting value is Float type. Coefficients of (SelectorI, SelectorJ)=(R,R),(G,G),(B,B) are internally fixed to 1.0 and read out data is always 1.0.

ColorCorrectionMatrix	Value
Minimum	-1.0
Maximum	+0.99

Initial factory setting

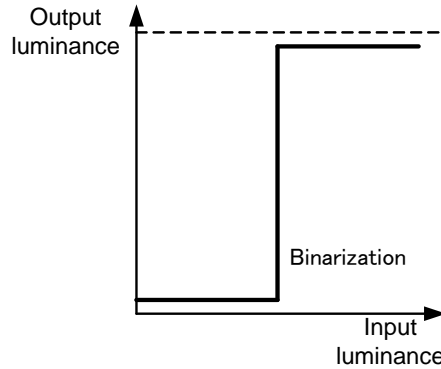|		SelectorJ		
		R	G	B
SelectorI	R		-0.50	0.15
	G	-0.50		-0.35
	B	0.10	-0.65	

● Note

ColorCorrectionMatrix control is available in following PixelForamt modes.

Bayer8/10/12-Full, RGB8, BGR8, YUV411, YUV422

LUTControl

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

example of LUT setting

● Registers

Register	Visibility	Access	Description
LUTEnable	Beginner	R/W	Sets the activation of LUT function.
LUTIndex	Beginner	R/W	Sets the input level of LUT.
LUTValue	Beginner	R/W	Sets the output level of LUT.

● Setting

- Set the activation of LUT

Set the following value to "LUTEnable" register. The setting value is Boolean type.

setting value	function
OFF (*)	Inactive
ON	Active

* initial factory setting

- Set the input/output value of LUT

Set the following value to "LUTIndex", "LUTValue" registers. These setting values are Integer type.

"LUTIndex" register value is input level of LUT, and "LUTValue" register value is output level of LUT.

LUTIndex / LUTValue	setting value
Minimum (*)	0
Maximum	4095

* initial factory setting

● Note

UserSetControl

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 "UserSetLoad"/"UserSetSave".

Table: List of registers to be applied to UserSet

Category	Register	Category	Register
ImageFormatControl	ImageFormatSelector	AnalogControl	Gain
	Width		BlackLevel
	Height		Gamma
	OffsetX		Hue
	OffsetY		Saturation
	Binning		BalanceRatio
	Decimation		ColorCorrectionMatrix
	Reverse	LUTControl	LUTEnable
	PixelFormat	EventControl	EventNotification
	TestPattern	VendorUniqueControl	FrameSynchronization
	BayerProcessingMode		LEDIndicatorLuminance
AcquisitionControl	AcquisitionFrameRate		AntiGlitch
TriggerControl	TriggerMode		AntiChattering
	TriggerSequence	DPCControl	DPCEnable(∗)
	TriggerSource		DPCNumber(∗)
	TriggerAdditionalParameter		DPCEntryX(∗)
	TriggerDelay		DPCEntryY(∗)
ExposureControl	ExposureTime	SequentialShutterControl	SequentialShutterEnable(∗)
DigitalIOControl	LineModeAll		SequentialShutterTerminateAt(∗)
	LineInverterAll		SequentialShutterEntry(∗)
	UserOutputValueAll		
	LineSelector		
	LineSource		
CounterAndTimerControl	TimerTriggerSource		
	TimerDuration		
	TimerDelay		

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

● Registers

Register	Visibility	Access	Description
UserSetSelector	Beginner	R/W	Selects a channel of user setting.
UserSetLoad	Beginner	W	Executes load a user setting.
UserSetSave	Beginner	W	Executes to save a user setting.
UserSetDefault	Beginner	R/W	Selects a channel of user setting when camera powers up.

● Setting

- Select a channel of a user setting

Set the following value to "UserSetSelector" register. The setting value is Enumeration type.

