

TOSHIBA

Leading Innovation >>>

USB³TM
VISION

USB3 Vision & TOSHIBA TELI
: New insight. Great benefits.

TOSHIBA TELI CORPORATION



Introduction of

USBTM
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***



Next Standard Interface for Machine vision

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System
Cost***

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)



Max. frame rate **50** fps
Data rate **115** MB/s



Max. frame rate **165** fps
Data rate **380** MB/s



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



Max. frame rate **25** fps
Data rate **105** MB/s



Max. frame rate **90** fps
Data rate **377** MB/s



Next Standard Interface for Machine vision

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***High
Bandwidth***

***High
Reliability***

***Low
System
Cost***

Reliability & Stability



USB3.0

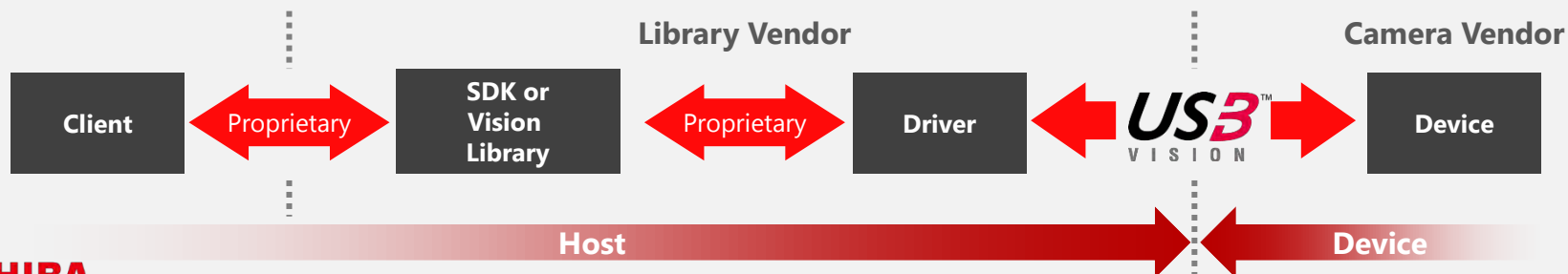
- Low CPU usage by DMA transmission
- Prevent dispersion of capturing time
- Structure of the USB3.0 offers reliable system.

■ 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.





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***

Low System Cost



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

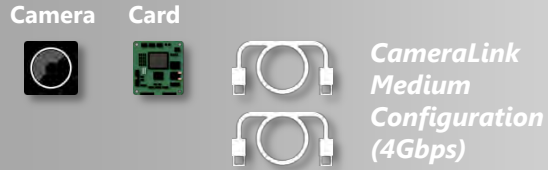
Low System Cost

Adoption of USB3.0 configuration

Camera Link camera



■ Single camera



1 camera
1 card
2 cables

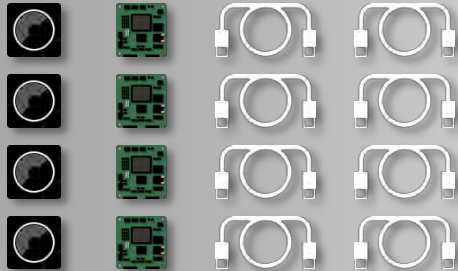
■ Single camera



1 camera
1 card
1 cable

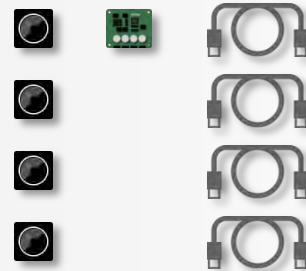
An equivalent performance can be achieved by USB3 simple configuration.

■ 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

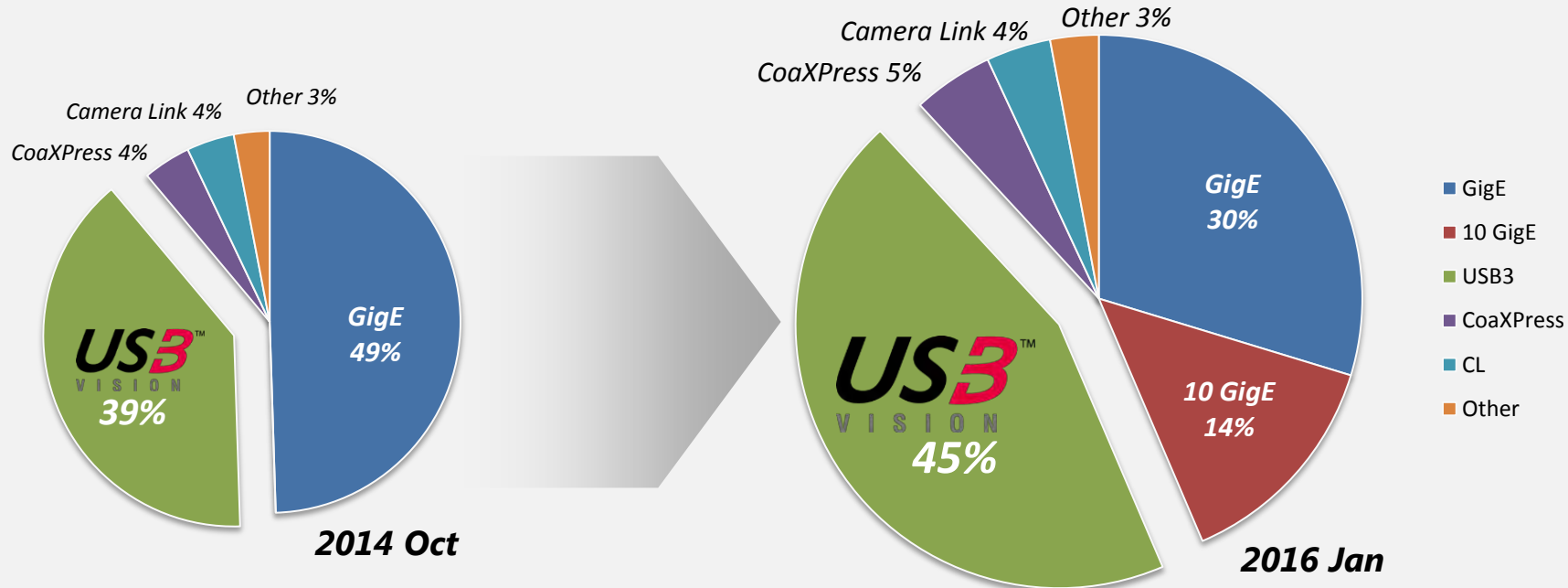


- **Easy-to-use plug and play interface**
- **Power and data over the same passive cable**
(more length with active cables)
- **Uses GenICam™ generic programming interface**
USB3 vision and GenICam promise users stability and low latency for image transmission and camera control
- **Improved Robustness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

