MITSUBISHI ELECTRIC

Changes for the Better

CONTACT IMAGE SENSOR (CIS)
KD series for Web Surface Inspection

KD6R1064DXL-NL, KD6R1247DXL-NL, KD6R1688DXL-NL

User's Manual

TM-XJ959B

March 13th 2020

Design and specification are subject to change without notice.

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Chapter 1 : Notice

1-1 RESTRICTION FOR USE

Thank you very much for purchasing Mitsubishi Electric Contact Image Sensor (CIS). This document contains information that introduces how to use this product appropriately and safely. Read through this document carefully before starting to use this product in your equipment or system.

This product is designed for the purpose of being used in general industries. Do not use this product for specific and particular applications (aerospace application, combustive equipment, transportation equipment, life-support system, safety device, etc.) where special quality and reliability are required and failure or malfunction could directly threaten people's lives, or do harm to the human body. Do not use for applications other than the purpose of being used in general industries intended by Mitsubishi Electric. If you plan to use such particular applications, contact our sales department personnel before doing so. If you have be used it for applications other than the general industries intended by Mitsubishi Electric without consulting our sales department personnel, Mitsubishi Electric SHALL HAVE NO RESPONSIBILITY OR LIABILITY (INCLUDING, BUT NOT LIMITEDTO ANY AND ALL RESPONSIBILITY OR LIABILITY BASED ON CONTRACT, WARRANTY, TORT, PRODUCT LIABILITY) FOR ANY INJURY OR DEATH TO PERSONS OR LOSS OR DAMAGE TOPROPERTY CAUSED BY the PRODUCT.

Determine the applicability of this product to your equipment or devices through an appropriate analysis or evaluation by the designer of such equipment or devices, or personnel related to the specification. Such designers or personnel shall warrant the performance and safety of your equipment or devices such as dust-proof, water-proof, EMC and EMI, by themselves.

Design, specification and the contents of this document are subject to change without notice.

1-2 PRECAUTIONS

Be aware of the following warnings and cautions to use this product appropriately and safely.

■Indications and definitions

Warning	This indicates that improper use of this product may result in a hazard such as death or catastrophic bodily injury.
Caution	This indicates that improper use of this product may result in a hazard such as a bodily injury or property damage.

■Indications and definitions

	This indicates the Warning or Caution described above.		This indicates a prohibited action such as an operation in a place where this product may get wet.
	This indicates the prohibited action that must not be handled.		This indicates the prohibition of the disassembly of this product.
	This indicates the mandatory action that must be carried out.		This indicates the possibility of the injury under the specific situation

1-2 PRECAUTIONS

	Warning
	**Do not operate this product in a place where it is explosive, combustible or inflammable.** Operating in a place having propane gas, gasoline or flammable gas may cause a fire and/or an explosion.
	**Use power supply having protection against overload.** This product may be able to flow large current due to short circuit fault.
	**Stop operation when you find any abnormalities or defects.** Otherwise, a fire or an electric shock may occur.
	**Do not repair, disassemble and/or modify by yourself.** Otherwise, a fire, defect, or an electric shock may occur. If you need to repair this product, you must contact the agency who sold you this product.
	**Do not get this product wet. Handle this product with water-proofing.** Otherwise, a defect or an electric shock may occur. This product is designated for indoor use. This product is designed as a line-scan module embedded in a system.
	**Do not operate this product outdoors.** This product is designed as a line-scan module embedded in a system. This product is designated for indoor use.

1-2 PRECAUTIONS

	Warning
	Do not put anything on this product. Otherwise, a fire or electrical shock may occur because of the things or materials in this product.
	**Do not put this product on an unstable surface, slanting and/or vibrating.** Otherwise, drop and/or fail of this product may cause injury.
	**Avoid the damage that ESD can cause. Never expose the internal electronics to a potentially hazardous environment. Do not handle this product with an insulation sheet or on wooden desk. In addition, do not cover this product with any materials having an electrostatic discharge.** Doing so may cause serious damage.

	Caution
	**Keep this product clean. And do not touch the scanning surface of this product.** Otherwise, a defect or a failure may occur. When you need to clean this product, you must clean the scanning surface of this product with a soft cloth and IPA etc.
	**Do not use the illumination emitted outside of visible area such as infra-red light source and ultra-violet light source.** This product is designed the line camera module to scan visible light. This product may be broken.
	Do not touch caution label pasted on this product in order to prevent damage to this product.

1-2 PRECAUTIONS

Caution

Do not store this product in the following places.

- In a vibrating or precarious place
- In a humid, smoky, vaporized or dusty place
- In a slanting place
- In a place exposed by direct sun light
- In a temperature varying place
- Near anything generating heat (eg. A stove, heater, etc)
- In a corrosive gas atmosphere (CL_2, H_2S, NH_3, SO_2, NO_X etc.)
- High humidity place (ex. Kitchen, Bath room)
- In strong magnetic & electrical wave atmosphere (ex. Magnet, Display, Speaker, Radio etc.)

Care should always be exercised when handling and operating this product with your equipment or device.

- Do not drop or damage this product.
- Do not put things on this product.
- No food or drink beside this product.
- Do not put any materials or liquids on this product.
- Avoid any ingression of materials, metals or smoke into this product and its connector.

Use the specified power cable connector and Camera Link® cable.

Power OFF when you insert or remove cables.
Otherwise, an electric shock or a malfunction may occur.

1-2 PRECAUTIONS

	Caution
	Keep this product clean. And do not touch the glass surface of this product. Otherwise, a defect or a failure may occur. When you need to clean this product, you must clean the glass surface of this product with a soft cloth and IPA.
	**Put cables in a fixed position appropriately while operating.** Otherwise, a connection failure and damage may occur.
	**Do not use or operate this product in a slanting or unstable place. Particularly for KD6R1247/1688DXL-NL, center of gravity is offset and product weight is heavy. When picking up and moving these products, please pay attention and hold these products by both hands and more than 2 peoples in order to prevent dropping these products and injury.**
	**Do not use or operate this product in a humid, smoky, vaporized or dusty place.**
	**Do not disassemble the side-bracket for mechanical mounting to your equipment or device.** Otherwise, an ingression of materials and dust, or a defect or a malfunction may occur.
	**Be cautious of your cloths and arms for not to be caught by the sheet metal attached to the both side of this product.** It may cause injury.

1-2 PRECAUTIONS

	Caution (Disclaimer)
	Mitsubishi Electric assumes no responsibility and no liability for any damages resulting from a fire, earthquake or any other act of God, acts by third parties, misoperation by the user intentionally or accidentally, or used under extreme operating conditions.
	Mitsubishi Electric assumes no responsibility and no liability for any damages resulting from indirect, additional or consequential damages, including but not limited to loss of expected income and suspension of business activities.
	Mitsubishi Electric assumes no responsibility and no liability for any damages resulting from an unintended use as stipulated in Manual and Datasheet of this product.
	Mitsubishi Electric assumes no responsibility and no liability for any damages resulting from improper handling, use or repair by any party other than Mitsubishi Electric.
	Mitsubishi Electric warrants this product in conformity with the specification specified only in the Datasheet and the Manual of this product.
	Mitsubishi Electric's total liability shall not exceed the purchase price of this product.

1-2 PRECAUTIONS

	Handling precautions
	Handle this product carefully. Do not drop, shock, vibrate this product.
	Do not operate not in compliance with the conditions defined in the Datasheet and the Manual of this product.
	Keep this product cool with the appropriate thermal management referred to in "2-7 Handling precautions" if this product is used on no-air flow area.
	This product is designed as an embedded line camera module. Determine the applicability of this product to your equipment or devices through the appropriate analysis or evaluation by the designer of such equipment or devices, or personnel related to the specification. Such designers or personnel shall warrant the performance and safety of your equipment or devices such as dust-proofing, water-proofing, EMC and EMI, by themselves.

1-3 CE marking

1-3-1 CE Mark compatibility conditions

KD6R1064DXL-NL and KD6R1247DXL-NL are designed to comply with EMC Directive 2014/30/EC of EU legislation.

In order to make this product CE mark compliant, use this product under the following conditions.

① Length of 5V power supply cables has to be 3m or shorter. Attach ferrite cores recommended in the following pages with the power supply cables in order to reduce noise emission. The details of the ferrite cores are explained in the following pages.

② Prepare your power supply dedicated for this product, and supply 5V power to this product.

Moreover, this product is designed as an embedded module. When this product shall be installed to the other equipment, the equipment has to be compliant with the necessary regulation and directives.

This product is complied with the following EMC directives and standards.

EMC directives	2014/30/EC
Applicable standards	Immunity EN 61000-6-2 : 2005 / AC : 2005
	Emission EN 61000-6-4 : 2007 + A1 : 2011

Category of ISM equipment by EN55011: Comply with Group 1, Class A test standard

Class A equipment is regulated to be used under industrial environment. It could be potentially difficult to assure the electromagnetic compatibility under other environment. Refer to EN55011 standards for further details.

1-3 CE marking

1-3-1 Conditions - CE mark certification

1. KD6R1064DXL-NL (L4 type）

In order to make this product complied with CE mark, attach ferrite cores on the cables as shown on the left diagram. The ferrite cores enable to reduce the noise emission from the cables.

Recommended ferrite cores are shown below.

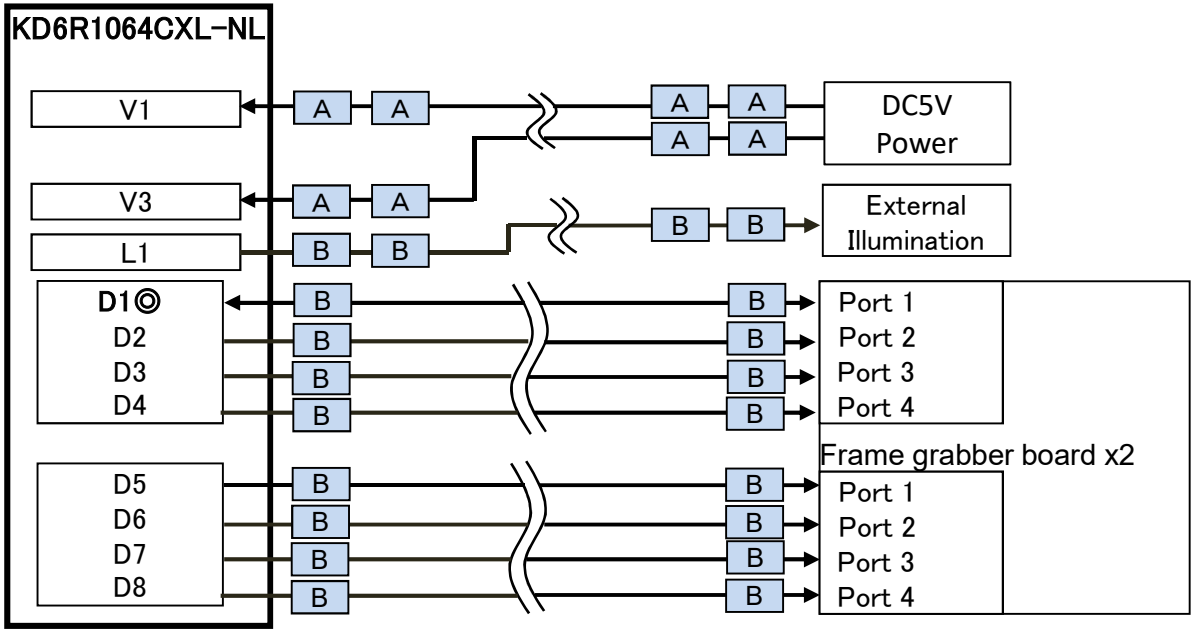
Ferrite core A : RFC-20 KITAGAWA INDUSTRIES CO.,LTD

Ferrite core B : RFC-H13 KITAGAWA INDUSTRIES CO.,LTD

1. KD6R1064DXL-NL (L4type）

Attach ferrite cores as described in below.

- Cable between V1,V3 connector and 5V power supply: 4 Ferrite cores A (2 turn)
- Cables between Connector D1 to D8, and Frame grabber: 2 Ferrite cores B (1 turn)
- Cables between Connector L1, and External Illumination: 4 Ferrite cores B (1 turn)



1-3 CE marking

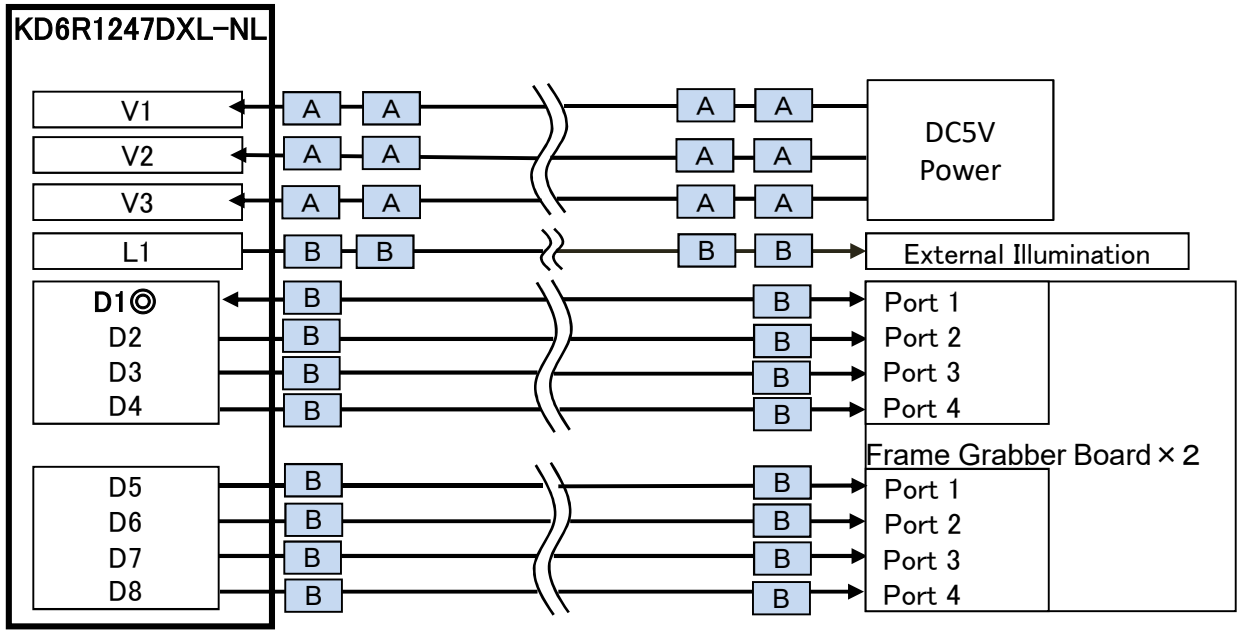
1-3-1 Conditions - CE mark certification

2. KD6R1247DXL-NL (L5 type)

2. KD6R1247DXL-NL (L5 type)

Attach ferrite cores as described below.

- Cables between V1/V2/V3 connectors and 5V power supply
  : 4 Ferrite cores A (2 turn)
- Cables between Connector D1 to D8, and Frame grabber
  : 2 Ferrite cores B (1 turn)
- Cables between Connector L1, and External Illumination
  : 4 Ferrite cores B (1 turn)



1-4 WARRANTY

1-4-1 Warranty

Mitsubishi Electric warrants this product in conformity with the specification specified only in Datasheet and Manual of this product within Warranty period.
(Mitsubishi Electric does not warrant any devices, equipments, and systems, which comprise this product.)

1-4-2 Warranty period

1 year from the ex-factory date.

1-4-3 Contents of warranty

If any product failure or defect which is recognized to happen under Mitsubishi Electric's responsibility is found within the warranty period, any repair services at Mitsubishi Electric's own expense or replacements with the same product under the scope of product specification shall be provided.

1-4-4 Out of Warranty

Notwithstanding above, this product shall not be warranted in the following circumstances.

- In case of out of warranty period.
- In case of improper handling, use or repair by any other party than Mitsubishi Electric.
- In case of improper conditions that are not stipulated in the data sheet or the manual and damage this product by direct sunlight, water, any chemicals, external pressure etc.
- In case of a malfunction due to improper use.

The cost of repair or replacement shall be charged to the customer who requested to repair the Out of Warranty product. Also, Mitsubishi Electric shall not be liable to any indirect damages, consequential damages, etc. related to the product.

1-5 REPAIR

1-5-1 Repair method

Your sole remedy shall be repair or replacement of this product (Contact Image Sensor), provided that the defective product is returned to our factory and analyzed by Mitsubishi Electric.
When you return this product (Contact Image Sensor) to Mitsubishi Electric, return it according to the packing specification of the shipment and use our packing materials (refer to 2-6 Packaging). If you cannot use our packing materials, this product should be protected by more than triple bubble wrap and be put it on suitable case.

Notwithstanding above, depending on circumstances of the discontinuity of material procurement and facility etc., repair of this product may not be available. In that case, such request is handled as an upgrade or repair into other equivalent products.

1-5-2 Request of repair

If you need to return this product for Repair, you must contact the agency who sold you this product. Do not return your product to Mitsubishi Electric without prior authorization. The shipment cost to return this product shall be borne by sending party.

1-5-3 Repair period

This product would be repaired for 1 year after the final production of this product, provided that Mitsubishi Electric would be able to maintain production equipment or tools and procure the necessary materials for the repair. The prior announcement of the discontinuation of this product will be announced through the agency who sold you this product, or through our website.

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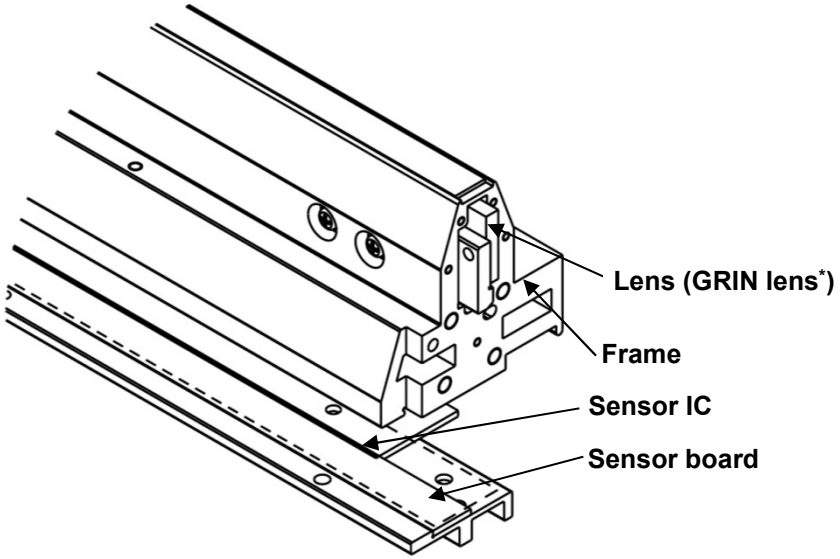
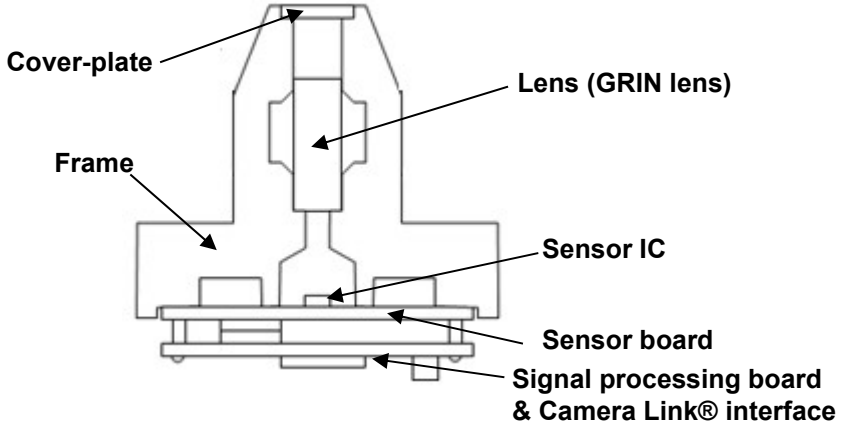
Chapter 2 : Overview

2-1 What's Contact Image Sensor

【Perspective view】



【Cross-section】



This product (CIS : Contact Image Sensor) is a scanning device that comprises several key-components in below;

- Sensor IC array in the length as same as scan width.
- Rod lens array in the length as same as scan width.
- Illumination in the length as same as scan width.