Select the channel of user setting for "UserSetLoad" and "UserSetSave".

setting value	Description	Save	Load
Default	- White balance unadjusted. - DPC feature is not set. - Other features similar to the initial factory setting.	**-**	○
UserSet1 (*)	Memory channel 1 for user setting. Following features are adjusted. - White balance - DPC feature ON in the defective pixel coordinates already set.	○	○
UserSet2~15	Select memory channel 2 to 15 for user setting.	○	○

* initial factory setting

- Load/Save a user setting

When execute "UserSetLoad", the camera loads user setting from the channel selected in "UserSetSelector" register and applies them.

When execute "UserSetSave", the camera saves user setting to the channel selected in "UserSetSelector" register.

- Load a user setting at the time of start-up

　Set the following value to "UserSetDefault" register. The setting value is Enumeration type.

　The camera loads user setting from the channel selected in "UserSetDefault" register and applies them at the time of next start-up.

setting value	Description
Default	- White balance unadjusted. - DPC feature is not set. - Other features similar to the initial factory setting.
UserSet1 (*)	Memory channel 1 for user setting. Following features are adjusted. 　- White balance 　- DPC feature ON in the defective pixel coordinates already set.
UserSet2~15	Select memory channel 2 to 15 for user setting.

* initial factory setting

● **Note**

　"UserSetDefault" register value is stored to non-volatile memory when "UserSetSave" is executed.

　Thus, "UserSetSelector" shall be set other than "Default" in advance.

EventControl

Camera notifies FrameTrigger status and other information by USB3 Vision Event Packet.

- FrameTrigger : Reception of Frame Start Trigger
- FrameTriggerError : Rejection of Frame Start Trigger
- FrameTriggerWait : Start of waiting for Frame Start Trigger
- FrameTransferStart : Start of transferring streaming data
- FrameTransferEnd : End of transferring streaming data
- ExposureStart : Start of Exposure
- ExposureEnd : End of Exposure
- Timer0Start : Start of Timer0
- Timer0End : End of Timer0

Events timing are as following chart.
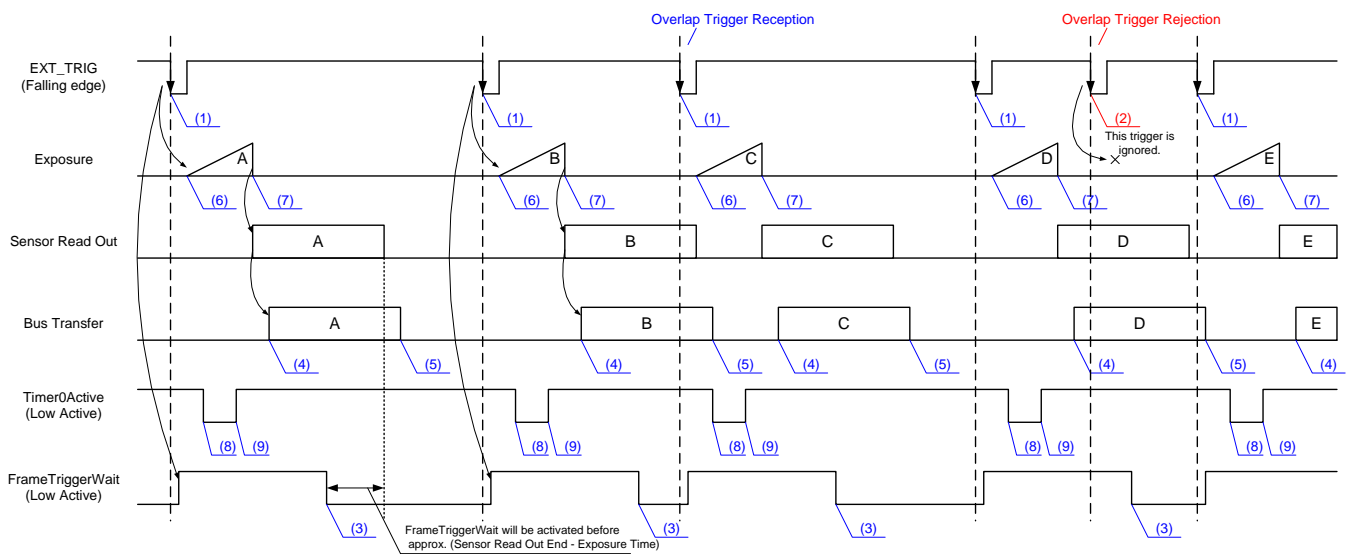
Event Name