Market trend of

USBTM
VISION

Dramatic market change



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

TELI's Advanced Technologies

US3[™]
VISION

BU Series

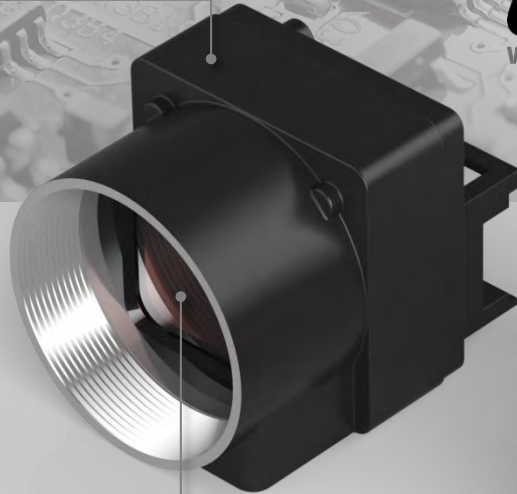
IMAGING REVOLUTION

USBTM
VISION



Compact body

Light Weight



Applying CCD and
CMOS Sensor

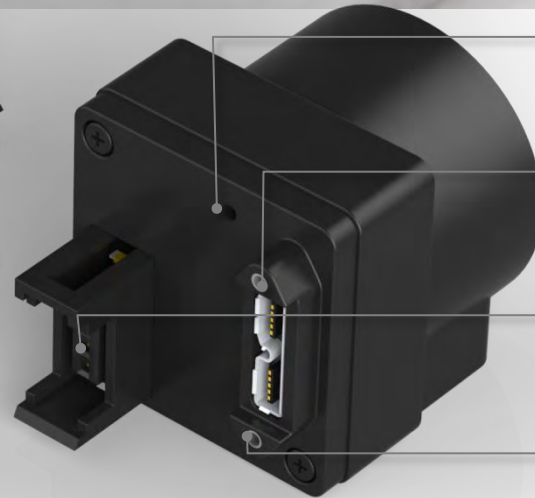
LED Status Indicator

USB3.0 Micro B

eCON Connector

■ GPIO 2 Output 1 Input

Screw lock

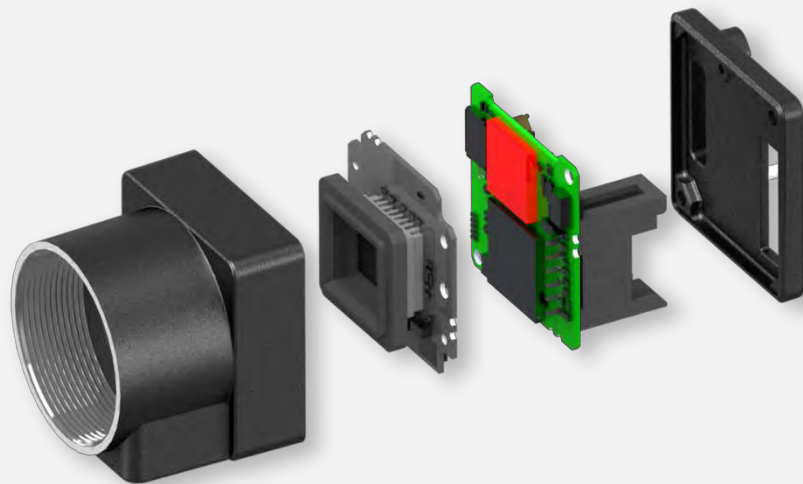


Compact Body & Light Weight

■ 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.



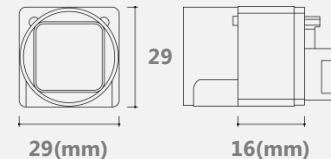
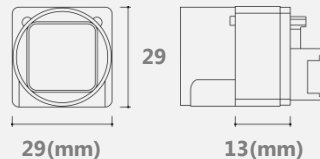
27g