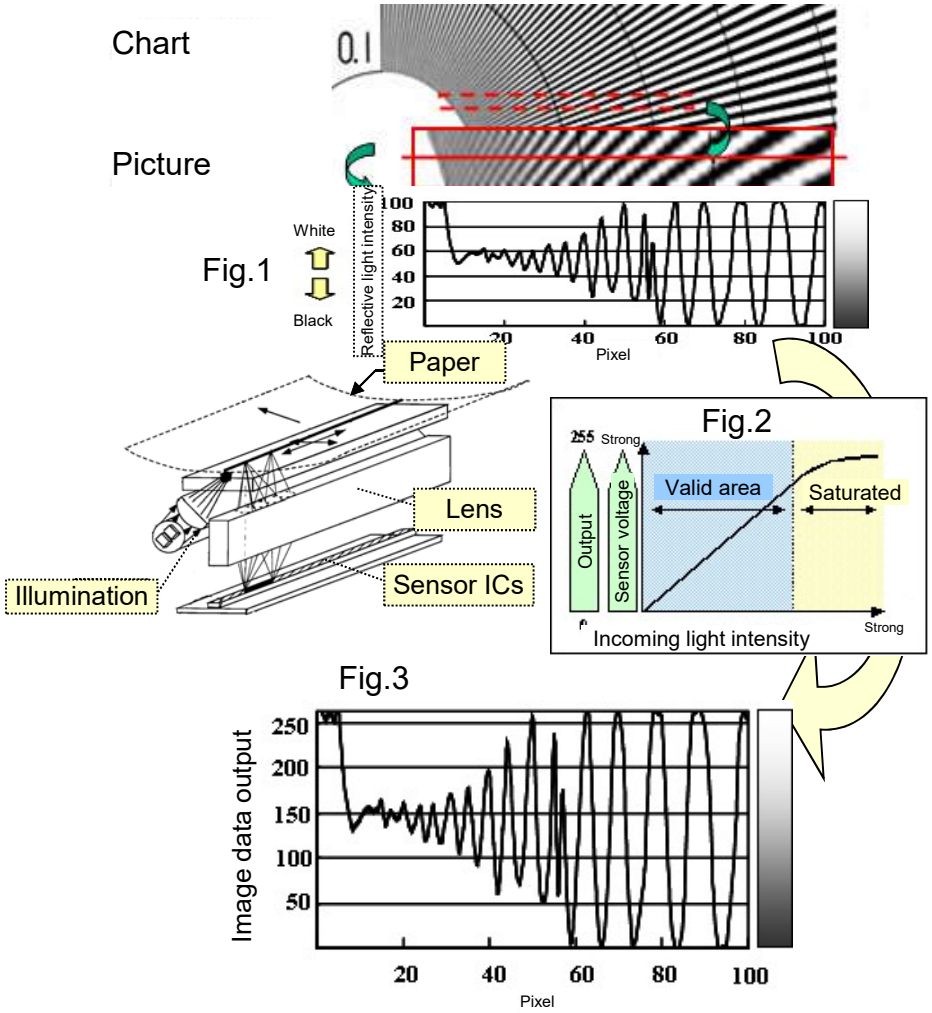
*GRIN lens : Gradient Index lens

The features of CIS can be compared to line camera as follows;

	CIS	Optical reduction system
① Resolution	Fixed	Flexible
② Depth of focus	Shallow (±0.5～ 2mm)	Deep (～ 4mm)
③ Distortion	Small	Large
④ Light path	Short (10～50mm)	Long(～200mm)
⑤ Requested light intensity	Small	Large
⑥ Power consumption	Small	Large
⑦ light-sensitive element	CMOS / CCD	CMOS / CCD
⑧ Impacting and vibration	Strong	Weak
⑨ Setup adjustment	Easy	Need to be adjusted with lens precisely.
⑩ Outline	Compact	Large

2-2 Principal technology of CIS

【How to acquire reflective light】



This clause explains how to acquire the raw information of the light and convert into electrical signal information.

・When scanning a surface of the object, the illumination on this product irradiates the object.

・The object reflects the light. Generally the illuminated black object reflects weaker reflective light. On the other hand, the illuminated white object reflects stronger one.

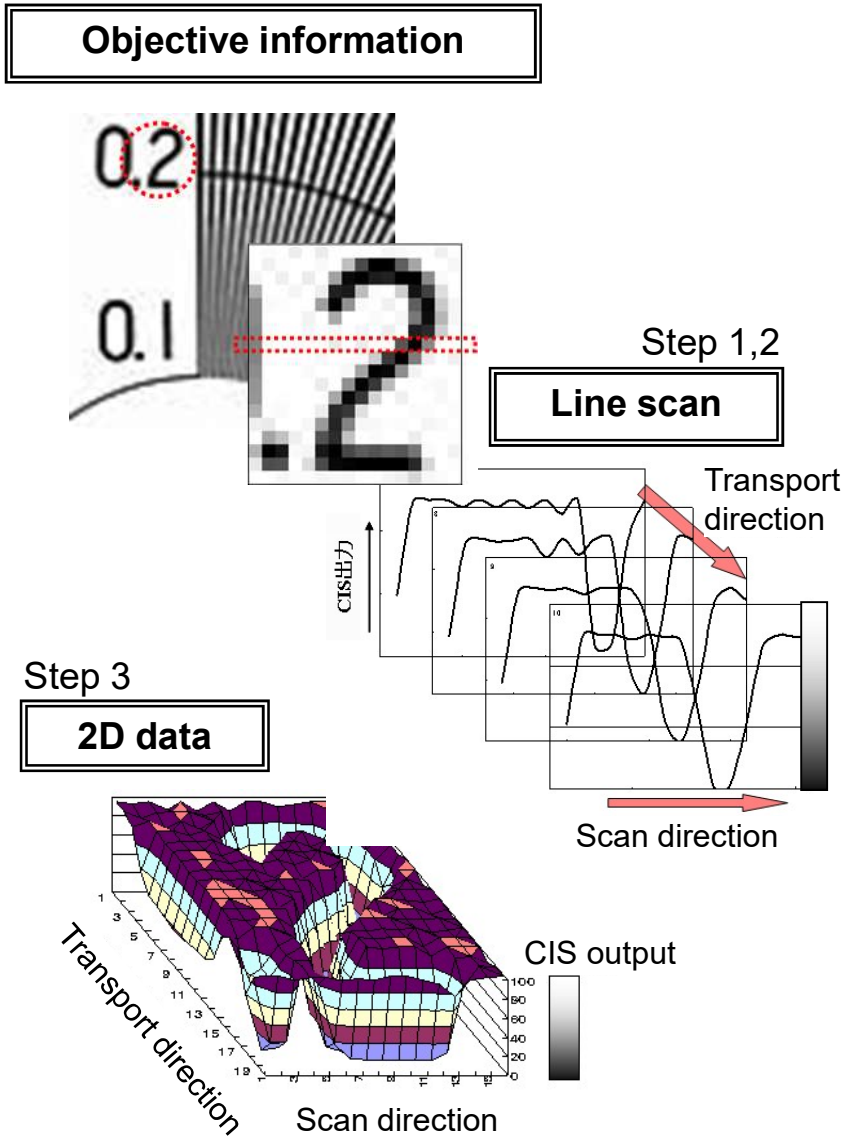
・Refer to the drawing on left side (Fig.1). The black and white charts have a correlation with the reflected light intensity.

・The strong and weak reflective light arrives at the surface of Sensor ICs (photo-diodes) through lens.

・As described in the drawing on the left side (Fig.3), Sensor ICs correspondingly converts the strong and weak light into the large and small electrical signal based on the converting property of Sensor ICs as described on the drawing on left side (Fig.2).

・Sensor ICs are arranged in an array and detect the optical information corresponding to that position.

2-2 Principal technology of CIS



This product captures 2-d image by scanning one line repeatedly and continuously.

・Acquiring a data of one line in scan direction.

・Relative transport in transport direction between the object and this product can accumulate 2 dimensional data.

Refer to left side of the drawings.

【Example of scanning “2”】

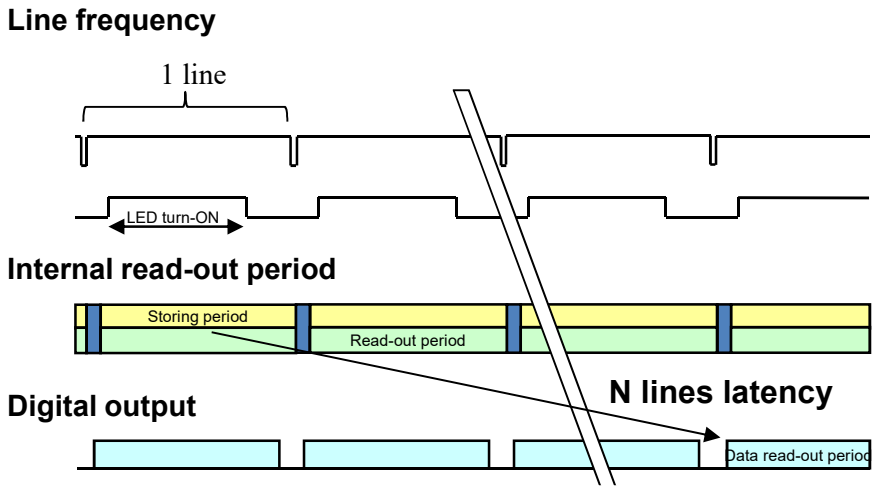
・Step 1: Sensor IC reads one line in red point-line area. The size of the line in transport direction is based on the size of pixel.

・Step 2: The scanning line is transported in transport direction.

・Step 3: Repeating Step 1 and 2 generates 2D image data. (The height of the 2D-data means the strength of CIS output.)

2-2 Principal technology of CIS

【Data output timing】



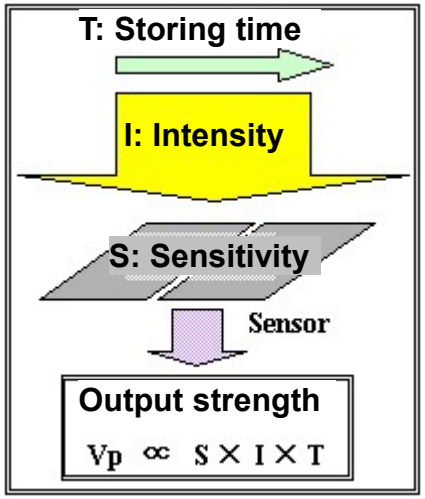
【Data output timing】

There is a latency to read-out a line data. The N-line latency is designated from a timing of LED turn-ON as described on the left drawing.

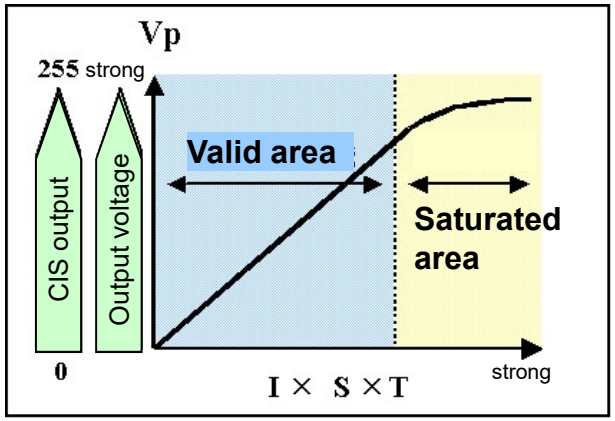
1) Sensor ICs converts the light information into the electrical signal (1 line)
2) Period to read out the analog data of sensor pixels (1 line)
3) Period to convert the analog data into digital data and rearrange the data position of each pixel in scanning direction (1 line)
4) Period to process internal image processing (3 to 10 lines)

2-2 Principal technology of CIS

【Strength of Sensor IC output】



【Property of Sensor IC】



【CIS output】

CIS output (Vp) is defined below;

- Light intensity : I
- Sensor IC Sensitivity : S
- Storing time (illuminated time to Sensor IC) : T

$$Vp = k \times I \times S \times T$$

(k: coefficient)

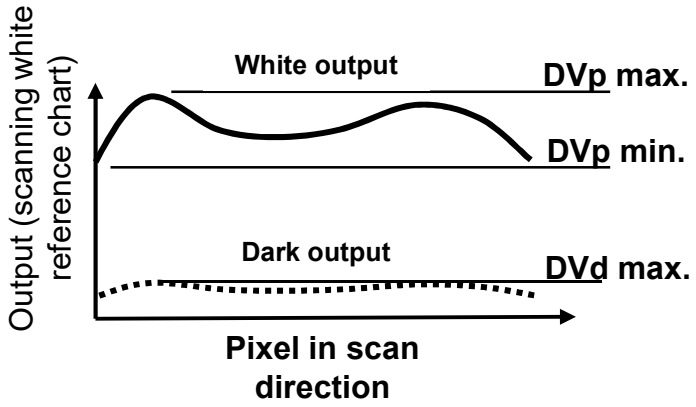
【Remark】

1) To keep a quality of the image, Vp is an important factor so that Light intensity (I) and Storing time (T) have to be adjusted appropriately.

2) If the intensity of the light source becomes too strong, CIS output becomes saturated. In order to avoid such saturation of the output, adjust the illumination's intensity (illumination-duty) appropriately.

2-3 Definition

【White output and Dark output uniformity】



【Definition of CIS output】

This product comprises CMOS sensor IC which each pixel has each DC offset and variation of sensitivity. And the variation of lens and light intensity also affect the CIS output. CIS output is defined in below.

1. Dark output uniformity

Dark output uniformity is an output uniformity when the illumination is turned OFF.

Dark output is defined as maximum value DVd max.

2. White output uniformity

White output after Dark correction (DVEp) means white output value after subtracting dark output from sensor output pixel by pixel . DVEp is calculated as follows;

$$DVEp(n) = DVp(n) – DVd0(n).$$

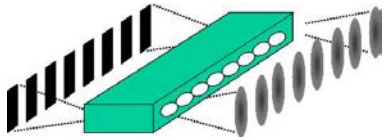
White output uniformity (UEp) indicates the output variation when this product is scanning white reference chart.
White output uniformity is calculated as follows;

$$UEp = (DVEp\ max.- DVEp\ min.)／DVEp\ max.$$

2-3 Definition

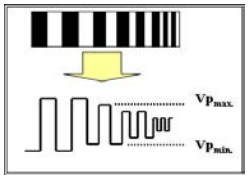
【Depth of Focus】

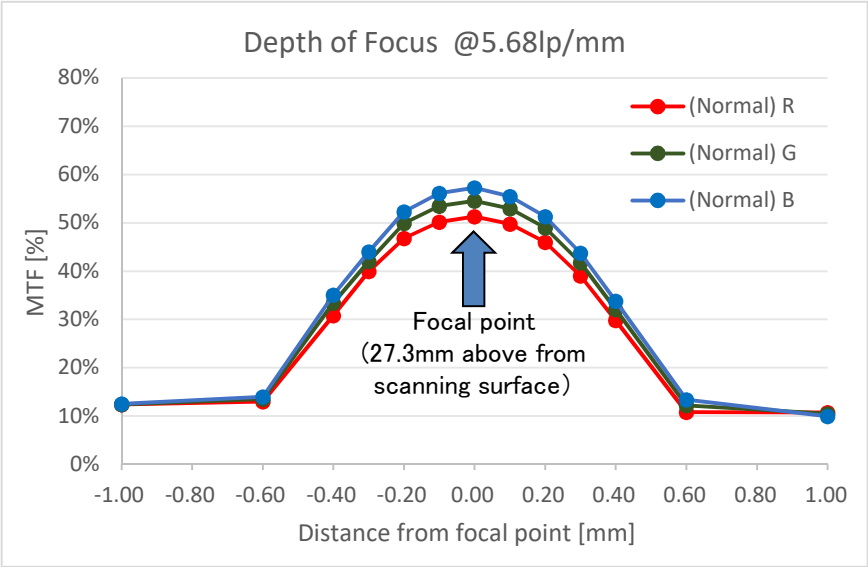
Definition of resolution



Object

Image (erected and same size)





Scan images

3mm	2mm	1mm	0mm (focal point)	-1mm

【Definition of CIS output】

3. DOF : Depth of Focus

Depth of Focus indicates a change of a focus performance on various positions of the object from focal position on a lens-axis.

Generally, the resolution becomes lower or defocused when the scanning position is moved away from a focal point.

The resolution is defined as MTF (Modulation Transfer Function) value.

The MTF value is calculated by the following formula when scanning a reference chart having a respective width and pitch of the white and black areas.

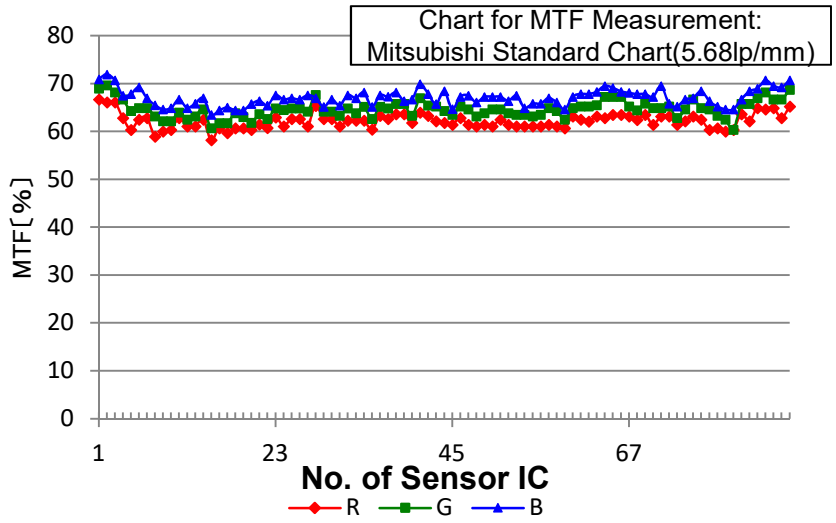
$$\mathrm{MTF} = \frac{\mathrm{Vpmax.} - \mathrm{Vpmin.}}{\mathrm{Vpmax.} + \mathrm{Vpmin.}} \times 100 \ (\%)$$

•lp/inch: lp/inch explains the resolution. The resolution is defined by reading the black and white same-width stripes. This pair of the same-width black and white stripe is called as “line pair” (lp), and the “lp/inch “ shows how many “lp”s are printed in 1 inch.

