TOSHIBA

Leading Innovation

CMOS Camera

DU1207M Series
DU806M Series

Users Guide

Rev. 1.1

May 19th 2017

Doc. No. 4000-0060

On the subject of this document

- **This document is to introduce the development source and technical source tackled by TOSHIBA TELI CORPORATION.**
- **This article information described in this document contains an under development source and subject to change without notice.**
- **Please read operation manual carefully before you use the product at the first time, and use it properly. Product specifications, operation manual and other related documents are available in our HP to download. Please keep these materials in your hand so that you can read them at any time.**

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

- **Please refer our HP or contact our sales person for your enquiry and the latest information.**

* Some of the names and logos of company, organization, standard might be registered trade mark of each.

Table of contents

USB3 Vision Camera
Product range

USB3 Vision Camera Product range

Model name				Sensor	Optical Size	Output Resolution	Frame Rate
Mono chrome		Color					
BU030	Available	**BU030C/CF**	Available	ICX424A	1/3 inch	640(H) x 480(V)	125fps
BU031	Available			ICX414A	1/2 inch	640(H) x 480(V)	125fps
BU040MG	under development	**BU040MCG/MCF**	under development	IMX287	1/2.9 inch	720(H) x 540(V)	436fps
BU080	Available			ICX204A	1/3 inch	1,024(H) x 768(V)	40fps
BU130	Available	**BU130C/CF**	Available	ICX445A	1/3 inch	1,280(H) x 960(V)	30fps
BU132M	Available	**BU132MC/MCF**	In plan	EV76C560	1/1.8 inch	1,280(H) x 1,024(V)	60fps
BG160MG	under development	**BG160MCG/MCF**	under development	IMX273	1/2.9 inch	1,440(H) x 1,080(V)	226fps
BU205M	Available	**BU205MC/MCF**	Under study	CMV2000	2/3 inch	2,048(H) x 1,088(V)	170fps
BU238M	Available	**BU238MC/MCF**	Available	IMX174	1/1.2 inch	1,920(H) x 1,200(V)	165fps
BU302MG	**New**	**BU302MCG/MCF**	**New**	IMX252	1/1.8 inch	2,048(H) x 1,536(V)	120fps
BU406M	Available	**BU406MC/MCF**	Available	CMV4000	1 inch	2,048(H) x 2,048(V)	90fps
BU505MG	**New**	**BU505MCG/MCF**	**New**	IMX250	2/3 inch	2,448(H) x 2,048(V)	75fps
DU657M	Available	**DU657MC**	Available	Own CMOS	1.1 inch	2,560(H) x 2,560(V)	55fps
DU806M	**In plan**	**DU806MC/MCF**	**In plan**	**IMX255**	**1.0 inch**	**4,096(H) x 2,160(V)**	**40fps**
DU1207M	**New**	**DU1207MC/MCF**	**New**	**IMX253**	**1.1 inch**	**4,000(H) x 3,000(V)**	**32fps**
BU602M	In plan	**BU602MC/MCF**	In plan	IMX178	1/1.8 inch	3,072(H) x 2,048(V)	60fps
		BU1203MC/MCF	Available	IMX226	1/1.7 inch	4,000(H) x 3,000(V)	30fps

Note :
- This documents does not confirm product release schedule as information in development plan are included.
- Contact our persons in charge of sales for your enquiry.
- BU602, BU1203 series : mounted Rolling shutter type CMOS sensor

xxx(M)C : without IR cut filter
xxx(M)CF : with IR cut filter
xxx(M)G/(M)CG : with Dust-proof glass

May 2017

Ordering information for B/D series camera

Interface

U : USB3.0
UD : USB3.0 Dual
G : Gigabit Ethernet
C : Camera Link

Image Sensor Type

None : CCD Sensor
M : CMOS Sensor

Low fps Output

None : Normal model
M : Low fps model

Optical Filter Type

None : without Optical filter or glass
F : with IR cut filter
G : with dust-proof glass
L : with Optical low-pass filter
M : with Opt-LPF + IR cut filter

Revision

None : First release
B : Rev.B

Model Signature

B : B (Standard) series
D : D (Deluxe) series
I : I (for ITS) series
None : Board type

Total Pixel Numbers

03 :	0.3 Mp	30 :	3 Mp
04 :	0.4 Mp	40 :	4 Mp
08 :	0.8 Mp	50 :	5 Mp
13 :	1.3 Mp	60 :	6 Mp
16 :	1.6 Mp	65 :	6.5 Mp
20 :	2 Mp	80 :	8.8 Mp
23 :	2.3 Mp	120 :	12 Mp

Color Type

None : Black/White(B/W)
C : Color

Lens Mount

None : C mount
BG205MC(F) only
-CS : CS mount

Image Size

0.3 Mp Type
0 : 1/3 type
1 : 1/2 type
0.4 Mp Type
0 : 1/3 type
0.8 Mp Type
0 : 1/3 type
1.3 Mp Type
0 : 1/3 type
2 : 1/1.8 type
1.6 Mp Type
0 : 1/3 type
2 Mp Type
2 : 1/1.8 type
5 : 2/3 type
2.3 Mp Type
8 : 1/1.2 type
3 Mp Type
2 : 1/1.8 type
4 Mp Type
6 : 1.0 type
5 Mp Type
5 : 2/3 type
6 Mp Type
2 : 1/1.8 type
6.5 Mp Type
7 : 1.1 type
8.8 Mp Type
6 : 1.0 type
12 Mp Type
3 : 1/1.7 type
7 : 1.1 type

Rev.1.12

Advantage of DU1207M / DU806M series

DU1207M/806M series

Pregius

As the 2nd product of DU camera series, USB3.0 camera with Sony's high performance CMOS image sensor is released!

USB VISION

- ☐ with Sony's high performance CMOS sensor
- ☐ Auto optical axis adjust

- ☐ LED status indicator
- ☐ USB3.0 Micro B connector
- ☐ Mounting screw
- ☐ 40(W)×40(H)×35(D)mm
- ☐ Weight 90g
- ☐ e-CON connector
- ☐ GPI×1 (external trigger)
  3.3~24V (diode protection I/P)
- ☐ GPIO×1 (I/P : external trigger)
  5V (CMOS I/O)
- ☐ GPO×1
  5V (CMOS O/P)

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Advantage of DU1207M/806M series

Pregius

■ TELI original IP core

- High integration, by originally developed innovative technology, achieves super high speed response

➡ *"TELI Core Technology Ver.5" inside*

■ High sensitivity and High quality image

- Adopting Sony's IMX253(12.3Mp) / IMX255(8.8Mp) Global Shutter (GS) CMOS sensor
- High speed, high sensitivity and high image quality, surpassing CCD
- High color image quality with ACPI processing (only color model)

■ Advanced function

- Function with Sequential shutter, bulk trigger (frame burst), scalable, event notification and Image buffer, etc.

■ Environmental conditions for use

- Operation Temp. : -5 to +45°C (10 to 90%Rh) (below 65°C on cabinet surface)
- EMI condition : Class B (EN61000-6-3 : Residential environment)

* Pregius or Pregius logo are trademarks of Sony Corporation.

TELI CORE TECHNOLOGY

■ “Vision Professional” Toshiba Teli’s confident core technology!

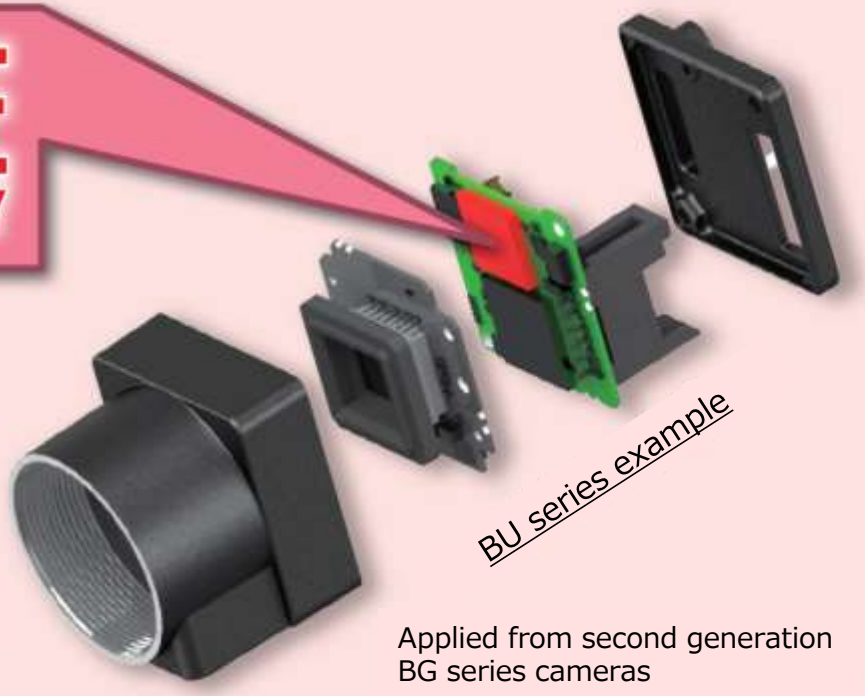
- **Innovational unique technology and latest FPGA achieved miniaturization and high integration.**
- **Completely hardware processing with no CPU and no firmware.**
- **Super fast response technology drastically reduces communication time.**

teli CORE TECHNOLOGY

Mounted Cameras

USB VISION® **BU series**
DU series

GiGE VISION® **BG series** *

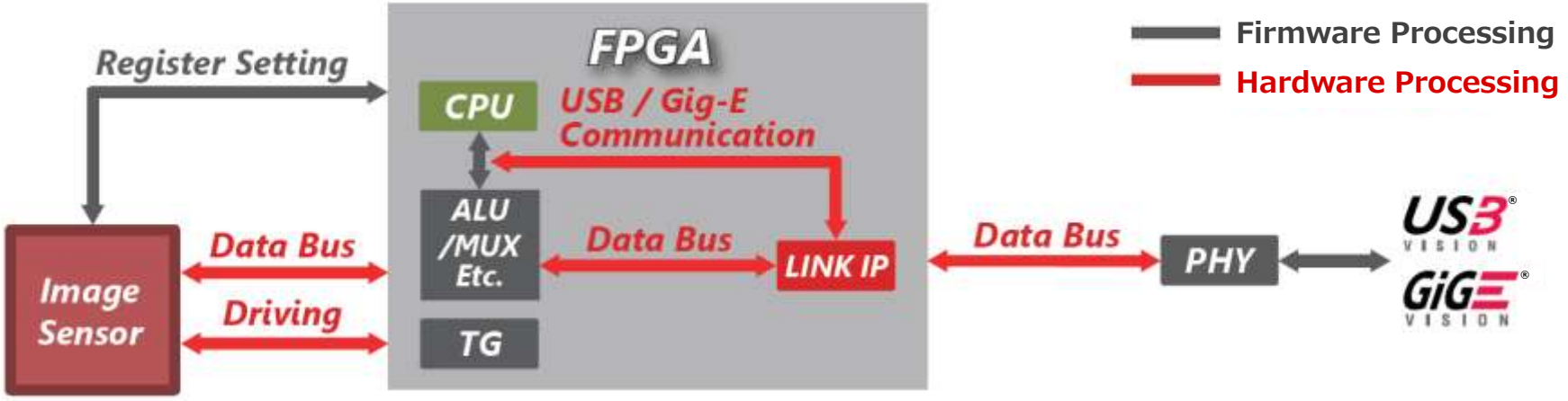


BU series example

Applied from second generation BG series cameras

TELI CORE TECHNOLOGY

Example of ordinary USB IP in use



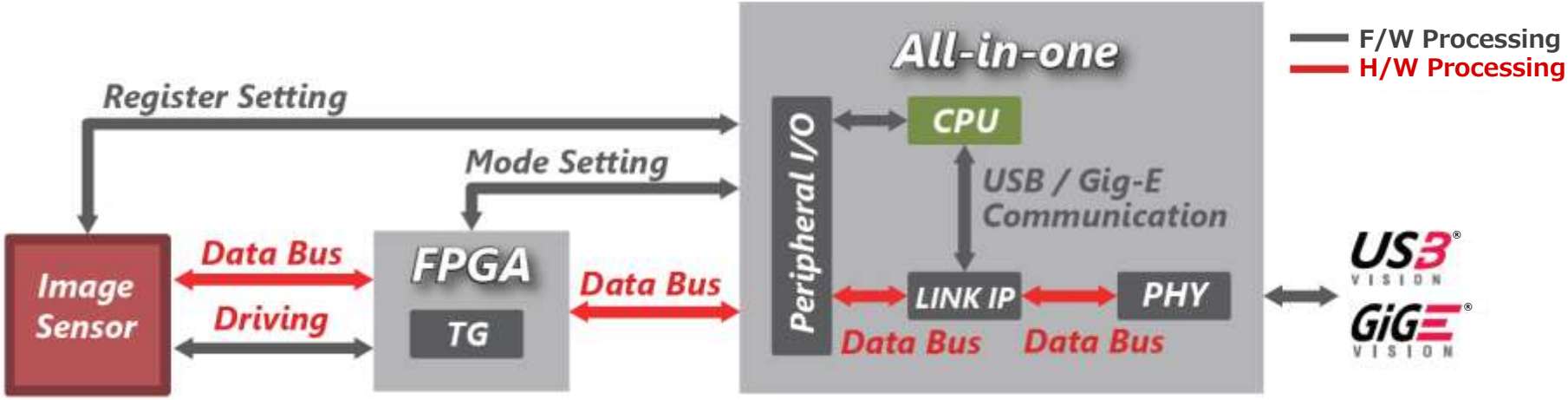
Architecture	Circuit scale	Cost	Processing speed	Response speed
FPGA (with CPU)	Average	Average	Average	Average

Most of other manufacturer's camera has this structure. Internal CPU(MPU) core can achieve optimal or efficient internal bus addition to size reduction.

