

TOSHIBA

Leading Innovation >>>



Reacting to changing machine vision needs by USB3.0 and Sony's next generation CMOS sensor

TOSHIBA TELI CORPORATION

November 5, 2014

Shunsuke Oka

Introduction

What is USB3.0 / USB3 Vision

USBTM
VISION



- ***Machine Vision standard :***
- ***High bandwidth in excess of 440 MByte/s :***
- ***Easy-to-use plug and play interface :***
- ***Power and data over the same passive cable to 8m
(more with active cables) :***
- ***Uses GenICamTM generic programming interface :***
- ***Improved Robustness than USB2.0 :***

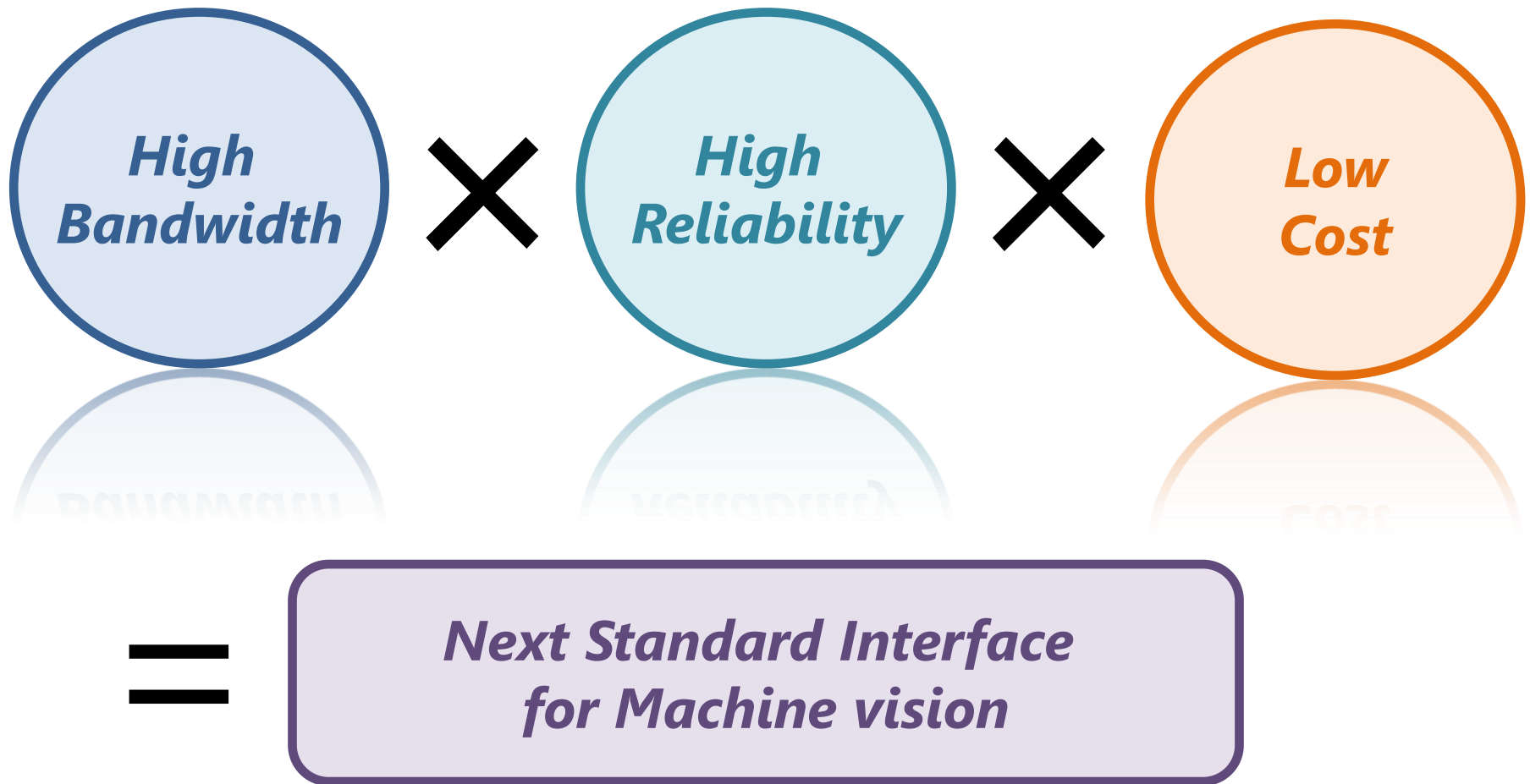
Compare with CameraLink System



***CameraLink
Medium Configuration
(4Gbps)***

***USB3.0
(4Gbps)***

Summary of USB3.0 / USB3 Vision



Applications of our USB3 Vision Camera

■ Factory Automation

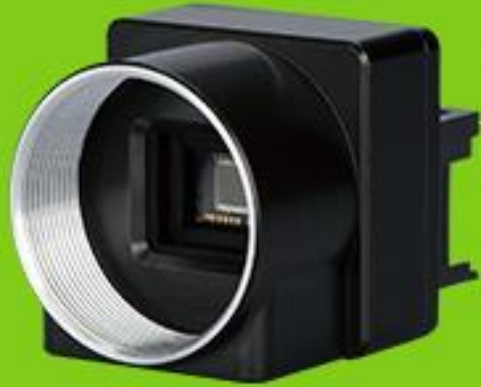
- Pick & place Machine (Chip Mounter)
- Wire Bonding Machine
- Die Bonding Machine
- Stepper
- Others (Bin Picking, etc.)

■ Inspection & Testing

- Appearance Optical Inspection (AOI)
- Industrial Endoscope / Pipe Inspection
- Industrial Microscope

Our advanced features

Toshiba Teli BU series : USB3 Vision Camera



USB3.0 Camera

BUseries

USB
VISION



IMAGING REVOLUTION

□ Compact Body

CCD model : □ 29mm×13mm

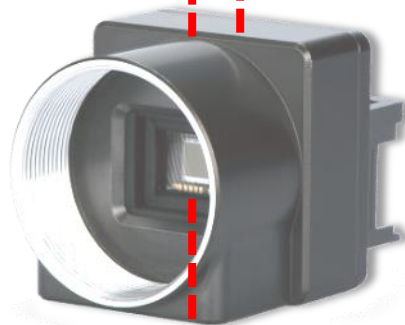
CMOS model : □ 29mm×16mm

□ Light Weight

CCD model : 27g

CMOS model : 32g

□ Applying CCD and CMOS Sensor



□ GPIO 2 Output 1 Input

□ LED Status Indicator

□ USB3.0 Micro B



□ Screw lock

□ eCON Connector



e-CON Connector

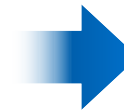
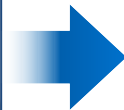
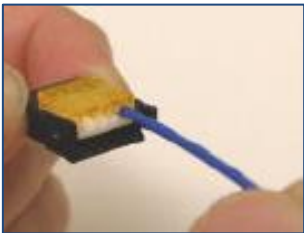
What is e-CON connector?

e-CON specifications are currently being promoted for standardization by manufactures of FA components and connectors such as Omron, SMC, 3M and so on.