32g



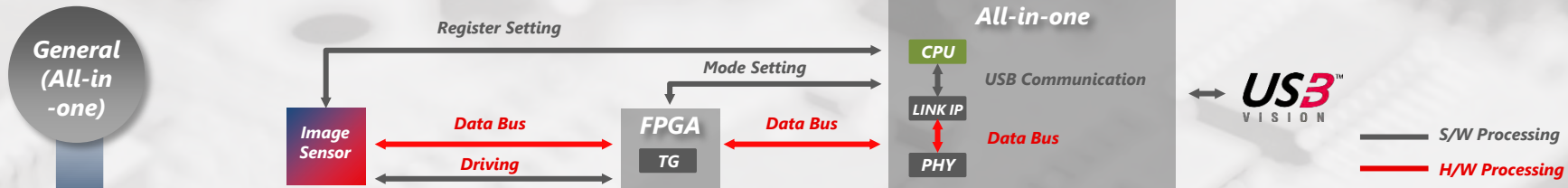
CCD model

CMOS model

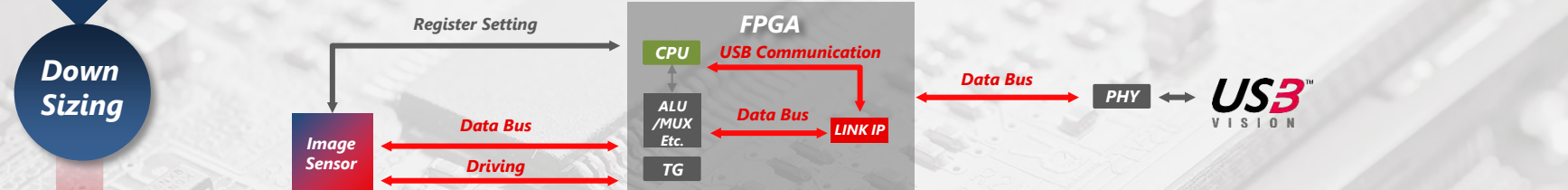


Toshiba Teli Original H/W core

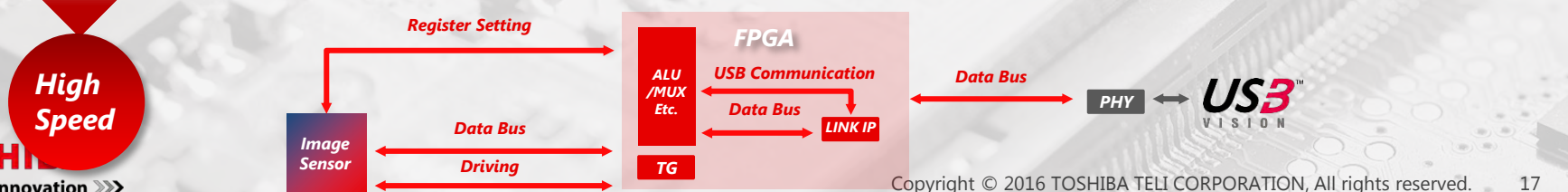
■ FPGA+All-in-one USB Chip



■ Generic USB IP



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



High Speed Response

S/W Processing



H/W Processing



Faster Process

- Command Analysis:
- Event notification
 - Register R/W
 - Image adjustment
 - Software trigger
 - etc.

Read register

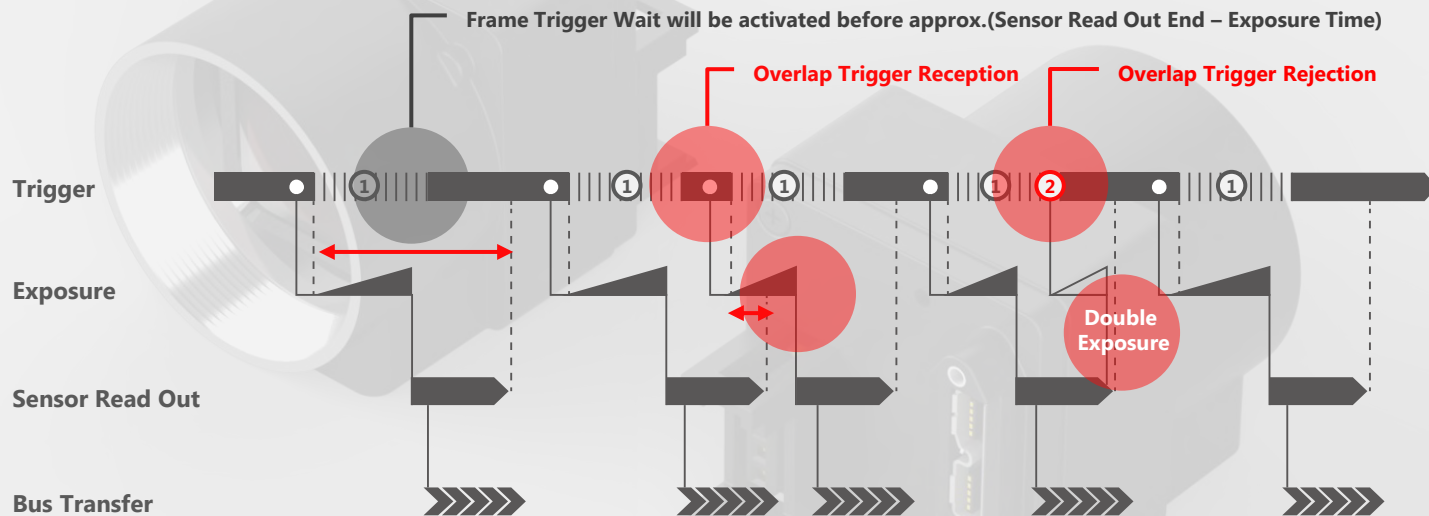
Software Trigger (Write register)

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

No Delay Event Notification

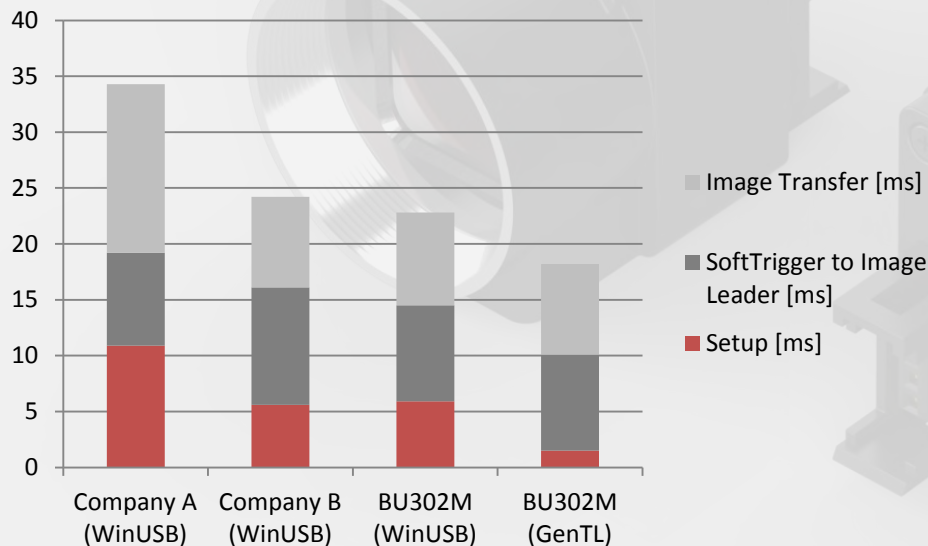
BU series equipped with our high-speed hardware IP has achieved
'No-Delay Event Notification' for effective machine control.