However, it inevitably takes longer time for host to receive camera response because command from host is set to main registers after interpretation by software.

TELI CORE TECHNOLOGY

Application example of FPGA & All in one USB chip



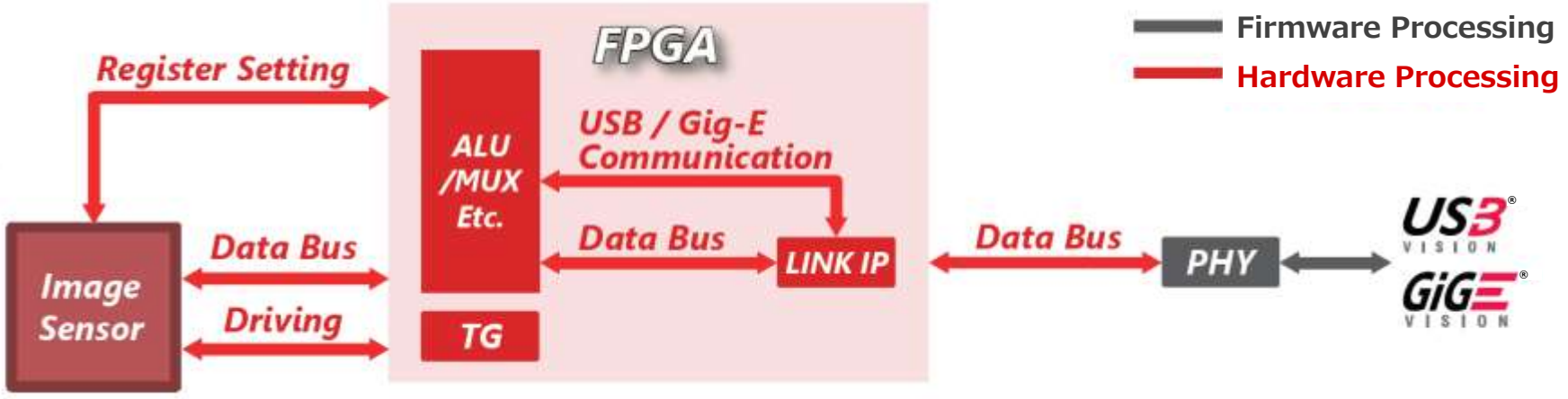
Architecture	Circuit Scale	Cost	Processing speed	Response speed
FPGA＋”All-in-one”	Large	Bit higher	Average	Slow

Visual signal processing system and sensor drive timing are generated in FPGA. All in one USB chip makes it easier to transmit data to USB bus by image data input.

However, speed of processing and response is slower because it is not optimized for image data transfer.

TELI CORE TECHNOLOGY

TELI CORE TECHNOLOGY in use



Architecture	Circuit scale	Cost	Processing speed	Response speed
TELI CORE TECHNOLOGY	**Small**	**Low**	**Very fast**	**Very fast**

In this structure, it is shifted from software (firmware) processing to completely hardware processing in order to solve responsive problem in previous method.

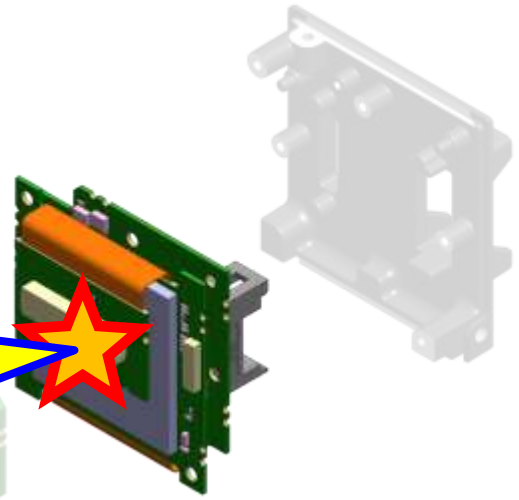
As command from host also interpreted by hardware, necessary time to set internal register in camera and time to send back a response to host can be drastically reduced.

TELI CORE TECHNOLOGY

■ Extremely quick response by original IP core

Newly developed original
TELI Core Technology
built in!

<example>
response time of software trigger
A company camera : 4msec
BU/DU series cam : 5µsec (average)

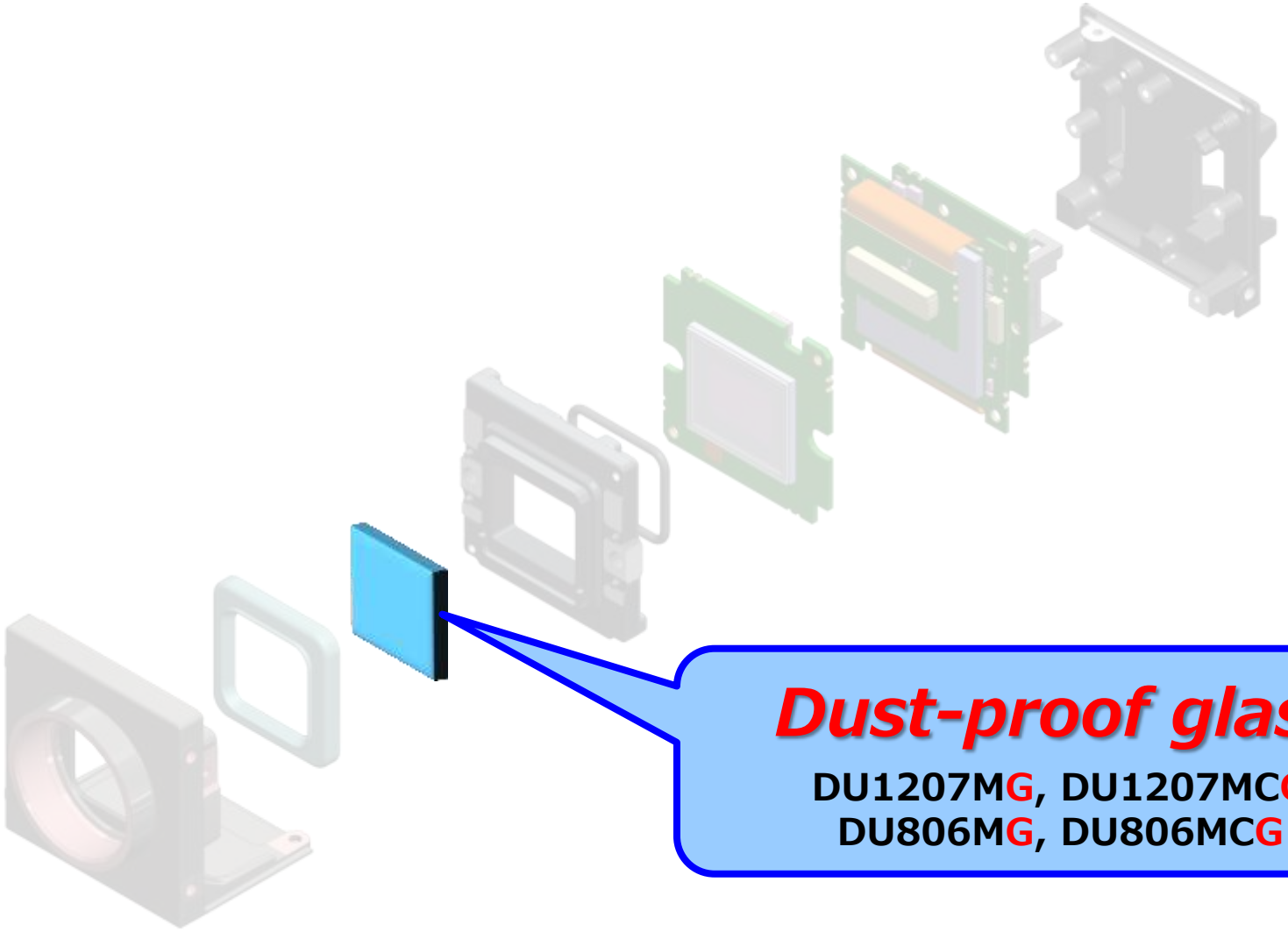


<u>Update function of Core Technology (Ver.4 or later)</u>

- ***ALC, AGC, FAWB, Sharpness, LUT12bit, Color correction, HUE, Color saturation, ACPI processing, Mono/Bayer10/12bit, RGB/YUV output, Chunk etc.***

Advantage of DU1207M/806M series

■Include Dust-proof glass as standard equipment



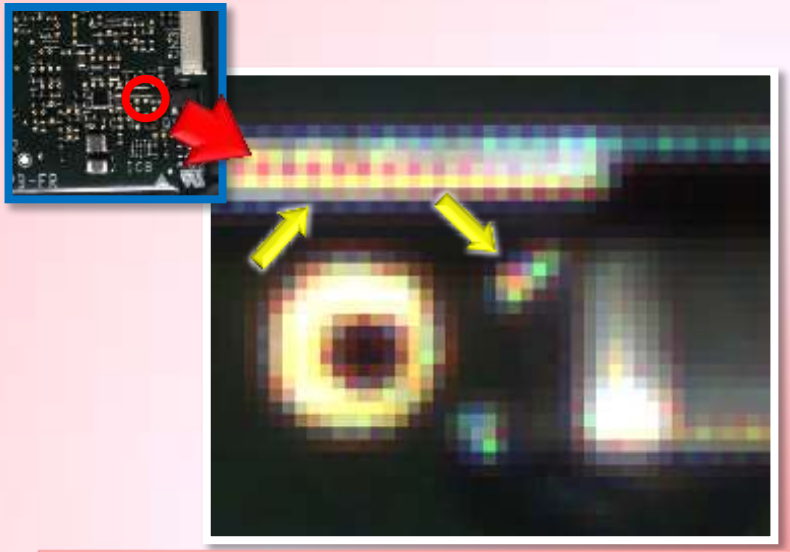
Advantage of DU1207M/806M series (for Color)

■ High color performance with ACPI processing (1)

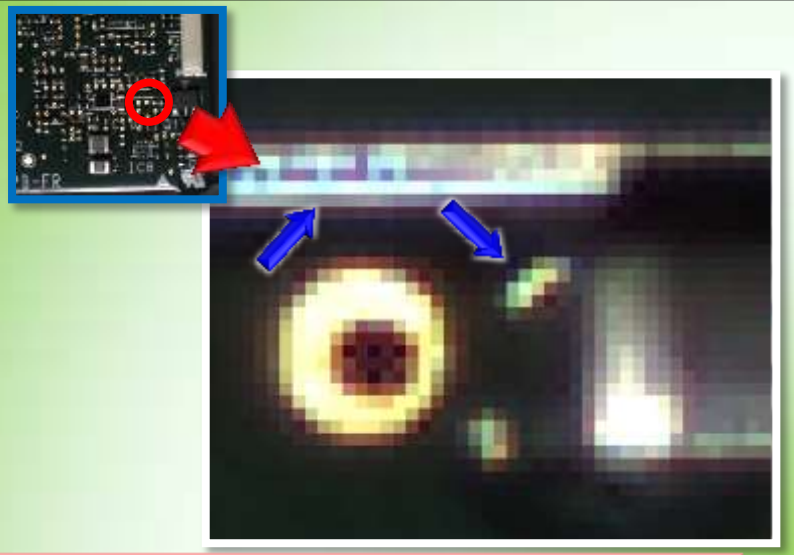
DU1207MCG/MCF
DU806MCG/MCF

➢ False color in the brightness edge part reduces by ACPI processing

Using Linear Conversion



Using ACPI Processing



Part of PC Board

ACPI (Adaptive Color Plane Interpolation)

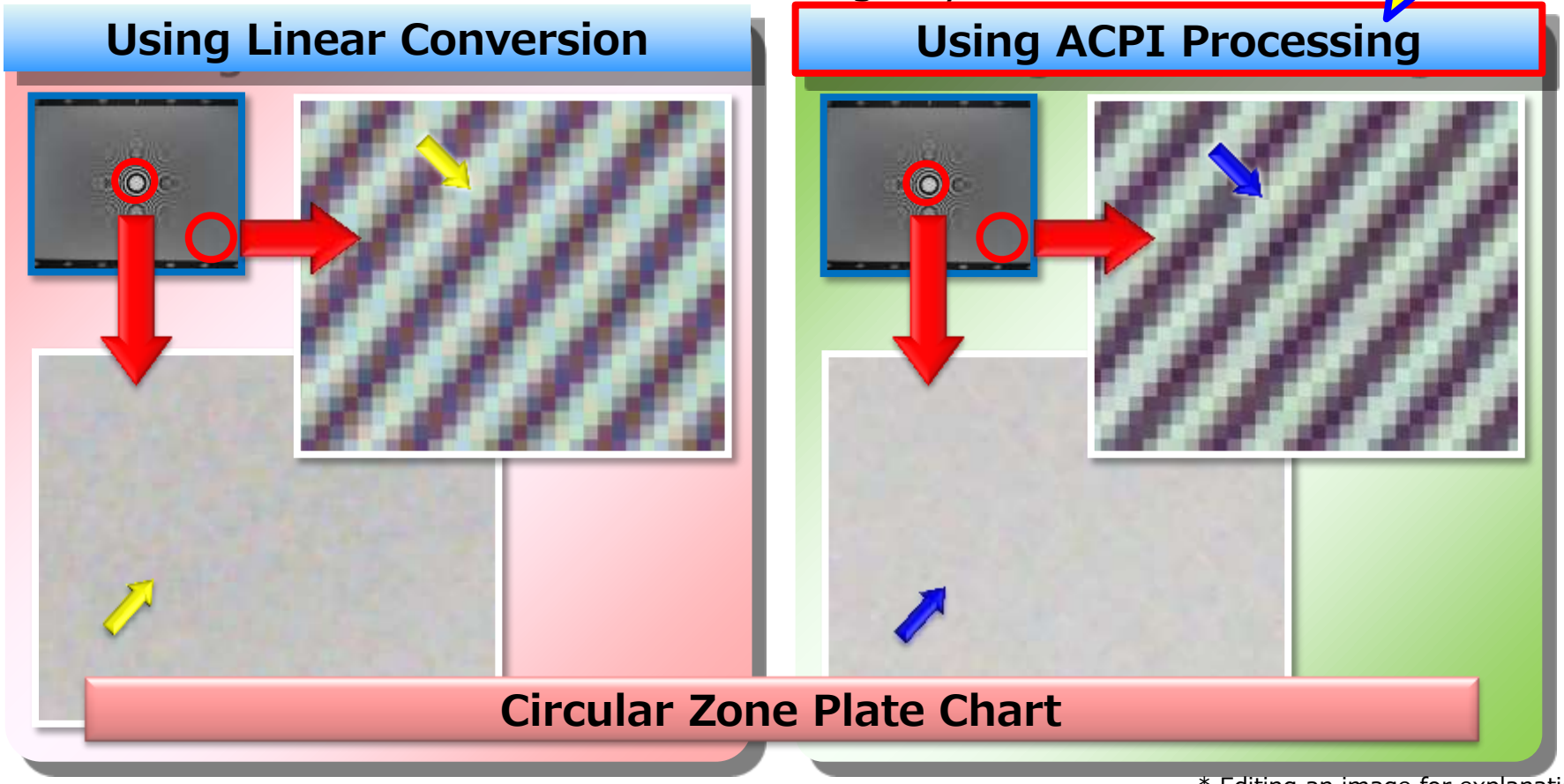
When RGB conversion (interpolation procedure) from Bayer pattern is in process, false color such as color shift and blur are likely to occur in edge part with general linear interpolation method. However, APCI processing can reduce occurrence of these false color and improve a resolution. And also, it reduce noise at the same time.

