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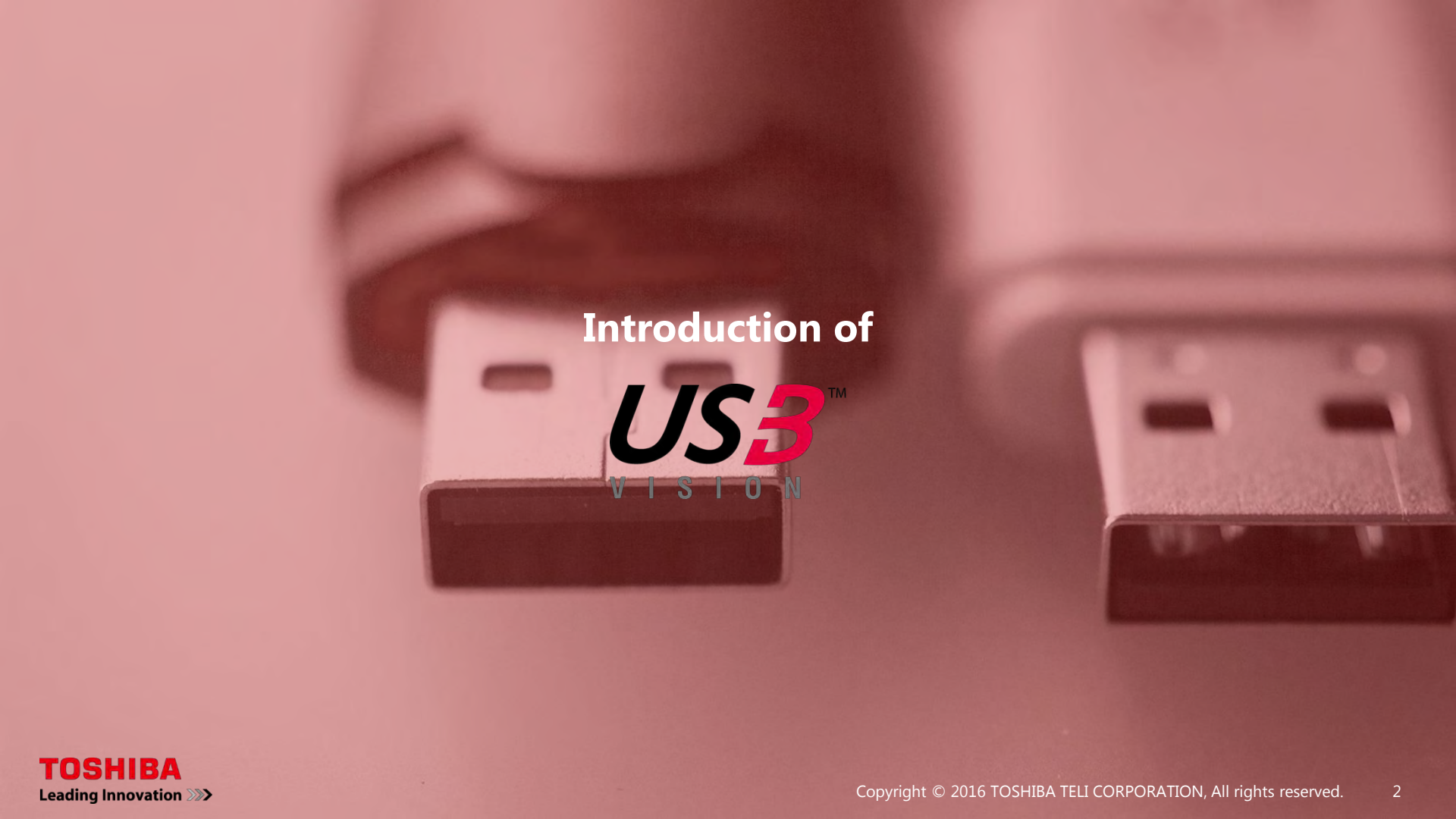
USB3 Vision & TOSHIBA TELI

: New insight. Great benefits.

TOSHIBA TELI CORPORATION



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USB3™ VISION

Next Standard Interface for Machine vision

The Standard for the USB3.0 interface in the machine vision industry hosted by the AIA (Automation imaging Association)

High Bandwidth

High Reliability

Low System Cost

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High Bandwidth

USB3.0

- **High bandwidth in excess of 440 MB/s**

USB3 Vision adopts suitable packet format for DMA and Burst Transfer.

- **Taking advantage of high speed image sensor**
- **High bandwidth transfer by burst transfer**

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

GigE Vision	Max. frame rate	50 fps	USB3 Vision	Max. frame rate	165 fps
	Data rate	115 MB/s		Data rate	380 MB/s

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

GigE Vision	Max. frame rate	25 fps	USB3 Vision	Max. frame rate	90 fps
	Data rate	105 MB/s		Data rate	377 MB/s

USB3™ VISION

Next Standard Interface for Machine vision

The Standard for the USB3.0 interface in the machine vision industry hosted by the AIA (Automation imaging Association)

High Bandwidth

High Reliability

Low System Cost

Reliability & Stability

USB3.0

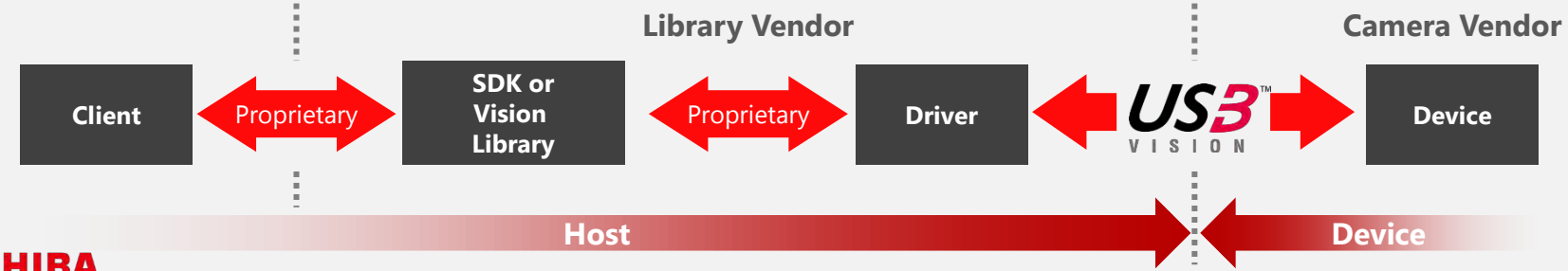
- Low CPU usage by DMA transmission
- Prevent dispersion of capturing time
- Structure of the USB3.0 offers reliable system.

DMA Transmission

As USB3.0 cameras comply with USB3 vision output image data at DMA transmission(Direct Memory Access), CPU usage is hugely reduced and achieve to conduct stability capturing.

Reliability System

The structure of the USB3 vision Standard is significant advantages for embedded system in terms of managing complete image transmission from host side software.