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

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

Real Time camera control

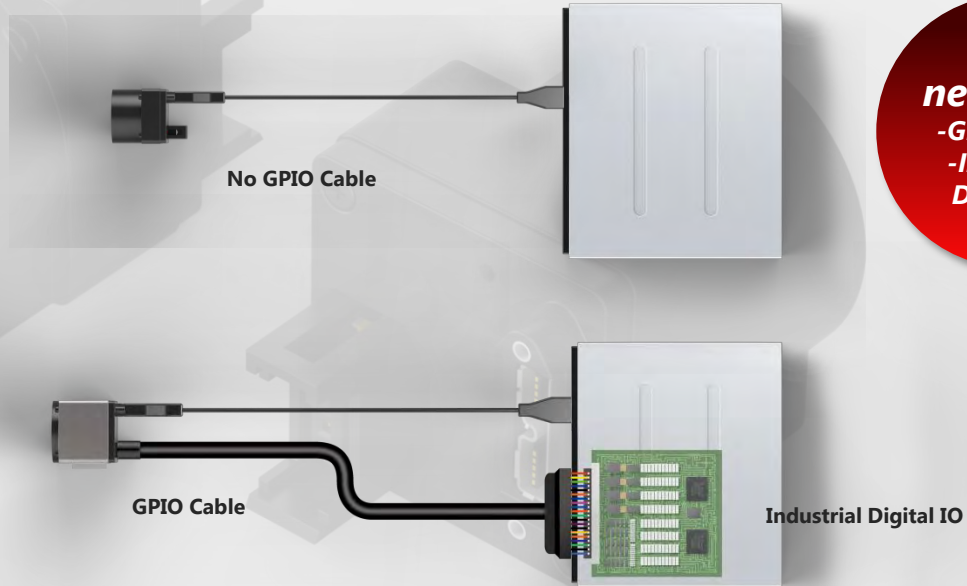
General IP core are not able to be realised real time processing without a GPIO cable and an industrial IO card.

■ 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

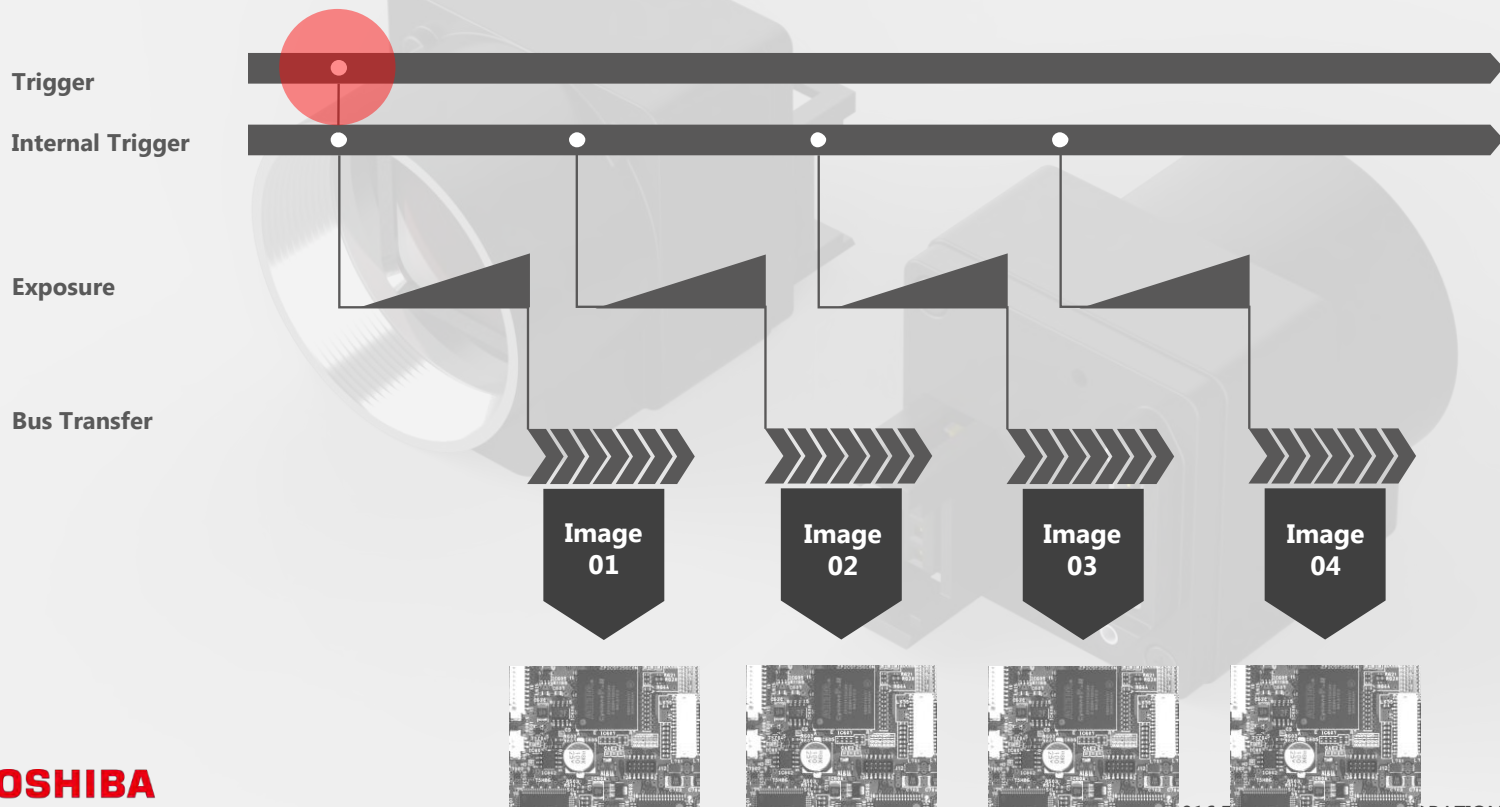
General IP core are not able to be realised real time processing without a GPIO cable and an industrial IO card.