Advantage of DU1207M/806M series (for Color)

■ High color performance with ACPI processing (2)

- Pseudo-color decreases and resolution improves !
- Color noise is reduced in the flat image by filter!

DU1207MCG/MCF
DU806MCG/MCF



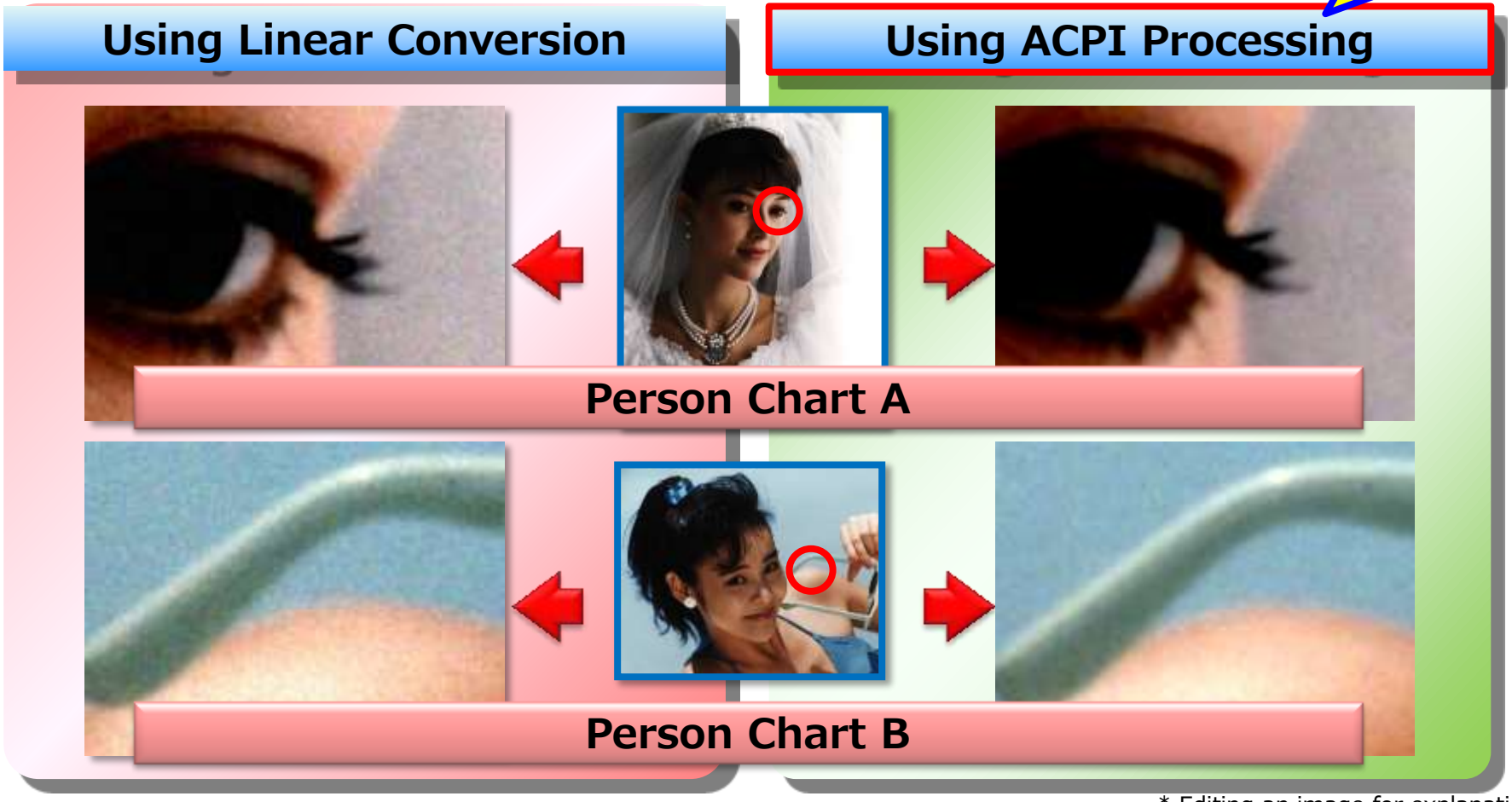
* Editing an image for explanation.

Advantage of DU1207M/806M series (for Color)

■ High color performance with ACPI processing (3)

➢ Color noise is reduced in the flat image by filter !

DU1207MCG/MCF
DU806MCG/MCF



* Editing an image for explanation.

Advantage of DU1207M/806M series

■O/P frame rate by mode setting (fps)

Decimations	DU1207M series			DU806M series		
	1x1	2x2	4x4	1x1	2x2	4x4
Mono8	32/31*	121	121	40	(TBD)	(TBD)
Bayer8	32/31*	121	121	40	(TBD)	(TBD)
RGB	10	43	87	(TBD)	(TBD)	(TBD)

x4 (Mono8, Bayer8)　1/3 (RGB)　x4　x2

* : DU1207MCG/MCF

Binning	DU1207MG			DU806MG		
	1x1	2x2	4x4	1x1	2x2	4x4
Mono8	32	121	121	40	(TBD)	(TBD)

x4

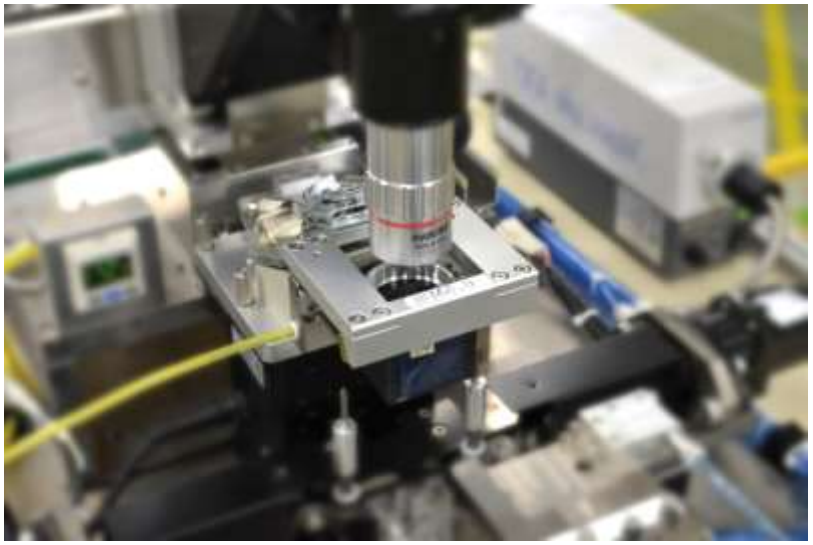
Binning	DU1207MCG/MCF			DU806MCG/MCF		
	1x1	2x2	4x4	1x1	2x2	4x4
Mono8	31	31	31	40	40	40
Bayer8	31	31	31	40	40	40
RGB	10	10	10	(TBD)	(TBD)	(TBD)

Appeal point ~ “Optical axis accuracy”

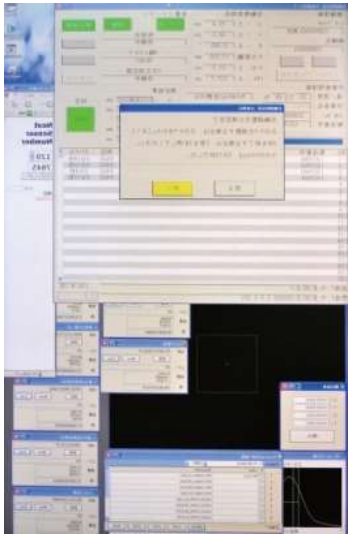
For higher accuracy

■ Sensor position adjustment ■

Applying auto adjustment of sensor position for extreme accuracy.



Measuring each part of imaging sensor



Control screen

Adjustment equipment of sensor position

Appeal point ~ “Optical axis accuracy”

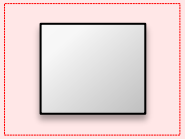
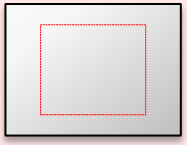
■ Optical axis accuracy as confident high quality

- **Auto adjustment of sensor mounting position**

Models	Positioning accuracy of imaging surface		Rotation angle accuracy of imaging surface (θ)	Flange back
	(X)	(Y)		
BG030・031・080 130・202	±400μm	±400μm	±1.75°	+40μm ~ -510μm
BU030・031・080 130	±400μm	±400μm	±1.75°	+40μm ~ -510μm
DU series	**±25 μm**	**±25 μm**	**±0.07°**	**Less ±50μm**

Items	Definition
Positioning accuracy of imaging surface (X, Y)	**Positioning accuracy of center of effective imaging surface against optical axis**
Rotation angle accuracy of imaging surface (θ)	**Angle accuracy around optical axis of effective imaging surface against reference plane**
Flange back accuracy (FB)	**Height accuracy of effective imaging surface center against lens mount plane. (Height accuracy against C mount flange back : 17.526 mm)**

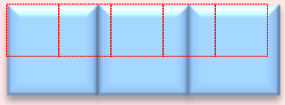
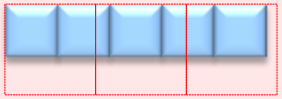
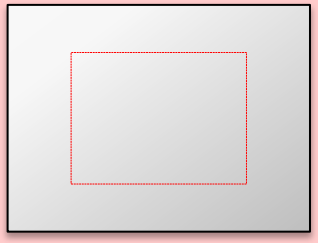
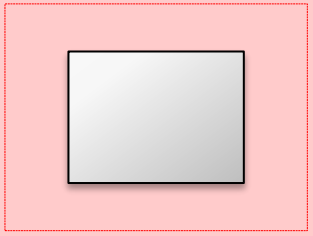
Camera spec. comparison (vs. CCD model -1)

Specification			CSCQS15 series	DU1207M series
Imager	Model (Type)		ICX625 (CCD)	IMX253 (GS-CMOS)
	Resolution		2,456(H)×2,058(V)	4,096(H)×3,000(V)
	Pixels		5.05Mp	12.29Mp
	Aspect ratio		6:5	4:3
	Pixel size		3.45μm(H)×3.45μm(V) 	3.45μm(H)×3.45μm(V) 
	Imager size		11.05mm (2/3 type) 	17.52mm (1.1 type) 
Output frame rate			15fps	B/W:32fps, Color:31fps
Standard Sensitivity (calculated F5.6, 1/60s)		B/W	1,600 lx	Almost same sensitivity → **1,613 lx**
		Color	3,600 lx	1.6 times higher sensitivity → **2,226 lx**
Minimum Sensitivity		B/W	6.25 lx	Imaging under 1/3 times low illuminance → **2 lx**
		Color	14 lx	Imaging under 1/5 times low illuminance → **3 lx**

Camera spec. comparison (vs. CCD model -2)

Specification	CSCQS15 series	DU1207M series
Dimensions /External view (Not including protrusion)	54(W)×43(H)×51(D)mm 	40(W)×40(H)×35(D)mm 
Lens mount	C	C
Mass	190 g	90 g
Operation assurance	-5 ~ +45℃ 10 ~ 90% RH (no condensation)	-5 ~ +45℃ (below 65°C on cabinet surface) 10 ~ 90% RH (no condensation)
Product availability from	Nov. 2007	Dec. 2016

Camera spec. comparison (vs. CSC12M25 series -1)

Specification			CSC12M25BMP19-01B CSC12M25CMP19	DU1207MG DU1207MCG or MCF
Imager	Model (Type)		TELI original (GS-CMOS)	IMX253 (GS-CMOS)
	Resolution		4,096(H)×3,072(V)	4,096(H)×3,000(V)
	Pixels		12.58Mp	12.29Mp
	Aspect ratio		4:3	4:3
	Pixel size		6.0μm(H)×6.0μm(V) 	3.45μm(H)×3.45μm(V) 
	Imager size		30.72mm (1.9 type) 	17.52mm (1.1 type) 
Output frame rate			25fps	B/W:32fps, Color:31fps
Standard Sensitivity (calculated F5.6, 1/60s)		B/W	2,000 lx → 1.2 times higher sensitivity	**1,613 lx**
		Color	6,000 lx → 2.7 times higher sensitivity	**2,226 lx**
Minimum Sensitivity		B/W	30 lx → Imaging under 1/15 times low illuminance	**2 lx**
		Color	125 lx → Imaging under 1/40 times low illuminance	**3 lx**