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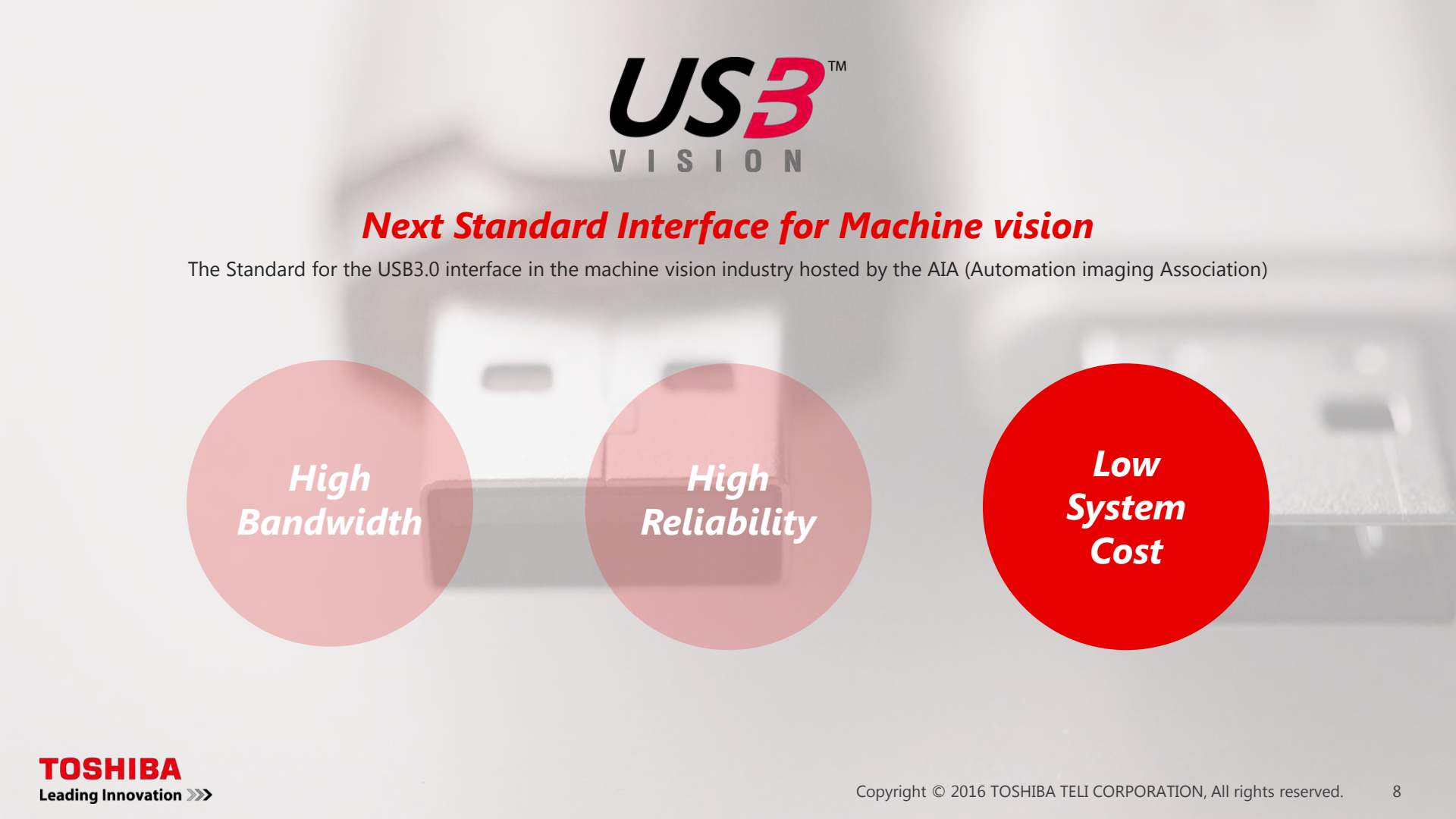

Next Standard Interface for Machine vision

The Standard for the USB3.0 interface in the machine vision industry hosted by the AIA (Automation imaging Association)

High Bandwidth

High Reliability

Low System Cost

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Low System Cost

USB3 VISION™

USB3.0 Peripheral accessories

- No need power supply
- Low cost accessories（Cable and FGB)
- USB3.0 FGB embedded in standard PC

	USB3.0	GigE	1394.b	Camera Link
Frame Grabber	Low	Low	Medium	High
Cable	Low	Medium	Medium	High
Power Supply	No Need	Medium	No Need	High
Camera	Low	Low	Medium	High
4-port frame grabber	Low	Low	Low	High
Cost for 4 camera solution	Low	Medium	Medium	High

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Low System Cost

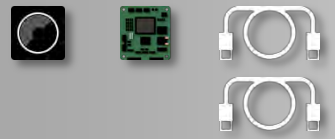
Adoption of USB3.0 configuration

Camera Link camera

USB3.0 camera

■ Single camera

Camera Card



CameraLink Medium Configuration (4Gbps)

1 camera
1 card
2 cables

■ Single camera

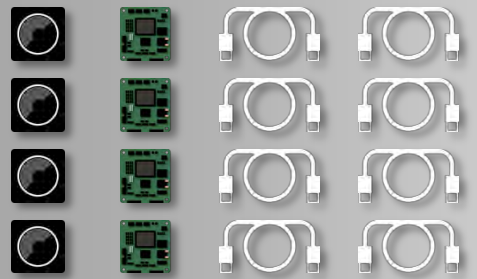
Camera Card

USB3.0 (4Gbps)

1 camera
1 card
1 cable

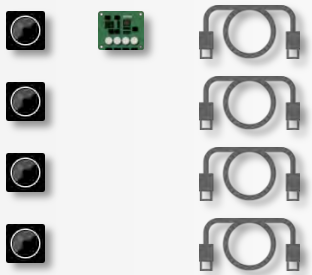
An equivalent performance can be achieved by USB3 simple configuration.

■ Multi cameras



4 cameras
4 cards
8 cables

■ Multi cameras



4 cameras
1 card
4 cables

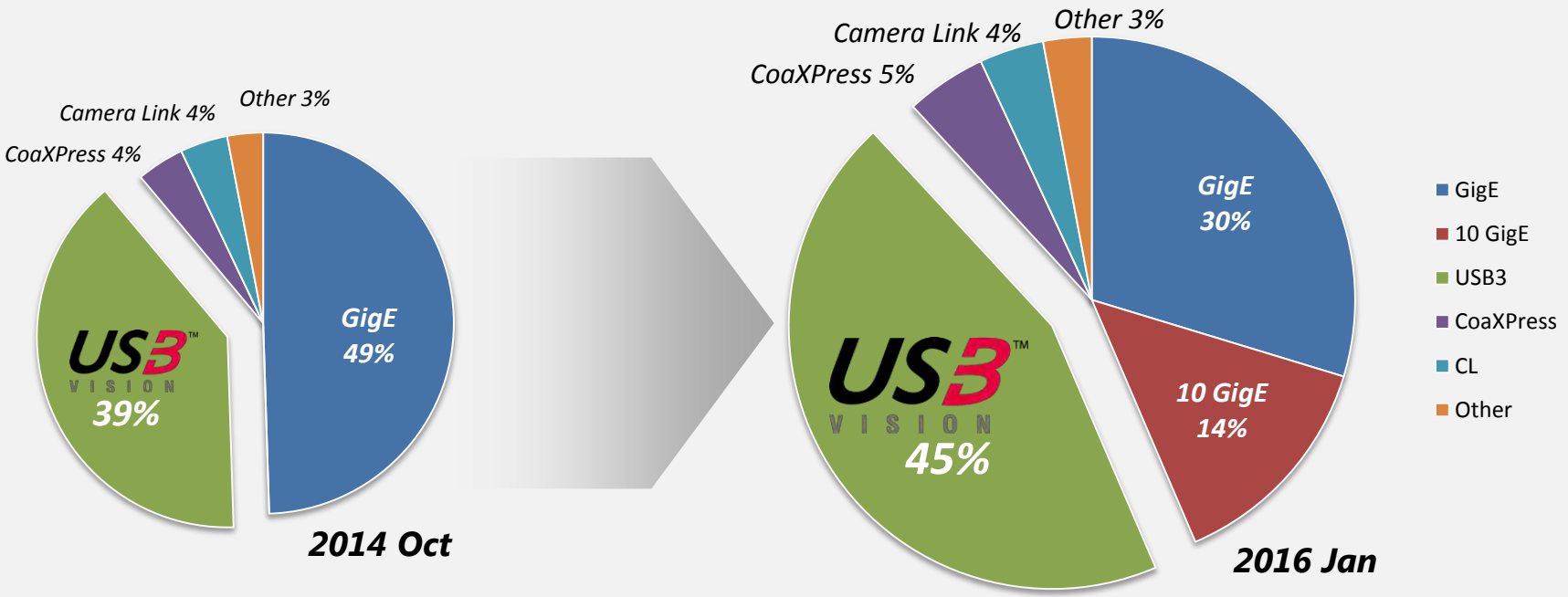
Lower cost can be achieved for multi cameras configuration.