(1) FrameTrigger   : Reception of Frame Start Trigger.
(2) FrameTriggerError : Rejection of Frame Start Trigger.
(3) FrameTriggerWait : Start of waiting for Frame Start Trigger.
(4) FrameTransferStart : Start of transferring streaming data.
(5) FrameTransferEnd : End of transferring streaming data.
(6) ExposureStart   : Start of Exposure.
(7) ExposureEnd   : End of Exposure.
(8) Timer0Start   : Start of Timer0.
(9) Timer0End   : End of Timer0.

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● Registers

Register	Visibility	Access	Description
EventControl			
EventSelector	Beginner	R/W	Selects the type of Event notifications.
EventNotification	Beginner	R/W	Sets the activation of Event notifications.
EventFrameTriggerData			
EventFrameTriggerTimestamp	Expert	R	Returns the timestamp at the time of Event.
EventFrameTriggerErrorData			
EventFrameTriggerErrorTimestamp	Expert	R	Returns the timestamp at the time of Event.
EventFrameTriggerWaitData			
EventFrameTriggerWaitTimestamp	Expert	R	Returns the timestamp at the time of Event.
EventFrameTransferStartData			
EventFrameTransferStartTimestamp	Expert	R	Returns the timestamp at the time of Event.
EventFrameTransferEndData			
EventFrameTransferEndTimestamp	Expert	R	Returns the timestamp at the time of Event.
EventExposureStartData			
EventExposureStartTimestamp	Expert	R	Returns the timestamp at the time of Event.
EventExposureEndData			
EventExposureEndTimestamp	Expert	R	Returns the timestamp at the time of Event.
EventTimer0StartData			
EventTimer0StartTimestamp	Expert	R	Returns the timestamp at the time of Event.
EventTimer0EndData			
EventTimer0EndTimestamp	Expert	R	Returns the timestamp at the time of Event.

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● **Setting**

- Select the type of Event notifications

Set the following value to "EventSelector" register. The setting value is Enumeration type.

setting value	Event ID	Timing of Event notification
FrameTrigger (*)	0x8020	Reception of Frame Start Trigger
FrameTriggerError	0x8021	Rejection of Frame Start Trigger
FrameTriggerWait	0x8022	Start of waiting for Frame Start Trigger
FrameTransferStart	0x8030	Start of transferring streaming data
FrameTransferEnd	0x8031	End of transferring streaming data
ExposureStart	0x8040	Start of Exposure
ExposureEnd	0x8041	End of Exposure
Timer0Start	0x9000	Start of Timer0
Timer0End	0x9100	End of Timer0

* initial factory setting

- Set the activation of Event notifications

Set the following value to "EventNotification" register. The setting value is Enumeration type.

setting value	Event notification
Off (*)	Inactive
On	Active

* initial factory setting

● **Note**

FrameSynchronization

Selects the camera frame synchronization method.

● Registers

Register	Visibility	Access	Description
FrameSynchronization	Beginner	R/W	Selects the camera frame synchronization method.

● Setting

- Selects the camera frame synchronization method.

Set the following value to "FrameSynchronization" register. Setting value is Enumeration type.

setting value	function
Off (*)	Internal synchronization
Bus	Bus synchronization

* initial factory setting

● Note

LEDIndicatorLuminance

Adjusts LED indicator luminance.

● Registers

Register	Visibility	Access	Description
LEDIndicatorLuminance	Expert	R/W	Sets LED indicator luminance.

● Setting

- Set LED indicator luminance

Set the following value to "LEDIndicatorLuminance" register. Setting value is Float type.

LEDIndicatorLuminance	Value
Minimum	0.00(%)
Maximum (*)	100.00(%)

* initial factory setting

● Note

AntiGlitch / AntiChattering

AntiGlitch and AntiChattering functions filter noise and unstable state of the digital input (trigger signal).

AntiGlitch circuit performs the digital integration of the trigger signal.