Camera spec. comparison (vs. CSC12M25 series -1)

Specification	CSC12M25BMP19-01B CSC12M25CMP19	DU1207MG DU1207MCG or MCF
Dimensions /External view (Not including protrusion)	70(W)×70(H)×69.5(D)mm 	40(W)×40(H)×35(D)mm 
Lens mount	TFL-II	C
Mass	450 g	90 g
Operation assurance	-5 ~ +50°C 10 ~ 90% RH (no condensation)	-5 ~ +45°C (below 65°C on cabinet surface) 10 ~ 90% RH (no condensation)
Product availability from	Dec. 2008	Dec. 2016

Specification comparison

Specification Comparison (DU series B/W models)

Model		DU657M	DU806MG	DU1207MG
Interface		USB3.0 (Super Speed)	USB3.0 (Super Speed)	
Protocol		USB3 Vision Ver1.0	USB3 Vision Ver1.0	
Imaging element		1.1 type CMOS TELI original	1.0 type CMOS IMX255	1.1 type CMOS IMX253
Max. output pixels		6.5M	8.8M	12.3M
Resolution		2,560(H)x2,560(V)	4,096(H)x2,160(V)	4,096(H)x3,000(V)
Max. frame rate (all pixels)		55fps	40fps	32fps
Pixel size		5.0x5.0µm	3.45x3.45µm	3.45x3.45µm
Protect glass/Optical filter		None	[G] : with Dust-proof glass (with AR coat)	
Standard Sensitivity		900 lx, F5.6, 1/60s	TBD	860 lx, F5.6, 1/32s
Minimum sensitivity		16 lx	TBD	2 lx
Gain	Manual	0 to 8[times] (digital gain)	0 to +24[dB] (analog gain)	
	Auto	-	✔	
Black level correction		-25 to +25[%]	-25 to +25[%]	
Gamma correction		0.45 to 1.0	0.45 to 1.0	
LUT		Input : 10[bit] Output : 10[bit]	Input : 12[bit] Output : 12[bit]	
Sharpness		-	✔	
Pixel defect correction		Max. 256 pixels	Max. 256 pixels	
Test pattern out		✓	✔	
Image memory (number of images)		64MB / over 10 images (Mono8)	256MB / over 30 images (Mono8)	256MB / Over 21 images (Mono8)
Image re-sending		- (Bulk transfer Retry only)	- (Bulk transfer Retry only)	

※ Differences from DU657M series are shown in RED

Specification comparison (DU series B/W models)

Model			DU657M	DU806MG	DU1207MG
Exposure control	Manual		10µs to 200ms	30µs to 16s	
	Auto		-	✔	
Trigger shutter	Hardware		Edge, Pulse width control (10µs to 200ms), +/- polarity	Edge, Pulse width control (30µs to 16s), +/- polarity	
	Software		USB3 Vision command	USB3 Vision command	
Bulk trigger			Max. 255 times	Max. 255 times	
Sequential shutter			Max. 16 entry	Max. 16 entry	
Trigger delay			0 to 2,000,000us	0 to 2,000,000us	
Synchronizing method			Bus sync / Internal sync	Bus sync / Internal sync	
Readout mode	All pixels		2,560(H)x2,560(V)	4,096(H)x2,160(V)	4,096(H)x3,000(V)
	Partial	Min. unit size	64(H)x64(V)	64(H)x64(V)	
		Offset setting unit	4(H)x2(V)	4(H)x2(V)	
		Number of windows	1	1	
		Window overlap	-	-	
	Binning reading (Digital image reduction)		2x2, 4x4 (Sensor)	2x2 (Sensor), 4x4 (Digital)	
	Decimation		-	2x2 (Sensor), 4x4 (Digital)	
Pixel format			Mono8	Mono8/10/12	
Image flip			Horizontal, Vertical	Horizontal, Vertical	
User memory			15 Channel	15 Channel	
			64 bytes	64 bytes	

※ Differences from DU657M series are shown in RED

Specification comparison (DU series B/W models)

Model		DU657M	DU806MG	DU1207MG
GPIO	Connector	e-CON connector	**e-CON connector**	
	Input	1 system (TRIG) : Line0 : High=5V	**2 systems (TRIG) : Line0 : high=2.0 to 24V Line2 (dual purpose I/O) : High=5V**	
	Output	2 systems : Line1, Line2 : High=5V Arbitrary wave form/ EXPOSURE_ACTIVE/ FRAME_ACTIVE/ FRAME_TRANSFER/ FRAME_TRIGGER_WAIT/ UserOutput/ AcquisitionActive : Switching	**2 systems : Line1, Line2 : High=5V (*Line2 : dual purpose I/O) Arbitrary wave form/ EXPOSURE_ACTIVE/ FRAME_ACTIVE/ FRAME_TRANSFER/ FRAME_TRIGGER_WAIT/ UserOutput/ AcquisitionActive : Switching**	
Anti-chattering		✔	✔	
Anti-glitch		✔	✔	
Event notification		U3V_EVENT_TEST/ FrameTrigger/ FrameTriggerError/ FrameTriggerWait/ FrameTransferStart/ FrameTransferEnd/ ExposureStart/ExposureEnd/ Timer0Start/Timer0End	**U3V_EVENT_TEST/ FrameTrigger/ FrameTriggerError/ FrameTriggerWait/ FrameTransferStart/ FrameTransferEnd/ ExposureStart/ExposureEnd/ Timer0Start/Timer0End**	
Chunk		-	✔	
BERT		✔	✔	

※ Differences from DU657M series are shown in RED

Specification comparison (DU series color models)

Model		DU657MC	DU806MCG/MCF	DU1207MCG/MCF
Interface		USB3.0 (Super Speed)	**USB3.0 (Super Speed)**	
Protocol		USB3 Vision Ver1.0	**USB3 Vision Ver1.0**	
Imaging element		1.1 type CMOS TELI original	**1.0 type CMOS IMX255**	**1.1 type CMOS IMX253**
Max. output pixel size		6.5M	**8.8M**	**12.3M**
Resolution		2,560(H)x2,560(V)	**4,096(H)x2,160(V)**	**4,096(H)x3,000(V)**
Frame rate		55fps	**40fps**	**31fps**
Pixel size		5.0x5.0µm	**3.45x3.45µm**	**3.45x3.45µm**
Protect glass/ optical filter		[C]: no filter [CF]: with IR cut filter	**[CG]: with Dust-proof glass [CF]: with IR cut filter**	
Standard Sensitivity		2,200lx, F5.6, 1/60s	**TBD**	**[CG]: 1,150 lx, F5.6, 1/31s [CF]: 1,425 lx, F5.6, 1/31s**
Minimum sensitivity		40 lx	**TBD**	**[C]: 3 lx, [CF]: 3 lx**
Gain	Manual	1 to 8[times] (digital gain)	**0 to +24[dB] (analog gain)**	
	Auto	-	**✔**	
Black level correction		-25 to +25[%]	**-25 to +25[%]**	
White balance	Manual gain	R/B gain set separately 1 to 8[times]	**R/B gain set separately 1 to 8[times]**	
	One push	All area [C]: N/A [CF]: 2500 to 6500[K]	**All area [CG]: N/A [CF]: 2500 to 6500[K]**	
	Full auto	-	**✔ (firmware update)**	

※ Differences from DU657M series are shown in RED

Specification comparison (DU series color models)

Model		DU657MC	DU806MCG/MCF	DU1207MCG/MCF
Gamma correction		0.45 to 1.0	**0.45 to 1.0**	
LUT		Input : 10[bit] Output : 10[bit]	**Input : 12[bit] Output: 12[bit]**	
Sharpness		-	✔	
Color correction		-	✔	
Saturation		-	✔	
HUE		-	✔	
Pixel defect correction		Max. 256 pixels	**Max. 256 pixels**	
Test pattern output		✔	✔	
Image memory (number of images)		64MB / over 10 images (Bayer8)	**256MB / over 30 images (Bayer8, Mono8)**	**256MB / over 21 images (Bayer8, Mono8)**
Image re-sending		- (Bulk transfer Retry only)	**- (Bulk transfer Retry only)**	
Exp. cntrl	Manual	10µs to 200ms	**30µs to 16s**	
	Auto	-	✔	
Trigger shutter	Hardware trigger	Edge, Pulse width control (10µs to 200ms), +/- polarity	**Edge, Pulse width control (30µs to 16s), +/- polarity**	
	Software trigger	USB3 Vision command	**USB3 Vision command**	
Bulk trigger		Max. 255 times	**Max. 255 times**	
Sequential shutter		Max. 16 entry	**Max. 16 entry**	
Trigger delay		0 to 2,000,000us	**0 to 2,000,000us**	
Synchro. Method		Bus sync / Internal sync	**Bus sync / Internal sync**	

※ Differences from DU657M series are shown in RED

Specification comparison (DU series color models)

Model			DU657MC	DU806MCG/MCF	DU1207MCG/MCF
Readout mode	All pixel scanning		2,560(H)x2,560(V)	4,096(H)x2,160(V)	4,096(H)x3,000(V)
	Partial reading	Min. unit size	64(H)x64(V)	64(H)x64(V)	
		Offset setting unit	4(H)x2(V)	4(H)x2(V)	
		Number of window	1	1	
		Window overlap	-	-	
	Binning reading (Digital image reduction)		2x2, 4x4 (Sensor)	(TBD)	
	Decimation		X	(TBD)	
Pixel format			Bayer8	Bayer8/10/12, RGB/BGR, YUV422/411, Mono8	
Image flip			Horizontal, Vertical	Horizontal, Vertical	
User mem.	Value set memory		15 Channel	15 Channel	
	Optional memory		64 bytes	64 bytes	

※ Differences from DU657M series are shown in RED

Specification comparison (DU series color models)

Model		DU657MC	DU806MCG/MCF	DU1207MCG/MCF
GPIO	Connector	e-CON connector	**e-CON connector**	
	Input	1 system (TRIG) : Line0 : High=5V	**2 systems (TRIG) : Line0 : high=2.0 to 24V Line2 (dual purpose I/O) : High=5V**	
	Output	2 systems : Line1, Line2 : High=5V Arbitrary wave form/ EXPOSURE_ACTIVE/ FRAME_ACTIVE/ FRAME_TRANSFER/ FRAME_TRIGGER_WAIT/ UserOutput/ AcquisitionActive : Switching	**2 systems : Line1, Line2 : High=5V (*Line2 : dual purpose I/O) Arbitrary wave form/ EXPOSURE_ACTIVE/ FRAME_ACTIVE/ FRAME_TRANSFER/ FRAME_TRIGGER_WAIT/ UserOutput/ AcquisitionActive : Switching**	
Anti-chattering		✔	✔	
Anti-glitch		✔	✔	
Event notification		U3V_EVENT_TEST/ FrameTrigger/ FrameTriggerError/ FrameTriggerWait/ FrameTransferStart/ FrameTransferEnd/ ExposureStart/ExposureEnd/ Timer0Start/Timer0End	**U3V_EVENT_TEST/ FrameTrigger/ FrameTriggerError/ FrameTriggerWait/ FrameTransferStart/ FrameTransferEnd/ ExposureStart/ExposureEnd/ Timer0Start/Timer0End**	
Chunk		-	✔	
BERT		✔	✔	

※ Differences from DU657M series are shown in RED

Specification comparison (all DU series)

Model		DU657M series	DU806M series	DU1207M series
Power supply		DC+5V±5% (from USB connector)	**DC+5V±5% (from USB connector)**	
Power consumption		3.6W	**[G]:4.0W, [CG][CF]:4.5W**	**[G]:4.0W, [CG][CF]:4.5W**
Lens mount		C mount	**C mount**	
Overall dimensions (exclude mount, protrusion)		40(W)x40(H)x35(D)mm	**40(W)x40(H)x35(D)mm**	
Weight		85g	**90g**	
Operation assurance	Operation temperature and humidity	Temperature : -5 to 45°C Humidity : 10 to 90% RH	**Temperature : -5 to 45°C (below 65oC on cabinet surface) Humidity : 10 to 90% RH**	
	Storage temperature and humidity	Temperature : -20 to 60°C Humidity : below 90% RH (No condensation)	**Temperature : -20 to 60°C Humidity : below 90% RH (No condensation)**	
	EMC condition	EMI : EN61000-6-4 FCC Part 15 Subpart B Class A EMC : EN61000-6-2	**EMI : EN61000-6-3 (Residential environment) FCC Part 15 Subpart B Class A EMC : EN61000-6-2**	
Conformity		CE, EU-RoHS, China-RoHS(10), WEEE, GenICam Ver.2.3, IIDC2 Ver.1.0.0	**CE, EU-RoHS, China-RoHS(10), WEEE, GenICam Ver.2.3, IIDC2 Ver.1.1.0**	

※ Differences from DU657M series are shown in RED

Specification comparison (all DU series)

Model		DU657M series	DU806M series	DU1207M series
Optical accuracy	Optical axis	X: ±25µm, Y: ±25µm	**X: ±25µm, Y: ±25µm**	
	Rotating angle of imaging area	±0.07°	**±0.07°**	
	Flange back	±50µm	**±50µm**	
Vibration		10G	**10G**	
Shock		70G	**100G**	
Criteria of sensor defect		not specified	**not specified**	

Model		DU657M series	DU806M series	DU1207M series
Option	Tripod attachment	CPTC6M	**CPTC6M**	