Other Benefit of

- **Easy-to-use plug and play interface**
- **Power and data over the same passive cable**
  (more length with active cables)
- **Uses GenICamTM generic programming interface**
  USB3 vision and GeniCam promise users stability and low latency for image transmission and camera control
- **Improved Robustness than USB2.0**
  Low bit error rate in Physical Layer
  Enhanced retry mechanism in Link and Protocol Layer

Market trend of

Dramatic market change



USB3 Vision will be most preferable interface according to a survey conducted by VSD in 2016, January

Reference: Vision System Design Magazine Web Jan, 2016

TELI's Advanced Technologies

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BU Series

IMAGING REVOLUTION

USB3 VISION™

WARRANTY 3 YEARS

Compact body

Light Weight

Applying CCD and CMOS Sensor

LED Status Indicator

USB3.0 Micro B

eCON Connector

- GPIO 2 Output 1 Input

Screw lock

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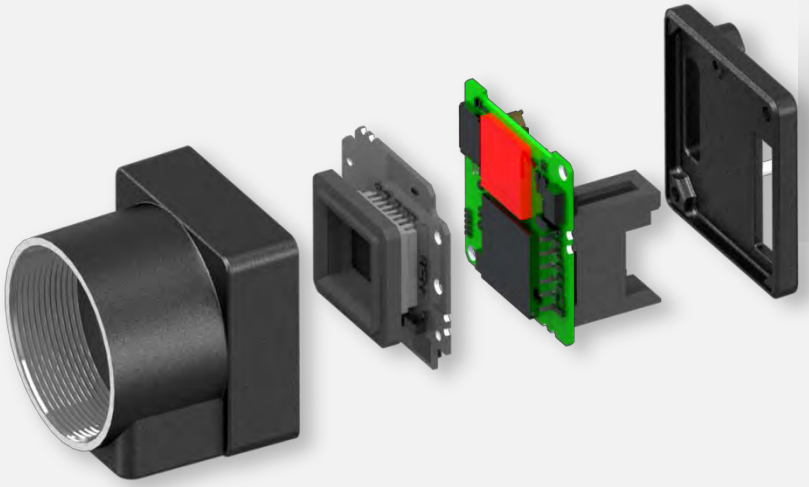
Compact Body & Light Weight

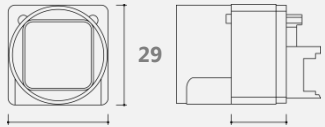
■ *Toshiba Teli Original IP Core*

High level of hard logic integration is archived by developing original IP core.
As the parts structures are reviewed by advanced FPGA processing, the number of wafer board structures are reduced.



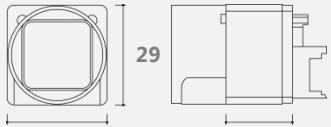
27g

CCD model



32g

CMOS model



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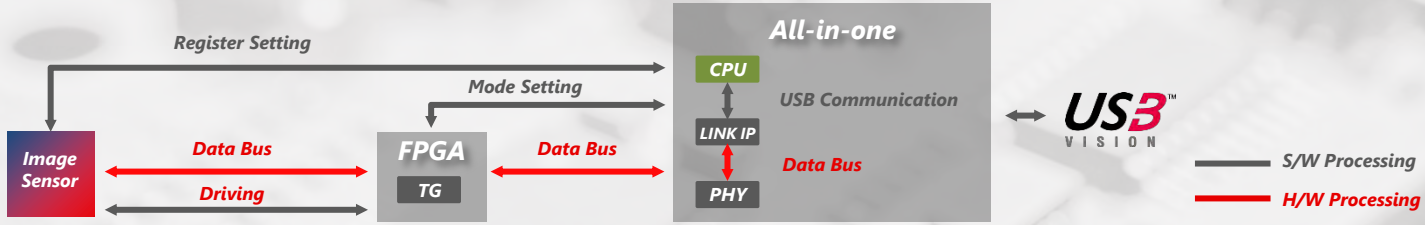
Toshiba Teli Original H/W core

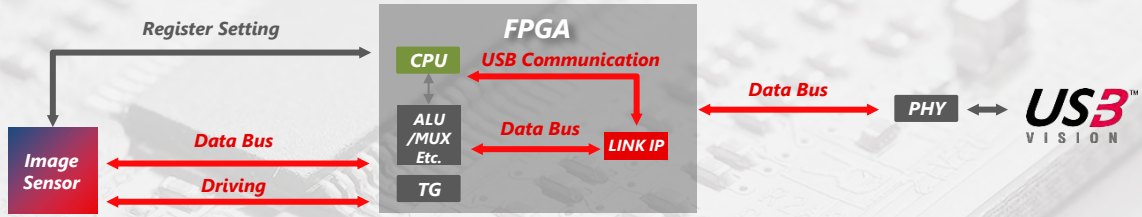
■ FPGA+All-in–one USB Chip

General (All-in -one)



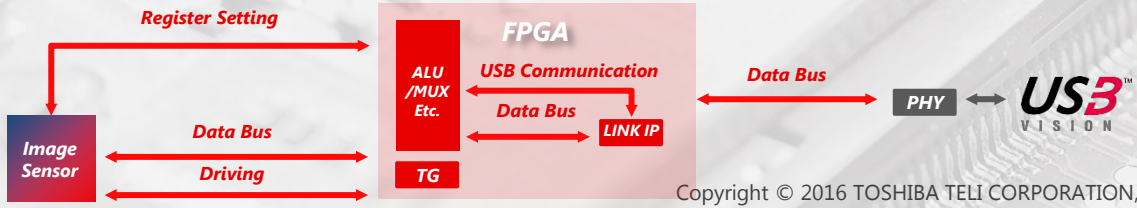
■ Generic USB IP

Down Sizing



■ Toshiba Teli's USB IP Core - All H/W Processing-

High Speed



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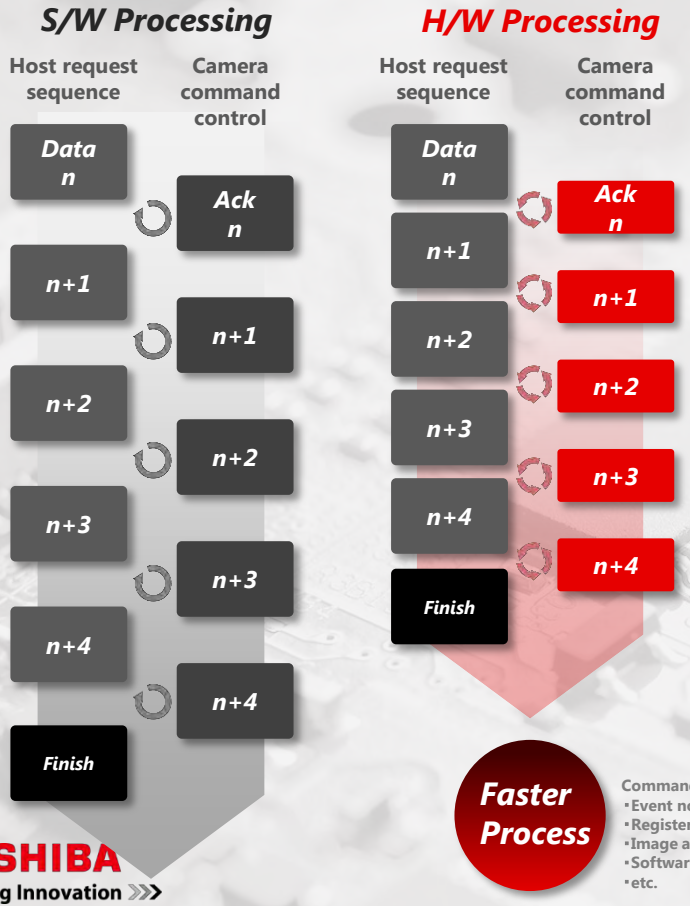
High Speed Response



	Read register	Software Trigger (Write register)
FPGA+All-in-one USB Chip	223.0-546.0 us	314.0-324.0 us
Generic USB IP	40.8-44.6 us	46.9-71.0 us
Toshiba Teli's USB IP Core	2.2-5.0 us	2.2-5.4 us