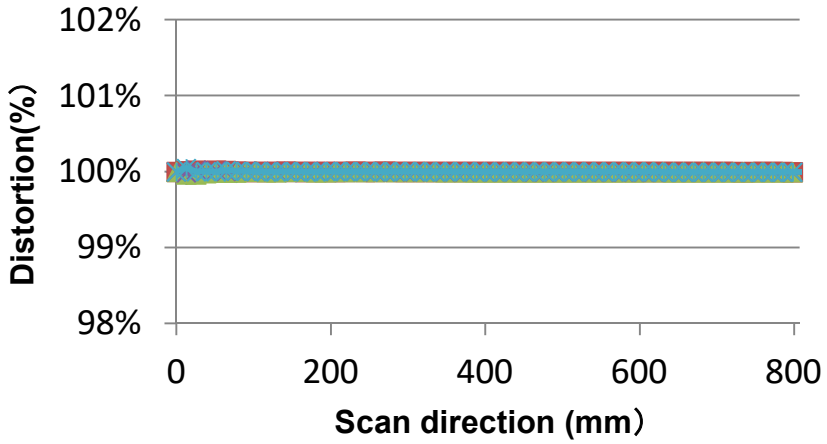
For example, “150 lp/inch chart” means that 150 pairs of black and white stripes are printed in 1 inch on the chart. And, the calculation of the resolution is 25.4 (mm) / 300 (stripes) = 84.66, which is about 85μm width strips are printed .

2-3 Definition

【MTF variation of scan direction】



Variation of MTF value (KD6R1064DXL-NL)



Distortion ratio of KD Series

The graph on the left shows a property of resolution uniformity in the scanning direction of KD6R1064DXL-NL. Each dot on this Graph shows MTF value of each sensor chip in a CIS.

1. MTF value variation in the scanning direction

The graph on the upper left shows an example of MTF values of each sensor ICs. This shows that this CIS has uniform resolution in whole scanning width.

2. Distortion

The graph on the lower left shows an example of distortion values in 1st pixel of each sensor ICs, which are calculated by measurement value of each pixel after assemble (n = 5).

Distortion(%)
= Measured distance* / Designed distance* × 100

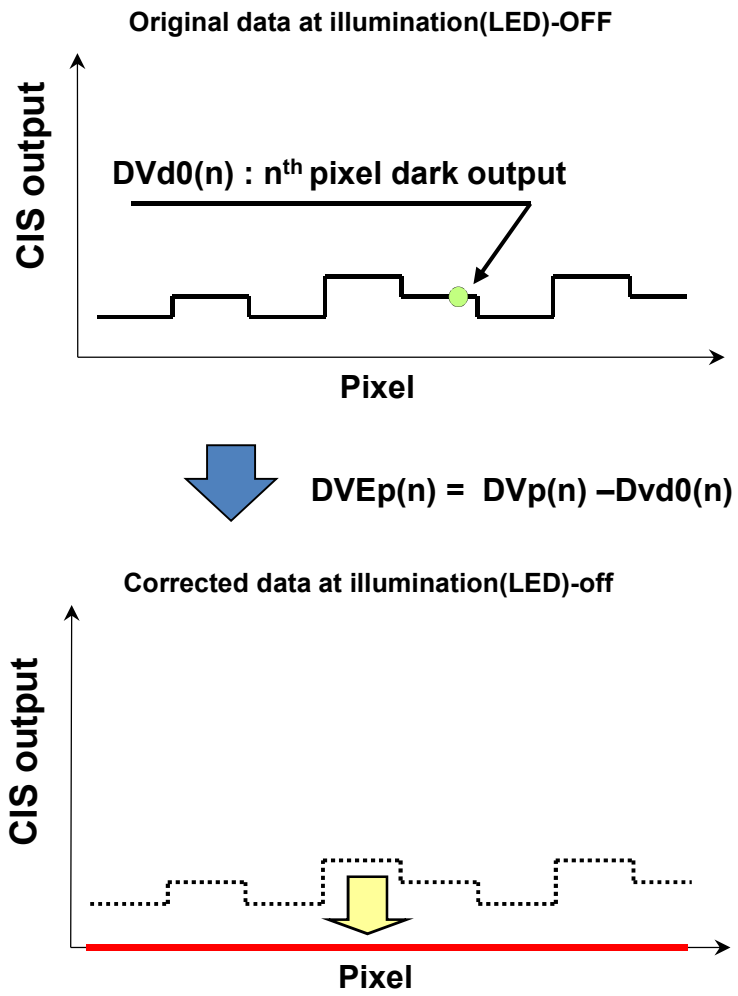
*Measured distance: a distance between the first pixel and the measured pixel.

*Designed distance: an ideal distance between the first pixel and the designed pixel.

This data shows that this CIS has extremely less distortion in whole scanning width.

2-3 Definition

【Dark correction】



【CIS output and signal processing function】

This product is equipped with correction functions of the pixel unit. These functions correct the variations due to DC offset and the sensitivity variation of each pixel of the CMOS sensor, the lens, and the illuminations, and enable this product to provide good images.

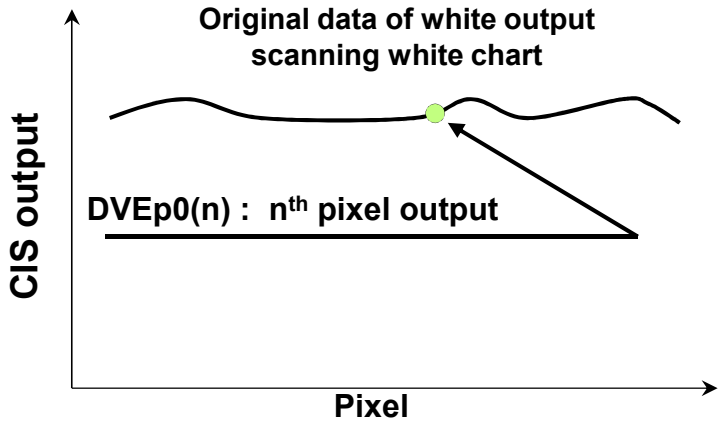
1. Dark correction

This is a function that corrects DC-offset on each pixel into zero. This function subtracts the pixel dark-correction data (Dvd0 (n)) from the original pixel dark output data (Dvp (n)) pixel by pixel.

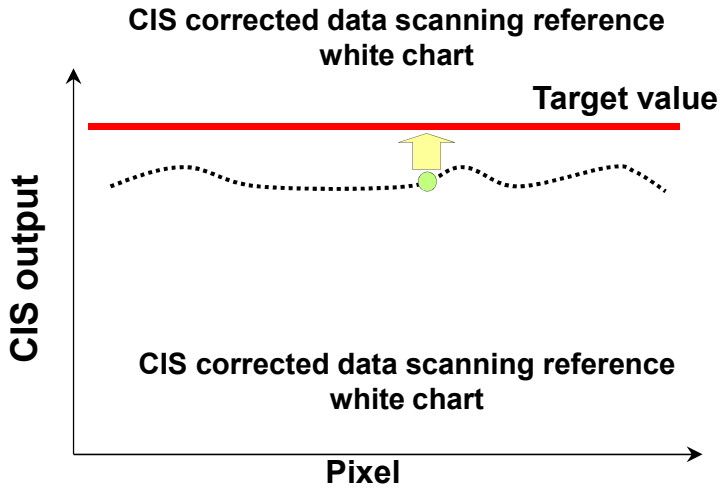
Dark-correction data (Dvd0 (n)) is generated by averaging 32 lines of the data to minimize the effect of noise on each pixel in the condition of turning off the illumination. Using Dark correction on CIS output allows this product to provide the only dynamic range responding the incoming light.

2-3 Definition

【White correction】



$$DVp'(n) = \frac{DVEp(n)}{DVEp0(n)} \times \text{Target value}$$



【 CIS output and signal processing function 】

2. White correction

CIS output corrected by Dark correction is affected by the sensitivity of the CMOS sensor, the imaging efficiency of the lens, and the illumination intensity. White correction enables this product to correct these variations and to provide a uniform output, when a uniform-reflectance chart is scanned.

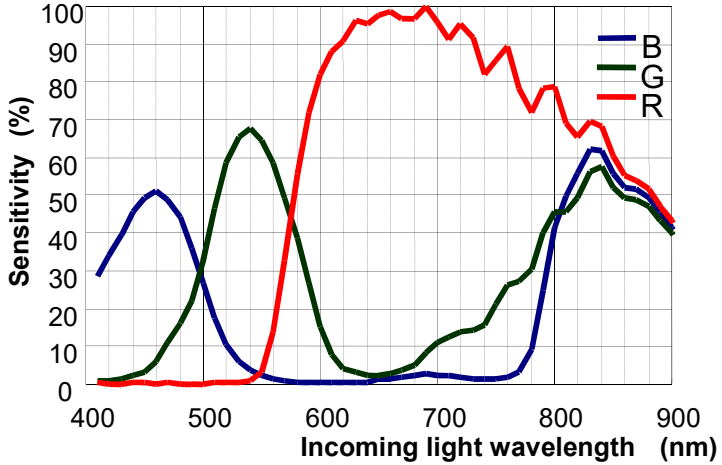
White correction corrects the white output (DVEp (n)) acquired in an actual scanning operation by using the white correction data (DVEp0(n)) acquired in scanning another object having an uniform reflectance.
CIS output corrected by White correction, DVp'(n) is calculated by the following formula.

$$DVp'(n) = \frac{DVEp(n)}{DVEp0(n)} \times \text{Target value}$$

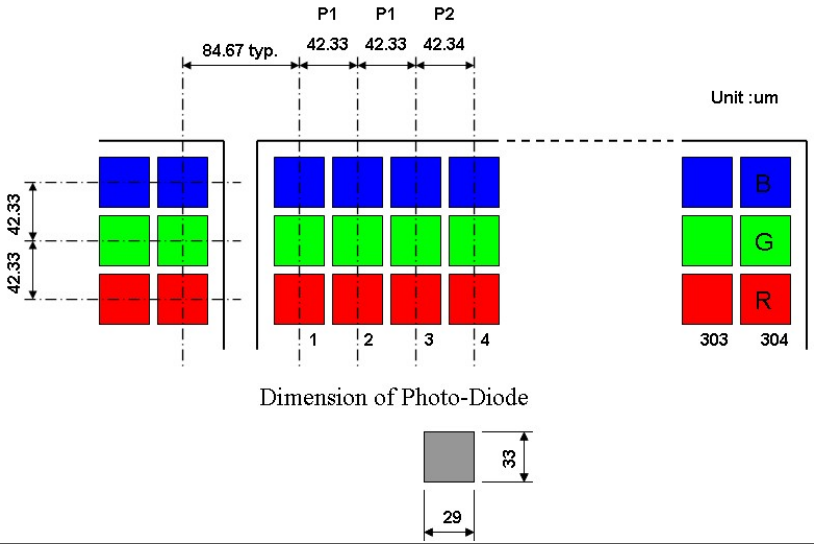
Target value can be set by register value. There are several methods to create White correction data. Refer to Function specification for further detailed information.

2-4 Features of scanning pixels

【Sensor IC spectral sensitivity】



【Pixel alignment of Sensor ICs】



【Sensor IC spectral sensitivity】

This product comprises a color trilinear sensor ICs that feature Filter-on-Chip technology. The Sensor IC's spectral sensitivity is described on the left.

【Pixel alignment of Sensor ICs】

The plural Sensor ICs are assembled in a line on a sensor board in this product. The numbers of 288 pixels x 3 color Sensor ICs for each length are as follows;

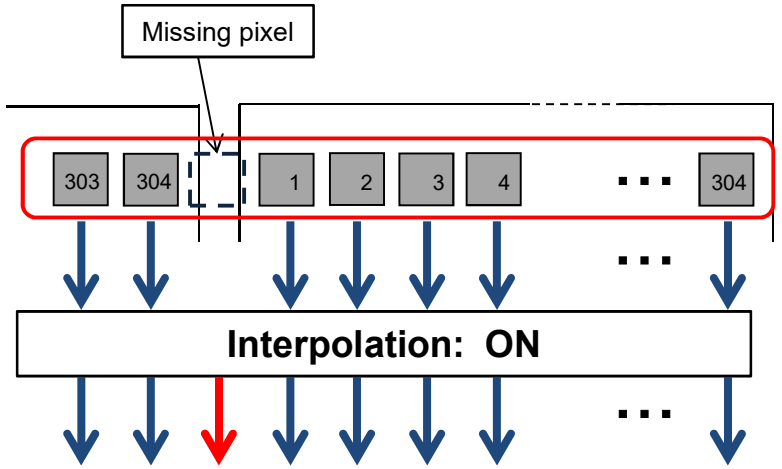
1064 mm size : 87 chips
1247 mm size : 102 chips
1688 mm size : 138chips

Because keeping enough dicing area at the edge of Sensor ICs is necessary, the resolution between the neighboring pixels of neighboring Sensor ICs is not 600 dpi, and is designated to be 300 dpi (84μm) pitch and controlled to be placed within 1/3 pixels(±15μm) tolerance.
Therefore, the pixel pitch between the neighboring sensor ICs is arranged in 300dpi pitch, and doesn't output a pixel data between sensor ICs, which is called "missing pixel".

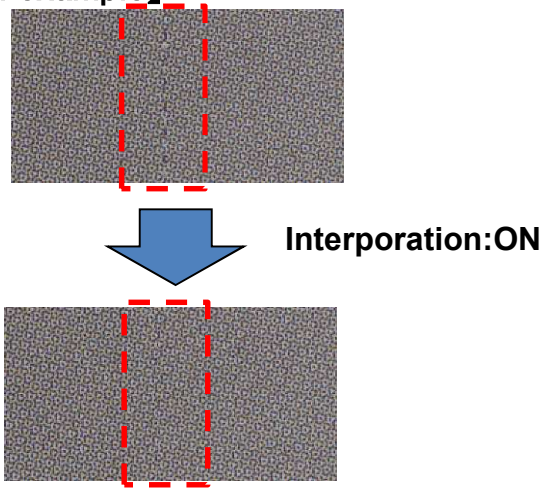
Additionally, a function of Interpolation that can insert a pixel data created by neighboring pixels data for each gap between neighboring Sensor ICs is available on this product.

2-5 Interpolation function

【Conceptual Diagram of Interpolation】



【Interpolation example】



【Interpolation function】

This product has a Sensor IC array having a reduction of a resolution at the gap between sensor ICs. This is a function to compensate a reduction of the resolution between neighboring Sensor ICs.

【Technology of Interpolation】

To get the most expected Interpolation data, the resolution of the gaps between neighboring Sensor ICs are designated to be 300dpi and precisely controlled by the tolerance of ±15μm in X/Y direction.

- The missing pixel data can be generally interpolated by generating the data of missing pixel based on Filter Interpolation.
- If the image data is cyclic, the missing pixel data may need to be interpolated by generating the data of missing pixel based on “Average keeping interpolation”. Refer to the following patent publication for further detail.

Japanese Related Patent No.:

(1) 3767593
(2) 3810404
(3) 4199784
(4) 4772754

2-6 Specification

Item	Unit	L4：KD6R1064DXL-NL L5：KD6R1246DXL-NL L6：KD6R1688DXL-NL
Scanning width	mm	1064.0 / 1247.8 / 1688.3
# of Valid pixels	pixel	25,056 /29,376 / 39,744 × R/G/B 3 lines (color)
Resolution	dpi	600
Line scan frequency (*1)	kHz	External sync. & Internal sync.: 24.0max(L4) 20.1max(L5/L6)
I/F Format	—	Camera Link® V2.1 compliant
Output format	—	Refer to the next page
Data output frequency	MHz	84 max
Additional Signal Processing	—	- White / Dark Correction function - Programmable Gain Amplifier - Interpolation - γ correction etc.
illumination	—	none
Focal point	mm	62.5 from reference holes at CIS
Outline (L×W×H)	mm	1131.1 / 1314.1 / 1755.1 X 59 X 119.3
Weight	Kg	5.9 / 6.8 / 9.1

(*1) 600dpi 10bit RGB, refer to the next page

Please confirm detail specification of these products with separated datasheet.
Product specification of developing products will be changed without notice.

2-6 Specification

Output Mode-1

- Output configuration: Camera Link® Base/Medium/Full/Deca Configuration switchable
(In this Product, Camera Link® Specification 8bit-Modes, 80bit and 10bit-Modes, 80bit is called Deca Configuration)
- Number of channel: 1ch or 2ch (switchable) (refer next page for detail)
- Output frequency: Camera Link® Ver2.1 48MHz～84MHz
- Image format: 24bit color, 30bit color, 8bit mono, 10bit mono switchable
- Line frequency is changed by the output format of data, output resolution, and sync mode.

Maximum Line Rate
（@Color: Full Configuration 84MHz, 2ch output @Monochrome: Deca Configuration 84MHz, 2ch output）

Resolution	Max. Line Frequency [KHz]							
	L4				L5,L6			
	30bit Color	24bit Color	10bit Mono	8bit Mono	30bit Color	24bit Color	10bit Mono	8bit Mono
600dpi	24.0	35.1	53.0	55.0	20.1	29.3	53.0	55.0
300dpi	47.5	72.1	90.4	93.4	39.4	60.8	90.4	93.4
200dpi	71.0	104.4	124.2	127.2	58.0	88.5	124.2	127.2
150dpi	82.0	134.5	153.0	155.0	78.0	114.6	153.0	155.0

2-6 Specification

Output Mode-2

- Refer to p34-36 for Connector assignment of Camera Link® D1-D12
- Image data is outputted by adjacent format only. (Other image data format is not available.)
- Refer to next page to check relationship between connector and output channel.

［1ch Output］

•KD6R1064/1247DXL-NL：

Image data is outputted from 4 connectors (D1,D2,D5,D6) if using Medium, Full, Deca Config.

Image data is outputted from 2 connectors(D1,D5) if using Base Config.

D1,D2,D5,D6 connectors belong to “Ch1”.

•KD6R1688DXL-NL：

Image data is outputted from 6 connectors (D1,D2,D5,D6,D9,D10) if using Medium, Full, Deca Config.

Image data is outputted from 3 connectors(D1,D5,D9) if using Base Config.

D1,D2,D5,D6,D9,D10 connectors belong to “Ch1”.

Hereinafter above output method is called “1ch output”. This method is the standard output mode in ordinary operation and ex-factory condition.

［2ch Output］

•KD6R1064/1247DXL-NL：

Image data is outputted from 8 connectors (D1-D8) if using Medium, Full, Deca Config.

Image data is outputted from 4 connectors(D1,D3,D5,D7) if using Base Config.

The connectors belonged to Ch1 and Ch2 are used in this output mode.

•KD6R1688DXL-NL：

Image data is outputted from 12 connectors (D1-D12) if using Medium, Full, Deca Config.

Image data is outputted from 6 connectors(D1,D3,D5,D7,D9,D11) if using Base Config.