Not necessary
-GPIO Cable
-Industrial Digital IO

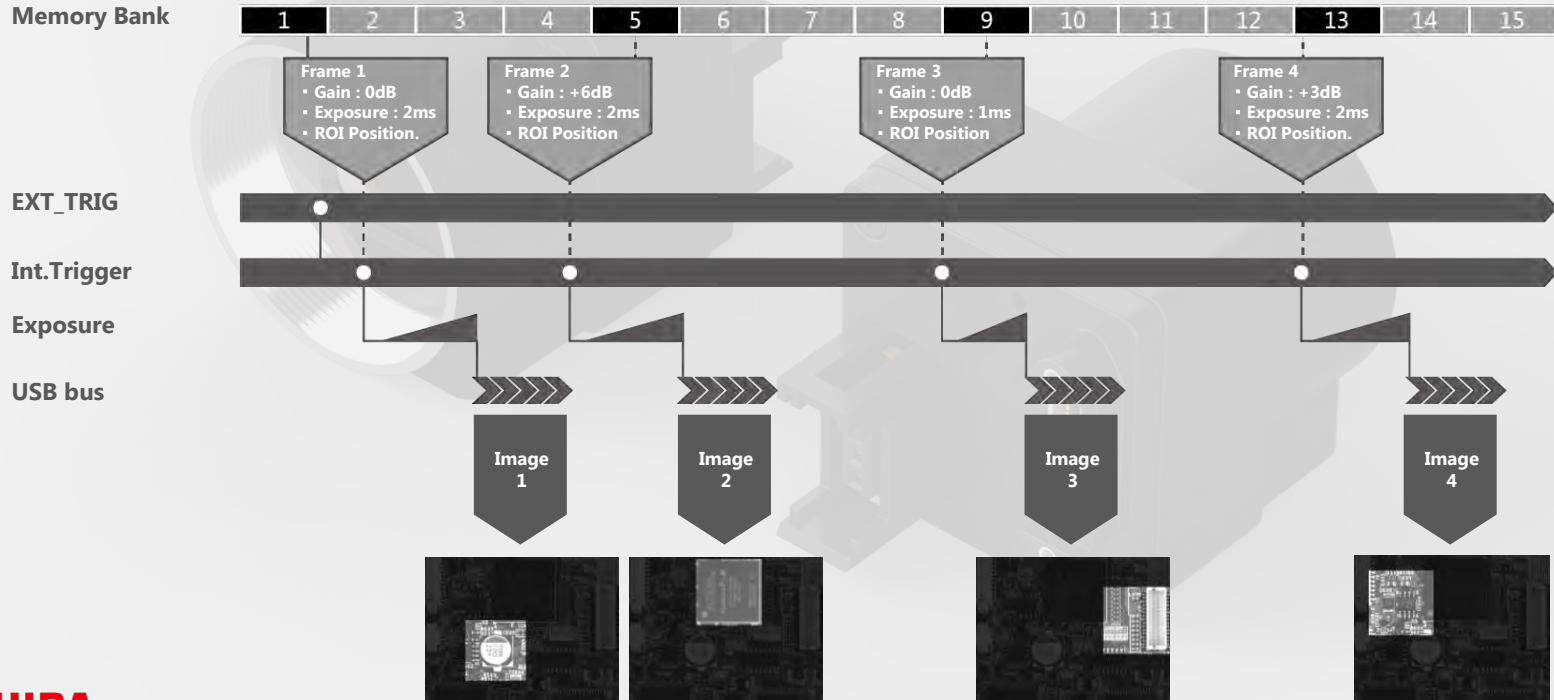
Bulk Trigger

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



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.*



Previous methods

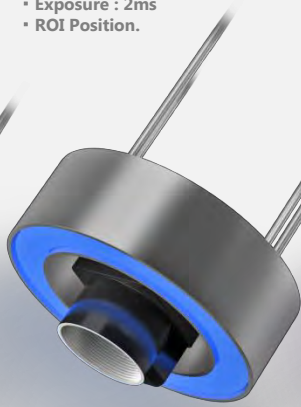
EXT_TRIG

Memory Bank

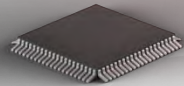
- Frame 1
- Gain : 0dB
 - Exposure : 2ms
 - ROI Position.



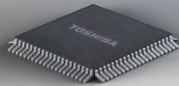
- Frame 2
- Gain : 0dB
 - Exposure : 2ms
 - ROI Position.



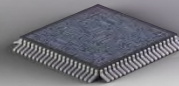
- Frame 3
- Gain : 0dB
 - Exposure : 2ms
 - ROI Position.



Best effect for
lead inspection



Best effect for
marking inspection



Best effect for
Package surface
cosmetic inspection

Sequential Shutter(ROI)

EXT_TRIG

Memory Bank

Frame 1

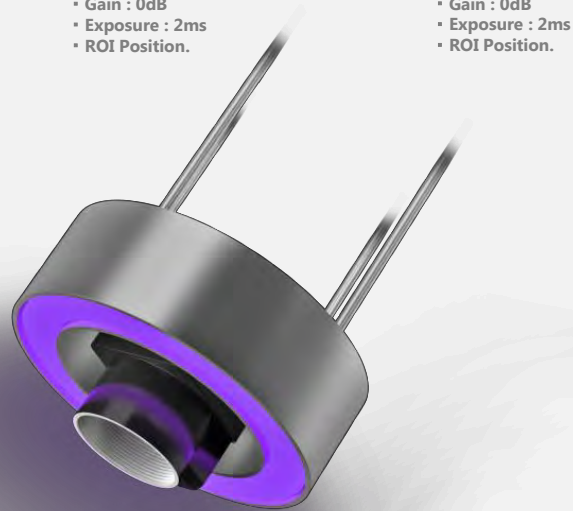
- Gain : 0dB
- Exposure : 2ms
- ROI Position.