100 times faster

10 times faster

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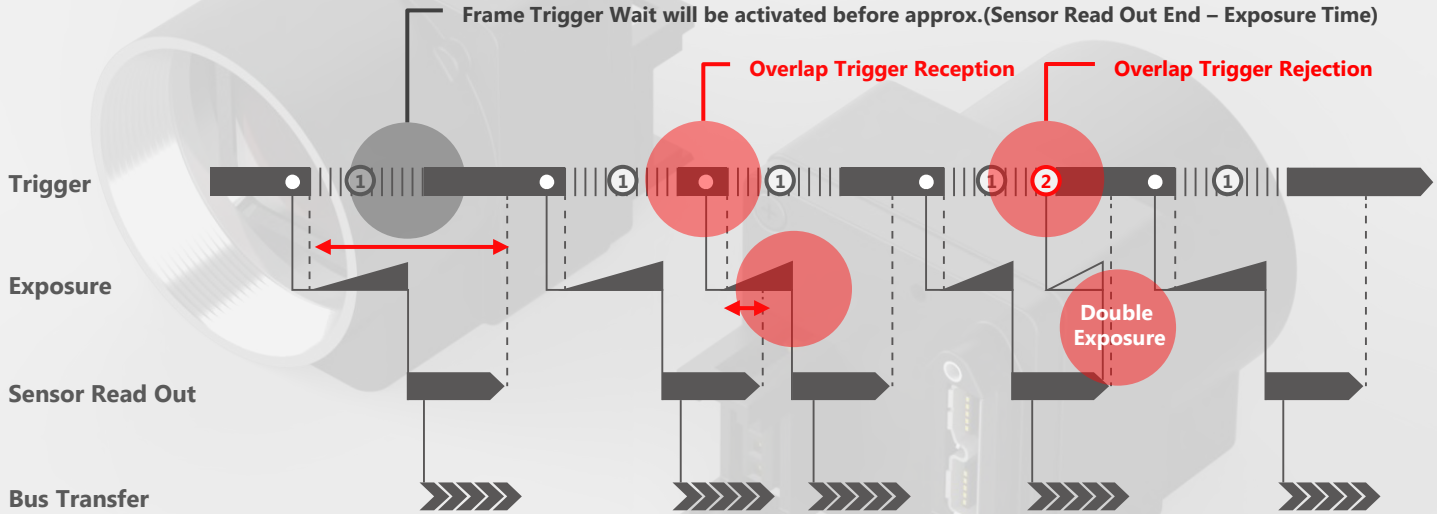
No Delay Event Notification

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



① **Frame Trigger Wait :** Start of waiting for Frame Start Trigger
② **Frame Trigger Error :** Rejection of Frame Start Trigger

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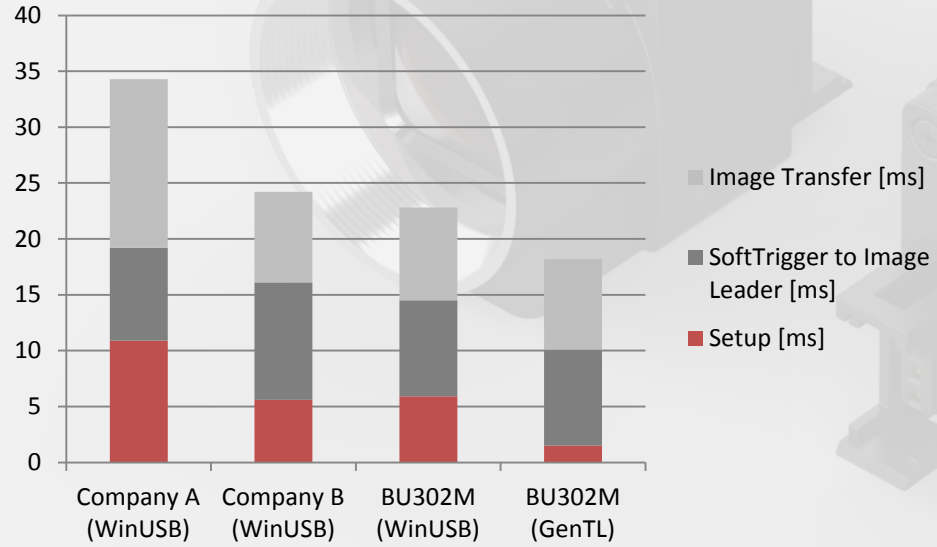
Benefit from our advanced technology

Benchmark test of response time with HALCON proved that our BU302M is xxx times faster than major competitor's camera.
It means that our advanced technology gives great benefit to customer systems.



	BU302M	Company A	Company B
Width x Height	2048 x 1536	2048 x 1536	2048 x 1536 (ROI)
PixelFormat	Mono8	Mono8	Mono8
Payload[byte]	3,145,728	3,145,728	3,145,728
ExposureTime[us]	8,000	8,000	8,000
Frame Rate[fps]	120	118.3	120

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Real Time camera control

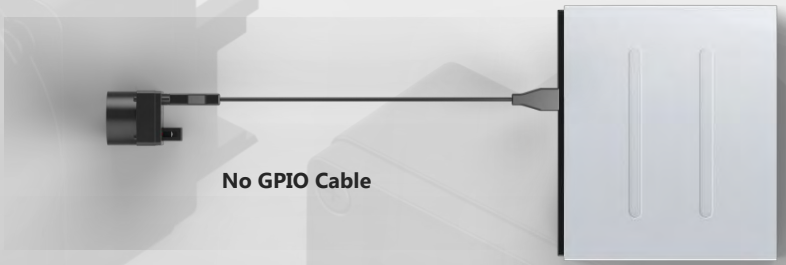
General IP core are not able to be realised real time processing without a GPIO cable and an industrial IO card.

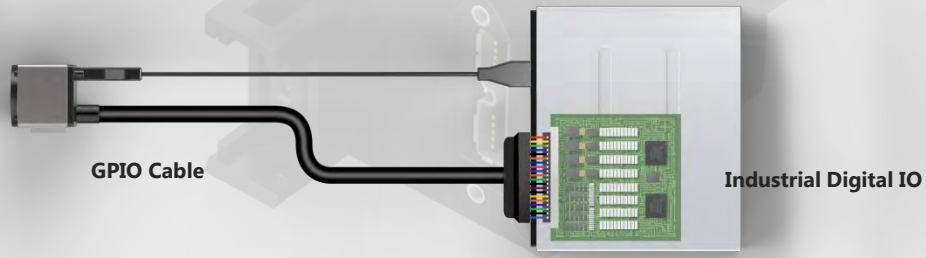
■ ***Toshiba Teli Original IP Core***

The real time handshake provides attractive total cost as unnecessary of a GPIO cable and an industrial IO card.

■ ***General IP Core***

General IP core are not able to be realised real time processing without a GPIO cable and an industrial IO card.





Not necessary
-GPIO Cable
-Industrial Digital IO

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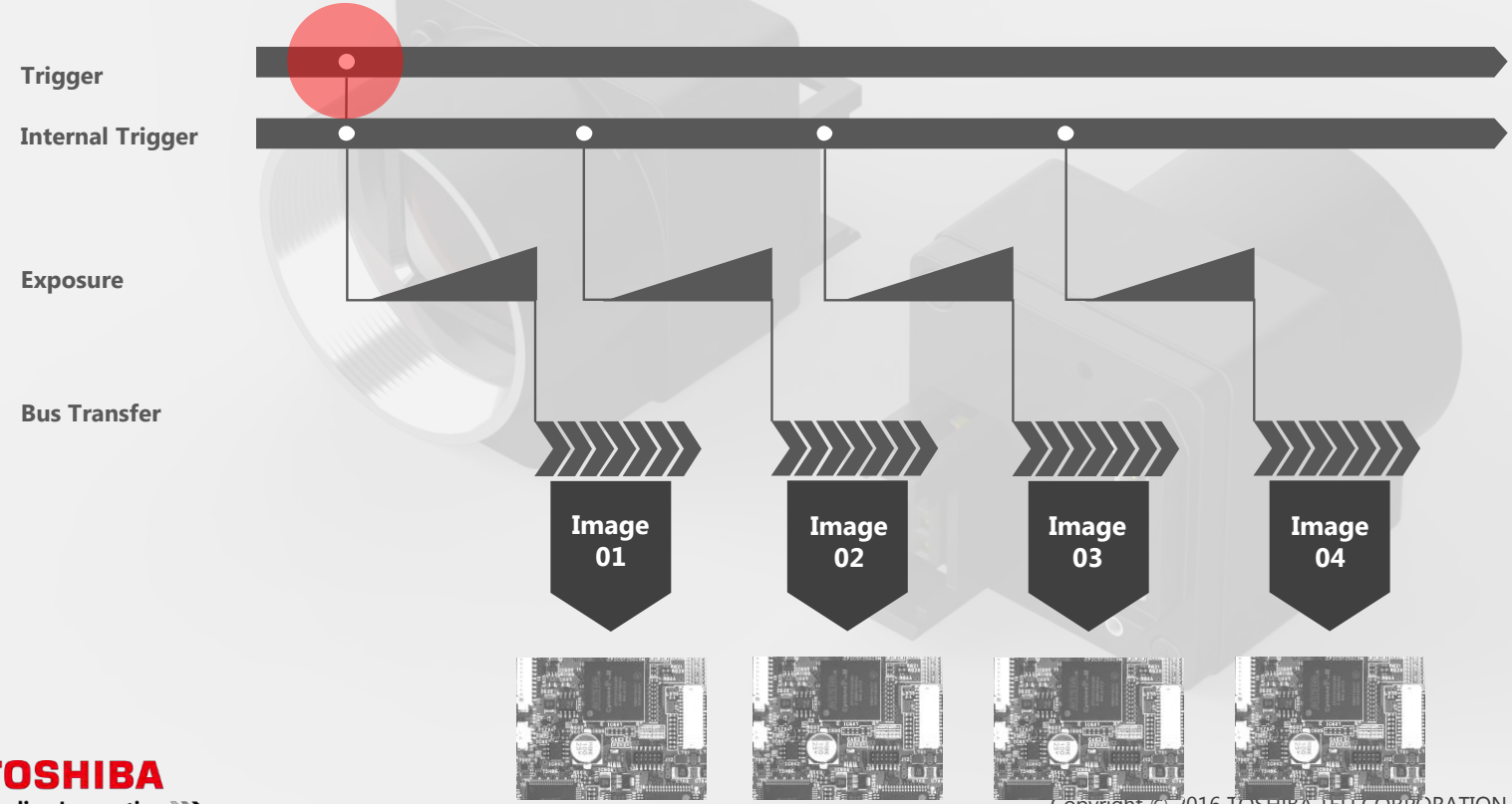
Bulk Trigger