It is effective to remove impulsive noise.

AntiChattering circuit sets the edge insensible time to avoid trigger malfunction.

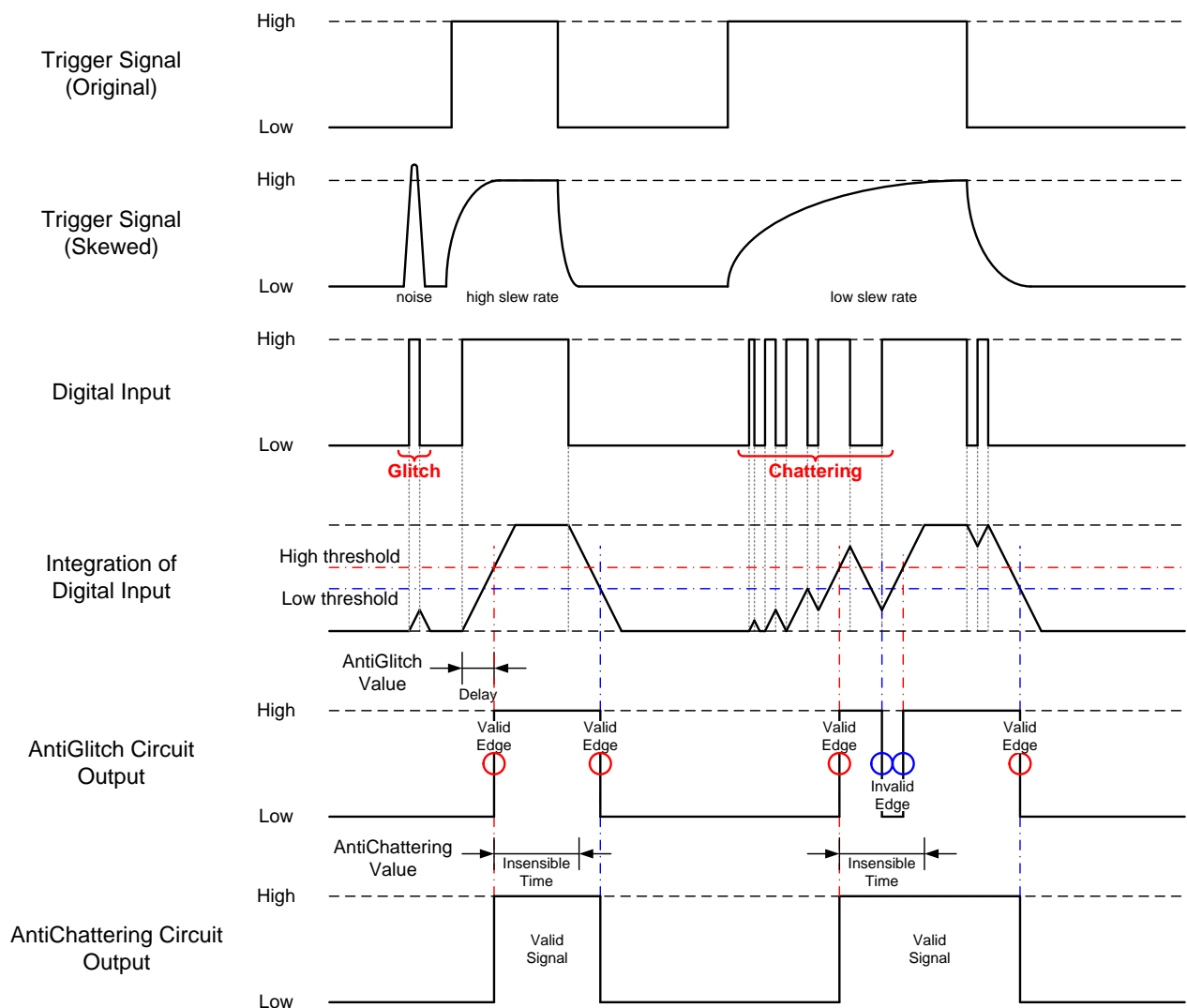It is effective to remove unstable logic state and switch-chattering.