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

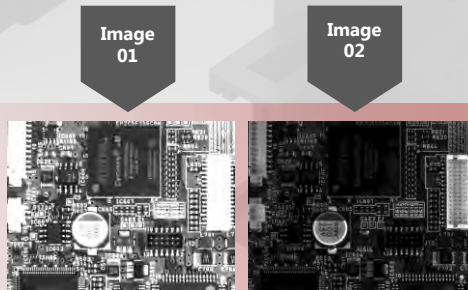
Best effect for
Package surface
cosmetic inspection

Bulk Trigger+Sequential Shutter

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

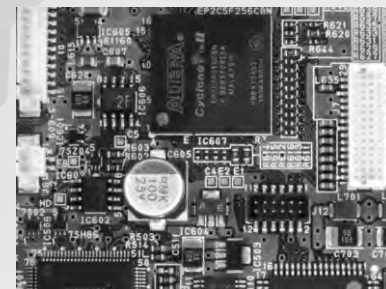


Long Exposure



Long Exposure image Short Exposure image

Image 01+02



CMOS Model Features

*Sequential Shutter mode can combine Bulk trigger (CMOS model only).
Case study : multiple different programmed 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.

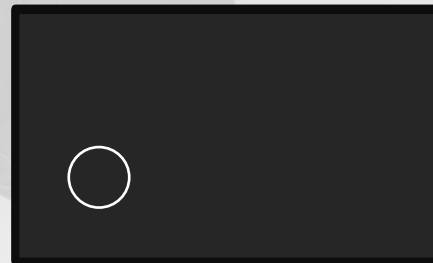
64MB
Image
Buffer

256MB
Image
Buffer

DU Series

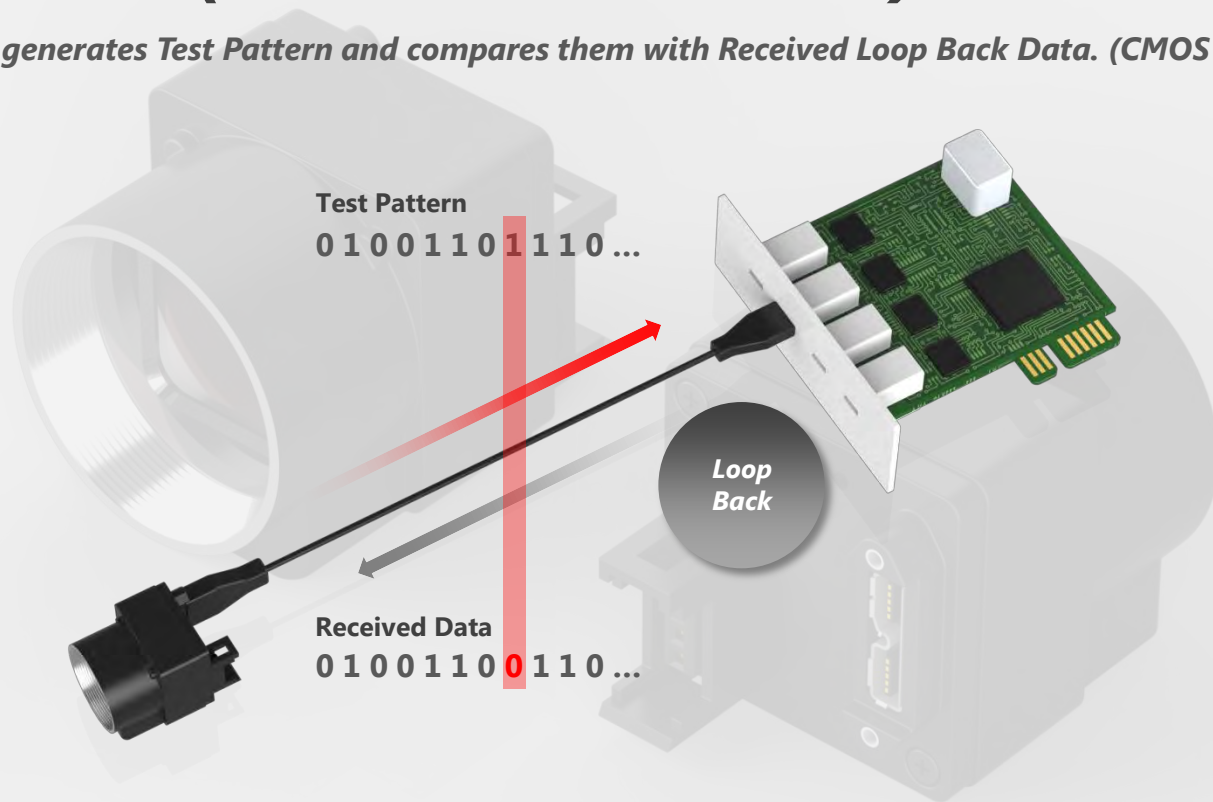
■ Defective Pixel Correction (On Board Correction)

The camera can correct defective pixels



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.

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.