Using the Bulk trigger, one trigger will trigger multiple image acquisitions.



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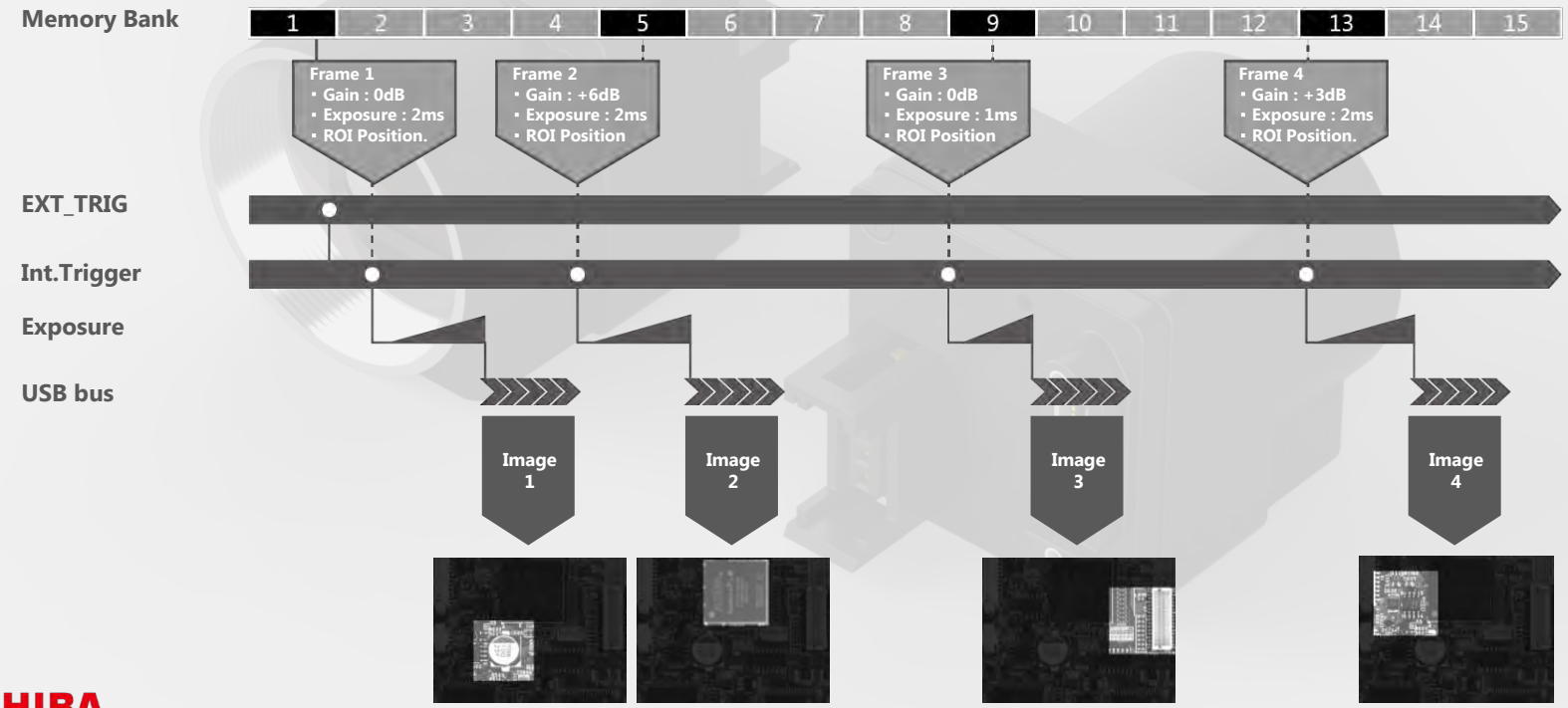
Sequential Shutter(ROI)

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.



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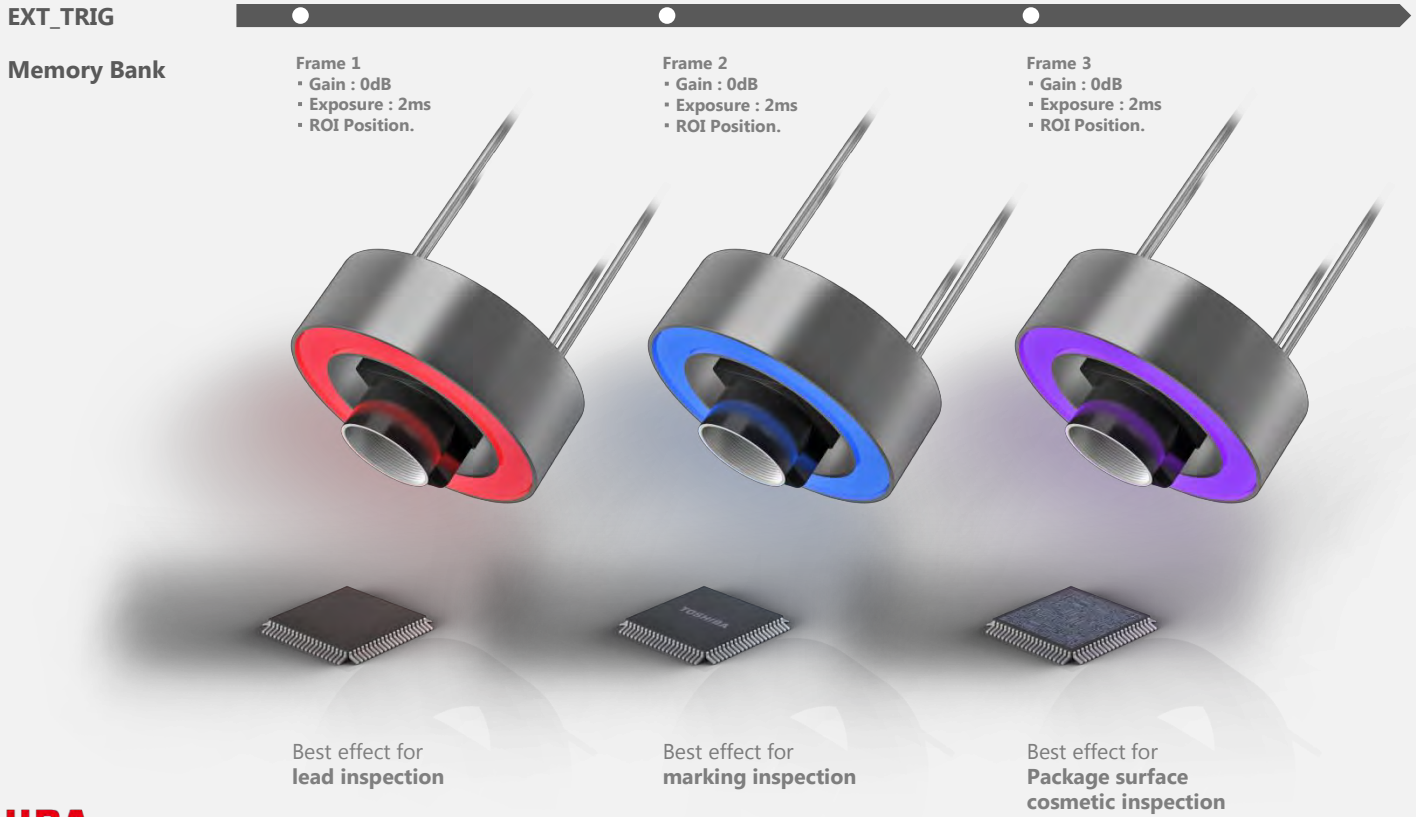
Previous methods



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Sequential Shutter(ROI)

EXT_TRIG

Memory Bank

Frame 1
- Gain : 0dB
- Exposure : 2ms
- ROI Position.