Fig. AntiGlitch and AntiChattering

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● Registers

Name	Visibility	Access	Description
AntiGlitch	Expert	R/W	Integration time of digital input signal. (Absolute value)
AntiChattering	Expert	R/W	Insensible time of digital input signal. (Absolute value)

● Setting

- Set the integration time for AntiGlitch.

    Set the integration time to "AntiGlitch Value" register.

    Trigger signal is delayed by AntiGlitch setting.

    The setting is applied to the GPIO Input of Line0 and Line2.

AntiGlitch	Integration time [sec]
Minimum (*)	0.000 000 090
Maximum	0.002

* initial factory setting

- Set the insensible time for AntiChattering.

    Set the insensible time to "AntiChattering Value" register.

    The setting is applied to the GPIO Input of Line0 and Line2.

AntiChattering	Insensitive time [sec]
Minimum (*)	0.000 001 992
Maximum	0.001 999 992

* initial factory setting

● Note

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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.

● Registers

Register	Visibility	Access	Description
DPCEnable	Beginner	R/W	Sets the activation of DPC function.
DPCNumber	Beginner	R/W	Sets the number of pixels to correct.
DPCIndex	Beginner	R/W	Sets the index number for entry.
DPCEntryX	Beginner	R/W	Sets the X coordinate of defective pixel.
DPCEntryY	Beginner	R/W	Sets the Y coordinate of defective pixel.

● Setting

- Set the activation of DPC

Set the following value to "DPCEnable" register. The setting value is Boolean type.

setting value	function
OFF	Inactive
ON (*)	Active

* initial factory setting

- Set the coordinates of defective pixels

Set the number of pixels to correct to "DPCNumber" register.

Then, set the index number for entry to "DPCIndex" register, and coordinates of defective pixels to "DPCEntryX", "DPCEntryY" register. After setting coordinates, the defective pixel is corrected by calculation from the neighboring pixels. In the case that there is a number of defective pixels, they can be corrected by pointing new DPCIndex and setting coordinates

	DPCNumber	DPCIndex
Minimum	0	0
Maximum	256	255

|	DPCEntryX	DPCEntryY
Minimum	0	0
Maximum	WidthMax-1	HeightMax-1

● **Note**

DPCEntryX and Y shall be sorted in order from the top left to the top right and to the bottom left to the bottom right.
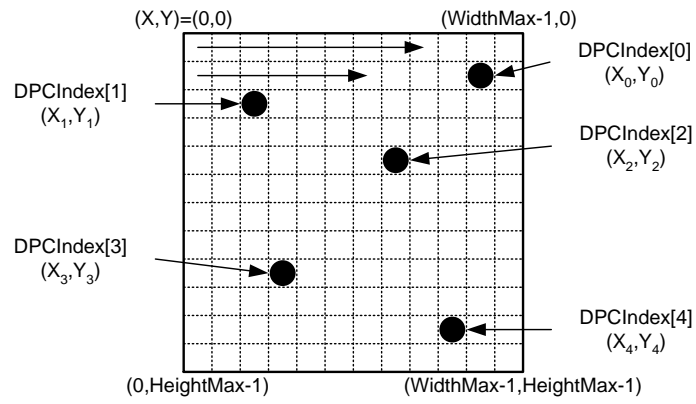
Sorting of DPCIndex and DPCEntryX, Y