TELI's Advanced Technologies

GiG™
VISION

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

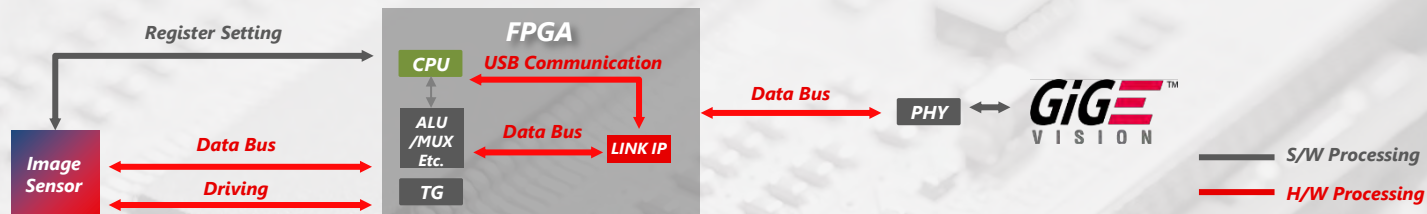
Applied PoE

Screw lock

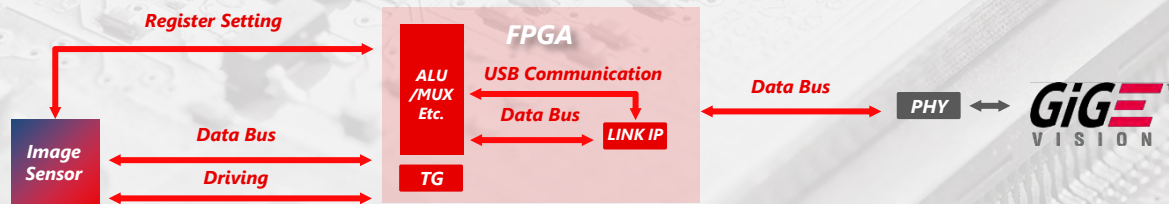
Toshiba Teli Original H/W core

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-

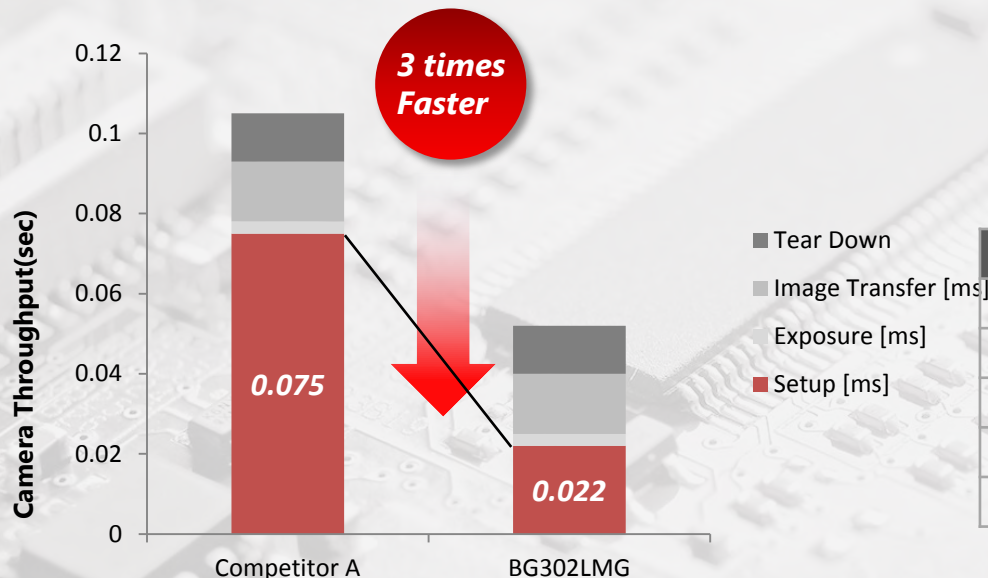


High Speed

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.

Toshiba Teli's Camera Lineup



USB3 Vision Camera Lineup



BU Series **CCD** Model



BU Series **CMOS** Model



DU Series



USB3 Vision Camera Lineup

USBTM VISION BU Series **CCD Model**



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

USB3 Vision Camera Lineup

USBTM **VISION** BU Series **CMOS** Model 01



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

Coming
Soon

Coming
Soon

USB3 Vision Camera Lineup

USBTM **VISION** BU Series **CMOS** Model 02

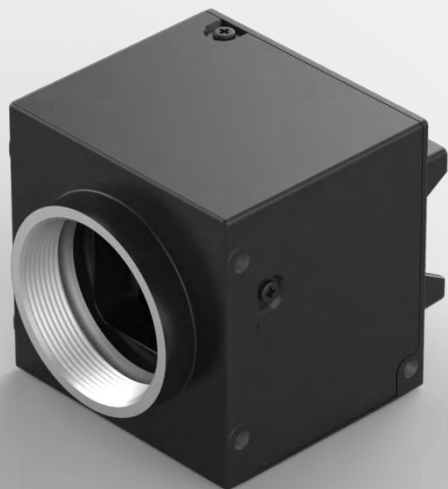


	BU302MG	BU406M	BU505MG	BU602M	BU1203M
	BU302MCG	BU406MC	BU505MCG	BU602MC	BU1203MC
<i>Model</i>	BU302MCF	BU406MCF	BU505MCF	BU602MCF	BU1203MCF
<i>Imager</i>	GS-CMOS	GS-CMOS	GS-CMOS	RS-CMOS	RS-CMOS
<i>Imager type</i>	IMX252	CMV4000	IMX250	IMX178	IMX226
<i>Pixel</i>	3.1M	4M	5M	6.2M	12M
	2048 x 1536	2048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