Frame 2
- Gain : 0dB
- Exposure : 2ms
- ROI Position.

Frame 3
- Gain : 0dB
- Exposure : 2ms
- ROI Position.

Best effect for **lead inspection**

Best effect for **marking inspection**

Best effect for **Package surface cosmetic inspection**

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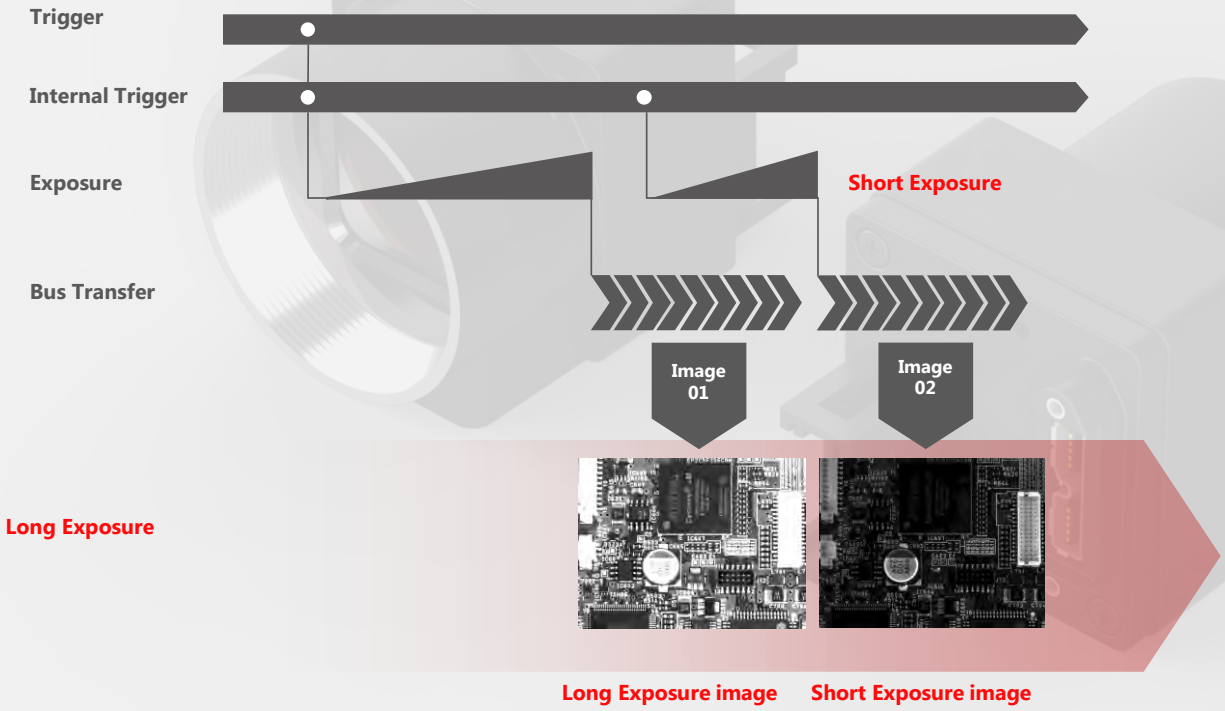
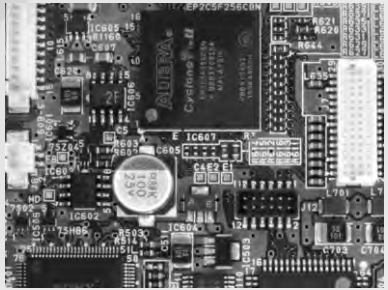
Bulk Trigger+Sequential Shutter

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



External Processing

Image 01+02



Wide dynamic range image

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CMOS Model Features

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

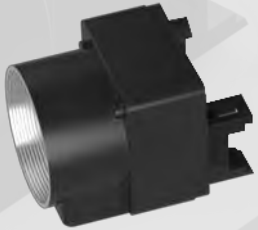
■ *Image buffer*

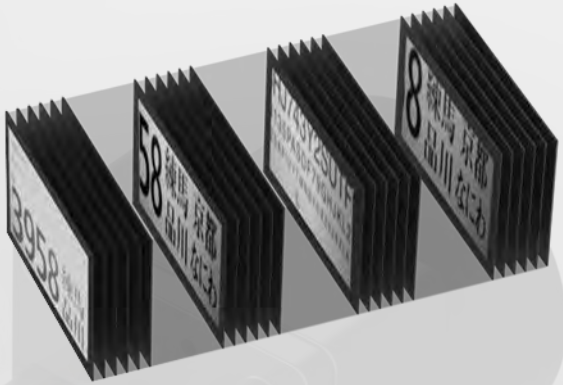
Image data can be stored temporarily to internal buffer memory, and read them out in arbitrary timing. The image buffer size is 64MByte.

64MB Image Buffer

256MB Image Buffer

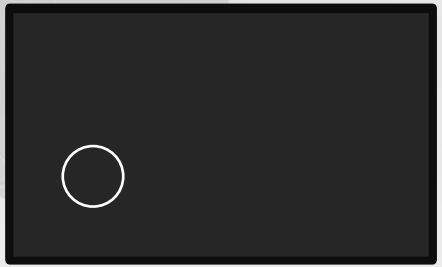
DU Series





■ *Defective Pixel Correction (On Board Correction)*

The camera can correct defective pixels



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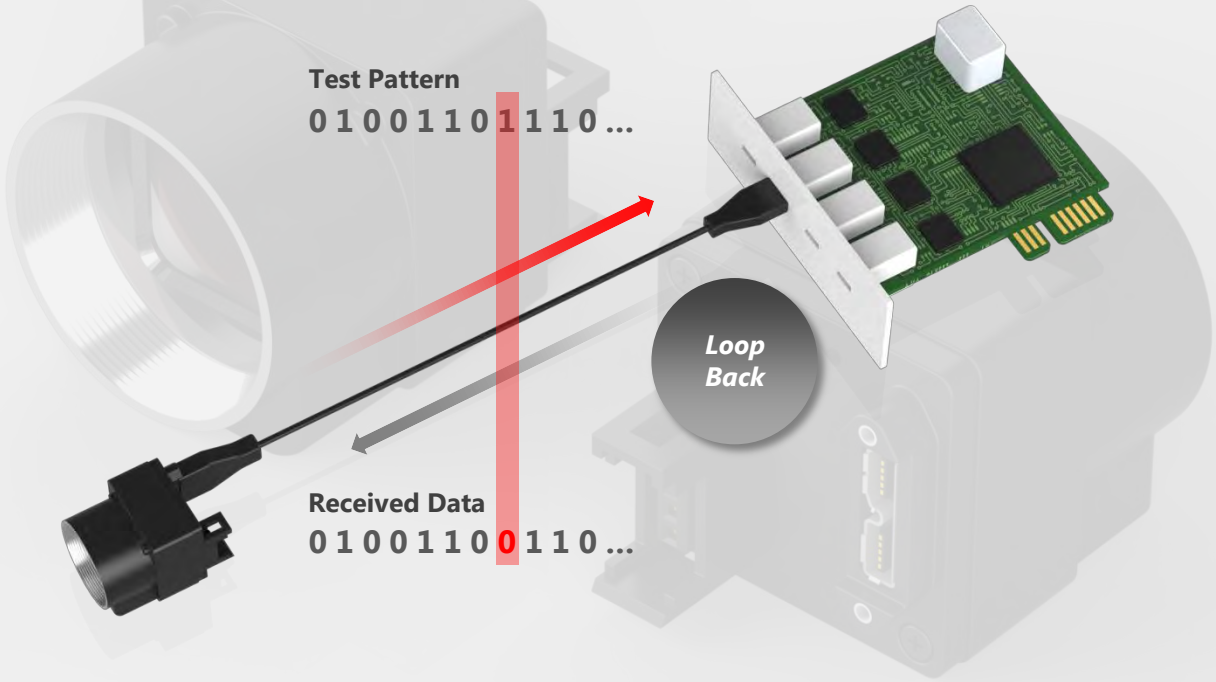
BERT(Bit Error Rate Test) Function

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.