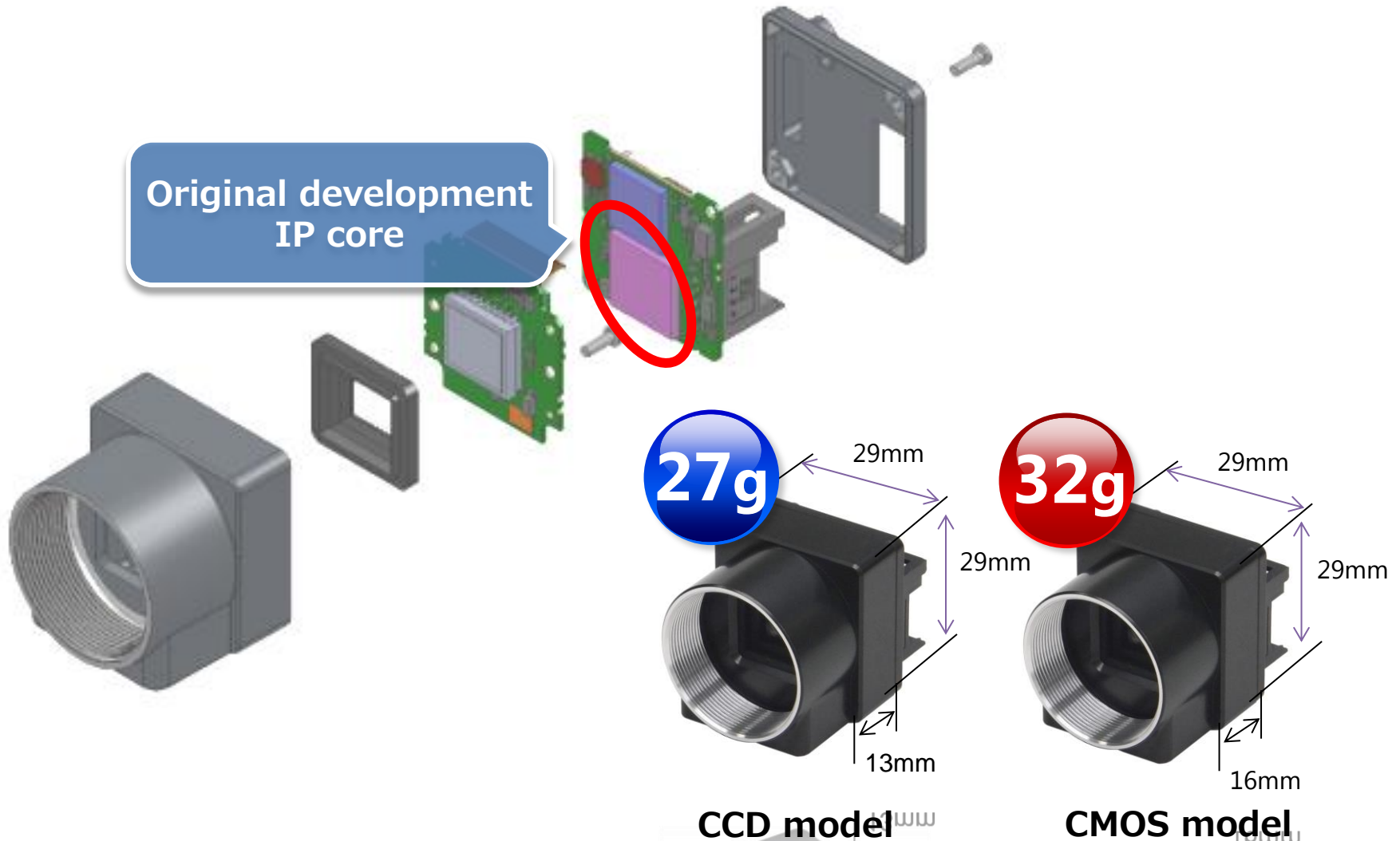
- Use industry-proven spring clamps for assembling.
- No Special tools required for assembling.
- Rewiring (Repairing) is possible.
- Reasonable price comparing to Hirose pin connector.



**Easy
assembling!!**

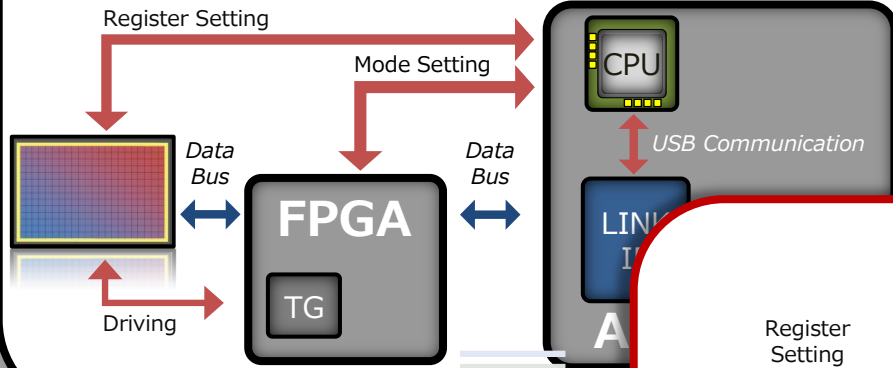


Compact Body & Light Weight



Our Unique USB IP

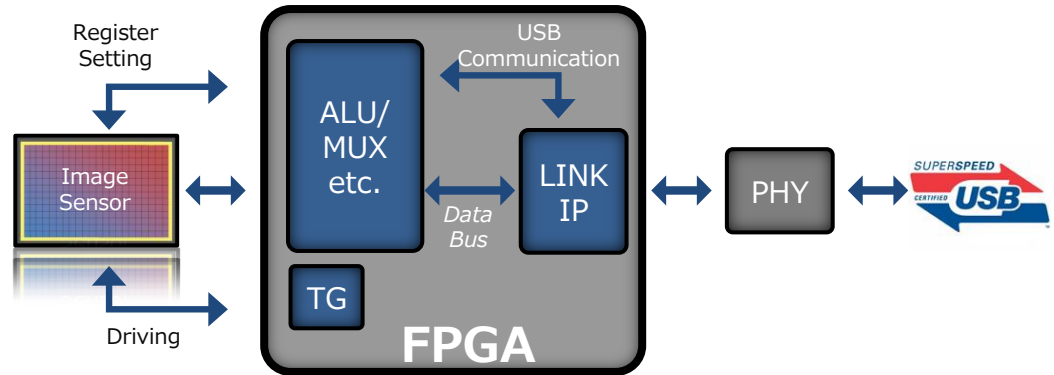
FPGA+ All - In - One USB Chip



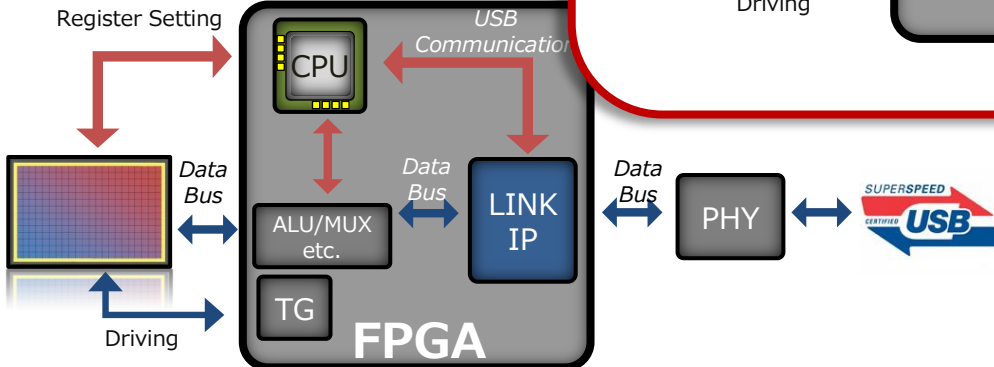
↔ Software Processing
↔ Hardware Processing

Down Size

Toshiba Teli's USB IP Core



Generic USB IP



High Speed Response

CPU Processing

Hardware Processing

CPU Processing		Hardware Processing		
Host request sequence	Camera command control	Host request sequence	Generic USB IP	All in one USB chip
Data_n	command	Our Unique USB IP	Generic USB IP	All in one USB chip
Data_n+1				<i>100 times faster</i>
Data_n+2	Read register	2.2 - 5us	40.8 - 44.6us	223 - 546us
Data_n+3	Software trigger			
Data_n+4	(write register)	2.2 - 5.4us	46.9 - 71.0us	314 - 324us
	Ack_n+4			