Coming
Soon

USB3 Vision Camera Lineup

USB³™ DU Series
VISION



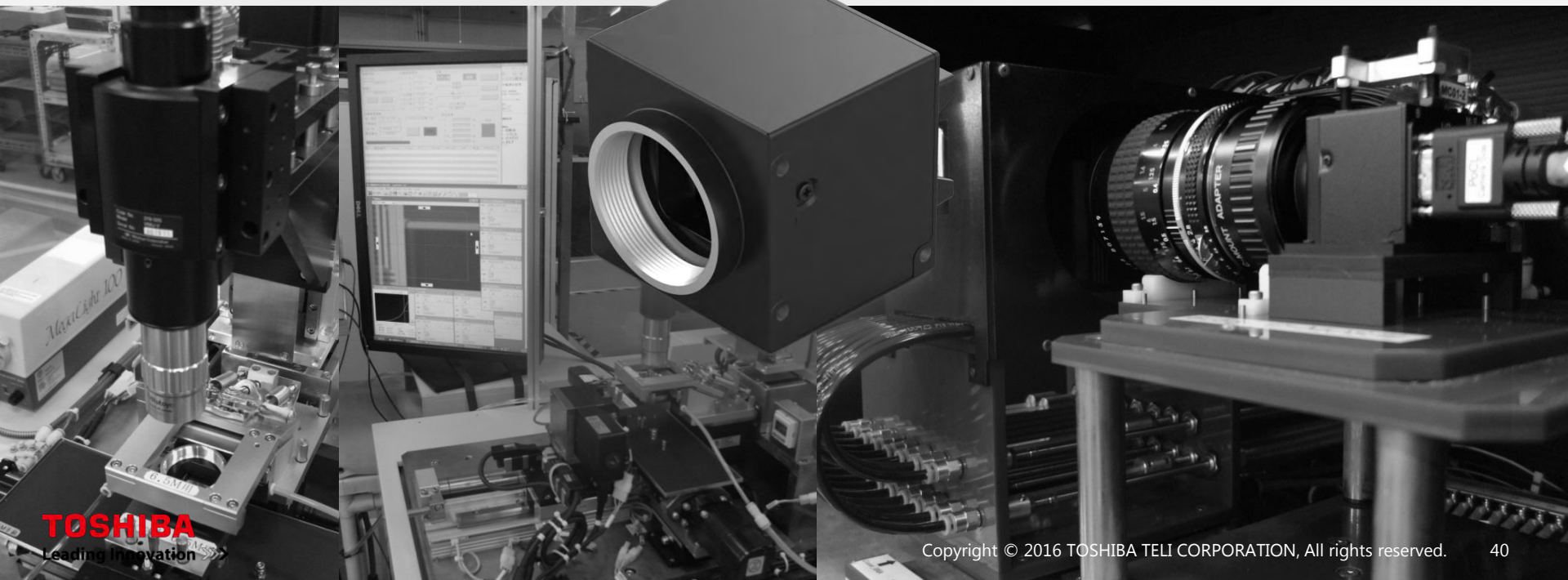
	<i>DU657M</i>	<i>DU806MG</i>	<i>DU1207MG</i>
<i>Model</i>	<i>DU657MC</i>	<i>DU806MCF</i>	<i>DU1207MCF</i>
<i>Imager</i>	GS-CMOS	GS-CMOS	GS-CMOS
<i>Imager type</i>	Original	IMX255	IMX253
<i>Pixel</i>	6.5M	8.8M	12M
	2560 × 2560	4096 x 2160	4096 x 3000
<i>Optical format</i>	1.1 type	1 type	1.1 Type
<i>Pixel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

Coming
Soon

Coming
Soon

USB3 Vision Camera Lineup

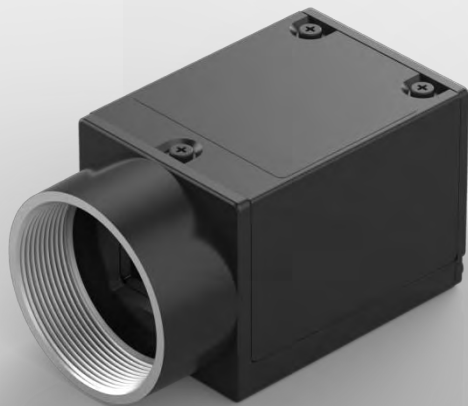
Equipment of automatic tuning for optical axis. We provide high precision optical axis by 3D measurement system.



GigE Vision Camera Lineup



BG Series **CCD** Model



BG Series **CMOS** Model



GigE Vision Camera Lineup

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



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

GigE Vision Camera Lineup

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



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

Application case 1

Market	AOI, SPI	Making panel	Fruit sorting	Medical
Use	<ul style="list-style-type: none"> • soldering check • solder paste inspection 	<ul style="list-style-type: none"> • Alignment 	<ul style="list-style-type: none"> • scratch, shape, ripe degree(color) 	<ul style="list-style-type: none"> • Image diagnosis
First camera	<ul style="list-style-type: none"> • Gig-E camera • CL camera 	<ul style="list-style-type: none"> • Gig-E camera 	<ul style="list-style-type: none"> • Gig-E camera 	<ul style="list-style-type: none"> • Analogue camera
Customer's challenge	<ul style="list-style-type: none"> • FGB, cable cost down 	<ul style="list-style-type: none"> • Cost down • reliability improvement 	<ul style="list-style-type: none"> • Speed up • Cost down • Image quality improvement • Color reproducibility 	<ul style="list-style-type: none"> • Replace CCD camera with CMOS camera • Higher sensitivity with less lighting • 60fps recording
Point of adoption	<ul style="list-style-type: none"> • TELI original sensor • Quick response (TELI original IP core) • High image quality • Advantage of own equipment with new camera 	<ul style="list-style-type: none"> • Quick response (TELI original IP core) • Resolution • Cost benefits • Software support • Most compact overall dimensions in the industry 	<ul style="list-style-type: none"> • Quick response (TELI original IP core) • System cost benefits • High image quality • High frame rate • Most compact in the industry 	<ul style="list-style-type: none"> • 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

Application case 2

Market	Automobile parts	Automobile manufacturer
Use	<ul style="list-style-type: none"> • Appearance inspection 	<ul style="list-style-type: none"> • Data logger (for evaluation, experiment)
First camera	<ul style="list-style-type: none"> • Gig-E camera 	<ul style="list-style-type: none"> • Gig-E camera
Customer's challenge	<ul style="list-style-type: none"> • To improve inspection efficiency 	<ul style="list-style-type: none"> • System cost down • Down sizing
Point of adoption	<ul style="list-style-type: none"> • Shorter processing time and optimization by sequential shutter function and bulk trigger function • Lighting control free • High image quality 	<ul style="list-style-type: none"> • 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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