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USB3.0 System Solution

We have evaluated many kind of peripheral components such as USB3.0 card , USB HUB , a long cable.

USB3.0 Card

USB3.0 HUB

USB3.0 Metal Cable(-5m)

USB3.0 Optical Cable(10m-50m)

We propose best solution for your system.

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TELI's Advanced Technologies

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Leading Innovation

BG Series

IMAGING REVOLUTION

GiGE VISION™

WARRANTY 3 YEARS

Compact body

Light Weight

Applying CCD and CMOS Sensor

GPIO 2 Output 1 Input

HIROSE Connector For GPIO and Power supply

Applied PoE

Screw lock

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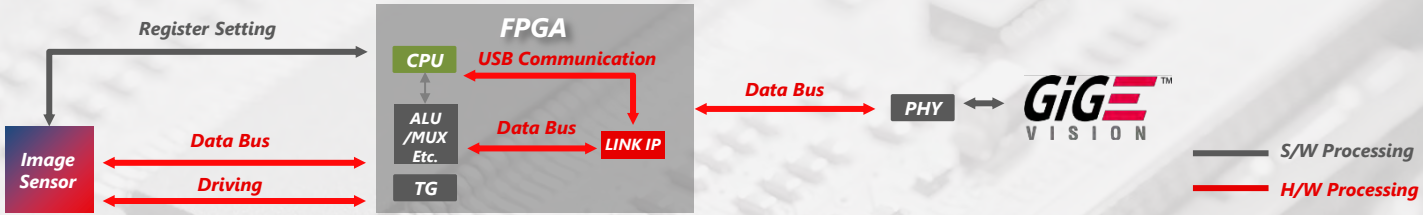
Toshiba Teli Original H/W core

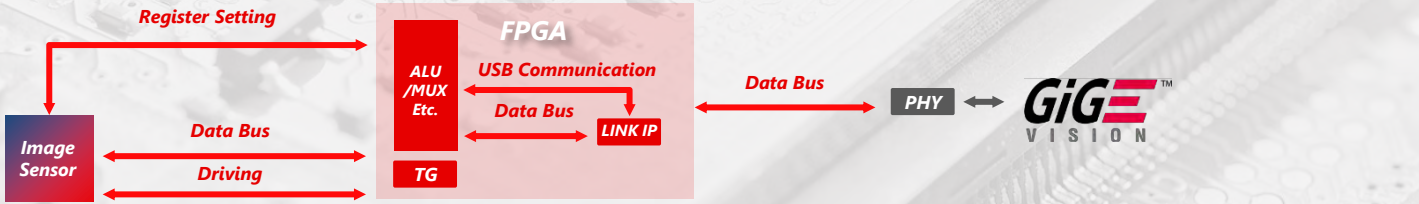
New BG series adopts advanced hardware IP as well as our USB line up.
High level of hardware integration is archived by developing our original IP core.
Since our unique IP provides high-speed processing,
it would greatly contributes to customer's application

■ Generic GigE IP



■ Toshiba Teli's GigE IP Core - All H/W Processing-

High Speed



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Benefit from our advanced technology

Benchmark test of response time with VisionPro proved that our BG302MG is 3 times faster than major competitor's camera.
It means that our advanced technology gives great benefit to customer systems.

Test Condition

items	setting
Resolution	1280(H) x 960(V)
Pixel format	Mono, 8bits/pixels
Frame rate	20fps
Exposure duration	
Packet size	8,000 bytes

【Remark】
The reason that BG302's video transfer time long depends on difference of sensor.

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Toshiba Teli's Camera Lineup

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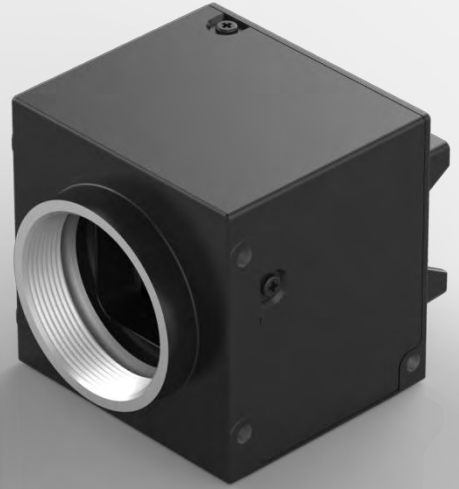
USB3 Vision Camera Lineup

USB3 VISION™

BU Series **CCD** Model

BU Series **CMOS** Model

DU Series



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USB3 Vision Camera Lineup

USB3 VISION BU Series CCD Model

Model	BU030 BU030C BU030CF	BU031	BU080	BU130 BU130C BU130CF
Imager	CCD	CCD	CCD	CCD
Imager type	ICX424	ICX414	ICX204	ICX445
Pixel	0.3M 640 × 480	0.3M 640 × 480	0.8M 1024 × 768	1.3M 1280 × 960
Optical format	1/3 type	1/2 type	1/3 type	1/3 type
Pixel size	7.4um	9.9um	4.65um	3.75um
Aspect ratio	4:3	4:3	4:3	4:3
Frame rate	125fps	125fps	40fps	30fps

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USB3 Vision Camera Lineup

USB3 VISION **BU** Series **CMOS** Model 01

Model	BU040MG BU040MCG BU040MCF	BU132M	BU160MG BU160MCG BU160MCF	BU205M BU205MC BU205MCF	BU238M BU238MC BU238MCF
Imager	GS-CMOS	GS-CMOS	GS-CMOS	GS-CMOS	GS-CMOS
Imager type	IMX287	EV76C560	IMX273	CMV2000	IMX174
Pixel	**0.4M** 720 x 540	**1.3M** 1280 x 1024	**1.6M** 1440 × 1080	**2.2M** 2048 × 1088	**2.3M** 1920 × 1200
Optical format	1/2.9 type	1/1.8 type	1/2.9 type	2/3 type	1/1.2 type
Pixel size	6.9um	5.3um	3.45um	5.5um	5.86um
Aspect ratio	4:3	5:4	4:3	2:1	16:10
Frame rate	**425fps**	**61fps**	**226fps**	**170fps**	**165fps**
	Coming Soon		Coming Soon		

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USB3 Vision Camera Lineup

USB3 VISION BU Series CMOS Model 02

Model	BU302MG BU302MCG BU302MCF	BU406M BU406MC BU406MCF	BU505MG BU505MCG BU505MCF	BU602M BU602MC BU602MCF	BU1203M BU1203MC BU1203MCF
Imager	GS-CMOS	GS-CMOS	GS-CMOS	RS-CMOS	RS-CMOS
Imager type	IMX252	CMV4000	IMX250	IMX178	IMX226
Pixel	3.1M 2048 x 1536	4M 2048 × 2048	5M 2448 × 2048	6.2M 3072 × 2048	12M 4000 × 3000
Optical format	1/1.8 type	1 type	2/3 type	1/1.8 type	1/1.7 type
Pixel size	3.45um	5.5um	3.45um	2.4um	1.85um
Aspect ratio	4:3	1:1	6:5	3:2	4:3
Frame rate	120fps	90fps	75fps	60fps Coming Soon	30fps

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USB3 Vision Camera Lineup

USB3 VISION DU Series

Model	DU657M DU657MC	DU806MG DU806MCG DU806MCF	DU1207MG DU1207MCG DU1207MCF
Imager	GS-CMOS	GS-CMOS	GS-CMOS
Imager type	Original	IMX255	IMX253
Pixel	**6.5M** 2560 × 2560	**8.8M** 4096 x 2160	**12M** 4096 x 3000
Optical format	1.1 type	1 type	1.1 Type
Pixel size	5.0um	3.45um	3.45um
Aspect ratio	1:1	17:9	4:3
Frame rate	**55fps**	**40fps** Coming Soon	**30fps** Coming Soon