Finish

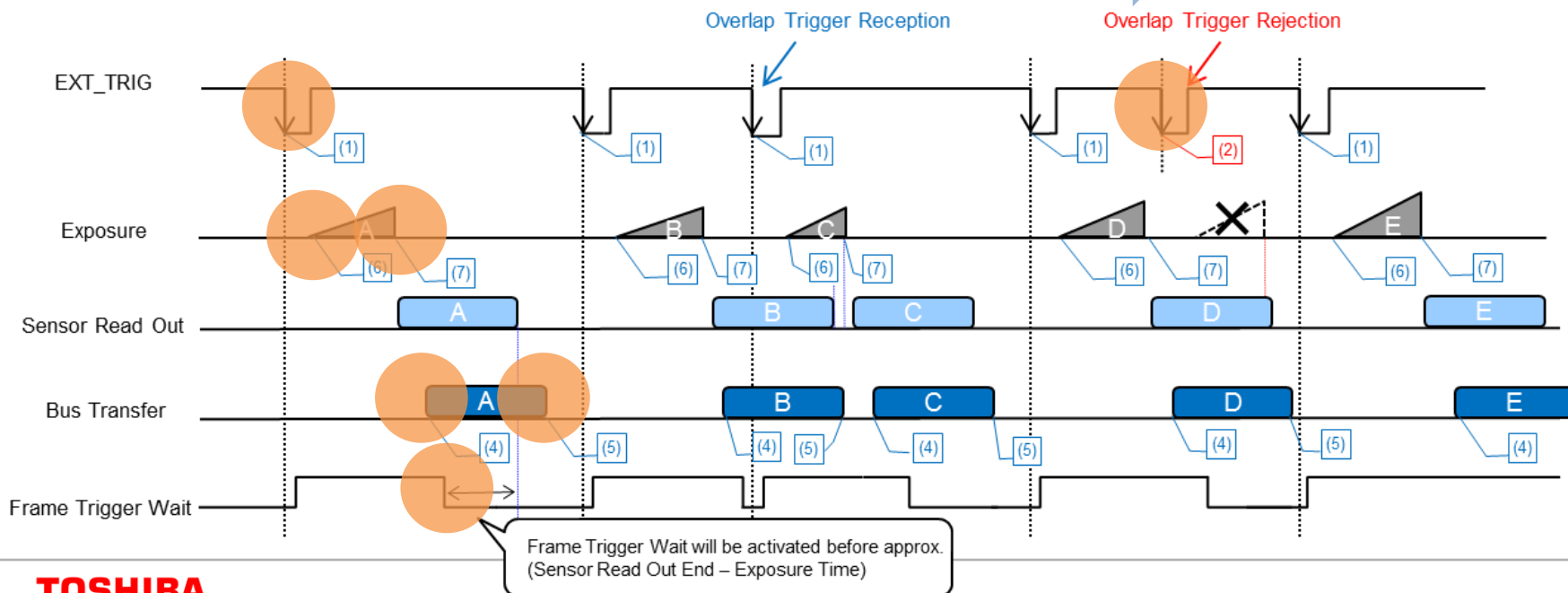
- Register R/W
- Image adjustment
- Software trigger
- etc.

No Delay Event Notification

- BU series equipped with our high-speed hardware IP has achieved **'No-Delay Event Notification'** for effective machine control.

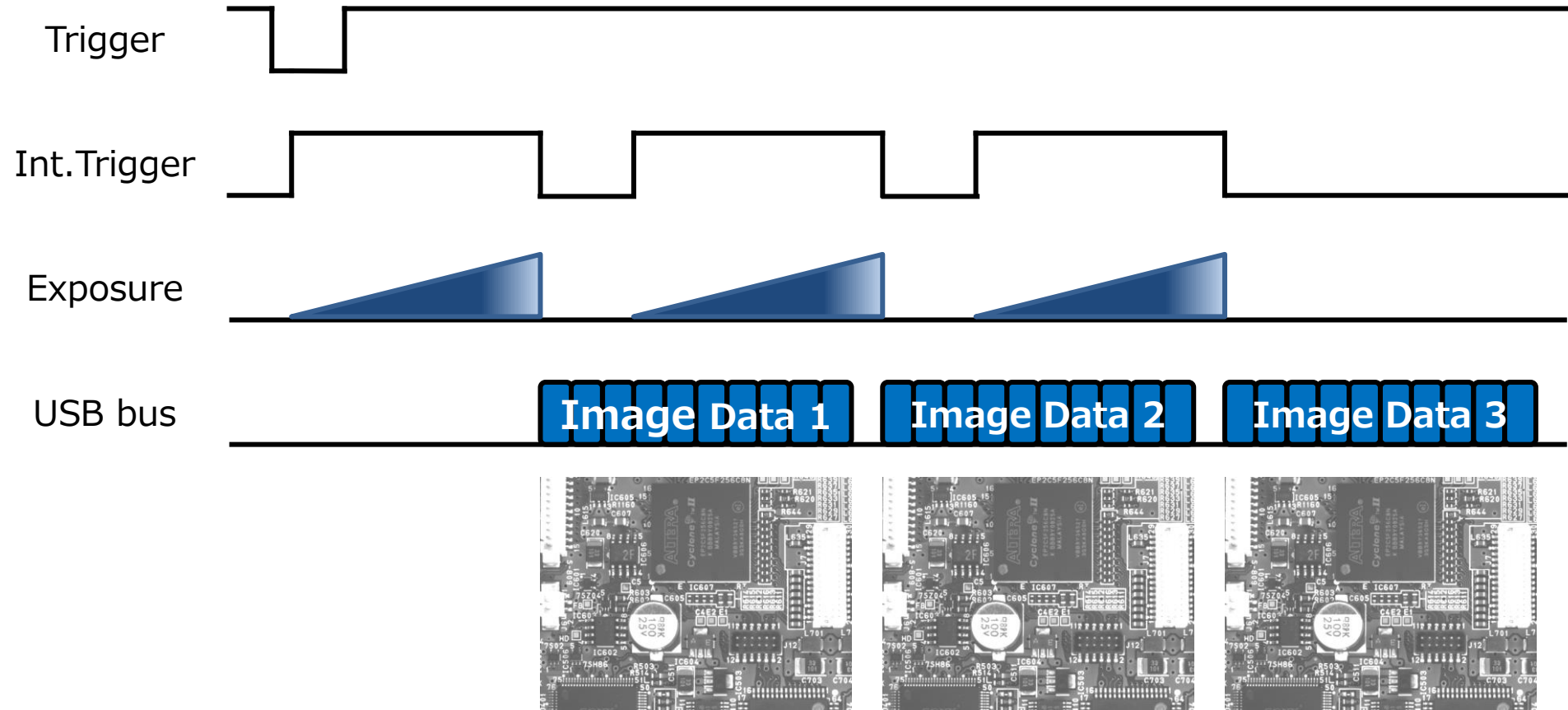


- (1) **Frame Trigger** : Reception of Frame Start Trigger
- (2) **Frame Trigger Error** : Rejection of Frame Start Trigger
- (3) **Frame Trigger Wait** : Start of waiting for Frame Start Trigger
- (4) **Frame Transfer Start**: Start of transferring Streaming data
- (5) **Frame Transfer End** : End of Transferring Streaming data
- (6) **Exposure Start** : Start of Exposure
- (7) **Exposure End** : End of Exposure



Bulk Trigger

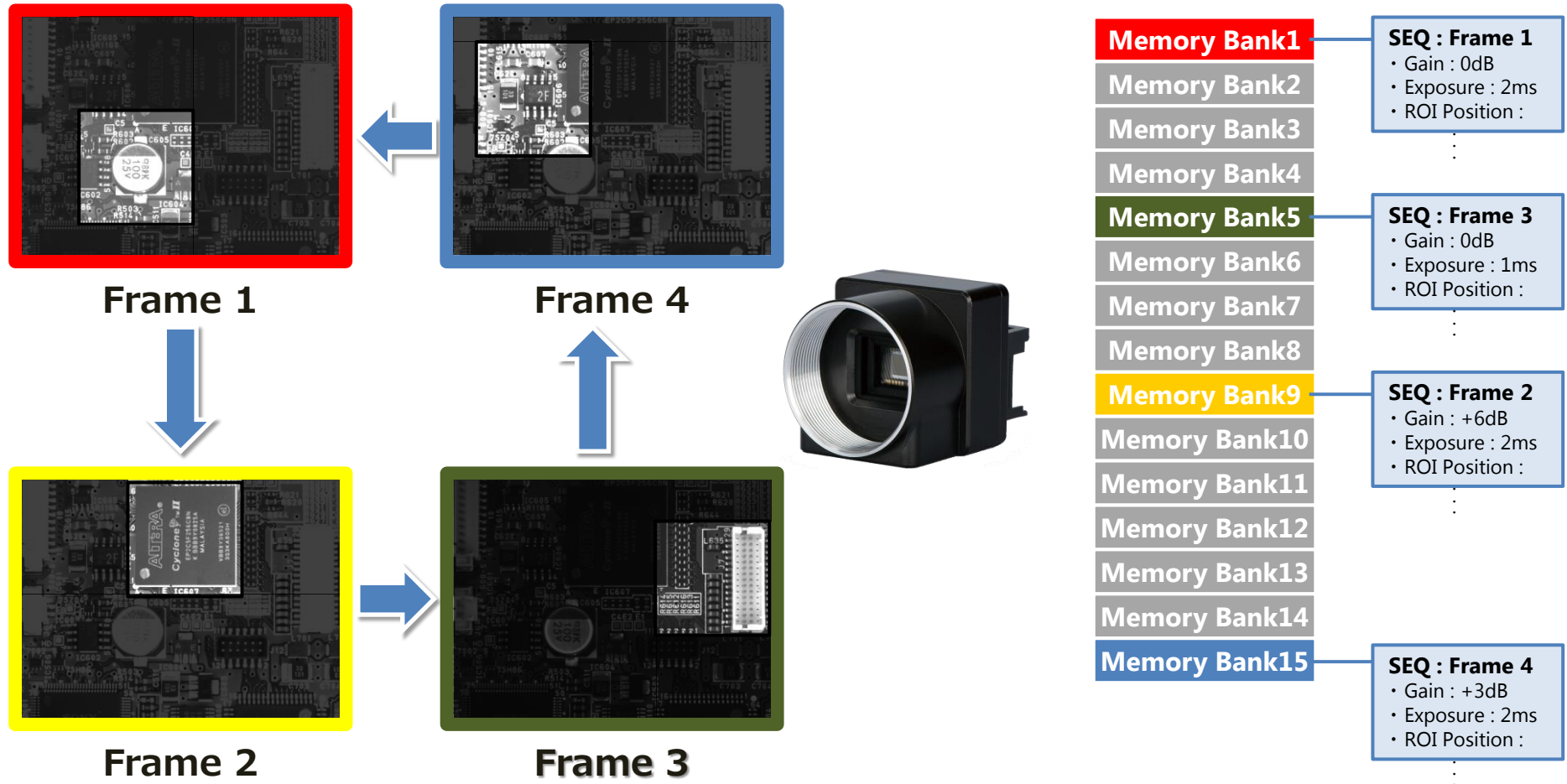
- Camera exposes and transfers multiple frames by a single trigger.