The connectors belonged to Ch1 and Ch2 are used in this output mode.

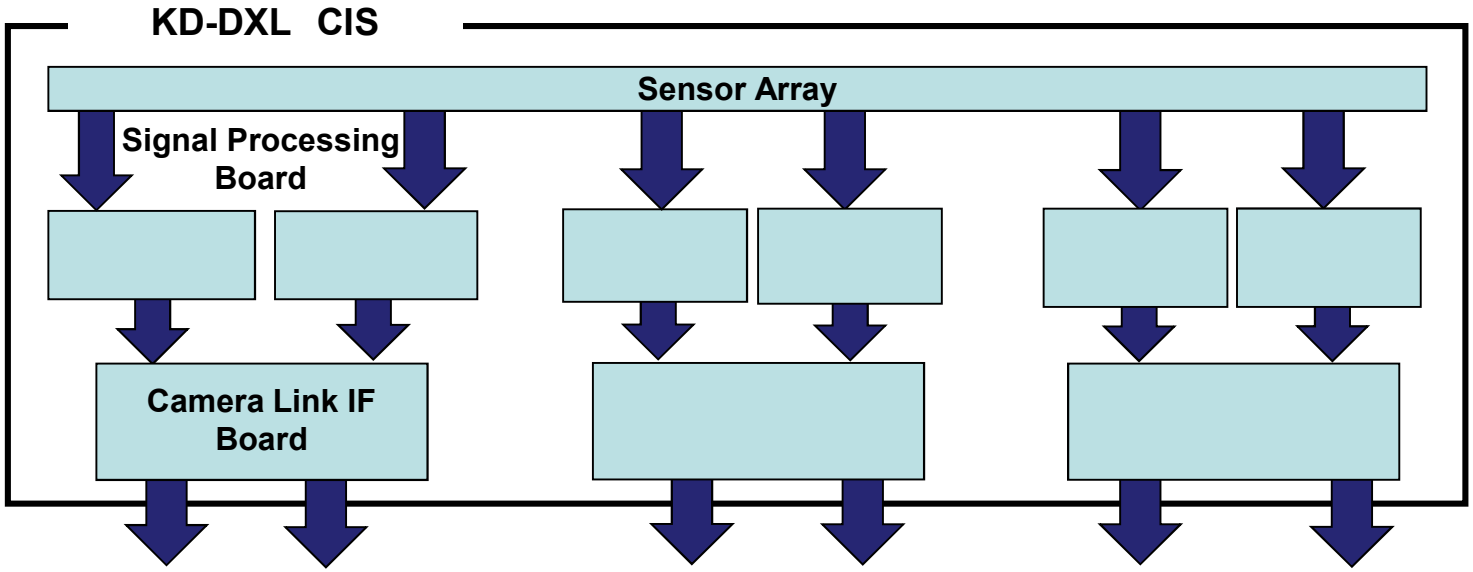
Hereinafter above output method is called “2ch output”.

2-6 Specification

Output Mode-3

Outline figure of relationship of output channel is shown in below.

Outline figure of relationship of output channel

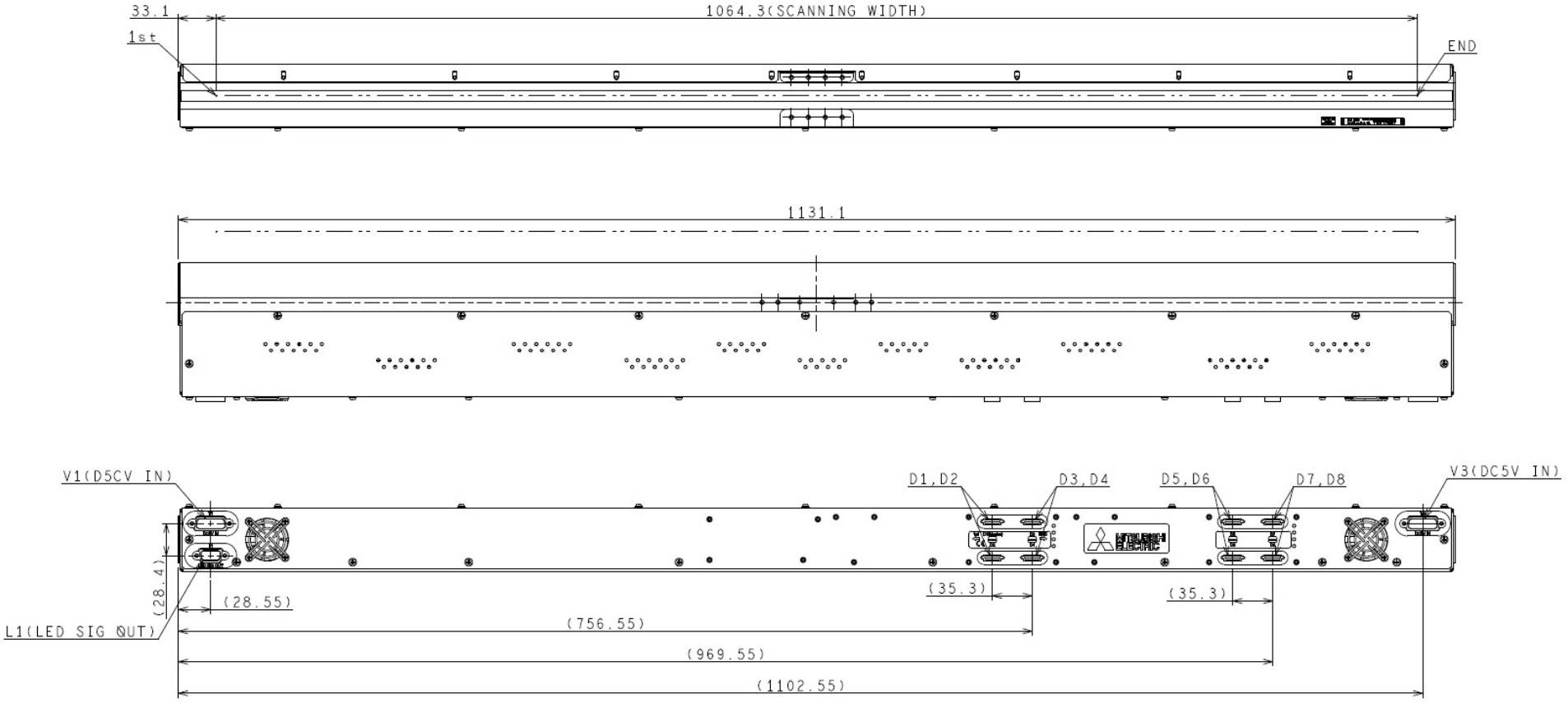


Camera Link® Connector	Camera Link® Connector	Camera Link® Connector	Camera Link® Connector	Camera Link® Connector	Camera Link® Connector
D1,D2	D3,D4	D5,D6	D7,D8	D9,D10	D11,D12
||	||	||	||	||	||
Ch1	Ch2	Ch1	Ch2	Ch1	Ch2

Refer to p34-36 for Connector assignment of Camera Link® D1-D12.

2-6 Specification

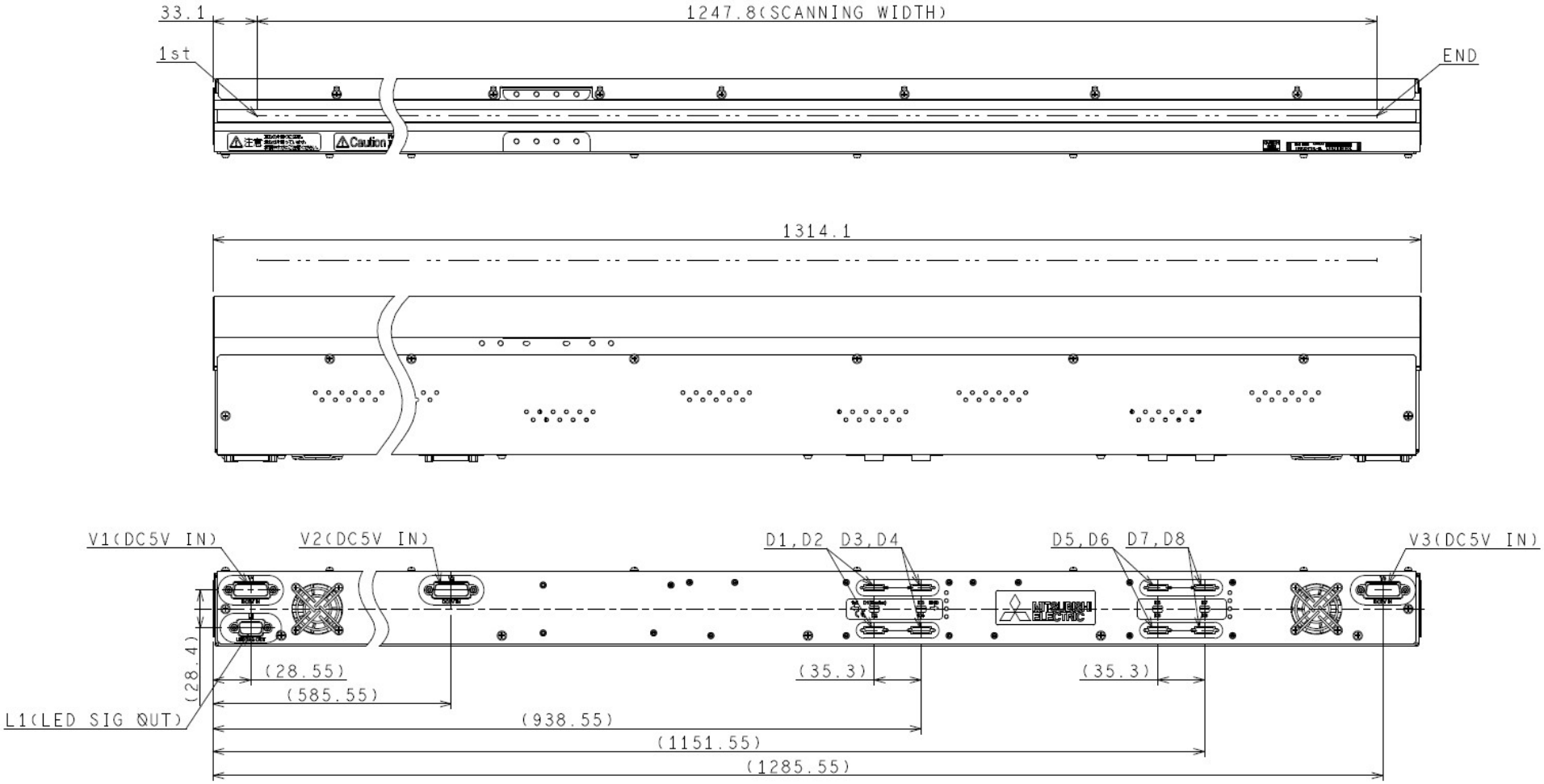
【 L4 type：KD6R1064DXL-NL Outline】



* Refer to p.37 for the side view

2-6 Specification

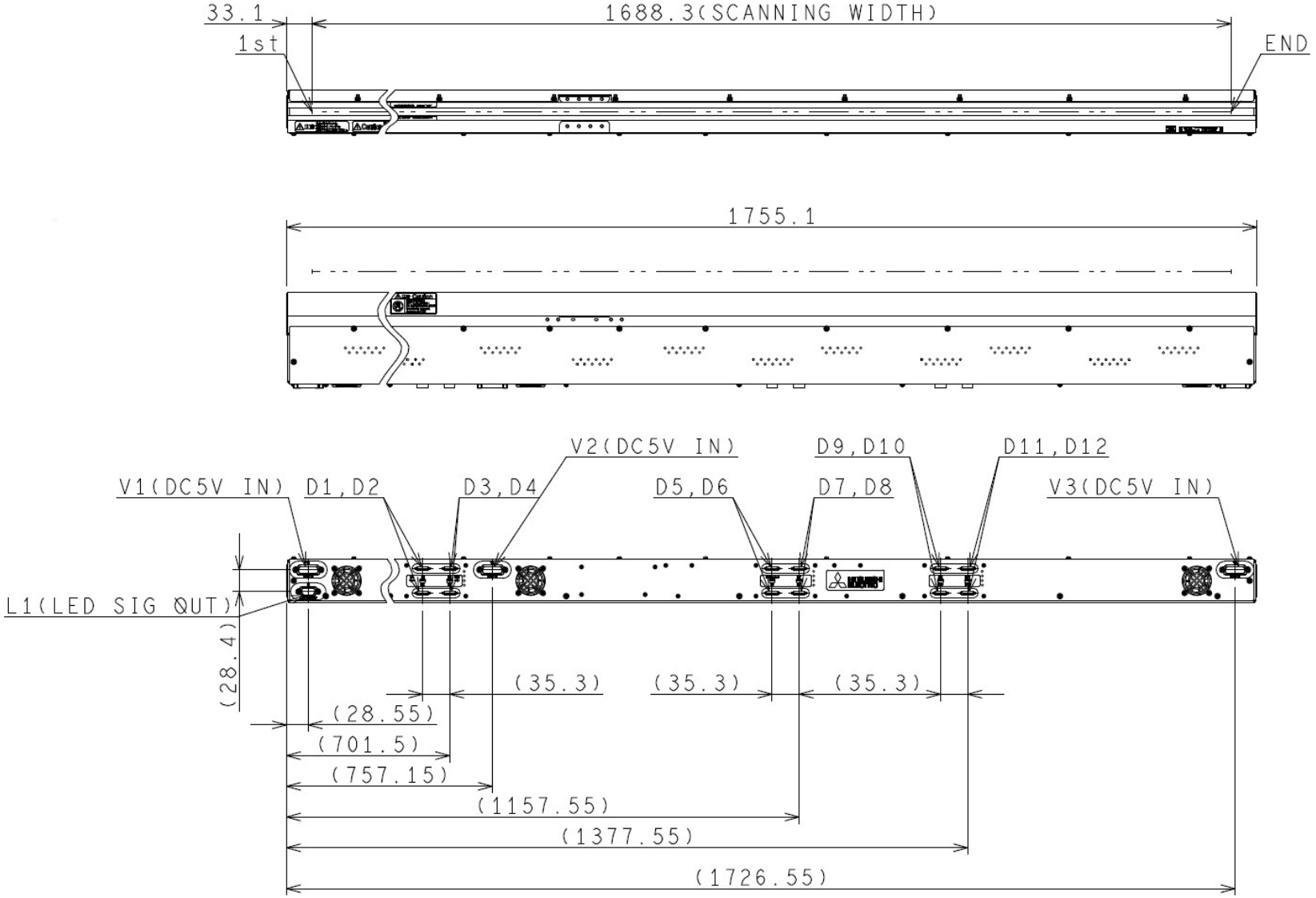
【 L5 type：KD6R1247DXL-NL Outline】



* Refer to p.37 for the side view

2-6 Specification

【 L6 type：KD6R1688DXL-NL Outline】

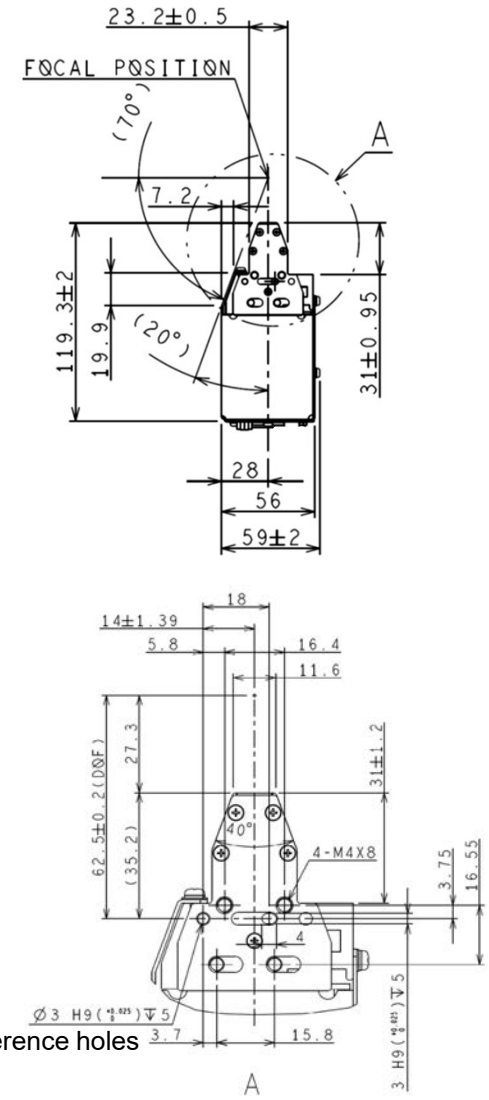


* Refer to p.37 for the side view

2-6 Specification

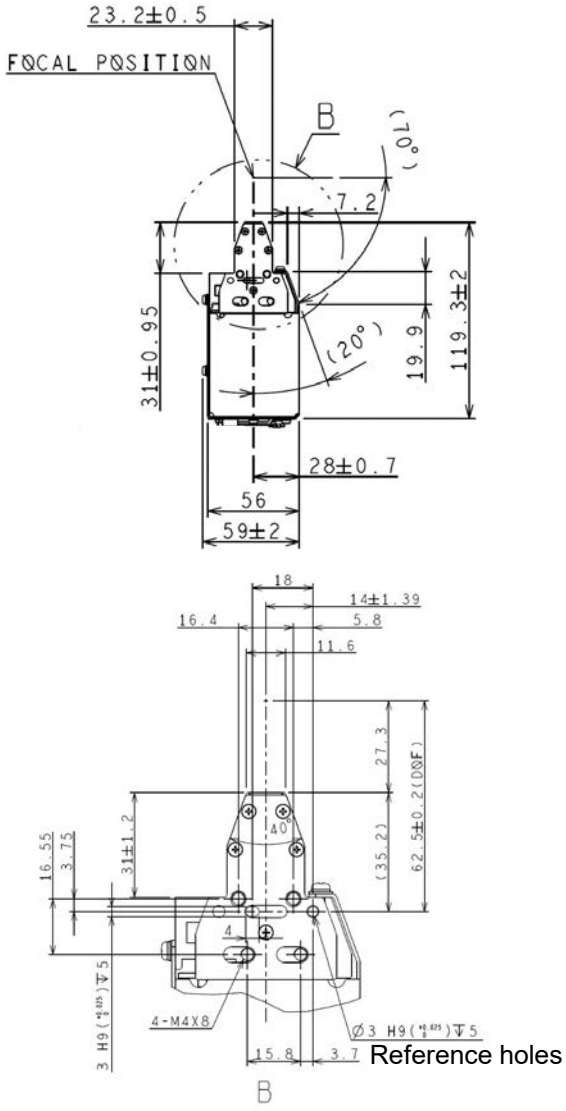
【 L4/L5/L6 ：KD6R1064/1247/1688DXL-NL side view (common)】