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SequentialShutterControl

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

Sequential Shutter
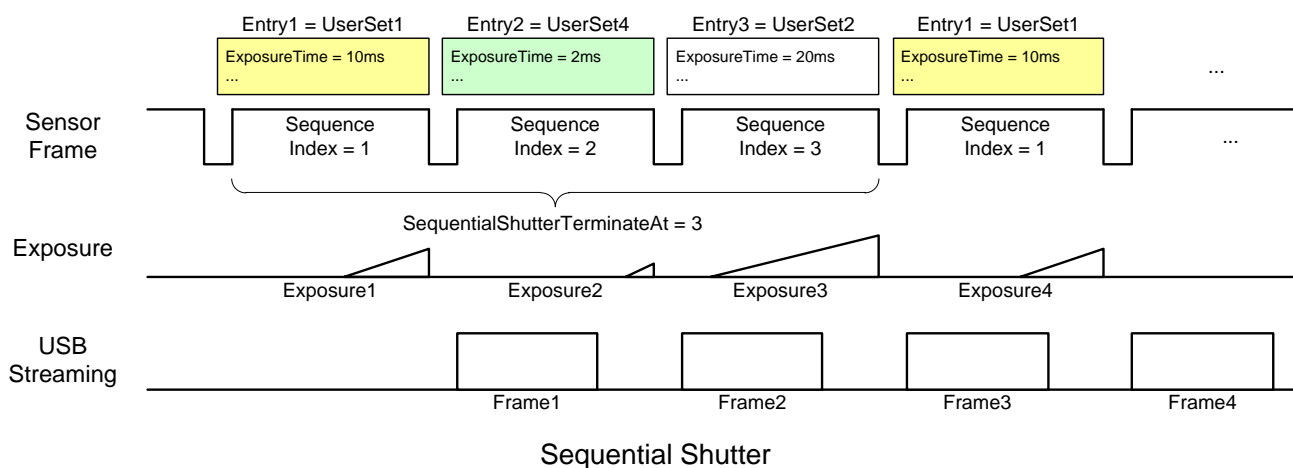
● Registers

Register	Visibility	Access	Description
SequentialShutterEnable	Expert	R/W	Sets the activation of Sequential Shutter function.
SequentialShutterTerminateAt	Expert	R/W	Sets the number of Index to repeat the sequence.
SequentialShutterIndex	Expert	R/W	Sets the sequence number to register.
SequentialShutterEntry	Expert	R/W	Sets the UserSet number to register to the sequence.

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● **Setting**

- Register to the sequence

　　Set the sequence number to "SequentialShutterIndex" register, and set the UserSet number to "SequentialShutterEntry" registers. These setting values are Integer type.

SequentialShutterIndex	setting value
Minimum (*)	1
Maximum	16

* initial factory setting

SequentialShutterEntry	setting value
Minimum (*)	UserSet1
Maximum	UserSet15

* initial factory setting

- Register the loop termination

　　Set the number of Index to repeat to "SequentialShutterTerminateAt" register.

　　For example, If you set [3] to "SequentialShutterTerminateAt" register, camera captures the images of Index1, Index2 and Index3. Then repeats capturing the images of Index1, Index2…

- Set the activation of Sequential Shutter

　　Set the following value to "SequentialShutterEnable" register. The setting value is Boolean type.

setting value	function
OFF (*)	Inactive
ON	Active

* initial factory setting

● **Note**

The following table is the list of registers applied to "SequentialShutter".

Table: 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
	Hue
	Saturation
	BalanceRatio
	ColorCorrectionMatrix
LUTControl	LUTEnable

Appendix

MultiFrame and Bulk function difference

This section describes the difference between MultiFrame function of AcquisitionMode and Bulk function of TriggerSequence.

- MultiFrame function sets limits to the number of frames to transfer with AcquisitionFrameCount register.
- Bulk function sets limits to the number of frames to exposure with TriggerAdditionalParameter register.

- MultiFrame function in Normal Shutter mode (TriggerMode = Off)

Camera transfers "AcquisitionFrameCount" frame(s).

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- MultiFrame function in Random Trigger Shutter mode (TriggerMode = On, TriggerSequence = 0 or 1)