Sequential Shutter

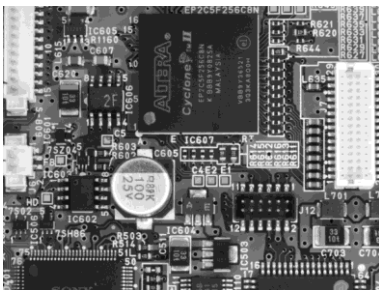
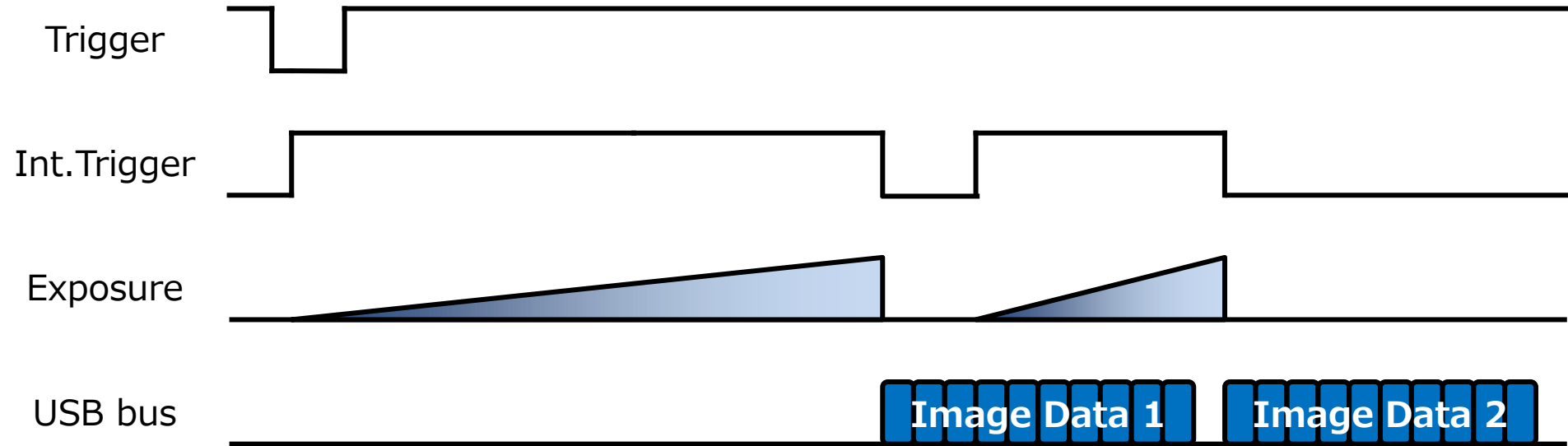
- BU Series can capture images sequentially while applying registered settings. (Gain, Exposure, ROI position, etc.) (CMOS model only).

Case study : Capture ROI with proper brightness to the subject.



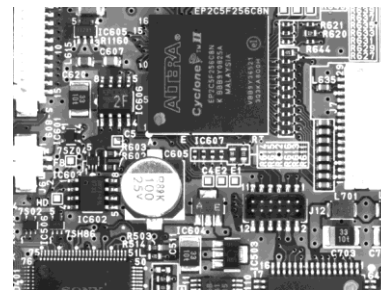
Bulk Trigger + Sequential Shutter

- Sequential Shutter mode can combine Bulk trigger (CMOS model only).
Case study : multiple different programmed exposures by one trigger input.

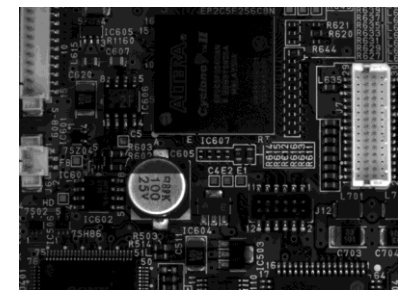


Wide dynamic range image

External Processing



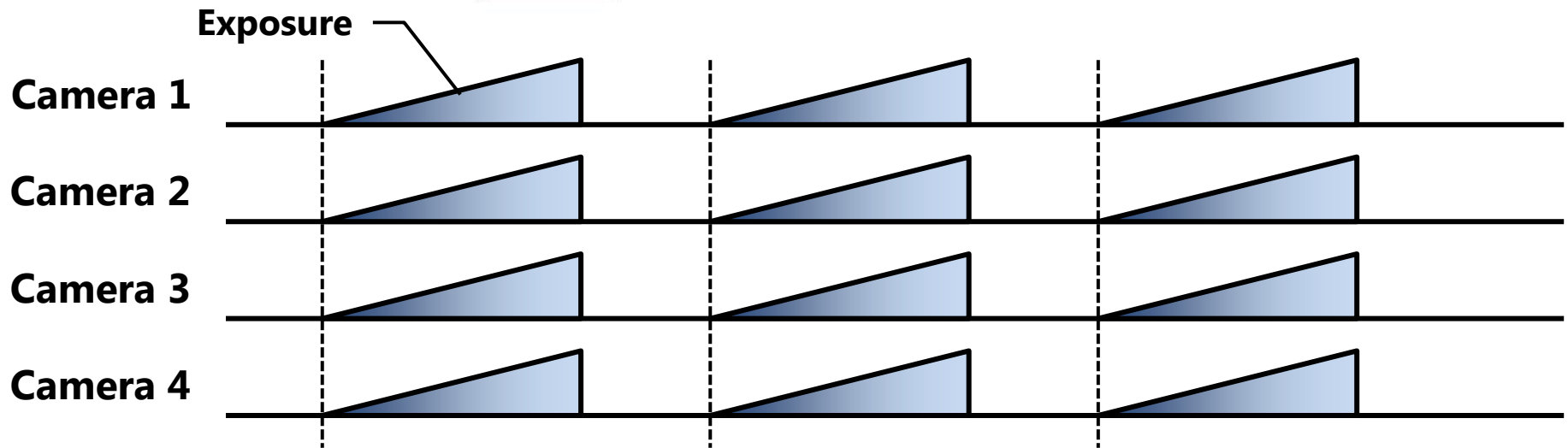
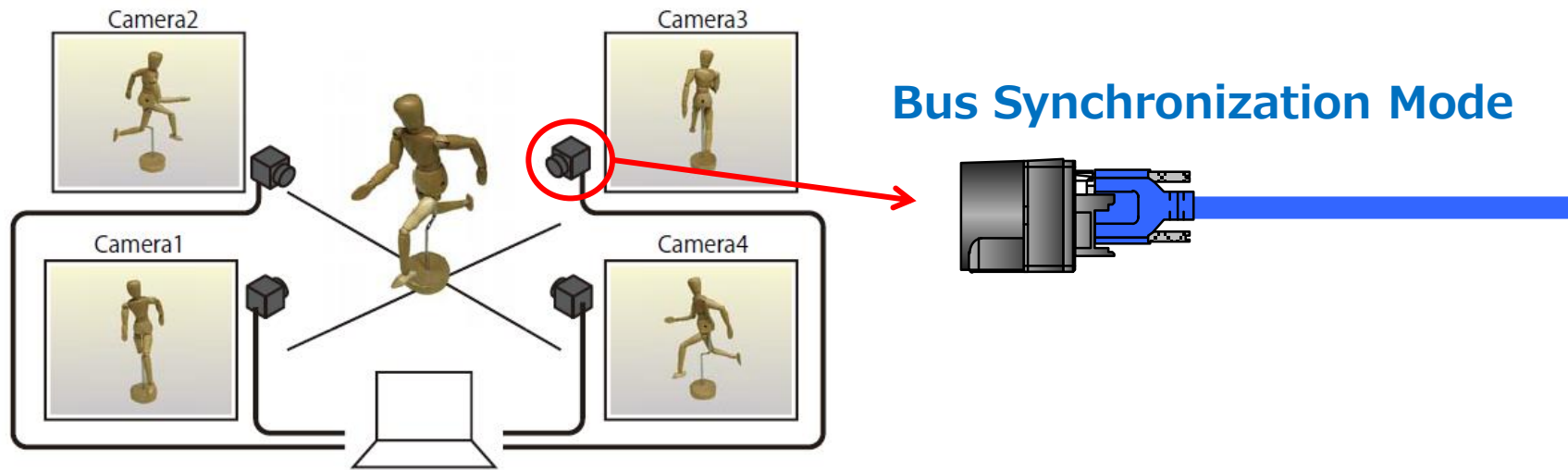
Long exposure image