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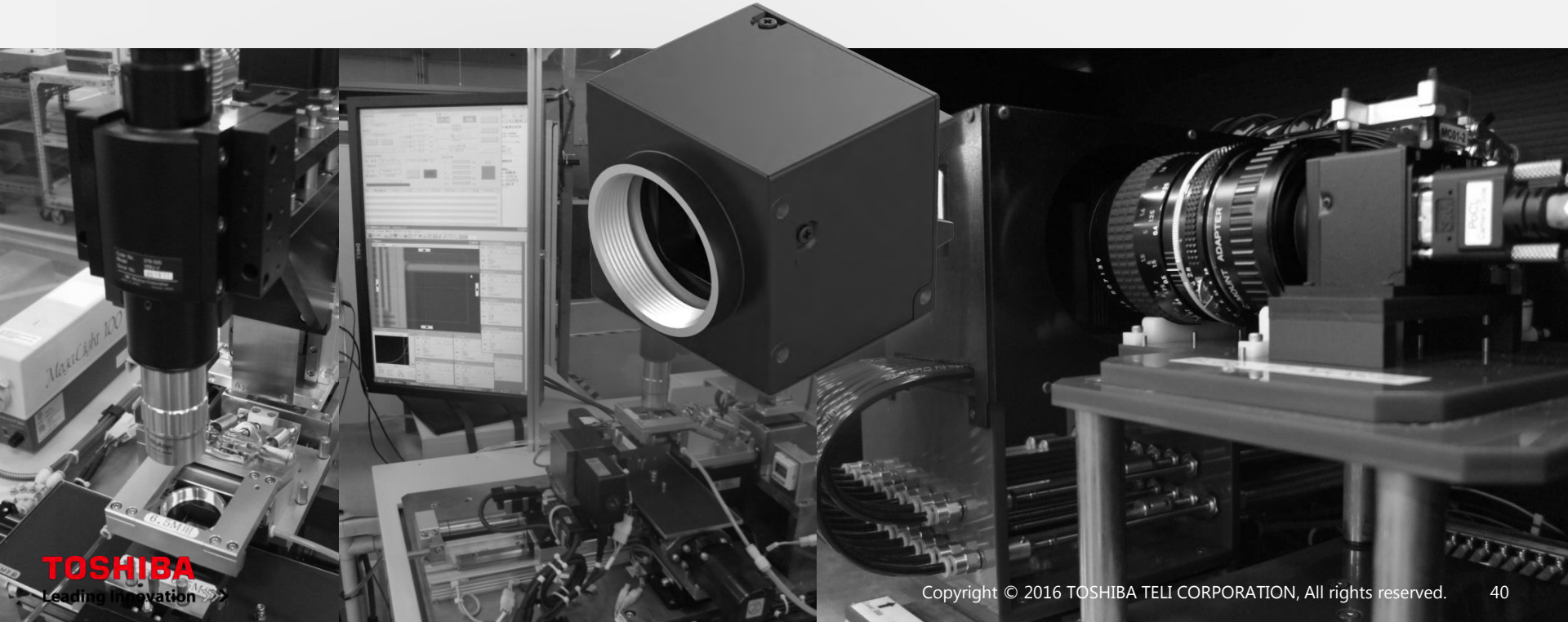
USB3 Vision Camera Lineup

Equipment of automatic tuning for optical axis. We provide high precision optical axis by 3D measurement system.



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GigE Vision Camera Lineup

BG Series **CCD** Model

BG Series **CMOS** Model

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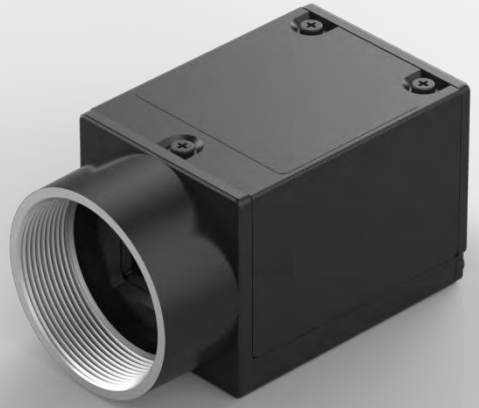
GigE Vision Camera Lineup



GiGE VISION™ **BG** Series **CCD** Model

Model	BG030 BG030C BG030CF	BG031	BG080	BG130 BG130C BG130CF	BG202 BG202C BG202CF
Imager	CCD	CCD	CCD	CCD	CCD
Imager type	ICX424	ICX414	ICX204	ICX445	ICX274
Pixel	**0.3M** 640 x 480	**0.3M** 640 x 480	**0.8M** 1024 × 768	**1.3M** 1280 × 960	**2M** 1600 × 1200
Optical format	1/3 type	1/2 type	1/3 type	1/3 type	1/1.8 type
Pixel size	7.4um	9.9um	4.65um	3.75um	4.4um
Aspect ratio	4:3	4:3	4:3	4:3	4:3
Frame rate	**125fps**	**125fps**	**40fps**	**30fps**	**20fps**

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GigE Vision Camera Lineup

GiGE VISION™ **BG** Series **CMOS** Model

		BG205M-CS	BG238LMG	**BG302LMG**	**BG505LMG**
		BG205MC-CS	BG238LMCG	BG302LMCG	BG505LMCG
Model	BG132M	**BG205MCF-CS**	BG238LMCF	BG302LMCF	BG505LMCF
Imager	GS-CMOS	GS-CMOS	GS-CMOS	GS-CMOS	GS-CMOS
Imager type	EV76C560	CMV2000	IMX249	IMX265	IMX264
Pixel	**1.3M**	**2M**	**2.3M**	**3.1M**	**5M**
	1280 x 1024	2048 x 1088	1920 × 1200	2048 x 1536	2448 × 2048
Optical format	1/1.8 type	2/3 type	1/1.2 type	1/1.8 type	2/3 type
Pixel size	5.3um	5.5um	5.86um	3.45um	3.45um
Aspect ratio	5:4	2:1	16:10	4:3	6:5
Frame rate	**61fps**	**50fps**	**30fps**	**35fps**	**22fps**
			Plan		

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Application case 1

Market	AOI, SPI	Making panel	Fruit sorting	Medical
Use	・soldering check ・solder paste inspection	・Alignment	・scratch, shape, ripe degree(color)	・Image diagnosis
First camera	・Gig-E camera ・CL camera	・Gig-E camera	・Gig-E camera	・Analogue camera
Customer's challenge	・FGB, cable cost down	・Cost down ・reliability improvement	・Speed up ・Cost down ・Image quality improvement ・Color reproducibility	・Replace CCD camera with CMOS camera ・Higher sensitivity with less lighting ・60fps recording
Point of adoption	・TELI original sensor ・Quick response (TELI original IP core) ・High image quality ・Advantage of own equipment with new camera	・Quick response (TELI original IP core) ・Resolution ・Cost benefits ・Software support ・Most compact overall dimensions in the industry	・Quick response (TELI original IP core) ・System cost benefits ・High image quality ・High frame rate ・Most compact in the industry	・High sensitivity ・High S/N ・High speed CMOS sensor
Choice of camera	BU238MCF/BU406MC/BU602MCF/DU657MC/DU1207MCF	BU1203MC	BU238MCF	BU238M
Needs/ann.	2,000 to 3,000 sets	1,000 to 1,500 sets	300 to 500 sets	100 sets

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Application case 2

Market	Automobile parts	Automobile manufacturer
Use	・Appearance inspection	・Data logger (for evaluation, experiment)
First camera	・Gig-E camera	・Gig-E camera
Customer's challenge	・To improve inspection efficiency	・System cost down ・Down sizing
Point of adoption	・Shorter processing time and optimization by sequential shutter function and bulk trigger function ・Lighting control free ・High image quality	・Bus synchronism (No hardware trigger wiring needed) ・System cost benefits ・High resolution, high FPS ・Compact size system for easier carrying
Choice of camera	BU238MCF	BU238MCF
Needs/ann.	4 cameras per 1 system x ** sets	(4 cameras, a set of data logger) per system x ** sets

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