Camera transfers "AcquisitionFrameCount" frame(s). It requires "AcquisitionFrameCount" time(s) of trigger.
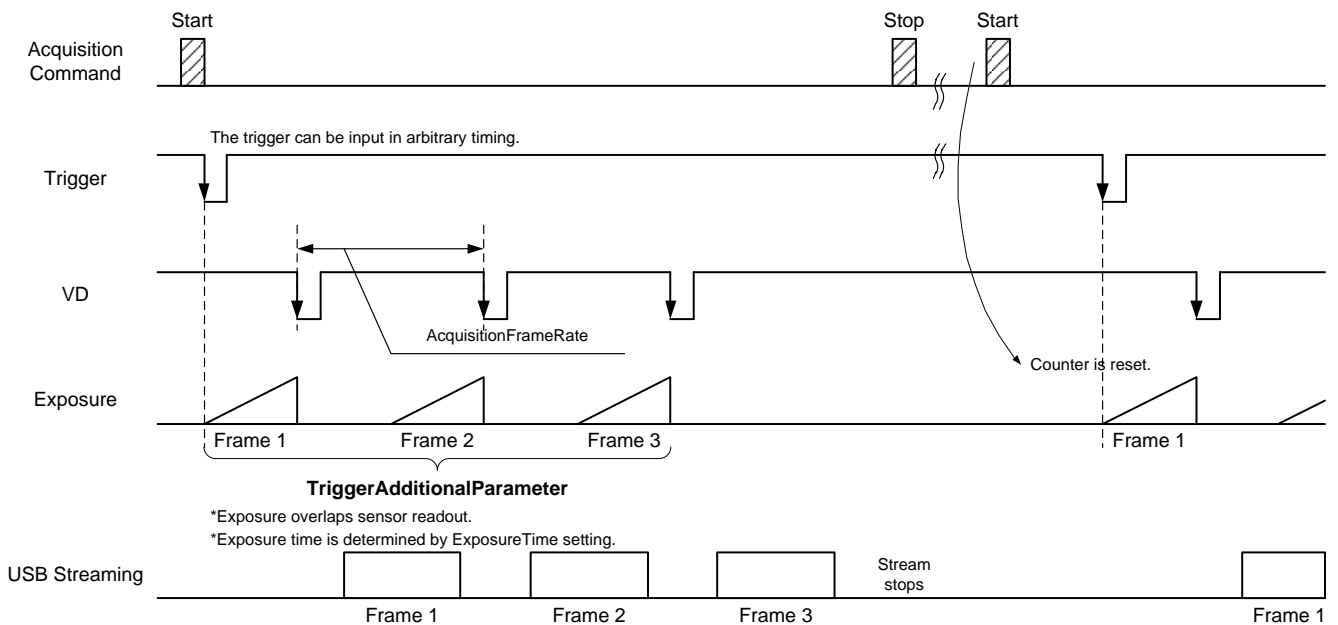

- Bulk function (TriggerMode = On, TriggerSequence = 6)

Camera transfers "TriggerAdditionalParameter" frame(s) by a single trigger.
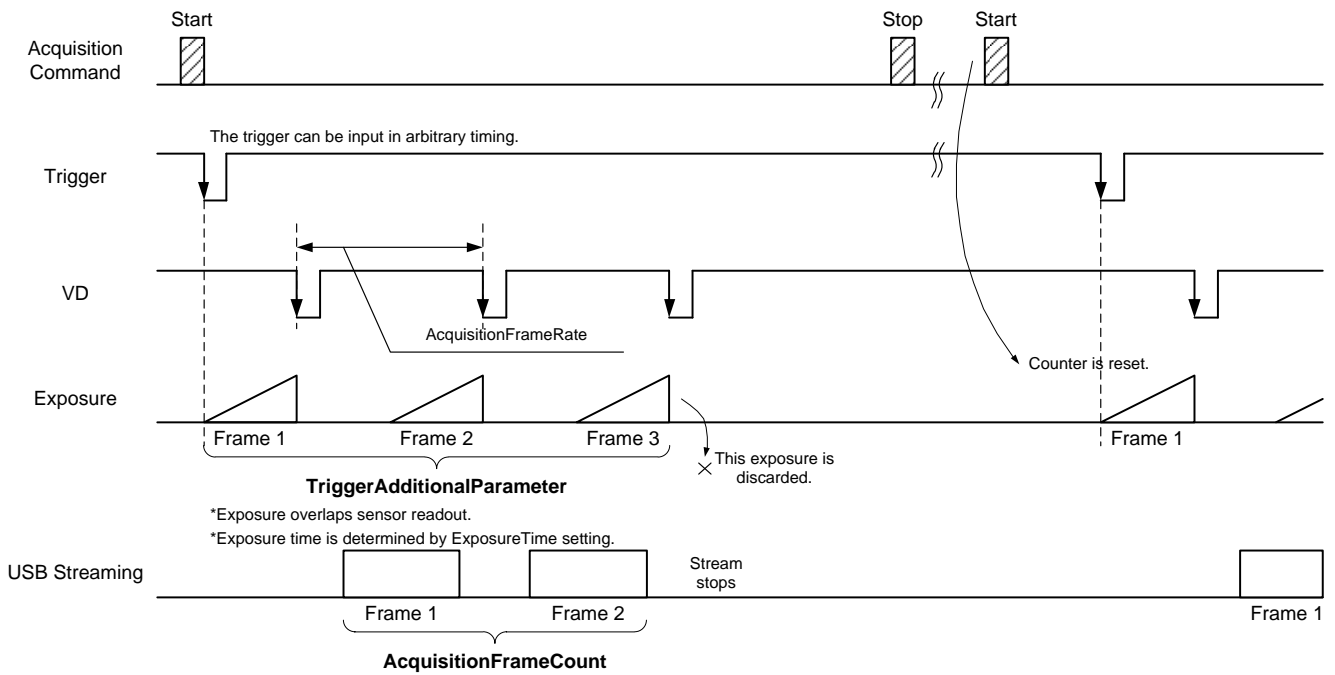
● **Note**