1st-side Bracket



Reference holes

end-side Bracket

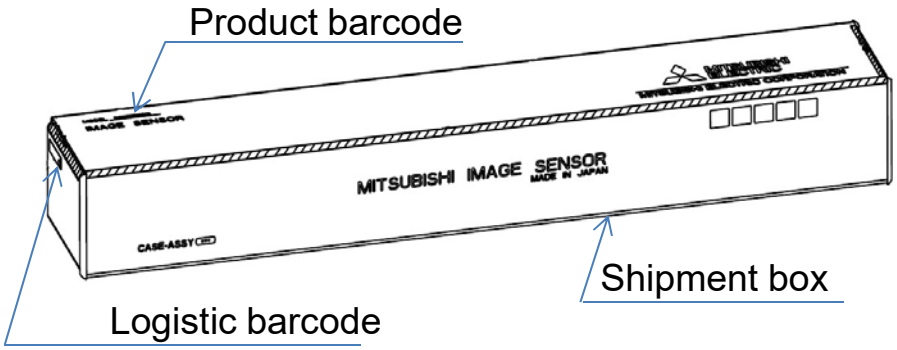


Reference holes

2-6 Specification（Packaging）

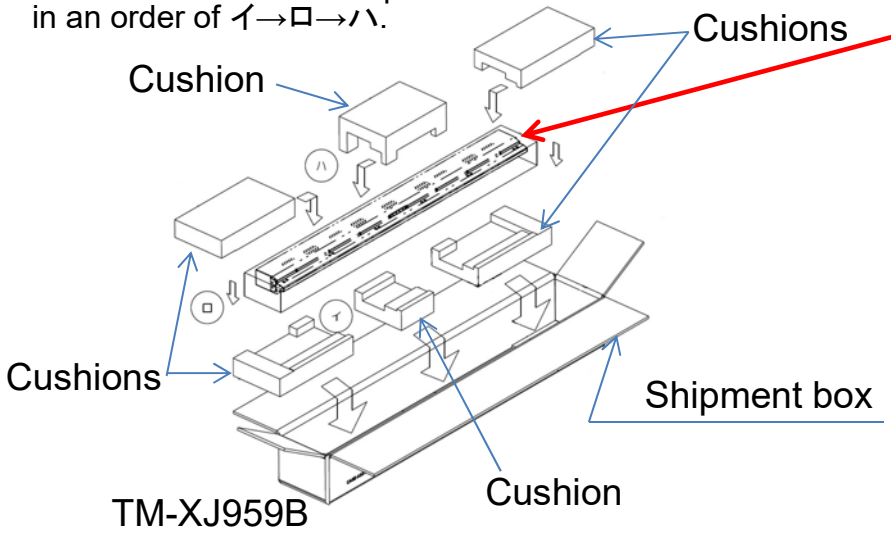
【 L4/L5/L6（KD6R1064/1247/1688DXL-NL） Packaging】

＜Shipment box＞

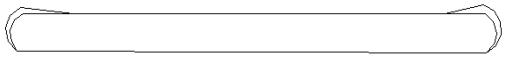


③

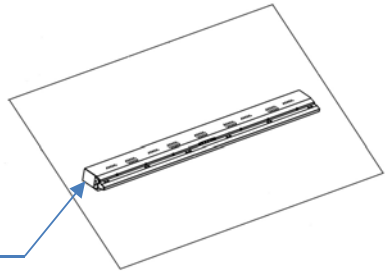
Pack CIS（②）wrapped by an electrostatic sheet and cushions into the shipment box in an order of イ→ロ→ハ.



② CIS wrapped by the electrostatic sheet

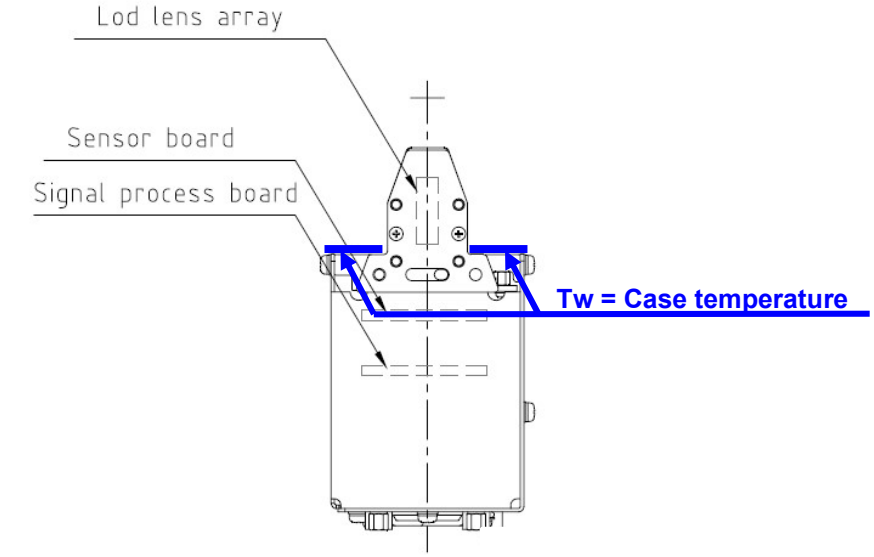


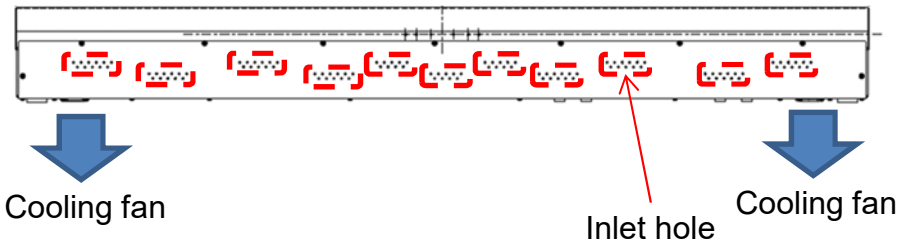
① Put sideways scanning surface of CIS to the electrostatic sheet and wrap.



2-7 Handling precautions

2-7-1 Thermal management





【Thermal management 】

This product can be operated under an environmental temperature (Ta) between +5 and +50℃ (in case of L4) , +5 and +40℃ (in case of L5/L6) under natural air cooling circumstance.

In other circumstance that the product temperature may be raised by the incoming heat from the peripheral devices and/or the connecting part, check the case temperature Tw (refer left diagram), and control the temperature Tw to be between +5 and +70℃ (in case of L4) , +5 and +60℃ (in case of L5/L6) .

【Precaution on the inlet hole 】

The air flow taken in through inlet holes and vented out through cooling fan enables this product cooled down. Therefore, when installing the product to your system, do not to block the inlet holes and the cooling fan.

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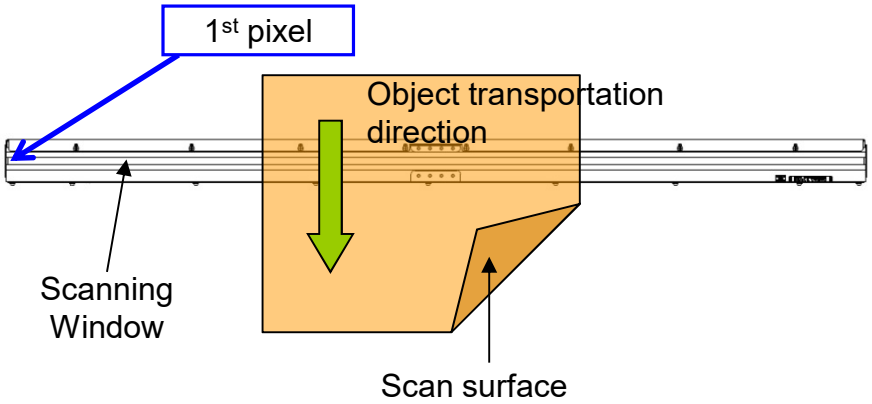
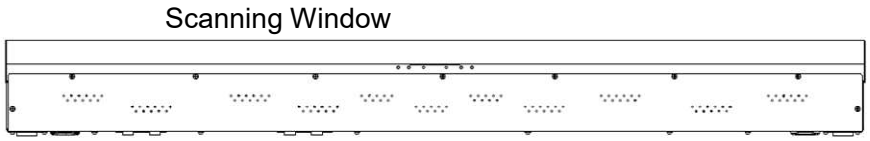
Chapter 3 : Installation

3-1 Installation

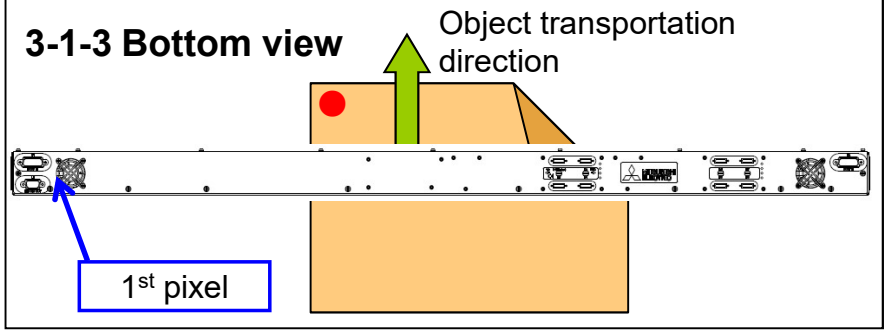
3-1-1 Top view



3-1-2 Side view



3-1-3 Bottom view



【Remarks】 Where to place the object

① Set the object in front of the glass surface of CIS.

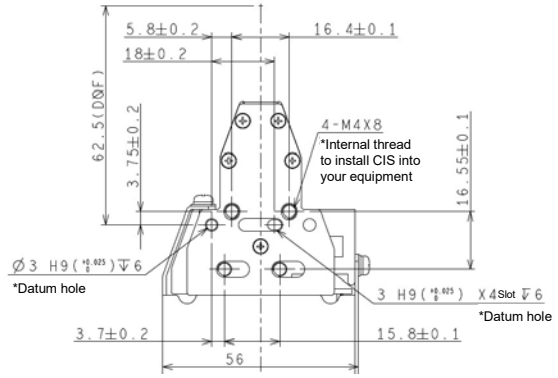
② Set the object as shown in left diagram.
Set the left side (● mark) of the object at Bottom view close to the 1st pixel position.

③ Transfer the object to the direction as shown in figure 3-1-1.

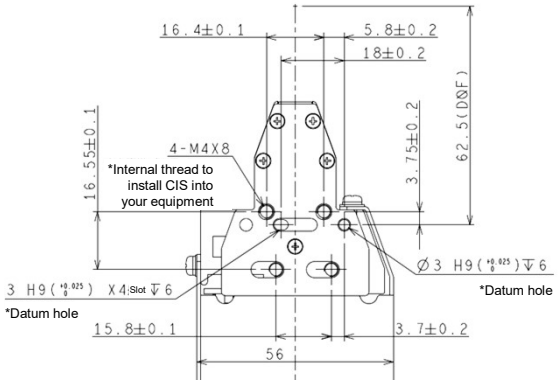
3-1 Installation

3-1-4 Both Side View of CIS

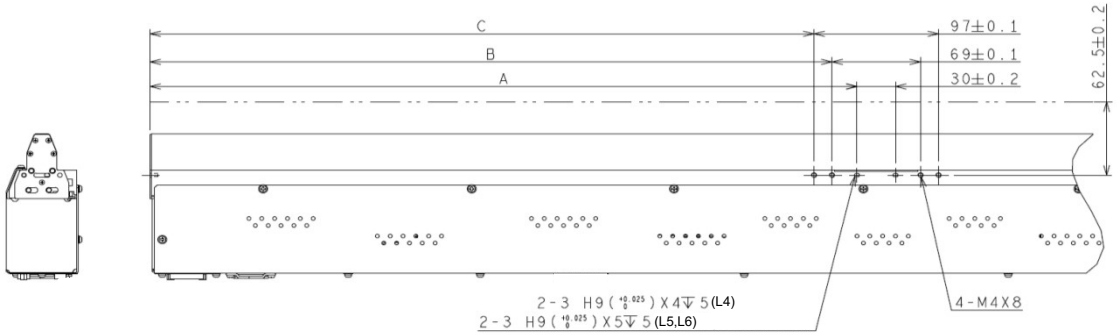
1st-side Bracket



End-side Bracket



3-1-5 Front View of CIS



Dimension Conversion Table

Product Name	Dimension A[mm]	Dimension B[mm]	Dimension C[mm]
KD6R1064DXL-NL	550.55±0.4	531.05±0.4	517.05±0.4
KD6R1247DXL-NL	642.05±0.43	622.55±0.43	608.55±0.43
KD6R1688DXL-NL	862.55±0.47	843.05±0.47	829.05±0.47

3-1 Installation

3-1-6 Precautions for installing CIS to your equipment

〇The weight of this product is approx. 7Kg (for L5) 9Kg (for L6).

・Main parts of this product consist of Metal, and the center of gravity of CIS is skewed to the Scanning Surface side.
When you handle and install to equipment, please take care not to drop this product.

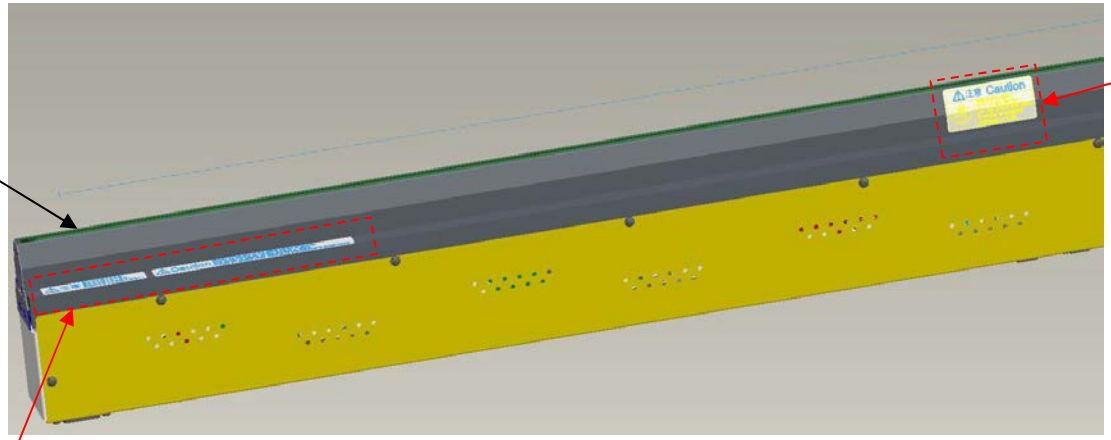
・This product weight(especially, L5, L6 size) is so heavy, so the caution label is pasted on the product to alert it.

〇There is a connection point of Rod Lends Arrays in L5/L6 products

・The caution label is pasted on the connection point of Rod Lends Arrays. When you bring and install to your equipment, please do not hold the connection point of Rod Lends Arrays (the area which the caution label is pasted on).

・This product may be broken if the excessive power is pressed on the connection point of Rod Lends Arrays (the area which the caution label is pasted on).

Scanning Surface



※Caution Label which is pasted on the connection point Rod Lends Arrays

※Caution label to alert offset center of gravity.

TM-XJ959B

3-1 Installation

【Remark】 How to install CIS into your equipment

①Attach CIS to your system at both end sides of CIS by M4 screws.
Focal point is defined the position from the datum holes at the end of CIS.
There is the focal point of CIS at 62.5mm from the datum holes.

②There are 4screw holes(M4) each end side of CIS (total 8 screw holes). Use datum holes (φ3 hole and 3x4slot) to make sure the CIS is on the right position.

③Please fasten between CIS and your equipment by M4 screws with 4 internal threads in front of CIS.
Use 2 datum holes (3x4slot or 3x5slot) to make sure the CIS is on the right position.
Furthermore, when the CIS is installed to your equipment, to absorb small deformation of CIS(for example, the bend of aluminum parts of CIS),
please make the through holes to fix between CIS and your equipment in the bracket prepared by customer as slot.
(Detail is shown in next page.)

④To install CIS in your system, please use all of fastening points (12points).
Recommended way to fasten torque is shown in below table.

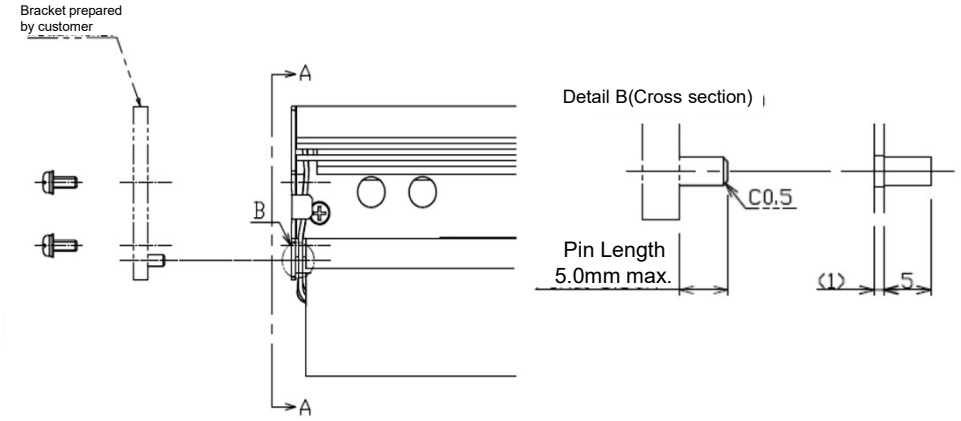
Material of screw	Fastening torque [N･cm]
Iron (strength ranking 4.6)	165 ± 16
Stainless (SUS 304)	144 ± 14
Brass (C3601BD)	96 ± 9

⑤A frame of CIS is made of aluminum. When fasten a screw, be careful about thread damage of screw hole.

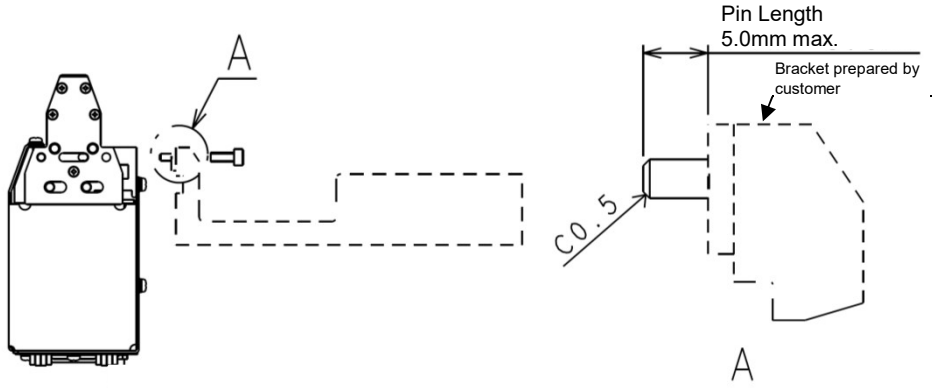
⑥Pin length for adjusting position of CIS is 5.0mm or less.

⑦Maximum product length of this product is 1.7m. When this product is carried or installed into your system, please be careful surrounding you and this product. And please do not hit anything.