※ Differences from DU657M series are shown in RED

Advanced function

Advanced function

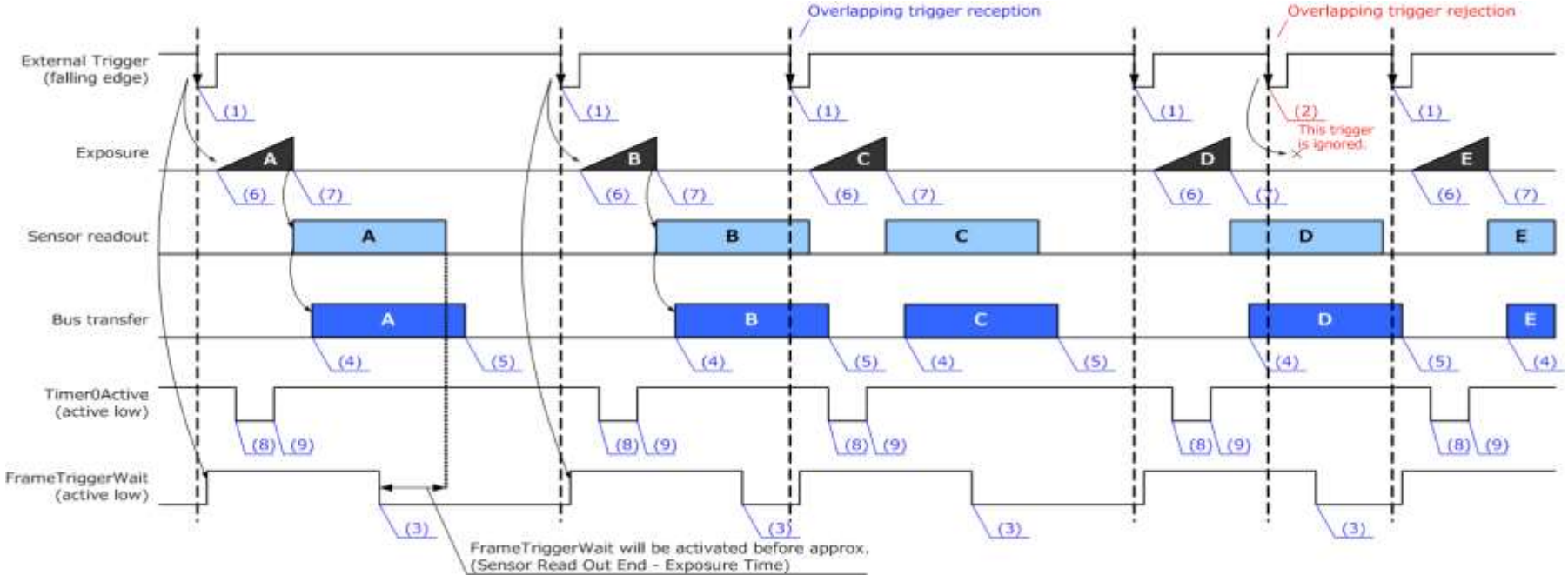
●Event notice ・・・・・・・・・	BU / DU series
●Bulk trigger ・・・・・・・・・	BU / DU series
●Sequential shutter ・・・	DU / BU-CMOS model
●Image buffer ・・・・・・・・	DU / BU-CMOS model
●Pixel defect correction	DU / BU-CMOS model
●Image inversion	DU / BU-CMOS model
●Bus synchronization・・	CCD / CMOS-GS model
●BERT ・・・・・・・・・・・・・・・・	DU / BU-CMOS model

Advanced function (1)

■ Event notification :

- Camera status can be referred through USB3 by using event packet of USB3 Vision

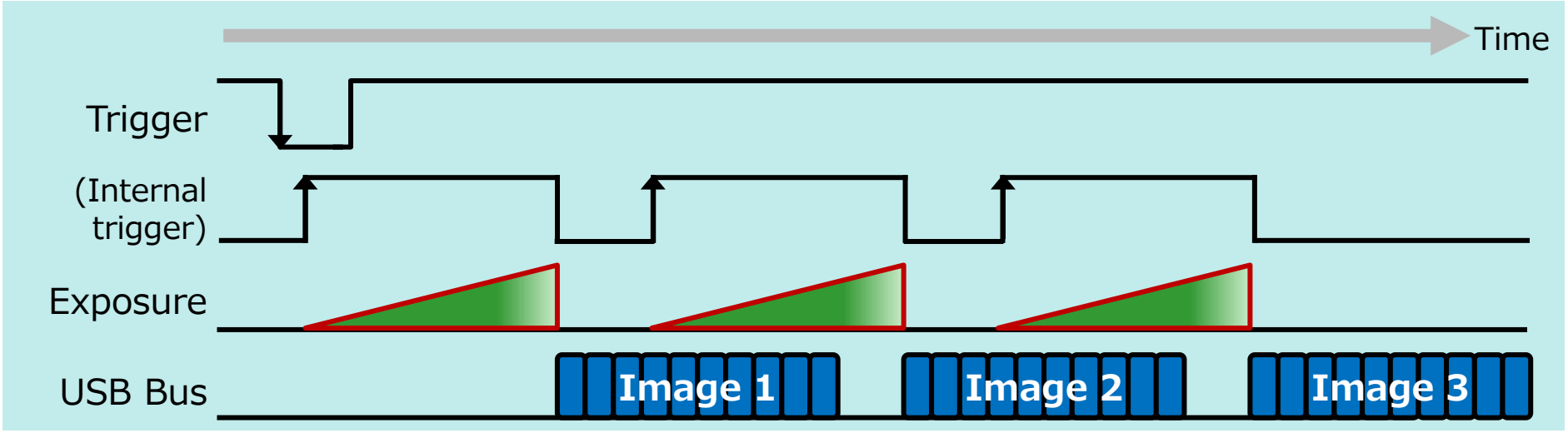
(1) Frame Trigger : Reception of Frame Start Trigger
(2) Frame Trigger Error : Rejection of Frame Start Trigger
(3) Frame Trigger Wait : Start of waiting for Frame Start Trigger
(4) Frame Transfer Start : Start of transferring Streaming data
(5) Frame Transfer End : End of Transferring Streaming data
(6) Exposure Start : Start of Exposure
(7) Exposure End : End of Exposure
(8) Timer0Active : Start of Timer0
(9) Timer0End : End of Timer0

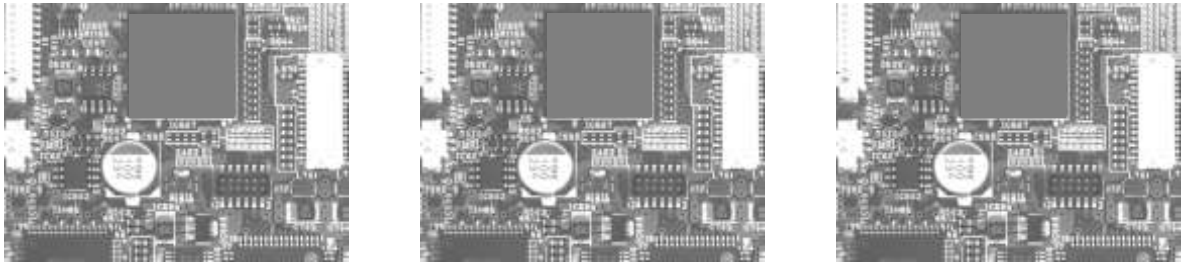


Advanced function (2)

■ Bulk trigger (Trigger burst) mode :

- Exposure and image output of multiple times can be achieved by one time input of trigger signal
- Example of use :
  selecting the best image among several frames, measuring moving distance etc.





Advanced function (3-1)

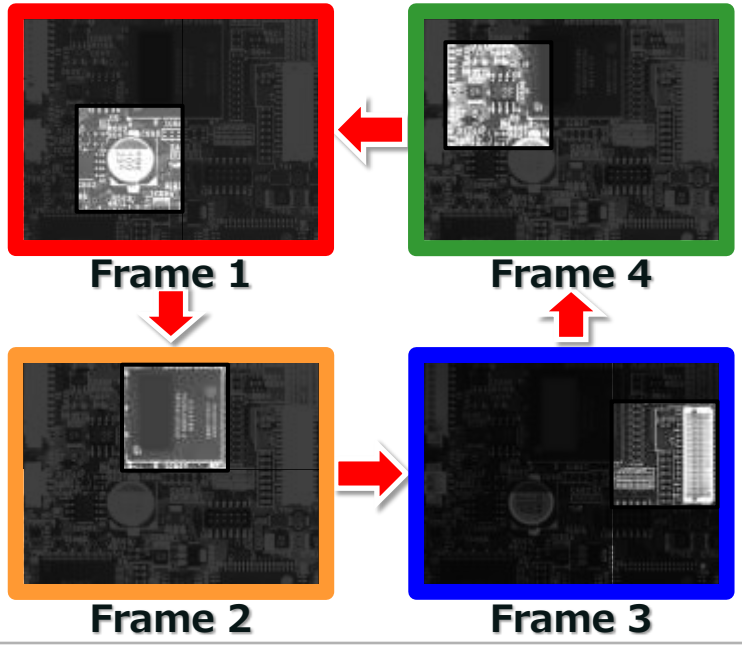
■ Sequential shutter mode

- Together with trigger mode, sequential shutter function of BU/DU (CMOS) series can switch programed settings such as gain, exposure, AOI trigger delay in each time of trigger input with each frame.

<Ex.1>

Changing ROI position, Gain and Exposure Time every time

Sequential Shutter Setting : 4 shots



Memory Bank1	**SEQ : Frame 1** ・Gain : 0dB ・Exposure : 2ms ・ROI Position :
Memory Bank2	
Memory Bank3	
Memory Bank4	
Memory Bank5	**SEQ : Frame 3** ・Gain : 0dB ・Exposure : 1ms ・ROI Position :
Memory Bank6	
Memory Bank7	
Memory Bank8	
Memory Bank9	**SEQ : Frame 2** ・Gain : +6dB ・Exposure : 2ms ・ROI Position :
Memory Bank10	
Memory Bank11	
Memory Bank12	
Memory Bank13	
Memory Bank14	
Memory Bank15	**SEQ : Frame 4** ・Gain : +3dB ・Exposure : 2ms ・ROI Position :

Advanced function (3-2)

■ Sequential shutter mode

<Ex.2>

Changing Gain and Exposure Time every time

Sequential Shutter Setting : 4 shots

Trigger
(3 times)

Image data output
(3 frames)

First Shot

Gain: 0.5dB
Exp: 0.7msec

Second Shot

Gain: 3dB
Exp: 0.7msec

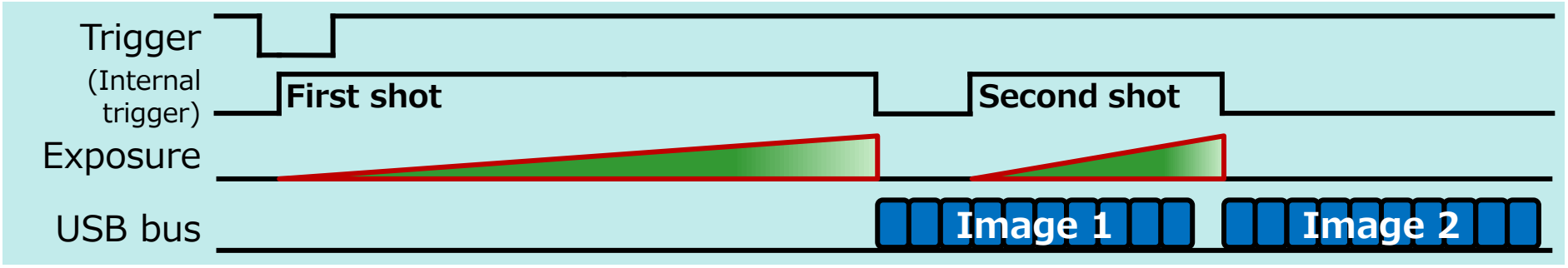
Third Shot

Gain: 8dB
Exp: 0.3msec

Advanced function (4)

■ Sequential shutter with Bulk trigger mode

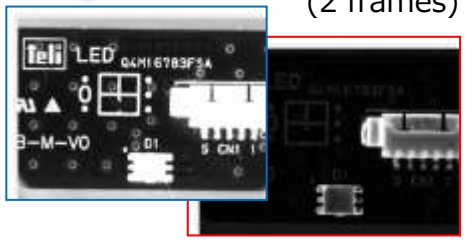
<Ex.3> Output multiple images of different shutter speed by one shot trigger



Bulk trigger setting : 2 shots
Sequential shutter setting : 2 sequences

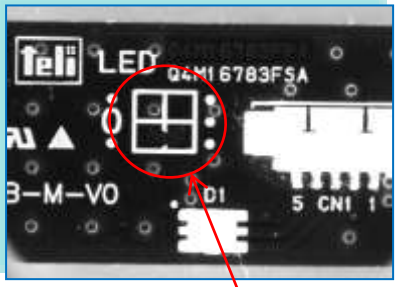
Trigger (1 time)

Image data output (2 frames)



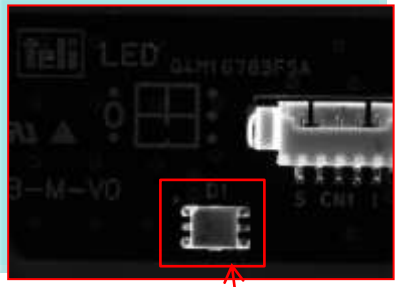
Inspection on multi items by one time trigger input!