In Bulk function, you may want to set "Continuous" to "AcquisitionMode" register.

You can set "MultiFrame", but acquisition frame number is limited by "AcquisitionFrameCount.

AcquisitionMode = MultiFrame
AcquisitionFrameCount = 2
TriggerMode = On
TriggerSequence = 6
TriggerAdditionalParameter = 3

Start

Stop   Start

Acquisition
Command

The trigger can be input in arbitrary timing.

Trigger

VD

AcquisitionFrameRate

Counter is reset.

Exposure

Frame 1   Frame 2   Frame 3   Frame 1

This exposure is
discarded.

TriggerAdditionalParameter

*Exposure overlaps sensor readout.
*Exposure time is determined by ExposureTime setting.

Stream
stops

USB Streaming

Frame 1   Frame 2   Frame 1

AcquisitionFrameCount

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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

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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 the failure situation report sheet to be filled out.

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.

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Failure situation report sheet　　　　Ver.2.06　　■Entry date

In order to grasp the details of failure,
please fill out the following information, and send us the defective product with this report sheet enclosed.

(1) Customer information

Company Name	Department	Your Name
Telephone number	E-Mail address	FAX number
Postal code number	Address	

(2) Return address　　　　Please fill out this information, if the return addrrss is different from above address (1).

(3) We suggest a possible solution before your repair request.
Please ensure your safety when you check following items.
Please handle power supply with proper procedure, and make sure it does not impede any operation.

a) Restart the power supply of this product.	Check → ☐ Tried　☐ Not Tried
Please turn off this product once, switch on a power supply again after passing for a while, and confirm operation.	

b) Exchange for other products.	Check → ☐ Tried　☐ Not Tried
Please exchange for other same products, and confirm operation.	

c) Connect to other PC systems.	Check → ☐ Tried　☐ Not Tried
Please connect this product to other PCs, and confirm operation.	

d) Check Specifications of this product.	Check → ☐ Tried　☐ Not Tried
Please confirm that specifications of this product conform to usage environment refering to following URL. URL:http://www.toshiba−teli.co.jp/index.htm	Please check our website for the latest information.

(4) Failure situation　　　　　　　　　　　　　■Accurual date

Model name	Serial No.	Your dealer
		Purchase date

Failure condition:　(Please fill out the phenomenon in detail.)

(5) From when
☐ Unknown　　　☐ From the beginning　　　☐ After a while
☐ After environment was changed.
(　☐ Others _____)

(6) Occurrence frequency
☐ Unknown　　　☐ It certainly occurs.　　　☐ It sometimes occurs.
☐ It occurs, after time passes.
(　☐ Others _____)

<For dealer use>

Reception date :　　　Receipt No. :　　　JOB No. :　　　Check :

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