Short exposure image

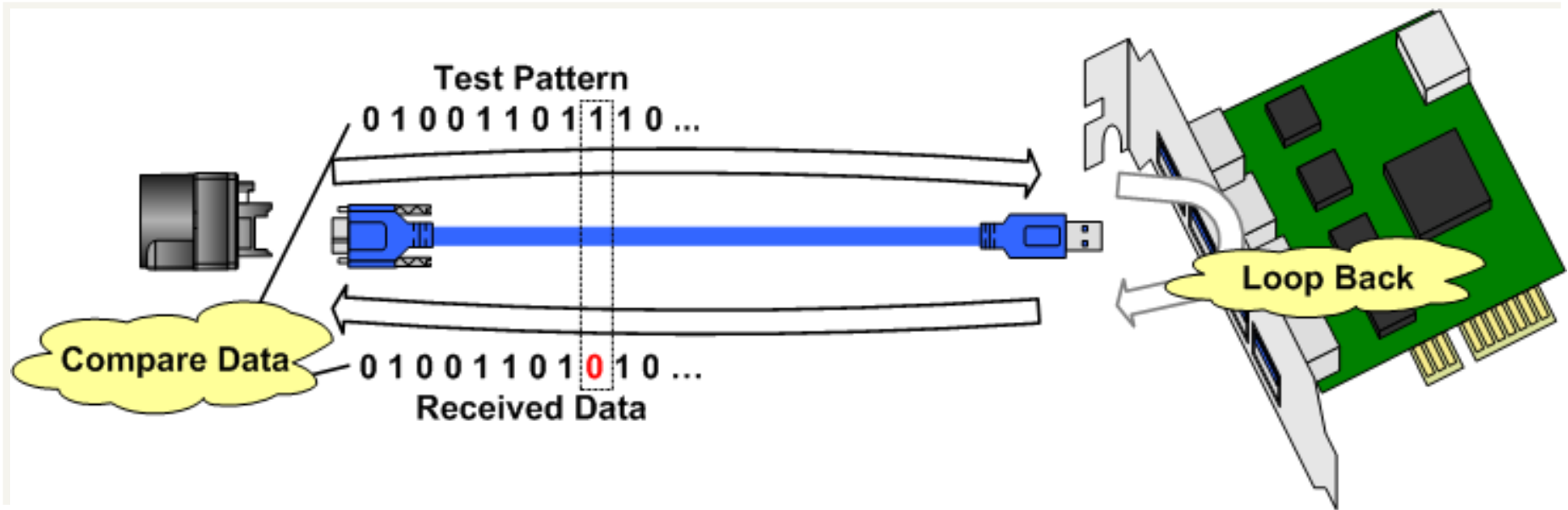
Bus Synchronization

- BU series have a function of synchronized exposure mode without trigger input.



BERT(Bit Error Rate Test) Function

- Camera generates Test Pattern and compares them with Received Loop Back Data. (CMOS model only)



You can evaluate cable quality by our Camera before you install the cable into your system.

CMOS model Features

■ Image buffer

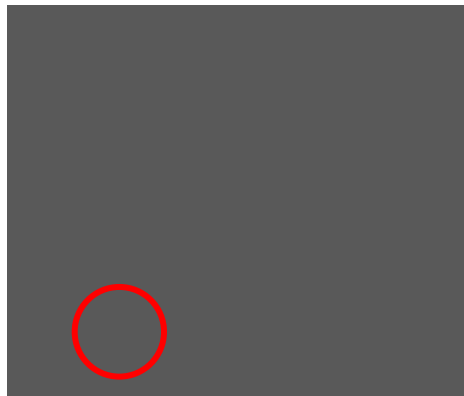
Image data can be stored temporarily to internal buffer memory, and read them out in arbitrary timing. The image buffer size is 64MByte.



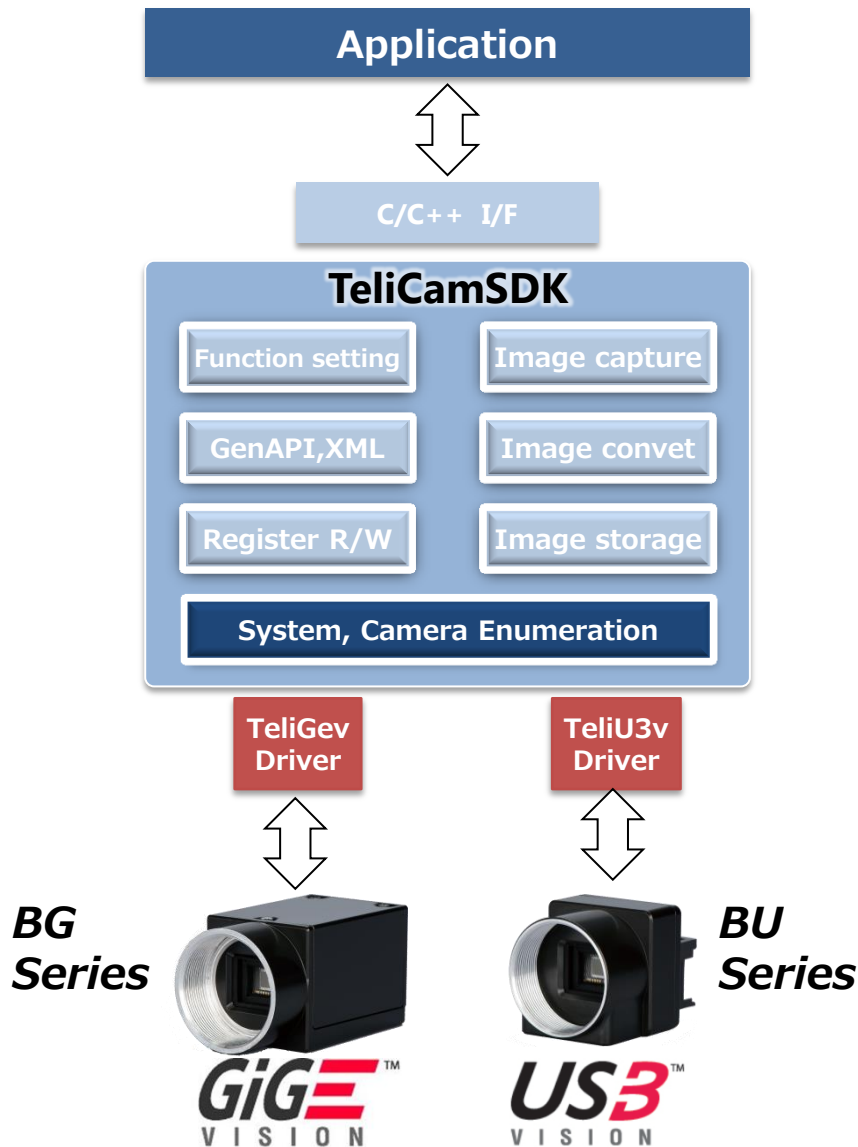
■ Defective Pixel Correction (On Board Correction)

The camera can correct defective pixels.