3-1-7 Both Side of CIS



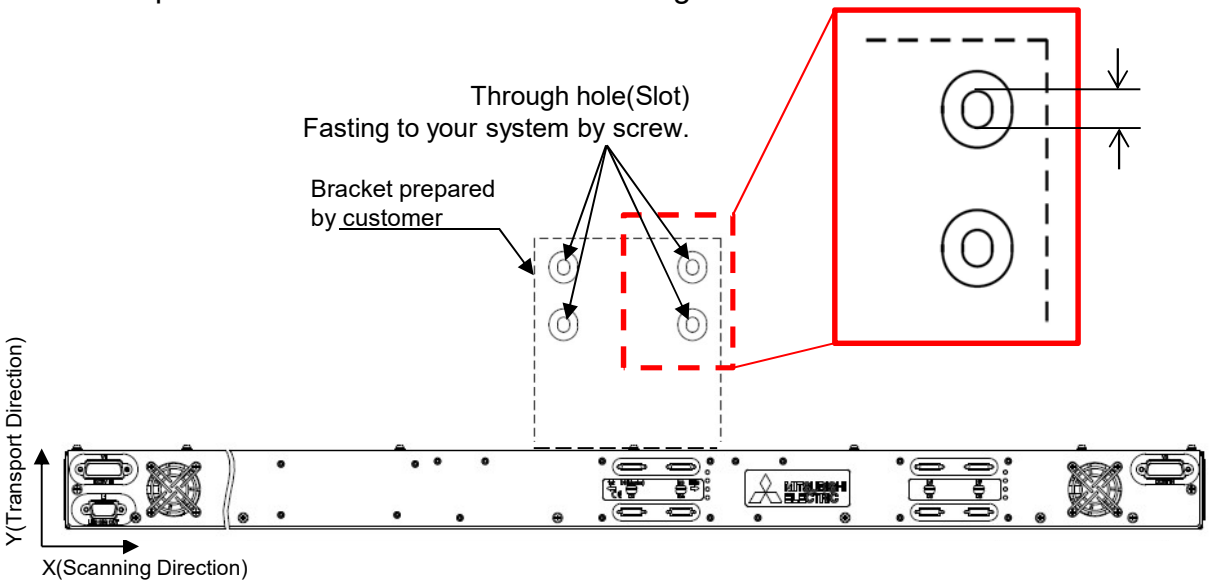
3-1-8 The view of fixing construction in front of CIS from side



3-1 Installation

3-1-9 The View of fixing construction in front of CIS from bottom

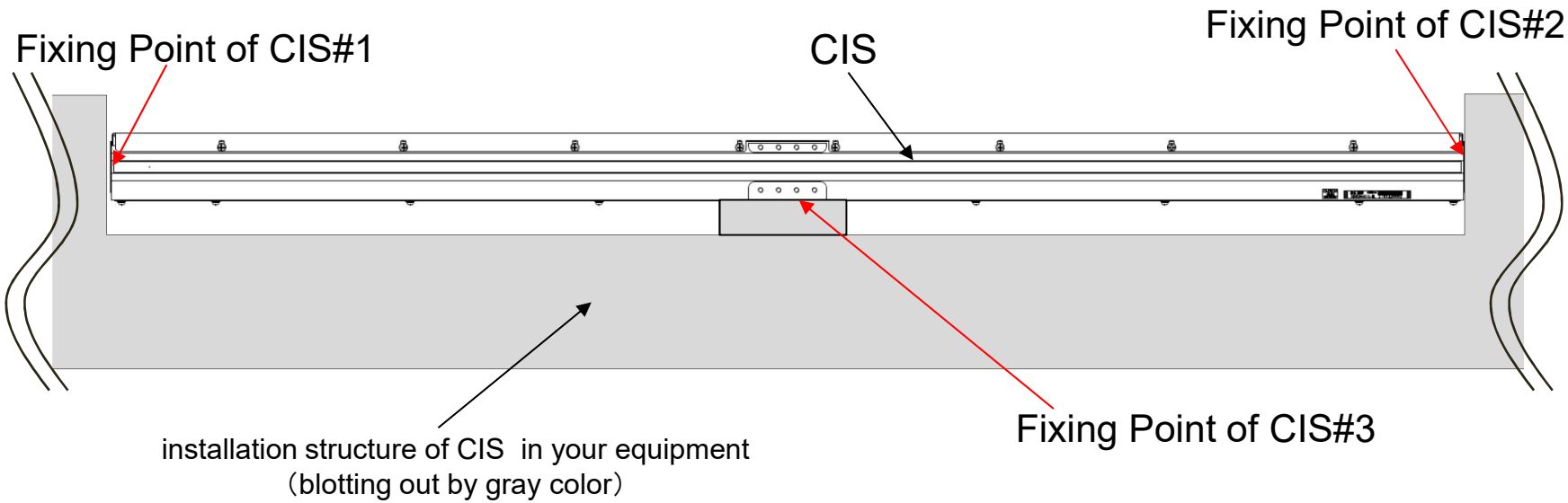
When the CIS is installed to your equipment, to absorb small deformation of CIS(for example, the bend of aluminum parts of CIS), please make the through holes to fix between CIS and your equipment in the bracket prepared by customer as slot.
The example to fix the CIS is shown in below figure.



Please make a slot of Y direction (Transport direction)
Please keep adjustment width 1mm or more.

3-1 Installation

【Difference of thermal expansion coefficient between installation structure of CIS in your equipment and CIS】



・The frame of this prof Aluminum. If the installing structure of CIS in your equipment is **not** made of Aluminum, this product is made difference of thermal expansion is occurred between it and CIS when it is used in high temperature and low temperature.

・ **Strong force is occurred on the fixing point of CIS #1,#2,#3 fastened by the screws. To avoid it, please fix it at least 2 points of 3 fixing points by LM guide etc. to absorb difference of thermal expansion.**

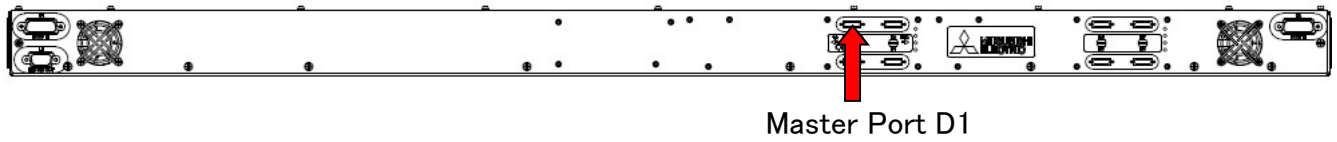
・In addition, if the installing structure of CIS in your equipment is made of Aluminum and thermal expansion coefficient is matched between CIS and installing structure of CIS in your equipment, this counterplan is not needed.

3-1 Installation

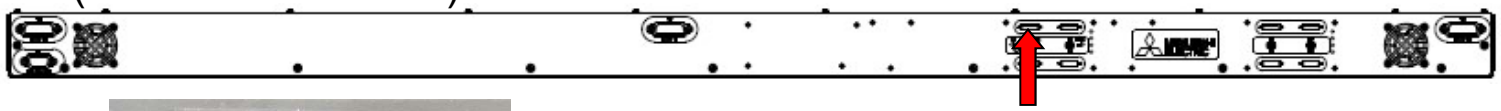
3-1-10 Bottom View

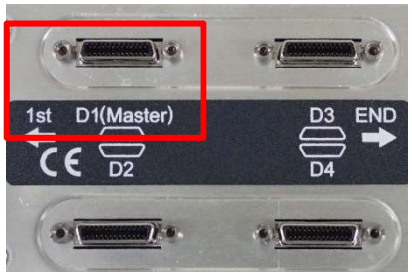
※Serial Communication(UART) can be from the master port.
:UART（Universal Asynchronous Receiver / Transmitter）

L4(KD6R1064DXL-NL)

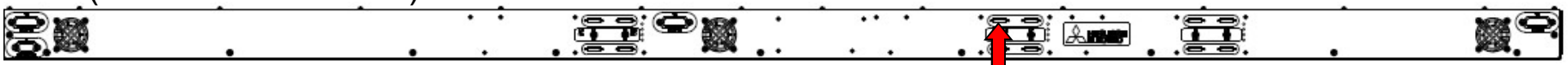


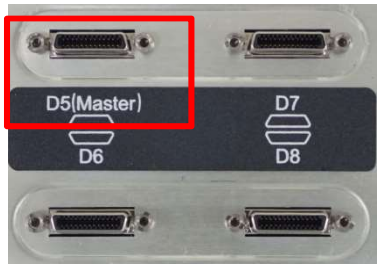
L5(KD6R1247DXL-NL)





L6(KD6R1688DXL-NL)





3-1 Installation

【Connectors of Interface and Power】

① Connecters are located on the bottom side of this CIS .
② Connecter No. is indicated on the cover .
③ Each connector is listed in the following table.
④ Connect all power lines (+5V) marked by “O”.

【L4/L5】

Item		No.	Model	
			L4	L5
Power supply for CIS (+5V)		V1	O	O
		V2	×	O
		V3	O	O
Camera Link® Connectors *◎:Master port	Masters	D1	◎	◎
		D2	O	O
		D3	O	O
		D4	O	O
	Slaves	D5	O	O
		D6	O	O
		D7	O	O
		D8	O	O

【L6】

Item		No.	Model
			L6
Power supply for CIS (+5V)		V1	O
		V2	O
		V3	O
Camera Link® Connectors *◎:Master port	Slaves	D1	O
		D2	O
		D3	O
		D4	O
	Masters	D5	◎
		D6	O
		D7	O
		D8	O
	Slaves	D9	O
		D10	O
		D11	O
		D12	O

3-2 Preparation

3-2-1 Preparation by users

Items shown in the following table have to be prepared by the users (details are shown from the next pages).
Note that the necessary cables are different by product to use.

【 Remarks 】
Be reminded the necessary cables shown as (*) are included in the trial set of loaner CIS.
However, those items are NOT INCLUDED in this product and need to be prepared by users, when you purchase this product.

Parts No	Items	Quantity		
		KD-DXL series		
		L4	L5	L6
①	DC5V power cable(*)	2	3	3
②	DC24V power cable	-	-	-
③	Camera Link® cable	8	8	12
④	Frame Grabber board	2		3
⑤	DC5V power	1		
⑥	DC24V power	-		
⑦	External illumination control cable (*)	1		

3-2 Preparation

3-2-1 Preparation by users

① DC5V power cable

Following cable connectors are recommended.

Housing : **DAU-15S-F0R(JAE)**
Contact socket : **030-50634(JAE)**

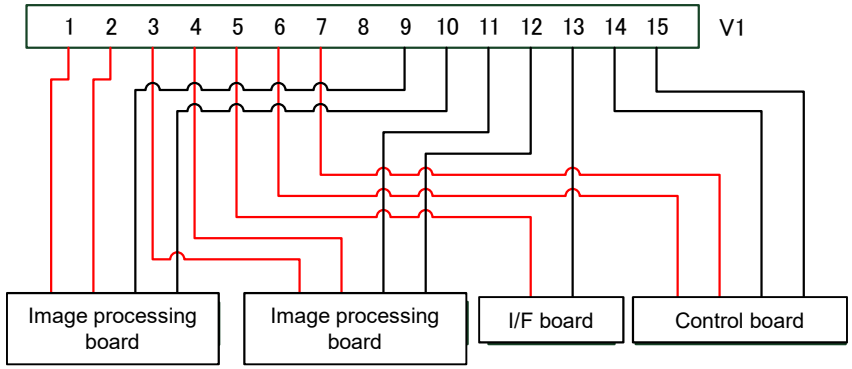
CIS connector is **DAU-15P-F0R (JAE),** and the contact pin is **030-50635 (JAE)**

Pin assignment of CIS connector is as shown below

Pin No	名称								記号
	L4		L5			L6			
	V1	V3	V1	V2	V3	V1	V2	V3	
1	+5V	+5V	+5V	+5V (NC)	+5V	+5V	+5V	+5V	VDD
2									
3				+5V					
4									
5				+5V (NC)					
6									
7		+5V (NC)			+5V (NC)			+5V (NC)	
8	NC	NC	NC	NC	NC	NC	NC	NC	
9	GND	GND	GND	GND (NC)	GND	GND	GND	GND	GND
10									
11				GND					
12									
13				GND (NC)					
14									
15		GND (NC)			GND (NC)			GND (NC)	

"NC" on the pin assignment means no connection. Therefore, the same pin assignment of V1 can be applied with the pin assignment of V2,V3.
Set the pairs of +5V and GND as follows, when you connect pins.
1 pin and 9 pin, 2 pin and 10 pin, 3 pin and 11 pin,
4 pin and 12 pin, 5 pin and 13 pin, 6 pin and 14 pin,
7 pin and 15 pin

【 Reference 】CIS internal connections (V1 in L4)



【Remarks】
When you use a cable on the market as the power cable, confirm the connection and the cable length and standard carefully.
Cable resistance 120mΩ or less between the power supply and CIS is recommended.
(Cable standard AWG22: approx. 2m, AWG20: approx. 3m, AWG18: approx. 5m)

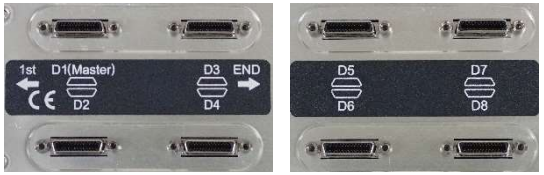
3-2 Preparation

3-2-1 Preparation by users

③ Camera Link ® cable

CIS (This product) has Mini-Camera Link® connectors 12226-1150-00PL(produced by 3M).

【L4/L5】



【L6】

Check the connectors of Grabber board (Mini-Camera Link® or Camera Link®) and prepare the connectable cables.

④ Frame grabber board

Prepare Frame Grabber board (or PC with Grabber board installed) supporting Camera Link®.

【Remarks】

CIS does not support PoCL. Set the Frame Grabber board settings **NOT** to supply +12V power over the Camera Link® cable.

⑤ DC5V power

Supply more than the current capacity listed in below.

No.	Configuration	Current capacity (A)		
		L4	L5	L6
1	KD-DXL series	20	24	31

3-2 Preparation

3-2-1 Preparation by users

⑦External illumination control cable

This product outputs a trigger signal from connector L1, that is used to synchronize the exposure timing of this product with an external illumination. When using this trigger signal for the external illumination control, prepare the cable to connect with the external illumination.

Cable with following connectors are recommended.

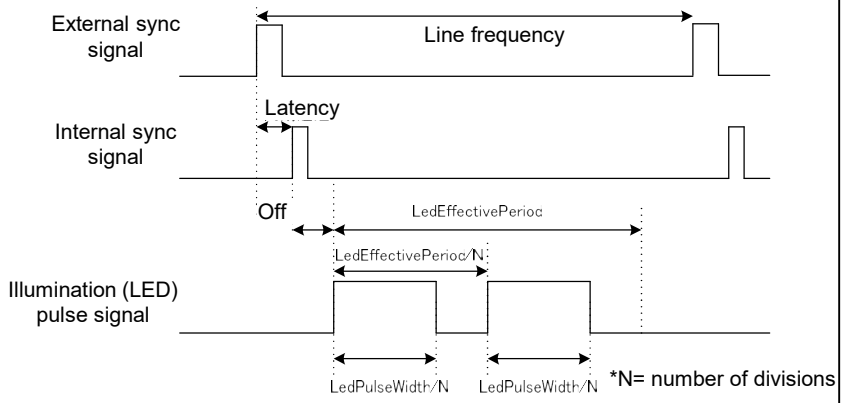
Housing: DEU-9P-F0R (JAE)
Contact pin: 030-50641 (JAE)

CIS connector has DEU-9S-F0R (JAE),
Contact socket has 030-50640 (JAE).

Pin assignment of CIS connectors is shown below.

Pin No	Name	I/O	Remarks
1	N C	-	
2			
3			
4	OUT PULSE1	O	3.3V LVTTL
5	N C	-	
6			
7			
8	OUT PULSE2	O	3.3V LVTTL
9	G N D	O	

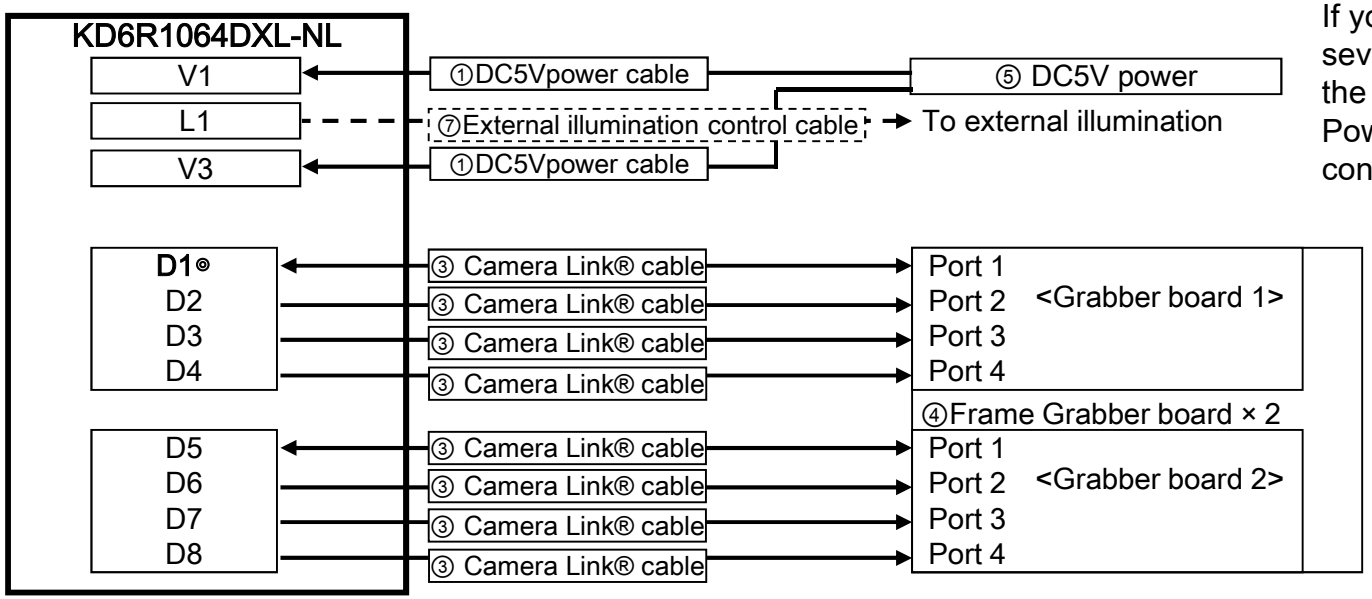
【Reference】
Illumination trigger signal timing chart



3-3 Connections

3-3-1 Connections

1) KD6R1064DXL-NL



【Remarks】
If you supply voltage from several power sources, use the common GND.
Power lines (V1, V3) must be connected.