First shot



Exposure time : 20msec

Second shot



Exposure time : 2msec

Silk inspection

Appearance inspection of scratch or dent

For example, appearance and silk lucking of parts can be inspected at the same time

Advanced function (5)

■ Image buffer

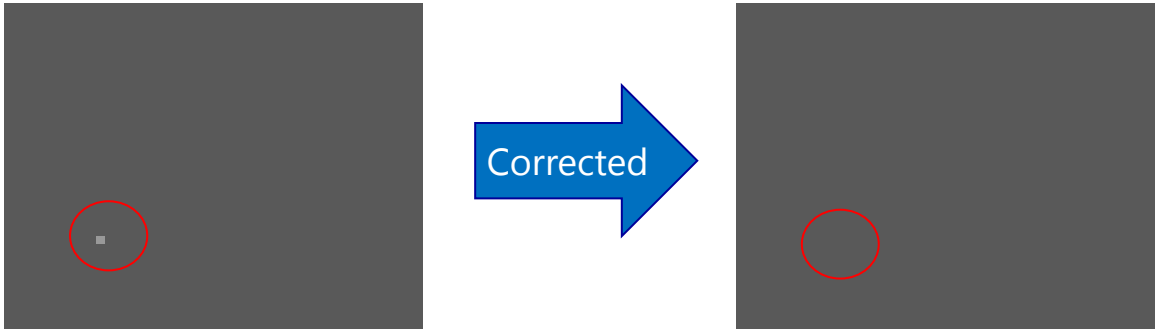
- As BU/DU(CMOS) series have image buffer memory in it, recorded image data can be read from host PC at any time.

Model	Memory	Number of recorded frames in representative output size								
		1.3M	2M	2.3M	3.1M	4.2M	5M	6M	6.5M	8.8M	12M
BU132M/205M/ 238M/302M/406M/ 505M/602M/1203M **DU**657M	**64MB**	51	30	29	21	16	13	10	10	7	5
DU1207M/806M	**256MB**	204	120	116	85	64	53	42	40	30	21

Advanced function (6)

■ Pixel defect correction

- BU/DU (CMOS) series have correction function of pixel defect. This function can be switched on and off depend on occasion.



■ Image inversion

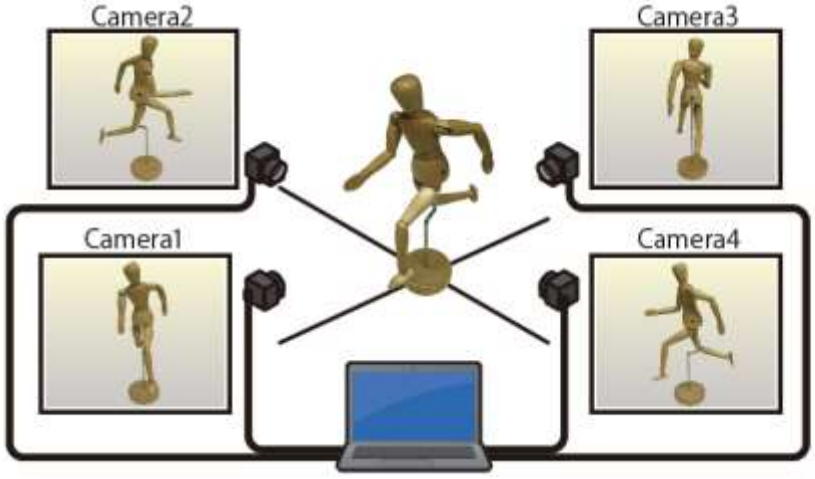
- Image mirroring, flip and rotation can be used

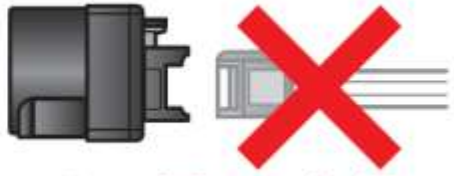
Normal image | Mirroring | Flip | Rotation

Advanced function (7-1)

■ Bus synchronization (1)

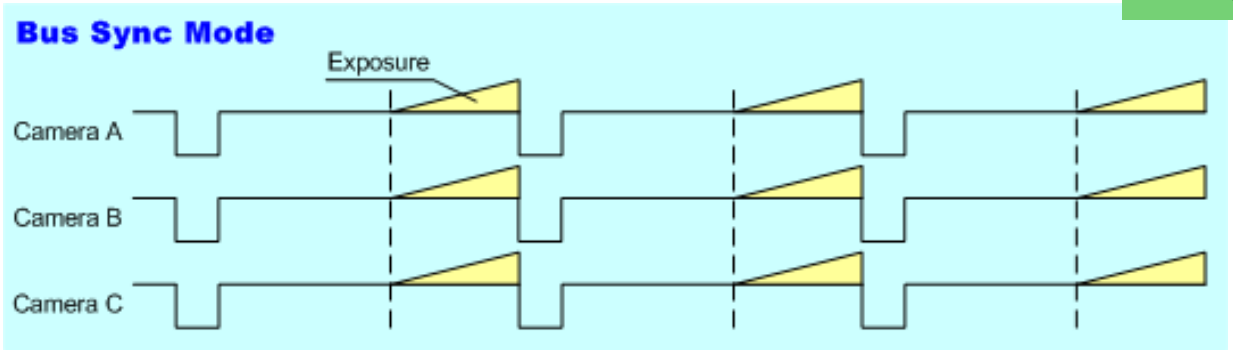
- Fully synchronized exposure timing among several cameras.





No cable needed for 'Trigger in' !

Applications:
Stereo camera
Motion capture



- Technical information of BERT function can download from following web site;
  http://www.toshiba-teli.co.jp/en/products/industrial/info/

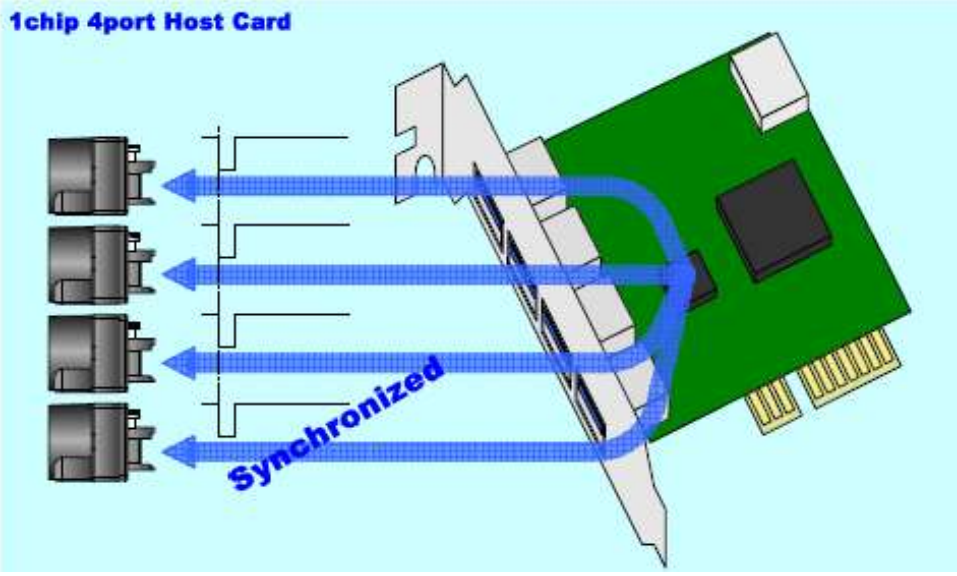
Advanced function (7-2)

■ Bus synchronization (2) Bus topology:

- Operation is synchronized with host controller in top level
- In case of a card with single host controller and multiple ports, all ports are synchronized.

  ● **In case of mother board with Intel Skylake-S :**
  USB3.0 port of Skylake-S has 4 separate host controller. BUS synchronizing feature is applicable as time stumps of all ports are verified to be the same.

- In BUS synchronizing, jitter value of exposure timing among 3 cameras are about +/-600ns (observed value)

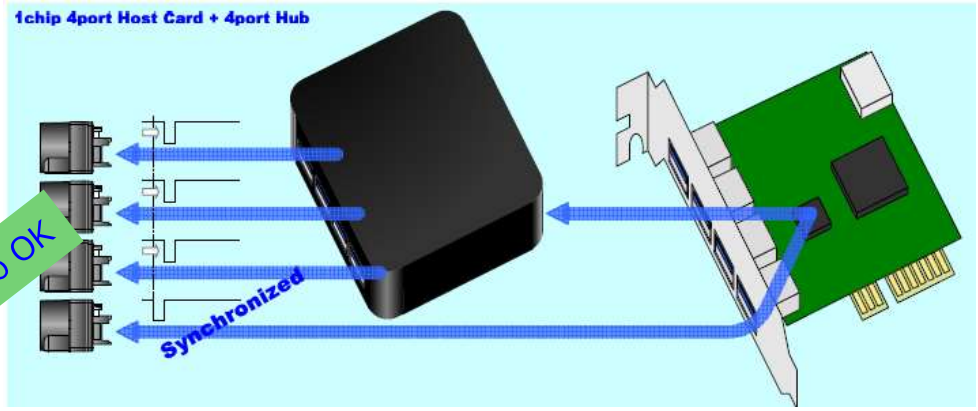


Advanced function (7-3, 7-4)

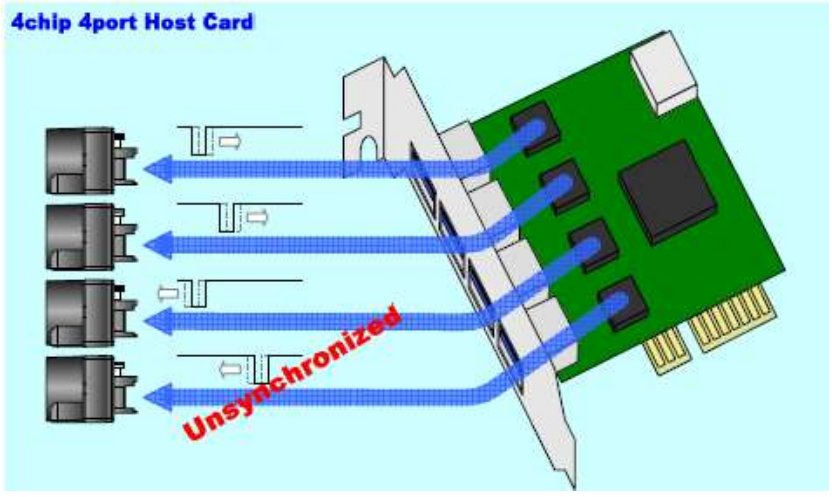
■ Bus synchronization (3) Hub connection:

- ➢ BUS can be synchronized through hub
- ➢ Delay time with hub is about 200~300ns

◆ **Popular 1 host × 4 port host card**
- ✓ IO DATA : U3B-4PX
- ✓ BUFFALO : IFC-PCIE4U3S
- ✓ AREA : SD-PEU3R-4E
- ✓ IOI : U3-PCIE1XG211



■ Bus synchronization (4) multiple host controller:



- ➢ BUS is not synchronized in case cameras are connected to each different port of a card with multiple controller (4ch independent port)

◆ **Popular 4 host × 4 port host card**
- ✓ AVAL DATA :APX-3424
- ✓ IOI : U3X4-PCIE1XE101
- ✓ IOI : U3X4-PCIE4XE111

BUS synchro NG

Advanced function (7-5)

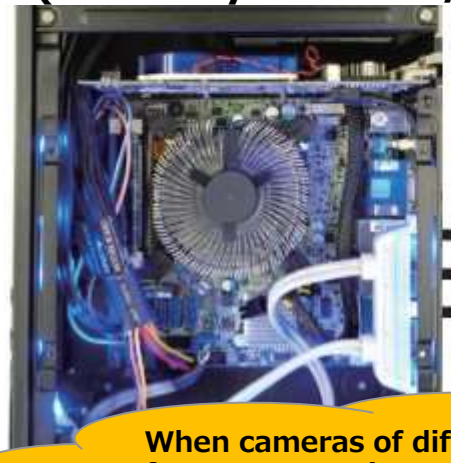
■ BUS synchronization(5) connection & operation:

Oscilloscope (Exposure timing output indication)

Jitter: aprox. +/-600ns (measured)

Upon the time stump issued by USB host controller, each camera starts exposure and output image.

PC (with Skylake-S M/B)



USB3 Camera x3

1ch — Camera1 BU238M

2ch — Camera2 BU238M

3ch — Camera3 BU238M

USB3.0×3ch

When cameras of different kinds or with different frame rate setting are connected for BUS synchronization, it synchronize with the slowest one.