Corrected



TeliCamSDK



Easy to program development

Add the Software function
Reduce the development cost

performance and reliability

CPU load is reduced -> stable operating

Integration of interface

GigE SDK and USB3.0 SDK is integrated

Industrial protocol supported

BG series

GigEVision ver1.2

GenICam ver2.3

BU series

USB3Vision ver1.0

IIDC2 ver1.0.0

GenICam ver2.3

Manual

Please refer *StartUpGuide* for the manual of the install and sample code.

Please refer *LibraryManual* for the procedure of the function.

FAQ

FAQ is available on the Web site



Toshiba
Teli FAQ

The Solutions of Peripheral equipment

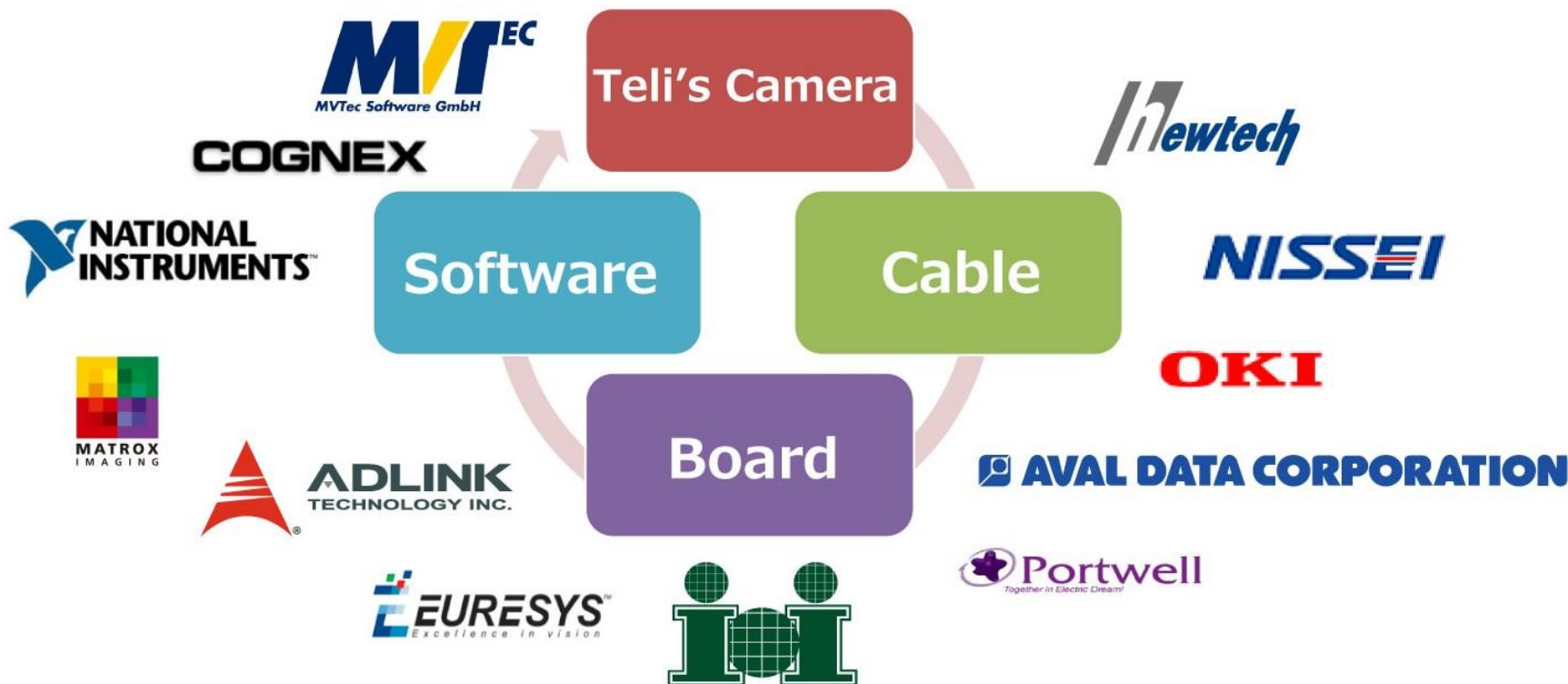


GiGE™
VISION

USB™
VISION



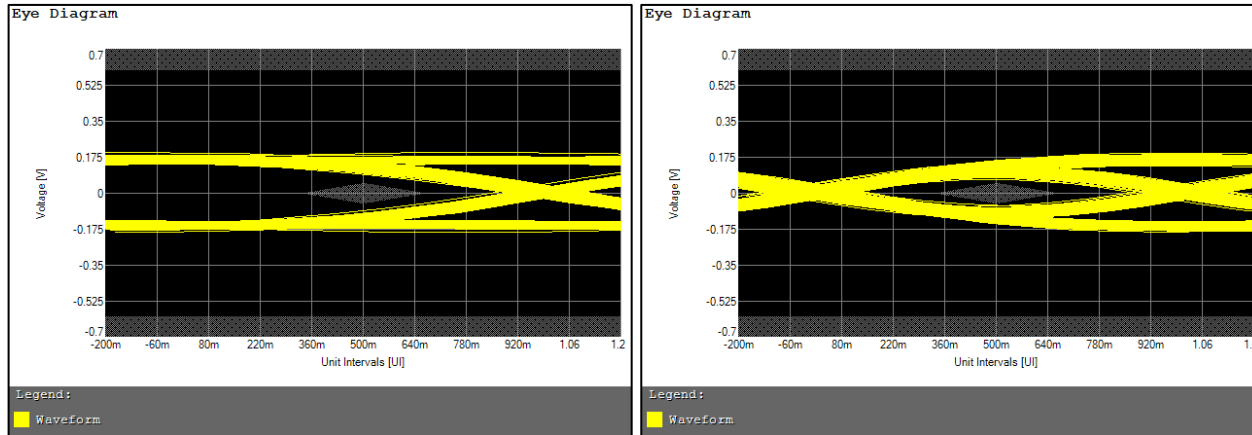
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Our reliability

Assured Signal Quality

- Signal Quality was verified by USB Compliance Test.



Test Name	Pass	Spec Range
LFPS Peak-Peak Differential Output Voltage	✓	800.0 mV <= VALUE <= 1.2000 V
LFPS Period (tPeriod)	✓	20.0000 ns <= VALUE <= 100.0000 ns
LFPS Burst Width (tBurst)	✓	600.0 ns <= VALUE <= 1.4000 μs
LFPS Repeat Time Interval (tRepeat)	✓	6.0000 μs <= VALUE <= 14.0000 μs
LFPS Rise Time	✓	VALUE <= 4.0000 ns
LFPS Fall Time	✓	VALUE <= 4.0000 ns
LFPS Duty cycle	✓	40.0000 % <= VALUE <= 60.0000 %
LFPS AC Common Mode Voltage	✓	VALUE <= 100.0 mV
TSSC-Freq-Dev-Min	✓	TSSCMin ppm <= VALUE <= TSSCMax ppm
TSSC-Freq-Dev-Max	✓	-300.000 ppm <= VALUE <= 300.000 ppm
SSC Modulation Rate	✓	30.000000 kHz <= VALUE <= 33.000000 kHz
SSC Slew Rate	✓	VALUE <= 10.000 ms
Far End Random Jitter (CTLE ON)	✓	VALUE <= 230 mUI
Far End Maximum Deterministic Jitter (CTLE ON)	✓	VALUE <= 430 mUI
Far End Total Jitter at BER-12 (CTLE ON)	✓	VALUE <= 660 mUI
Far End Template Test (CTLE ON)	✓	VALUE = 0.000
Far End Differential Output Voltage (CTLE ON)	✓	100.0 mV <= VALUE <= 1.2000 V