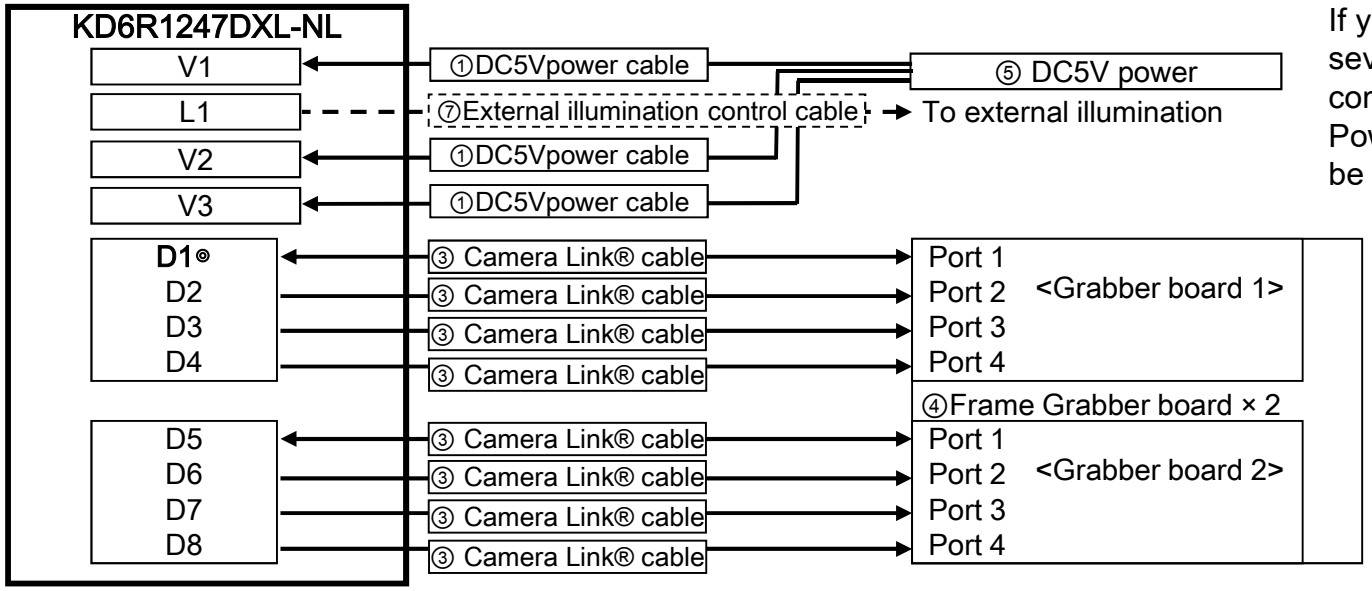
*** ◎ : Master port**

【Remarks】 When you use several Grabber boards, the external sync signal can be provided only through Master port. Remark when changing Grabber board settings.

3-3 Connections

3-3-1 Connections

2) KD6R1247DXL-NL



【Remarks】
If you supply voltage from several power sources, use the common GND.
Power lines (V1, V2 ,V3) must be connected.

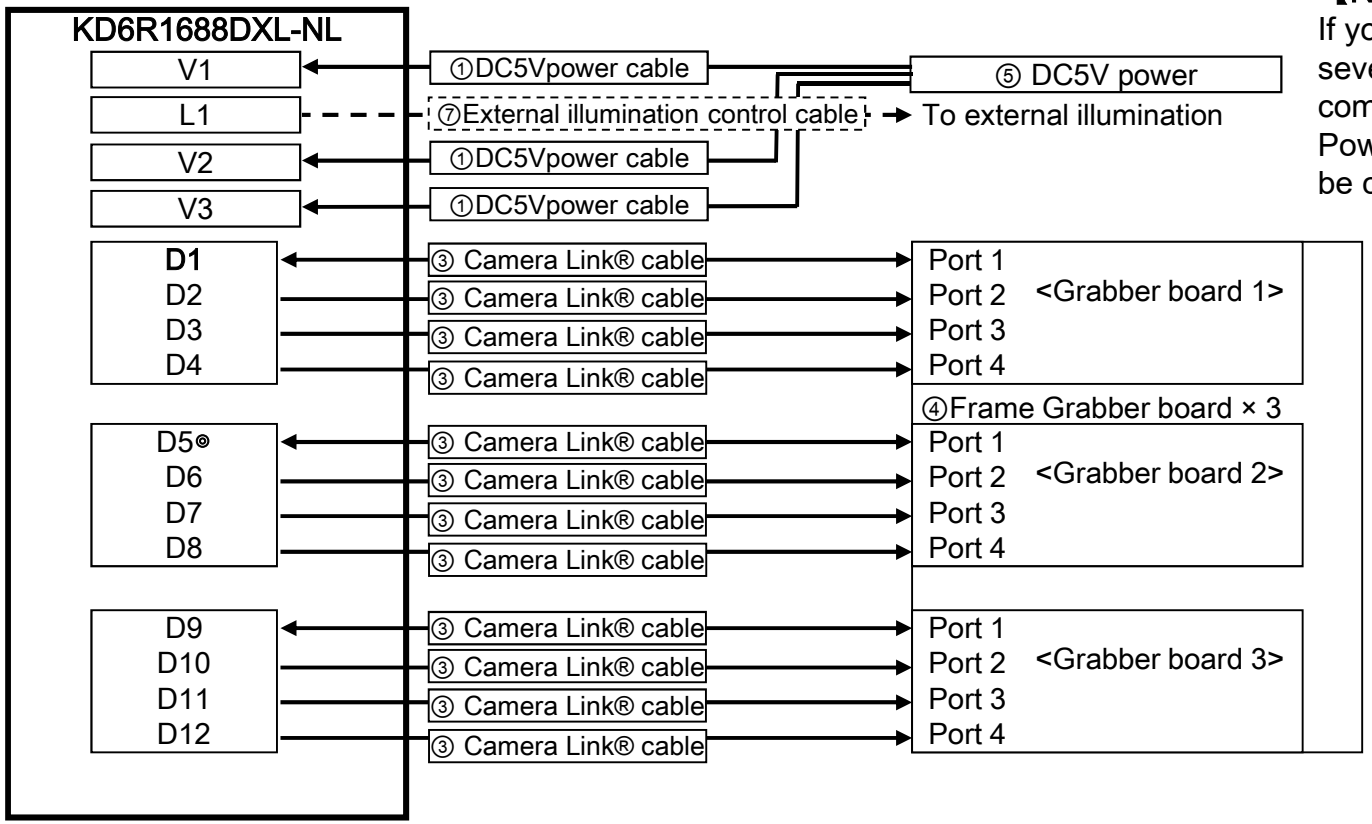
*** ◎ : Master port**

【Remarks】 When you use several Grabber boards, the external sync signal can be provided only through Master port. Remark when changing Grabber board settings.

3-3 Connections

3-3-1 Connections

3) KD6R1688DXL-NL



【Remarks】
If you supply voltage from several power sources, use the common GND.
Power lines (V1, V2 ,V3) must be connected.

* ◎ : Master port

【Remarks】 When you use several Grabber boards, the external sync signal can be provided only through Master port. Remark when changing Grabber board settings.

3-3 Connections

3-3-2 DC5V cable connection

(This cable is not included in the CIS product)

1) Connect ① DC5V power cable to CIS connectors **V1/V3(for L4) or V1/V2/V3(for L5/L6)**.

Type	No.	Model		
		L4	L5	L6
Power for CIS(+5V)	V1	○	○	○
	V2	×	○	○
	V3	○	○	○

2) Fix CIS connectors and the cable by screws
CIS has locknut D20418-J3R (JAE) (M2.6, female).
Use M2.6 screw, M2.5 screw, M2.6 type JAE Lock screw, etc., which are applicable to fix cable connectors.
Recommended screwing torque is 16 - 20 N*cm.

【Remarks】

1) Do not screw with higher torque than recommended. Otherwise, locknut on CIS may be loosened or removed when you remove screws.

2) CIS does not support hot-swap.
Make sure to power off CIS before connecting / removing cables. If the cables are connected / removed while powered on, it may cause failure on CIS.

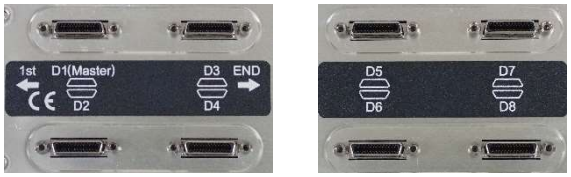
3-3 Connections

3-3-3 Camera Link® **connectors**

(This cable is not included in the CIS product)

1）Connect Camera Link® cable to **D1-D8(for L4/L5) or D1-D12(for L6)**.
* CIS has Mini-Camera Link® connectors 12226-1150-00PL(3M).

【L4/L5】



【L6】

【Remarks】

1)When you use several Grabber boards, the external sync signal can be provided only through Master port (L4/L5:D1,L6:D5). Also communication control for the main functions can be set only through Master port. (L4/L5:D1,L6:D5) Remark when changing Grabber board settings.

2)CIS does not support PoCL. Set the Frame Grabber board settings NOT to supply +12V power over the Camera Link® cable.

3)Pin assignment of the Camera Link® connectors are conformed to Camera Link® standard.

4) Recommended screwing torque is 12 N*cm.

Type	No.	Model		
		L4	L5	L6
Camera Link® Connectors *◎: Master port	D1	◎	◎	○
	D2	○	○	○
	D3	○	○	○
	D4	○	○	○
	D5	○	○	◎
	D6	○	○	○
	D7	○	○	○
	D8	○	○	○
	D9	×	×	○
	D10	×	×	○
	D11	×	×	○
	D12	×	×	○

3-3 Connections

3-3-4 DXL-NL series illumination (LED) control signal output

(This cable is not included in the CIS product)

Non-illumination type CIS (DXL-NL series) outputs a trigger signal from connector L1, that is used to synchronize the output of this product with an external illumination. When using this trigger signal for the external illumination control, connect ⑦External illumination control cable to the connector L1.

2) Fix CIS connectors and the cable by screws

CIS has locknut D20418-J3R (JAE) (M2.6, female).
Use M2.6 screw, M2.5 screw, M2.6 type JAE Lock screw, etc., which are applicable to fasten cable connectors.
Recommended tightening torque is 16 - 20 N*cm.

【Remarks】

1) Do not screw with higher torque than recommended.
Otherwise, locknut on CIS may be loosened or removed, when you remove screws.

2) CIS does not support hot-swap.
Make sure to power off CIS before connecting / removing cables. If the cables are connected / removed while powered on, it may cause failure on CIS.

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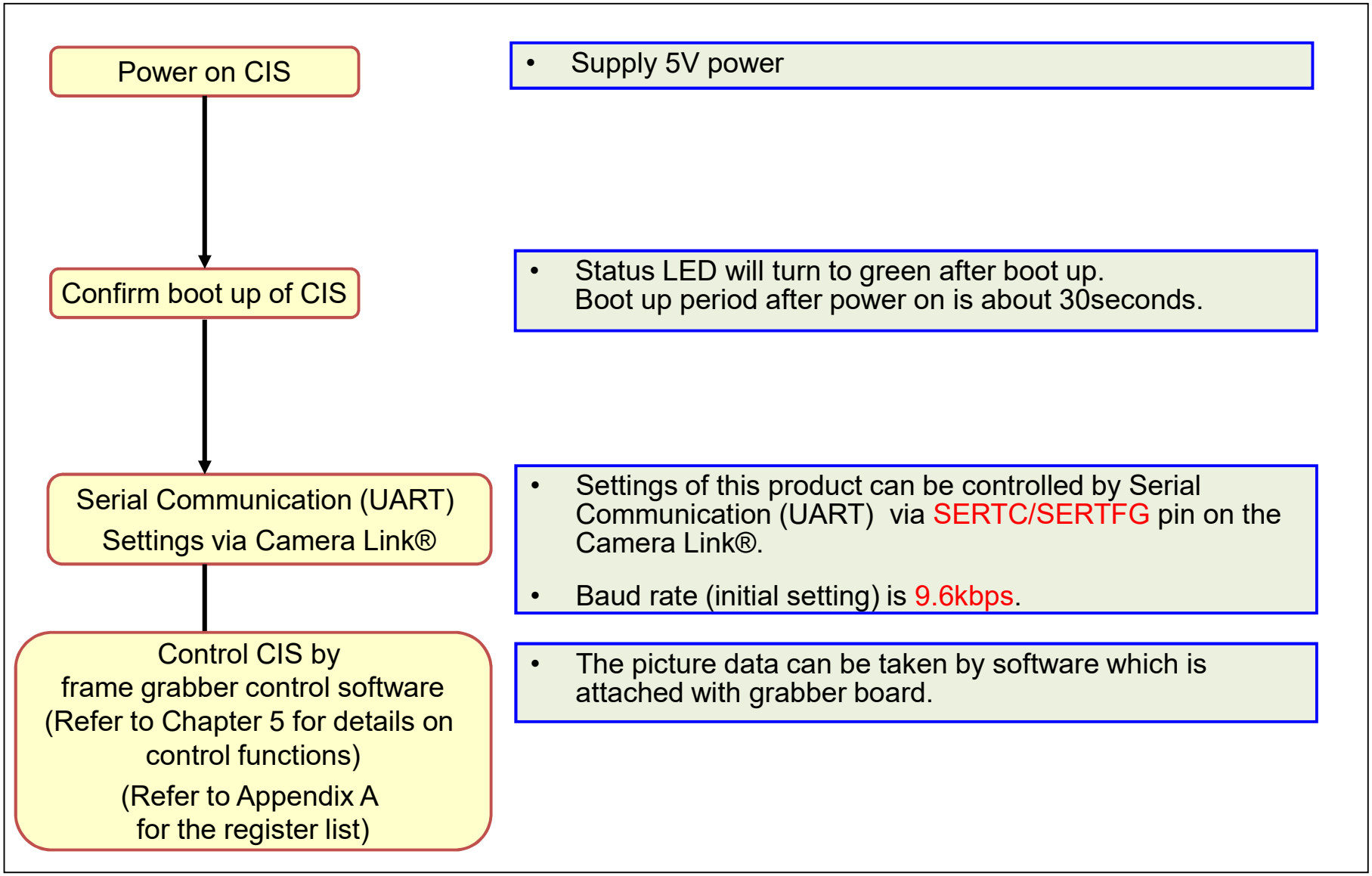
Chapter 4 : How to control CIS

4-1 Startup procedure

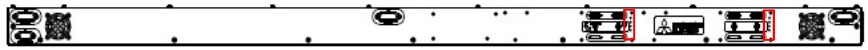


4-2 Status LED

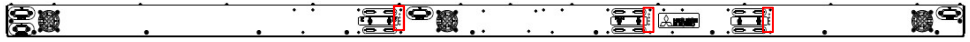
4-2-1 Status LED

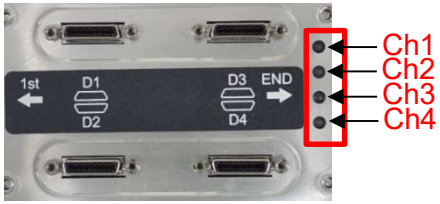
L4(KD6R1064DXL-NL)

L5(KD6R1247DXL-NL)



L6(KD6R1688DXL-NL)





LED status	CIS Status
LED off	No Power
Green LED on	Link established, no stream transfer
Green 0.5 sec. LED blink	Link established, transferring stream
Red 0.5 sec. LED blink	CRC error

【Status LED】

Status LED is located on the back of CIS.
Status LED shows the status of communication status and CIS.

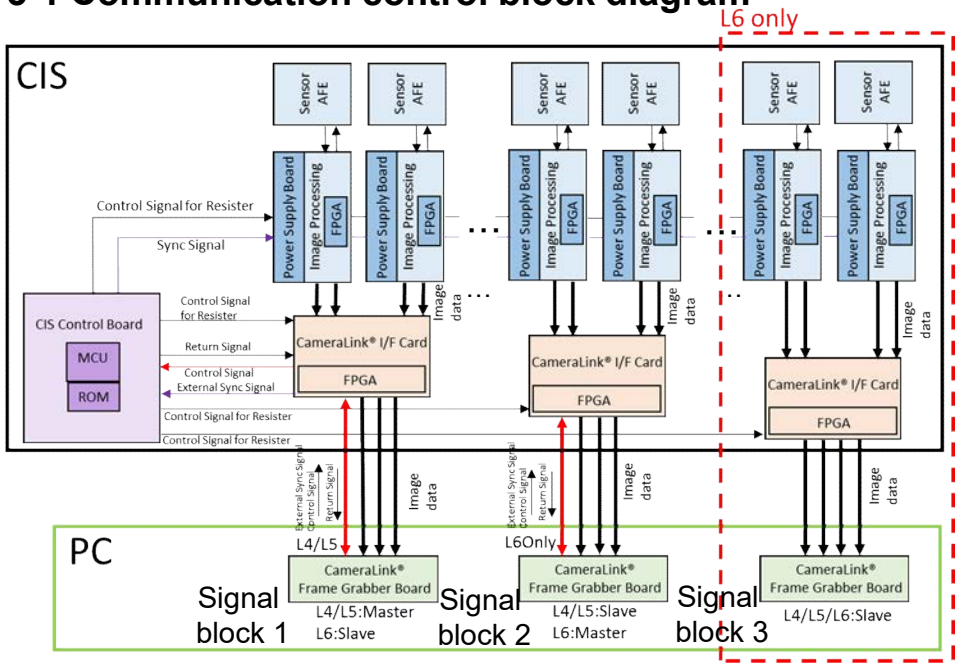
【 Status of CIS 】

Combination of the 4 status LED shows the status of CIS.

LED状態	ステータス
Ch1～3: Red LED on Ch4: OFF	FPGA abnormal temperature of I/F board
Ch1,4: OFF Ch2,3: Orange LED on	System boot (FPGA configuration of I/F board)
Ch1:Orange LED on Ch2～4: OFF	System boot (FPGA reset status of I/F board)
Ch1,2,4: OFF Ch3:Orange LED on	System boot (Initialize IF board and CIS booting)
Ch1～3: OFF Ch4:Orange LED on	Power supply voltage is not enough (Less than 3.4V)

4-3 Communication control (overview)

4-3-1 Communication control block diagram



【Line sync signal 】

1. External sync. mode

External sync signal, input through Master port, is distributed to the other block inside CIS. The line data from each block is synchronized at line scan basis.

2. Internal sync. mode

Sync signal created inside CIS is distributed to the other block inside CIS. The line data from each block is synchronized at line scan basis.

【Remarks】

1) CIS can be controlled only through Master port. (Signal through the other ports will not be reflected to CIS)

2) Confirm where to be connected from your Grabber board.

【Communication control 】

L4 and L5 types have two signal blocks for Camera Link® , and the 1st signal block (Connector D1 to D4) is the Master block. Main functions of the CIS can be controlled through the D1 of Master block. Slave block is used only for receiving picture data.

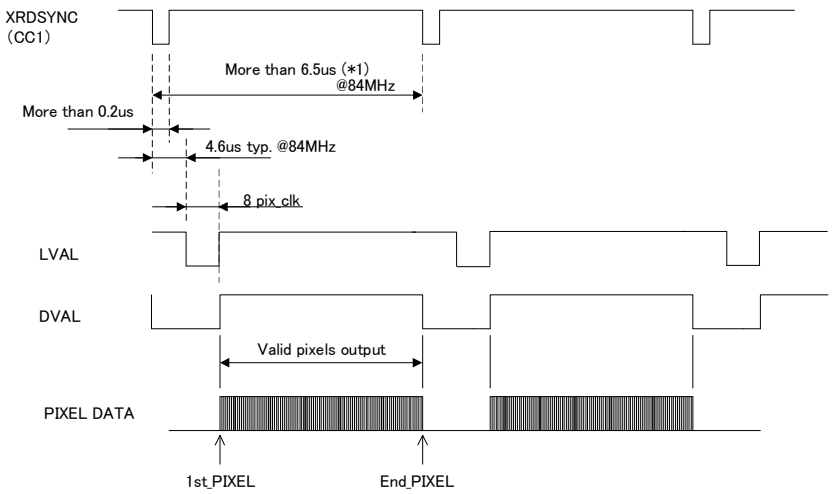
In case of using of the external sync mode, input trigger signal to the 1st Master port (D1). (No input required for the internal sync. mode.)