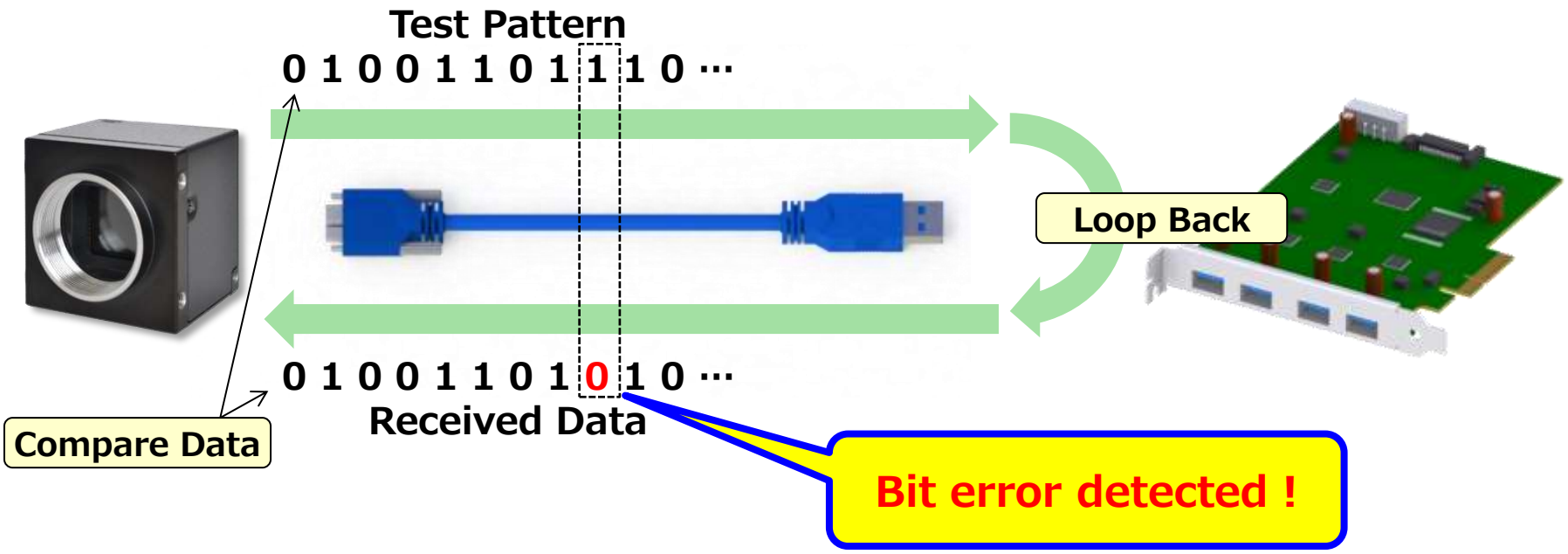
Corresponding Cameras;

BU030/C/CF BU031 BU080
BU130/C/CF
BU205M BU238M/MC/MCF
BU302MG/MCG/MCF BU406M/MC/MCF
BU505MG/MCG/MCF DU657M/MC
DU806MG/MCG/MCF DU1207MG/MCG/MCF

Advanced function (8-1)

■ BERT (Bit Error Rate Test) = CMOS model

- "BERT Function" can easily check a signal quality including cable. With "BERT Function", signal quality can be checked under user's circumstances at starting up or change system.



Advanced function (8-2)

■ Feature of BERT

- BU series (CMOS model) and DU series have BERT feature.
- BERT features error (discrepancy) checking by comparison of camera's test pattern and loop back data from the host controller.
- With BERT feature, cable quality can be measured without costly measuring equipment and without built in running test.
- As CMOS models use wide band of over 350MByte/s, Bit Error Rate affects system performance seriously.
- As CCD models do not use so wide band, Bit Error to a certain extent is allowed by recovery.

■ Convenient for…

- It is useful for the first cable insertion after system built up, or for cable replacement (for damage or extension)
- It features easier trouble shooting against image interruption after system built up as inspection can be concentrated on other (software or hardware) factor than transmission path.

Camera function list (all USB3.0 camera)

Color type		B/W	Color	B/W	B/W	B/W	Color	B/W	Color	B/W	Color	B/W	Color		B/W	Color	B/W	Color
Resolution		CCD	CCD	CMOS	CMOS	CMOS	CMOS	CMOS	CMOS	CMOS	CMOS	CMOS	CMOS		CMOS	CMOS	CMOS	CMOS
Imager		V1	V1	V4	V2	V2	V2	V2	V2	V4	V4	V4	V4	V2	V3	V3	V5	V5
TELI IP Core Version		BU030 BU031 BU080 BU130	BU030C/CF BU130C/CF	BU132M	BU205M	BU238M	BU238MC/CF	BU406M	BU406MC/CF	BU302MG BU505MG	BU302MCG/CF BU505MCG/CF	BU602M	BU602MC/CF	BU1203MC/CF	DU657M	DU657MC	DU806M DU1207M	DU806MCG/CF DU1207MCG/CF
USB3Vision	Bootstrap Registers	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
DeviceControl	DeviceControl	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
ImageFormatControl	ImageFormatSelector	O	-	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	Scalable	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	Binning	O	-	O	-	-	-	-	-	O	-	-	-		O	O	O	O
	Decimation	-	-	O	O	-	-	O	O	O	O	-	-		-	-	O	O
	Reverse	-	-	O	O	O	O	O	-	O	O	O	O		O	O	O	O
	PixelFormat	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	TestPattern	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
AcquisitionControl	AcquisitionControl	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	ImageBuffer	-	-	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	TriggerControl	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	ExposureControl	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
DigitalIOControl	DigitalIOControl	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
CounterAndTimerControl	TimerControl	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
AnalogControl	Gain	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	BlackLevel	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	Gamma	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	BalanceRatio	-	O	-	-	-	O	-	O	-	O	-	O		-	O	-	O
	BalanceWhiteAuto	-	O	-	-	-	O	-	O	-	O	-	O		-	O	-	O
	ColorCorrectionMatrix	-	O	-	-	-	-	-	-	-	O	-	O	-	-	-	-	O
LUTControl	LUTControl	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
UserSetControl	UserSetControl	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
EventControl	EventControl	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	FrameSynchronization	O	O	-	O	O	O	O	O	O	O	-	-		O	O	O	O
VenderUniqueControl	LEDIndicatorLuminance	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	AntiGlitch	O	-	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	AntiChattering	O	-	O	O	O	O	O	O	O	O	O	O		O	O	O	O
DPCControl	DPCControl	-	-	O	O	O	O	O	O	O	O	O	O		O	O	O	O
	SequentialShutterControl	-	-	O	O	O	O	O	O	O	O	-	-		O	O	O	O

Documents

Reference documents (released)

- **Product specifications**
  (for DU1207MG/MCG/MCF)

- **Operation manual**
  (for DU1207MG/MCG/MCF)

- **These documents are available in our HP to download;**

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

  ※Please contact our sales person in case you cannot download.

Related materials

Brochures by model

- Each edition of Japanese, English and Chinese is available. Please contact our sales person for them

Japanese edition

English edition

Chinese edition (簡体)

USB3.0 Camera materials (HP)

■ Catalog

- **[TOP] ⇒ [Product Inquiries]**
  ⇒[Catalog & Specifications]
  http://www.toshiba-teli.co.jp/en/support/catalog.htm

■ Spec sheet, manual

- **[TOP] ⇒ [Product Inquiries]**
  ⇒ [Catalog & Specifications]
  ⇒ [Specification & Operation manual Download]
  http://www.toshiba-teli.co.jp/en/support/catalog_pro.htm

■ Software (Register controller, SDK, driver etc.)

- **[TOP] ⇒ [Product Inquiries] ⇒ [Download]**
  https://www.toshiba-teli.co.jp/cgi/ss/en/service.cgi
  ※User registration required

USB3.0 Camera materials (HP)

■ Product brochure etc.

- [TOP]⇒[Industrial camera]⇒ each Camera series

➢ Catalog of USB3.0 camera BU/DU series (Fold in half)
➢ Brochure of USB3.0 camera with Sony CMOS sensor
➢ Brochure of USB3.0 camera DU1207M/DU802M series

■ Technical document (White paper)

- [TOP] ⇒[Industrial camera] ⇒ [Industrial camera info] ⇒[Technical info]

http://www.toshiba-teli.co.jp/en/products/industrial/info/index.htm#bkm_t

➢ Bit Error Rate Test (BERT) function (BU/DU series : CMOS model)
➢ Bus Synchronization Mode (BU/DU series)
➢ Guide line for Thermal design (BU series, BG series)
➢ GenICam: What does it taste like? (BU series, BG series)
➢ Color Appearances of Invisible Light by an IR Cutoff Filterless Color Camera
➢ Frame rate calculation tool (BU series : CMOS model)

USB3.0 camera materials (HP)

■ Product document

- **[TOP] ⇒ [Industrial camera]**
  ⇒ [Industrial camera information] ⇒ [Others]
  http://www.toshiba-teli.co.jp/en/products/industrial/info/index.htm#bkm_o

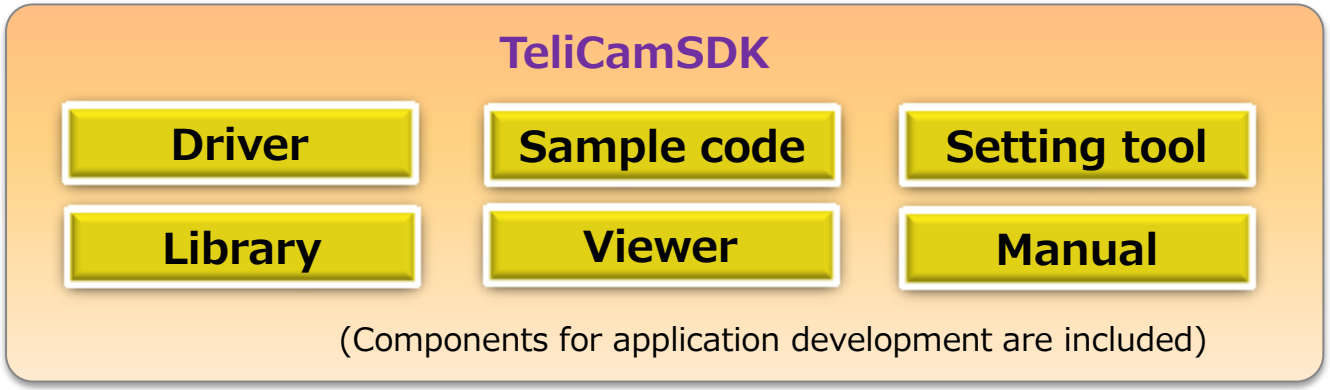
- **USB3 Vision camera BU/DU series product range**
- **User's guide of USB3 Vision camera BU1203MCF**
- **User's guide of USB3 Vision camera BU132M**
- **User's guide of USB3 Vision camera BU505M/BU302M series**

TeliCamSDK

What's TeliCamSDK

- Digital camera is usually used connecting with PC.
- As standard of digital camera such as GigE Vision or USB3 Vision is not supported by OS, software for control and imaging (driver, library etc.) is necessary.
- Third party's specific driver can be used with its image processing library. However, camera manufacturer's SDK is necessary for user who does not use third party's software.

➢**TeliCamSDK** is ***SDK*** (Software Development Kit) for ***GigE Vision*** and ***USB3 Vision*** cameras supplied by Toshiba Teli Corporation.



TeliCamSDK feature

■ Supporting OS (as of March 2017)

■ Windows

Releasing latest
V2.1.1.1
In February 2017!

v1.0.7.1	WindowsXP SP3	32bit
	WindowsVista	32/64bit
	Windows7	32/64bit
	Windows8.1	32/64bit
v2.1.1.1	Windows7	32bit
	Windows8.1	32/64bit
	Windows10	**32/64bit**

■ Linux version (for USB3.0 only)

v1.1.0	Ubuntu 14.04 LTS	amd64
	Debian 8.1.0	amd64

Supporting distribution will be continuously added.

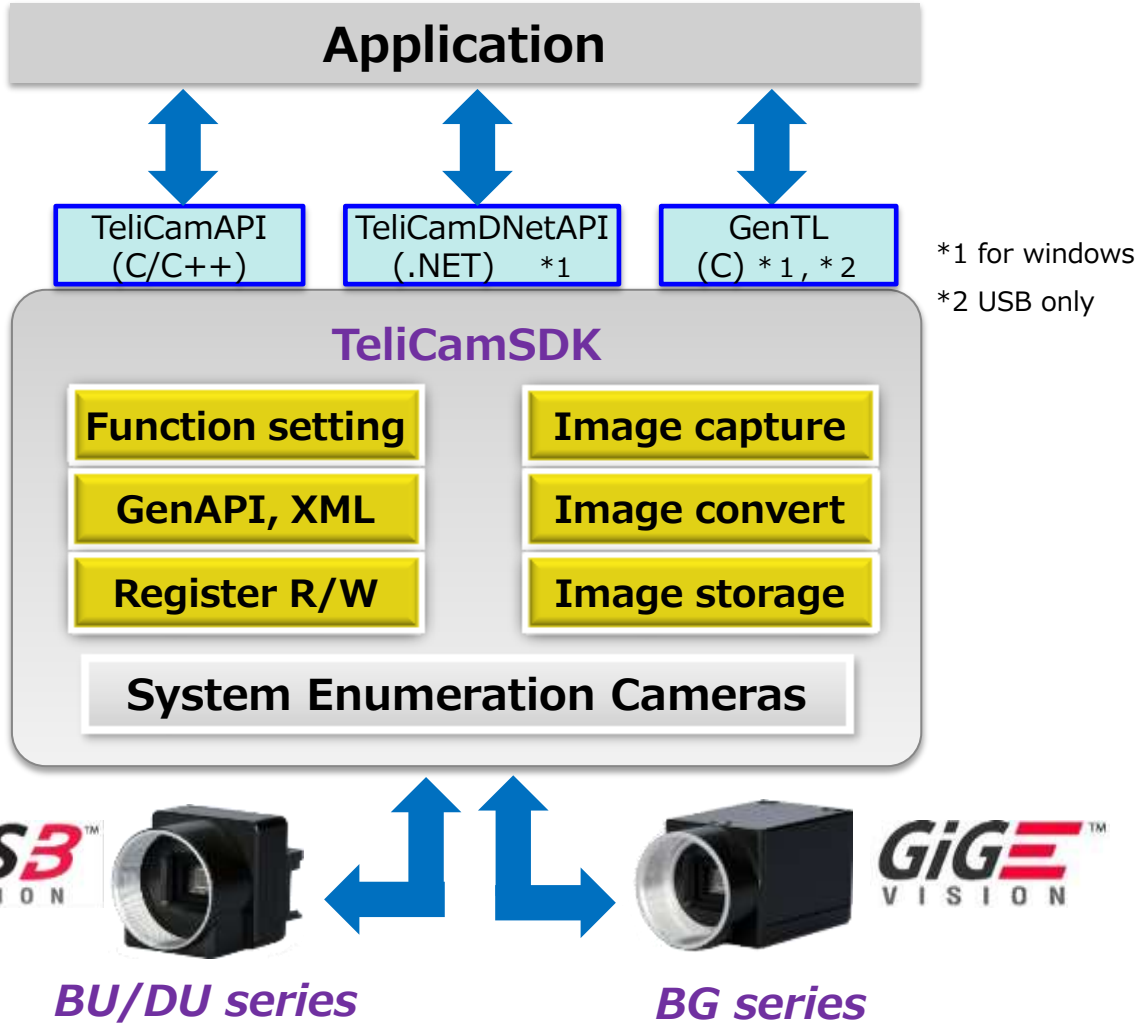
■ Programming language

- C/C++
- C# , VB.NET , C++/CLI (Windows version)

■ Supporting industrial protocol

- GigE Vision, USB3 Vision
- IIDC2, GenICam

TeliCamSDK structure



* GenICam GenTL are specification of interface in transport layer regarding control method of stream data transfer such as image.