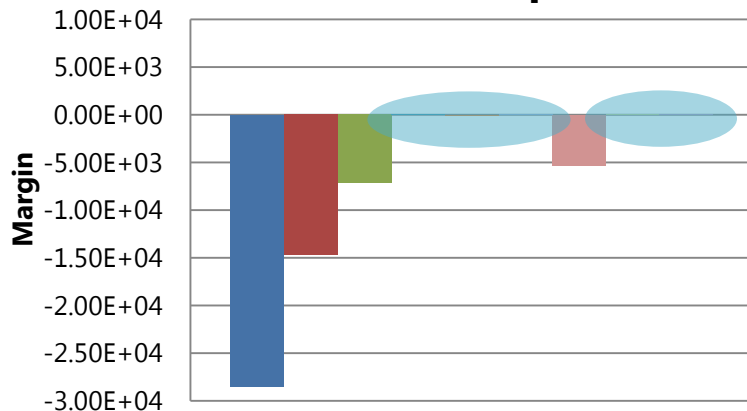


Cable Quality

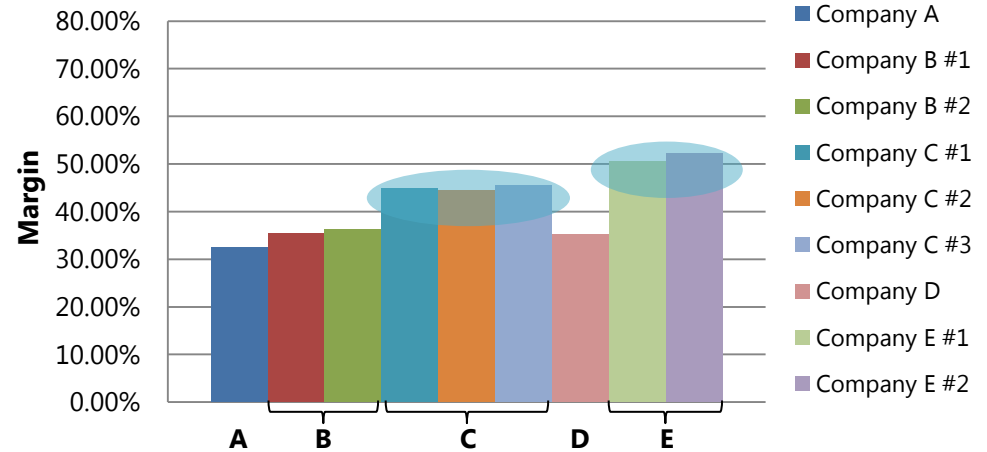
- Cable selection is the most important matter for USB3.0 application.
- We can conduct the cable quality test in our lab.



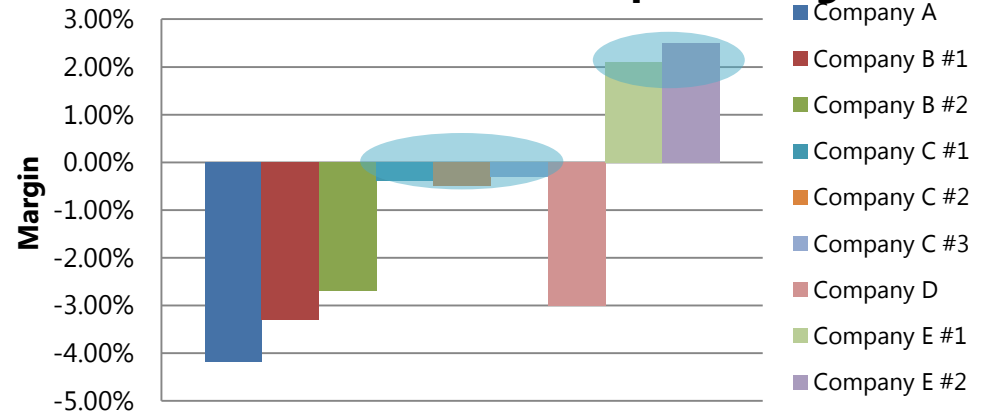
Far End Template Test



Far End Total Jitter at BER-12



Far End Differential Output Voltage



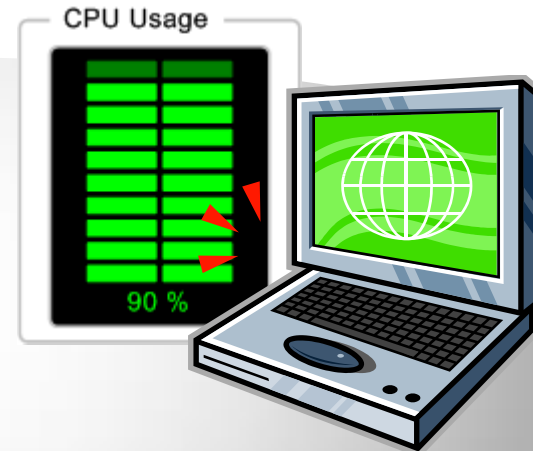
Our Efforts for Robustness

■ Image Buffering

BU series offers two ways of achieving stable image transfer.

- On Board Frame Buffer : CMOS Model
- Unique Buffer Flow Control : All Model

When CPU Usage is high



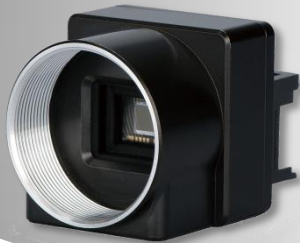
Our Unique Buffer Flow Control compensates for the volatility of the USB Bus

Our Efforts for Robustness

■ Error Handling

NOT ONLY USB3.0 standard retry,
BUT BU series also employs our Unique Error Handling.

*When Error Rate is high
(Bad Signal Quality)*



**Retry
packet**

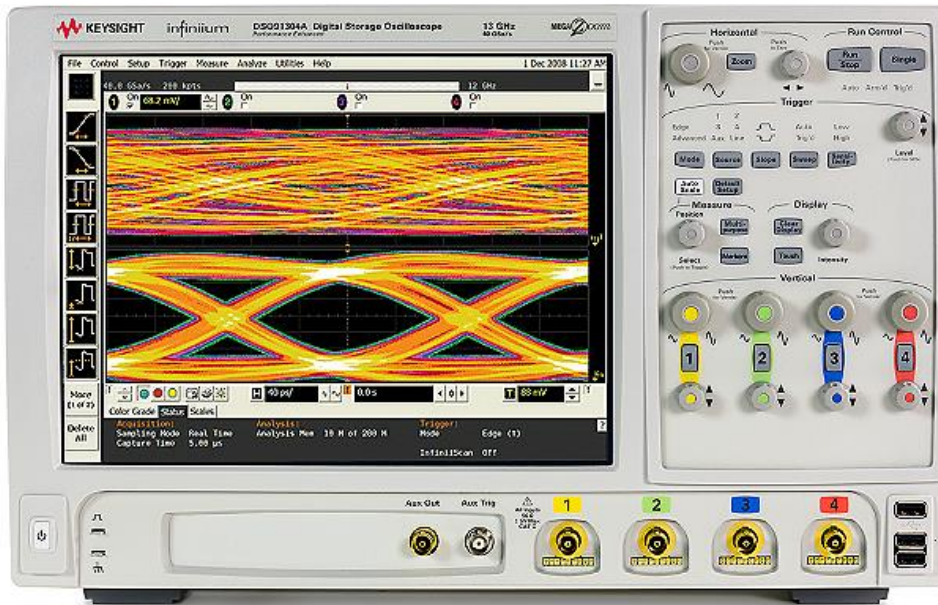


Good



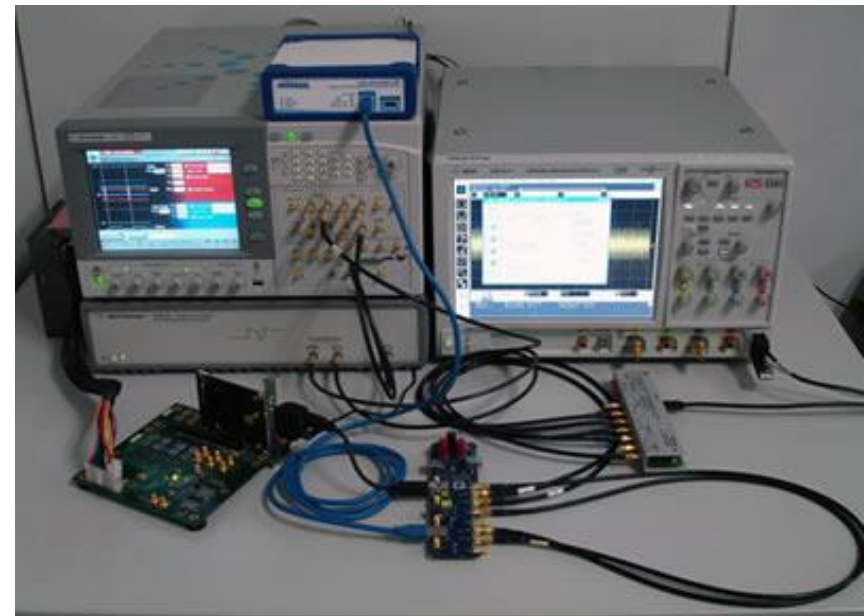
***Our Camera is expected to
recover from frequent error occurrence.***