[Appendix]
Introduction of USB3.0/USB3 Vision

About USB3.0/USB3 Vision

Outline of USB3.0 interface

- **Bit rate : 5Gbps max. (SuperSpeed)**
  - Can transfer Uncompressed HDTV (1920x1080) image in 60fps
- **Comm. Mode : Full duplex**
  - Improved in communication efficiency against USB2.0 (half duplex)
- **Bus power : 900mA max.**
  - Up to 4.5W with 5V supply
- **Lower compatibility**
  - USB3.0 device can be connected to USB2.0 port (works as USB2.0)
  - USB2.0 device can be connected to USB3.0 port

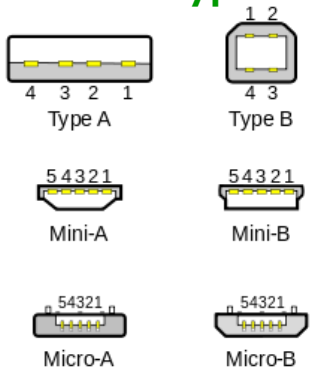
What's USB3 Vision?

- **Machine vision standard**
  - IEEE1394 by IIDC, Gig-E by GigE Vision
- **High band width of 5Gbps** (450MByte/s)
- **Easy connection with Plug & Play**
- **Standardized software interface with GenICam™**
- **Much improved robust than USB2.0**

Physical spec of USB standard (reference)

USB2.0

Connector types



Pin alignment of standard USB connector

Pin	Function(host)	Function(host)
1	V_{BUS} (4.75 – 5.25V)	V_{BUS} (4.4 – 5.25V)
2	D-	D-
3	D+	D+
4	GND	GND

Pin alignment of mini-micro USB connector

Pin	Function(host)	Function(camera)
1	V_{BUS} (4.75 – 5.25V)	V_{BUS} (4.4 – 5.25V)
2	D-	D-
3	D+	D+
4	ID	ID
5	GND	GND

USB3.0

Connector types

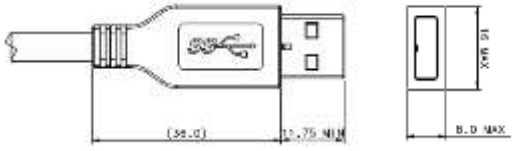
Suitable plugs for BU/DU series

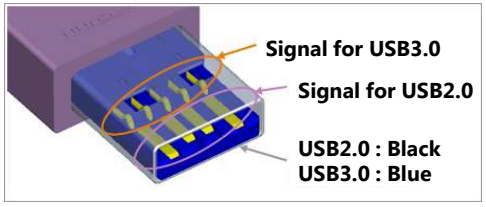
Micro-B (with screw lock)

Micro-B connector for USB3.0			
Connector for additional terminal by USB3.0 standard beside USB2.0 standard micro connector			
No. 1	Power (V_{BUS})	No. 6	USB3.0 signal line (-)
No. 2	USB2.0 dif pair(D-)	No. 7	USB3.0 signal line (+)
No. 3	USB2.0 dif pair(D+)	No. 8	GND
No. 4	USB OTG ID line	No. 9	USB3.0 signal line (-)
No. 5	GND	No.10	USB3.0 signal line (+)

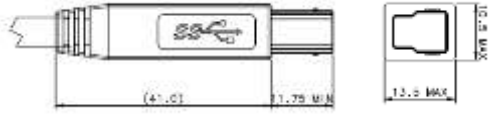
出典(写真)：マシンビジョン用インターフェース標準規格(JIIA)

Standard-A





Standard-B



Source: Universal Serial Bus 3.0 Specification (USB Implementers Forum)

High band width transfer

HIGH
Bandwidth

- Full use of high speed image sensor's feature … USB3.0
- High band width transfer by burst … USB3.0

Sensor : Sony IMX174
Resolution : 1920 x 1200 (2.3MP)

Gig-E Vision Camera	USB3 Vision Camera
Max. frame rate: 50fps	Max. frame rate: 165fps
Data rate: 115MB/s	Data rate: 380MB/s

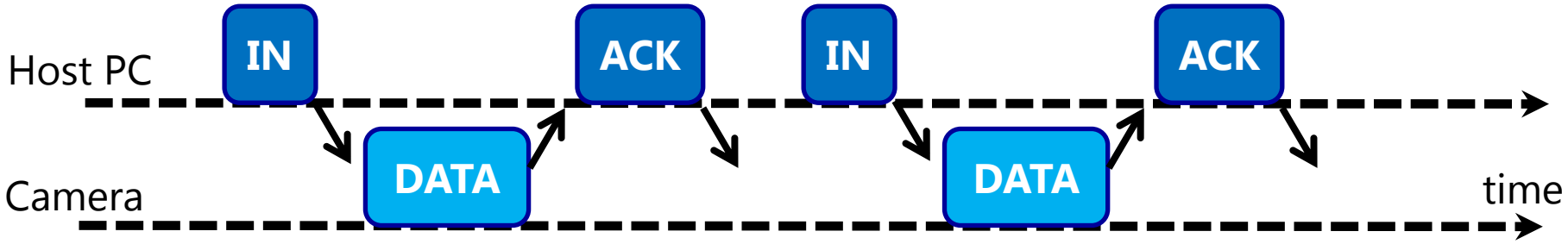
Sensor : CMOSIS CMV4000
Resolution : 2048 x 2048 (4.2MP)

Gig-E Vision Camera	USB3 Vision Camera
Max. frame rate: 25fps	Max. frame rate: 90fps
Data rate: 105MB/s	Data rate: 377MB/s

Burst transfer compliancy

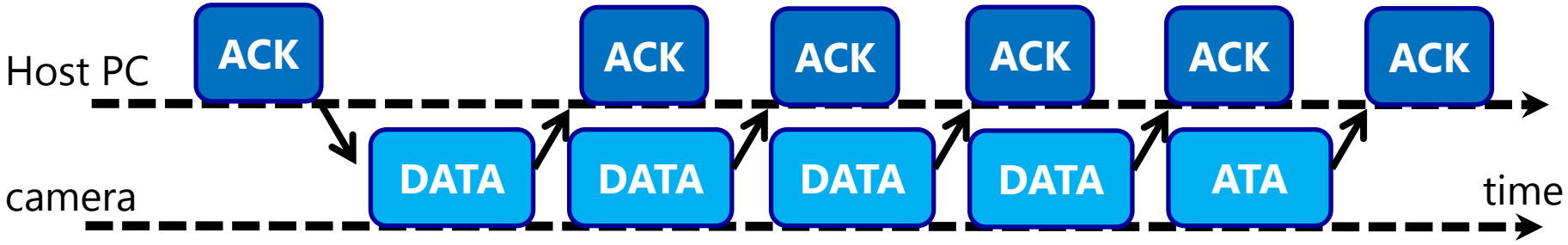
■USB2.0 : non compliancy to burst transfer

USB2.0 packet sequence cannot use bus band efficiently



■USB3.0 : compliancy to burst transfer

bus band can be used efficiently with burst transfer of USB3.0



System cost comparison

LOW COST

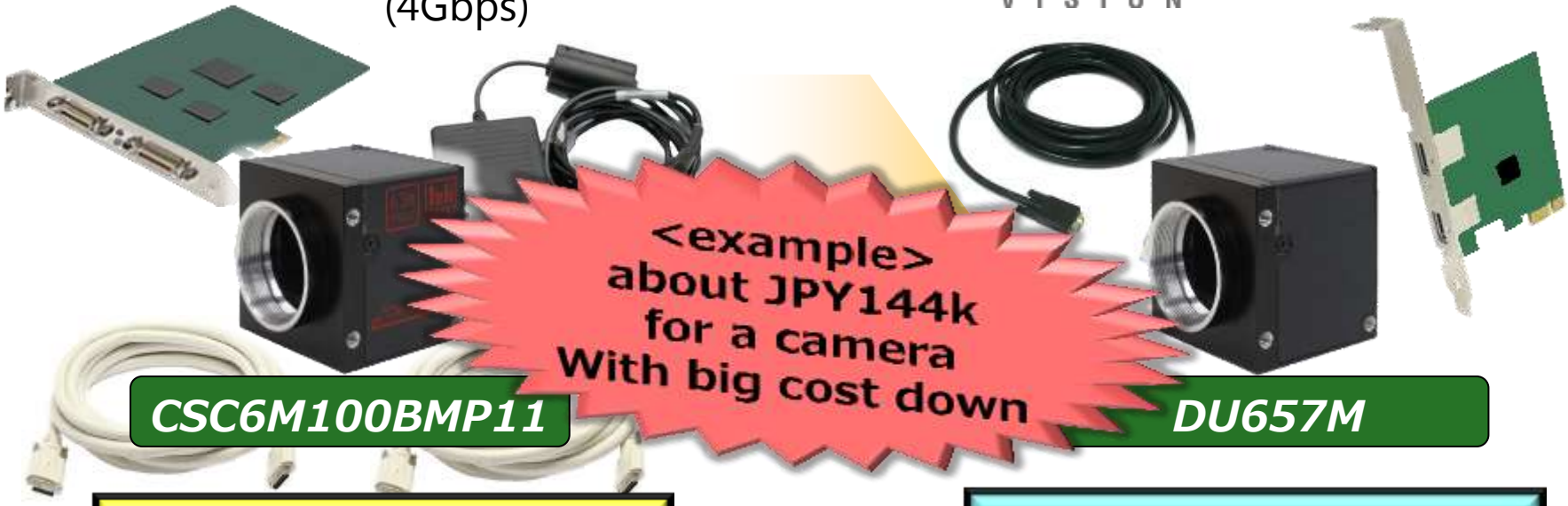
- Low cost accessories …USB3.0
- No power supply is needed …USB3.0

	USB3.0	Gig-E	1394.b	Camera Link
Frame grabber	Low	Low	Mid.	High
Cable	Low	Low	Mid.	High
Power supply	Bus	External/ PoE	Bus	External/ PoCL
Camera	Low	Mid.	Mid.	Low
System cost of 4 cameras	**Low**	**Mid.**	**Mid.**	**High**

Applicable range of USB3.0

CameraLink
Medium Configuration
(4Gbps)

USB3.0
(4Gbps)



A camera (CL-FullConfig)
About JPY420k

camera (6.5M)	: JPY280k
board	: JPY100k
cable	: JPY30k
(power)	: JPY10k

A camera (USB3 Vision)
About JPY276k

camera (6.5M)	: JPY260k
board	: JPY8k
cable	: JPY8k

Big cost down by replacing Camera Link system with USB3.0 system!

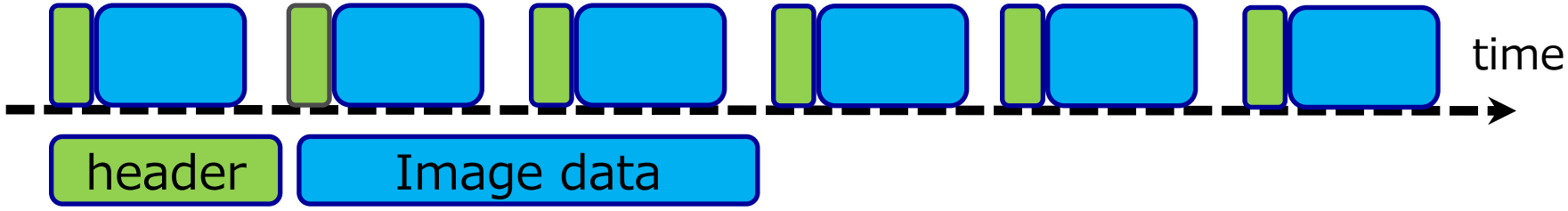
High reliability

HIGH Reliability

- Reliable data transfer is ensured ···USB3.0
- Packet format, Appropriate for DMA transfer ···USB3 Vision

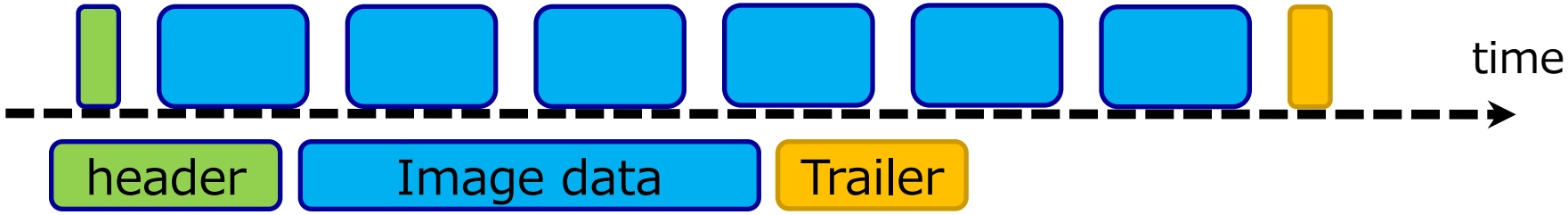
■UVC (USB Video Class) packet format

- CPU analyzes header, and separate it from image data.
- **Over head is bigger, CPU process and communication becomes unstable.**



■USB3 Vision packet format

- CPU processing and communication is stable because of less CPU load as image data is deployed on memory at one time by DMA transfer.

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