USB3 Test Environments



Keysight Technologies
DSO91304A Infiniium High Performance Oscilloscope

- USB3 compliance test
- USB3 Bus Analyzer



Our assessment systems

ISO 9001
ISO 14001
OHSAS 18001
BUREAU VERITAS
Certification



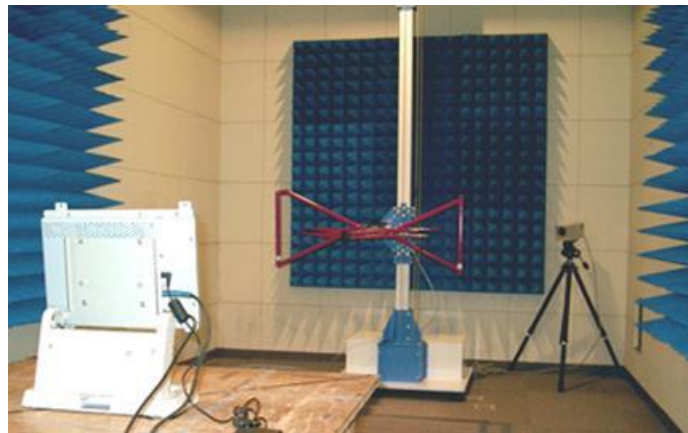
Toshiba Teli " Reliability assessment center "



Radio darkroom and Shield room

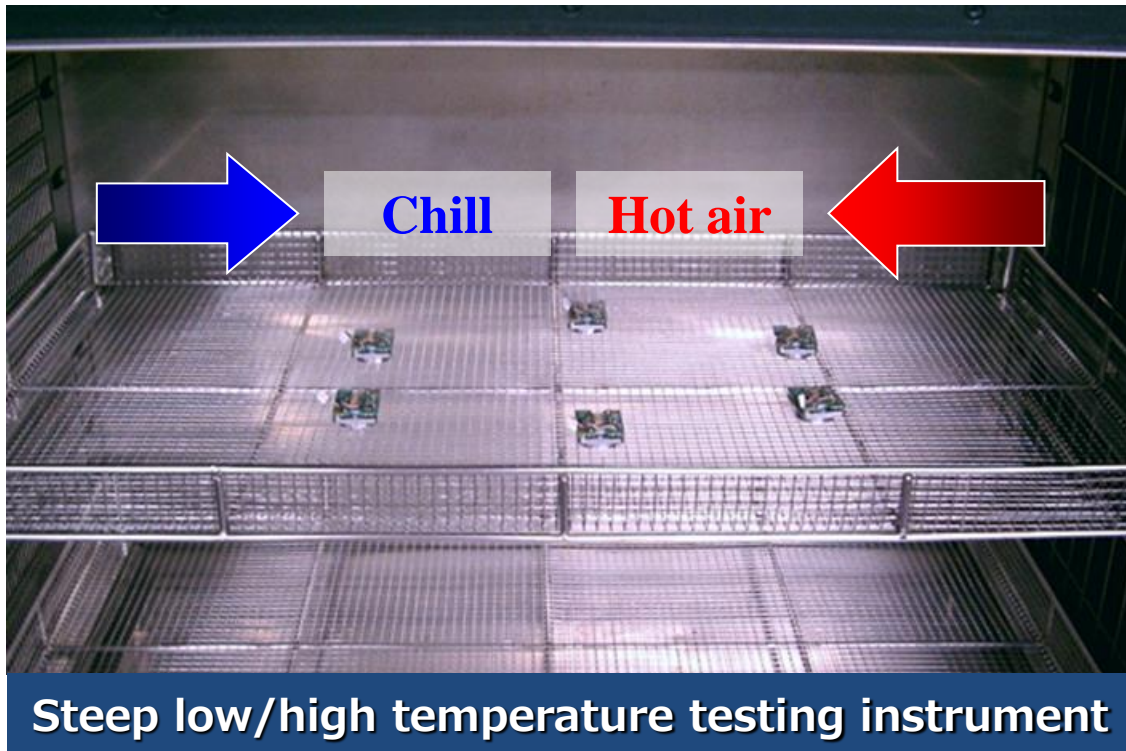


EMC measurement system



Inside the Radio darkroom

Toshiba Teli " Reliability assessment center "



Toshiba Teli " Special testing laboratory "



Vibration chip test equipment



Home thermal humid equipment

Our lineup

USB3 Vision Camera Lineup

Model	BU030	BU031	BU080	BU130	BU205M	BU238M	BU406M	DU657M	
	BU030C			BU130C	BU205MC	BU238MC	BU406MC	DU657MC	
	BU030CF			BU130CF	BU205MCF	BU238MCF	BU406MCF		BU1203MCF
Imager	CCD	CCD	CCD	CCD	GS-CMOS	GS-CMOS	GS-CMOS	GS-CMOS	RS-CMOS
Imager type	ICX424	ICX414	ICX204	ICX445	CMV2000	IMX174	CMV4000	Original	IMX226
Pixel	0.3M 640×480	0.3M 640×480	0.8M 1024×768	1.3M 1280×960	2M 2048×1088	2.3M 1920×1200	4M 2048×2048	6.5M 2560×2560	12M 4000×3000
Optical format	1/3 type	1/2 type	1/3 type	1/3 type	2/3 type	1/1.2 type	1 type	1.1 type	1/1.7 type
Pixel size	7.4um	9.9um	4.65um	3.75um	5.5um	5.86um	5.5um	5.0um	1.85um
Aspect ratio	4 : 3	4 : 3	4 : 3	4 : 3	2 : 1	16 : 10	1 : 1	1 : 1	4 : 3
Frame rate	125fps	125fps	40fps	30fps	170fps	165fps	90fps	55fps	T.B.D.
Original IP core	X	X	X	X	X	X	X	X	X
Event notifications	X	X	X	X	X	X	X	X	X
Bulk trigger	X	X	X	X	X	X	X	X	
Sequential shutter					X	X	X	X	
Bus synchronization	X	X	X	X	X	X	X	X	X
Image buffer					X	X	X	X	X
External dimension	□29×13mm	□29×13mm	□29×13mm	□29×13mm	□29×16mm	□29×16mm	□29×16mm	□40×35mm	□29×16mm
Mass	27g	27g	27g	27g	32g	32g	32g	T.B.D.	32g
Production	Available	Available	Available	Available	Available	Available	Available	CY2015 1Q	CY2015 2Q

Our future

Relationship with Sensor Manufacturers

Sony



Panasonic



TOSHIBA TELIC CORPORATION



TELEDYNE DALSA



e2v

ON Semiconductor®



Sony's Next Generation GS-CMOS Sensor

Industrial features
High frame rate

Pregius

The Pregius is global shutter pixel technology for active pixel-type CMOS image sensors that use Sony's low-noise CCD structure, and realizes high picture quality.

Pixel Size
□ **3.45um**

High sensitivity
Low noise
High dynamic range

※ "Pregius" is a trademark of Sony Corporation.

Camera Lineup Using Sony's GS-CMOS

Model	BU238M	DU302M	DU505M	DU806M	DU1207M
	BU238MC	DU302MC	DU505MC	DU806MC	DU1207MC
Imager	Sony's global shutter CMOS image sensor Pregius				
Imager type	IMX174	IMX252	IMX250	IMX255	IMX253
Pixel	2.3M 1920×1200	3.1M 2048×1536	5.0M 2456×2048	8.8M 4096×2160	12.0M 4000×3000
Optical format	1/1.2 type	1/1.8 type	2/3 type	1 type	1.1 type
Pixel size	□ 5.86um	□ 3.45um			
Aspect ratio	16 : 10	4 : 3	6 : 5	17 : 9	4 : 3
Frame rate	165fps	120fps	75fps	40fps	30fps
Interface	USB3.0 / USB3 Vision				
Lens mount	C-mount				
External dimensions	□ 29mm×16mm	□ 29mm×T.B.D.		T.B.D	
Mass	32g	T.B.D		T.B.D	
Status	MP : Available	ES : CY2015 3Q	ES : CY2015 2Q	ES : CY2015 4Q	ES : CY2015 3Q

※"This plan is subject to change without notice.

**Visit our booth and
Look at our advanced cameras!**



**Hall 1
Booth
1D53**

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- GenICam™ is a trademark owned by EMVA.
- IIDC2 is a machine vision industry standards hosted by JIIA.
- USB is an industry standard hosted by USB-IF.

- All other trademarks are the marks of their respective owners.

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