L6 type have three signal blocks for Camera Link® , and the 2nd signal block (Connector D5 to D9) is the Master block. Main functions of the CIS can be controlled through the D5 of Master block. Slave block is used only for receiving picture data.

In case of using of the external sync mode, input trigger signal to the Master port (D5) in the 2nd signal block . (No input required for the internal sync. mode.)

4-4 Sync signal timing (External sync mode)

4-4-1 Sync. signal timing



*1 6.5usec is the min. scan period at 150 dpi output.
Each min. scan period in different output modes is different.

【External sync. mode】

*The initial setting of this product is internal sync. mode.

1) To operate CIS at external sync. mode,
line trigger signal (XRDSYNC at left diagram) has to be input through the Master port (L4/L5:D1,L6:D5).

2) For scan operation, the scan cycle is decided by XRDSYNC startup timing.
Secure “L” term (more than 0.2us) of XRDSYNC.

3) If you input the sync. signal created by an encoder on the object conveyer through the Grabber boards, the scan timing of this product can be synchronized with the motion of the object.

【Remarks】

1) Input/set the longer sync. signal cycle than the line cycle.
Improper image data is output if the sync signal cycle is shorter than necessary line cycle.

2) Do not use TBD lines just after sync. signal input.
(Invalid data is output due to the internal line delay)

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Chapter 5 Getting started

5-1 Initial settings

5-1-1 Initial settings

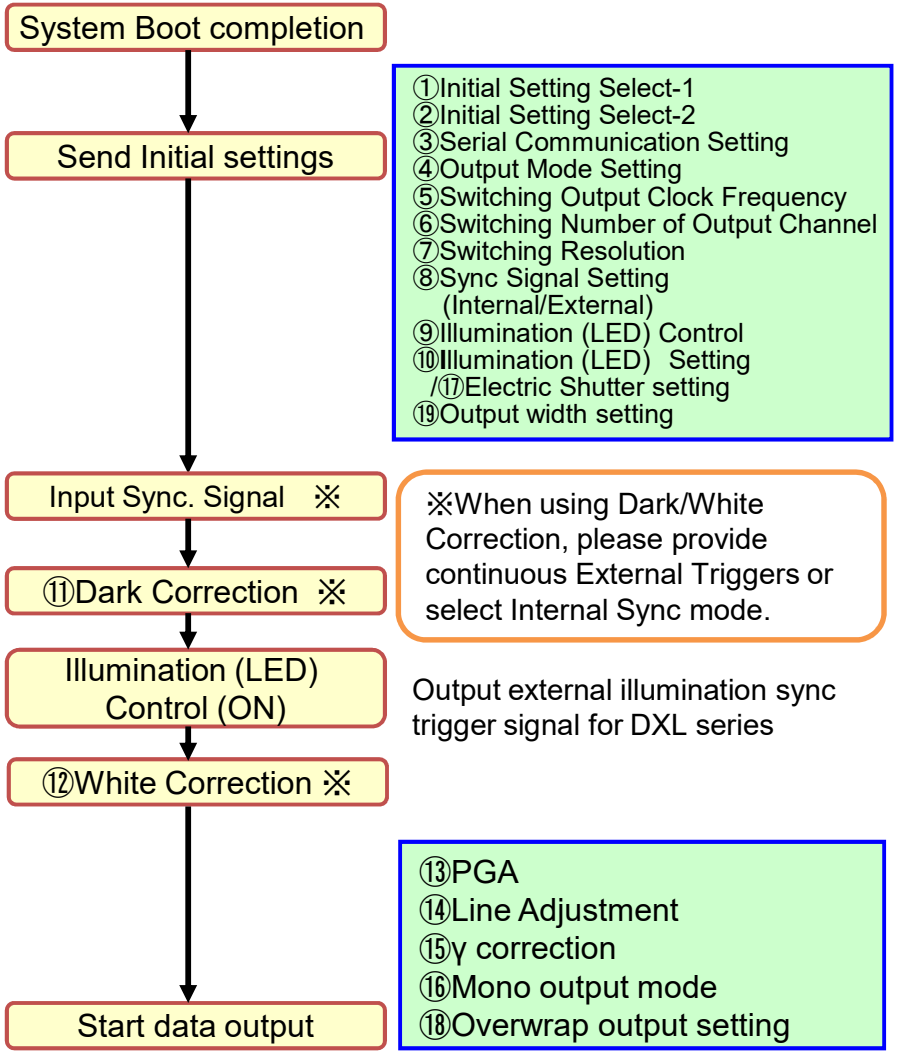
Items	Initial settings
Output format	24bit RGB Camera Link® Base Configuration 1ch
Output resolution	600dpi Interpolation OFF
Synchronization signal setting	Internal synchronization mode
Dark Correction	OFF
LED Control ※LED trigger signal control	Turn ON Duty period: 12.9us
White Correction	OFF
PGA	Not used (1 time)
Line adjustment	ON Resolution in transport direction: 600dpi Transport direction: Original (B→G→R)
γ correction	OFF
Overwrap output	OFF
Mono mode	OFF. Color output
Initial Setting Select	Boot Select: Factory Default Correction Select : Only 600dpi
Dark and White Correction Data	Correction Data: Only 600dpi

[CIS initial settings]

1) Initial settings of this product are described on the left table, when you power on the product without any uses after the shipment from our factory.
2) Refer to the following pages about any respective settings for your applications.

5-2 Procedure of function settings

5-2-1 Procedure of function settings



[Procedure of function settings]

1) This product contains several image processing function that can be controlled over Serial Communication (UART) via Camera Link®.
2) Procedure of several function settings is described on the left chart. Change each respective settings for your applications.
   - ① Initial Setting Select-1
   - ② Initial Setting Select-2
   - ③ Serial Communication Setting
   - ④ Output Mode Setting
   - ⑤ Switching Output Clock Frequency
   - ⑥ Switching Number of Output Channel
   - ⑦ Switching Resolution
   - ⑧ Sync Signal Setting (Internal/External)
   - ⑨ Illumination (LED) Control
   - ⑩ Illumination (LED) Setting ⑰Electric Shutter Setting
   - ⑪ Dark Correction
   - ⑫ White Correction
   - ⑬ PGA
   - ⑭ Line Adjustment
   - ⑮ γ Correction
   - ⑯ Mono output mode
   - ⑱ Overlap Output setting
   - ⑲ Output width setting
3) Control several functions (such as Dark/White Corrections) white monitoring a time-dependent output-change in a continuous operation.

[Remark]

1) When using Dark/White Correction, provide continuous External Triggers or select Internal Sync. mode.
2) Generate your Dark/White Correction data every time when you scan your object.

5-2 Communication Control（Format）

5-2-2 Serial Commination Command Format and Example

1) Register Write Example: Save setting data on UserSet_1_Save

Send: 0x40 0x00 0x04 | 0x00 0x00 0x72 0x00 | 0x00 0x00 0x00 0x01 | 0x0D

① ② ③ ④

Receive: 0x00 0x00 0x00 (Operation Succeed)

⑤

2) Register Read

Example: Read setting data from UserSet_BootSet_select

Send : 0x00 0x00 0x04 | 0x00 0x00 0x72 0x40 | 0x00 0x00 0x00 0x00 | 0x0D

① ② ③ ④

Example: In case of selecting "User Setting1"

Receive : 0x00 0x00 0x04 | 0x00 0x00 0x00 0x01

⑤ ⑥ (Operation Succeed :Completed/OK)

Description of Each Item

Serial Communication Send Format

No.	Item	Size (Byte)	Description
①	Start Code	3	▪Read : 0x00 0x00 0x04（Fixed） ▪Write: 0x04 0x00 0x04 （Fixed）
②	Address	4	▪Read/Write Address
③	Parameter Data	4	▪Read: 0x00 0x00 0x00 0x00（Fixed） ▪Write:8bit×4、 （Writing Data 4byte）
④	End Code	1	▪CR(Carrige Return) 0x0D (Fixed) Command Termination Code

UART Communication Receive Format

No.	Item	Size (Byte)	説明
⑤	Receive Code	3	▪for Read Command: (1) 0x00 0x00 0x04 (Completed/Succeed) (2) 0x40 0x00 0x00 (Invalid Address) (3) 0x80 0x00 0x00 (Invalid Data Size) (4) 0xC0 0x00 0x00 (Other Error) ▪for Write Command: (1) 0x00 0x00 0x00 (Completed/Succeed) (2) 0x40 0x00 0x00 (Invalid Address) (3) 0x80 0x00 0x00 (Invalid Data Size) (4) 0xC0 0x00 0x00 (Other Error)
⑥	Read Data	4	▪8bit×4、Read Data 4byte

【Command Set】

Command format of Serial communication is shown in left and above tables.

Refer to the table for detail of Function Specification.

The values in the table on the following pages that have h at the end are expressed in hexadecimal (values for Adress and some Parameter Data). In addition, the size of Address and Parameter Data is 4Byte, but the description is omitted if the value in the table is 0.Please transmit higher Byte for 0 at the command transmission.

ex. 7040h => 0x00 0x00 0x70 0x40

The values in the table on the following pages that do not have h at the end are expressed in decimal.

ex. 5833 => 0x00 0x00 0x16 0xC9

5-2 Setting①: Initial setting select-1

Address	Register name	R/W	Parameter Data	Function	Initial
7200h	UserSet_1_Save	R/W	1	Save CIS settings to User Setting 1 on Flash Memory.	-
7204h	UserSet_2_Save	R/W	1	Save CIS settings to User Setting 2 on Flash Memory.	-
7208h	UserSet_3_Save	R/W	1	Save CIS settings to User Setting 3 on Flash Memory.	-
720Ch	UserSet_1_Load	R/W	1	Read out CIS settings on User Setting 1.	-
7210h	UserSet_2_Load	R/W	1	Read out CIS settings on User Setting 2.	-
7214h	UserSet_3_Load	R/W	1	Read out CIS settings on User Setting 3.	-
7218h	UserSet_Load_ FactoryDefalut	R/W	1	Read out CIS settings on Factory Setting (Initial Setting).	-
7240h	UserSet_BootSet_ select	R/W	0 to 3	Select a setting to boot after power-ON. 0:Factory Setting, 1:User Setting 1, 2:User Setting 2, 3:User setting 3	0
7244h	UserSet_Boot_Error	R	0 to 7	Error flag of booting CIS ‘0’ or ‘1’ at bit0 :normal operation, ‘1’ at bit1 :Error of User setting value, ‘1’ at bit2 :Error of FPGA starting.	-

5-2-3 Initial Setting Select-1

[Function]
Save and read CIS Initial Setting

After power ON, this product boots an Initial Setting which is selected by the value of **“**UserSet_BootSet_select”.
By running a function of ”UserSet_#_Save”, the active CIS settings can be saved on a Flash Memory on this product. (For example, values of CIS Setting, White/Dark Correction, and γ Correction.)

Correction data for 600dpi can be saved in initial setting. If setting the correction data for other resolution, please refer to next page.

You can save 3 different User Settings (from 1 to 3).
By running a function of “UserSet_#_Load”, this product booth the selected User Setting.

[Remark]
1)Never turn off the product while UserSet _ # _ Save is running. This product may be not able to operate normally due to break setting data for saving.

It takes about 30 seconds to complete to save all data.

When this product detect to break the user setting data automatically, factory setting is loaded instead of user setting data when turn on this product.

2)If changing the resolution, please execute UserSet_Use_###dpi command shown in next page prior to save white/dark correction data.

5-2 Setting②: Initial setting select-2

Address	Register name	R/W	Parameter Data	Function	Initial
7248h	UserSet_Use_600dpi	R/W	0 to 1	Correction data for 600dpi resolution 0: Disable / 1:Enable	1
724Ch	UserSet_Use_300dpi	R/W	0 to 1	Correction data for 300dpi resolution 0: Disable / 1:Enable	0
7250h	UserSet_Use_200dpi	R/W	0 to 1	Correction data for 200dpi resolution 0: Disable / 1:Enable	0
7254h	UserSet_Use_150dpi	R/W	0 to 1	Correction data for 150dpi resolution 0: Disable / 1:Enable	0

5-2-4 Initial Setting Select-2

[Function]
Save and read CIS correction data when changing resolution

If changing the resolution, please execute this command prior to save white/dark correction data to flash memory in CIS.
When saving correction data if changing the resolution, please send this command to suitable address (resolution you want to use) and changing the value (Parameter Data=1:Activate) prior to execute UserSet_#_Save.

Correction data for 600dpi can be saved in initial setting.

※ Dark/White correction data is hold in this product every resolution. However saving and reading action from/to flash memory in CIS is valid only the resolution which is enabled by this command.

[Remark]

1) Due to all correction data is saved / read, the startup is slow, therefore it is recommended to set the unused resolution setting to “Parameter Data=0”.

2) When executing UserSet_#_Save, the correction data of the resolution set to disable is reset.

3) The setting of this command is also valid after turn off CIS and correction data is reflected when turn on CIS.

5-2 Setting③: Serial Communication Setting

Address	Register name	R/W	Parameter Data	Function	Initial
7004h	BaudRateSelect	R/W	0 to 2	Switch baud rate of Serial communication in Camera Link® 0: 9.6kbps, 1: 19.2kbps, 2: 115.2kbps	0
7008h	ContTimeOut	R/W	0 to 65535	Setting time of time out for Serial communication in Camera Link® 0:Disable, 1:0.2seconds afterwards every 0.2seconds	150

5-2-5 Serial Communication Setting

[Function]

UAER communication in Camera Link®

1) Switch baud rate
2) Setting time of time out

1) Switch baud rate for Serial communication (UART)
It is able to select from 9.6kbps/19.2kbps/115.2kbps.

Initial value is 9.6kbps.

2) Setting time of time out for Serial communication

Setting the time which is able to resume to receive the command if sending incorrect command and no reply from CIS.

Initial value is 30 seconds(Parameter Data = 150).

Serial Communication (UART) Specification

Item	Function
Baud Rate	9.6kbps,19.2kbps,115.2kbps
Data bit	8
Parity	None
Start bit	1
Stop bit	1
Flow Control	none

【Remarks】

1) Ignore return data from CIS due to change communication baud rate. Because communication baud rate is changed immediately on receiving this command and return data of this command is send by the changed baud rate from CIS.

2) When using the UserSet _ # _ Save command, set the TimeOut time back to the initial value. If time out time is shorter than 30 seconds, error is happened when executing UserSet_#_Save command and be not able to save the setting data.

5-2 Setting④: Output mode Setting

Address	Register name	R/W	Parameter Data	Function	Initial
6010h	PixelFormat	R/W	0401h, 0402h, 0101h, 0102h	Switch output image format 0401h: 24bit RGB color , 0402h: 30bit RGB color 0101h :8bit mono, 0102h: 10bit mono	0401h
600Ch	CameraLink Config	R/W	0 to 3	Switch Camera Link® Configuration of image output 0:Base Configuration , 1:Medium Configuration , 2:Full Configuration , 3:Deca Configuration	0

5-2-6 Output Mode Setting

[Function]

Switch image output format, and select among “24bit color”, “30bit color”,“8bit mono”, and “10bit mono”

Switch Camera Link® Configuration

Select from;

Base Configuration, Medium Configuration, Full Configuration, Deca Configuration(=8bit-Modes 80bit and 10bit-Modes 80bit)

Supported Output Mode

Legend:○:Supported -:Not supported

Configuration	Mono		RGB Color	
	8bit	10bit	24bit	30bit
Base	○(2tap)	○(2tap)	○(1tap)	-
Medium	○(4tap)	○(4tap)	○(2tap)	○(1tap)
Full	-	○(6tap)	○(3tap)	○(2tap)
Deca	○(10tap)	○(8tap)	-	-

1) Output mode is conformed to Camera Link® Standard Ver2.1
2) Refer to Appendix D or data sheet for detail of bit assignment

[Remark]

1) The frame grabber you use needs to be capable of the Output Format you select on this product.
2) When changing “PixelFormat” and “LinkConfig”, these are reflected including slave channel.
3) Because “Output Mode Setting” interacts with Line Frequency and number of output pixel, please set this setting based on your calculation for each setting.
4) Refer to Appendix C for relationship of output connectors.
5) 8bit-Modes 80bit and 10bit-Modes 80bit is called Deca Configuration

5-2 Setting⑤: Output Clock Frequency Setting

Address	Register name	R/W	Parameter Data	Function	Initial
6008h	CameraLink Clock_Select	R/W	0 to 28	Switch Camera Link® output clock frequency Refer to below tables for relationship of parameter vs. clock frequency.	28

5-2-7 Output Mode Setting

[Function]
Switch output clock frequency of Camera Link®

Relationship of parameter data vs. clock frequency.

Parameter Data	Clock Frequency (MHz)	Parameter Data	Clock Frequency (MHz)	Parameter Data	Clock Frequency (MHz)
0 (0x00)	48.0	11 (0x0B)	57.6	22 (0x16)	72.0
1 (0x01)	50.7	12 (0x0C)	58.3	23 (0x17)	76.0
2 (0x02)	51.0	13 (0x0D)	60.0	24 (0x18)	76.8
3 (0x03)	51.4	14 (0x0E)	61.7	25 (0x19)	78.0
4 (0x04)	52.0	15 (0x0F)	62.4	26 (0x1A)	80.0
5 (0x05)	52.8	16 (0x10)	64.0	27 (0x1B)	81.6
6 (0x06)	53.3	17 (0x11)	65.1	28 (0x1C)	84.0
7 (0x07)	54.0	18 (0x12)	66.0		
8 (0x08)	54.9	19 (0x13)	67.2		
9 (0x09)	56.0	20 (0x14)	68.0		
10 (0x0A)	57.0	21 (0x15)	68.6		

【Remark】

1) When changing CameraLinkClock_Select, this is reflected including slave channel.

2) Because “Output Mode Setting” interacts with Line Frequency and number of output pixel, please set this setting based on your calculation for each setting.

3) Set to 28 if inputting invalid parameter data (more than 28).

5-2 Setting⑥: Setting Number of Output Channel

Address	Register name	R/W	Parameter Data	Function	Initial
6054h	OutputCh_Select	R/W	0 to 1	Setting number of output channel 0: Output from Ch1 only （1Ch Output） 1: Output from Ch1 and Ch2 （2Ch Output）	0

5-2-8 Setting Number of Output Channel

[Function]

Setting number of output channel (connector)

Also check p.32 and p.33 of this document to setting this parameter.

（1ch Output）

Image data is outputted from max. 6 connectors (D1,D2,D5,D6,D9,D10)) if using Medium, Full, Deca Config.

Image data is outputted from max. 3 connectors(D1,D5,D9) if using Base Config.

This output method is called “1ch output”. This method is the standard output mode in ordinary operation and ex-factory condition.

（2ch Output）

Image data is outputted from max. 12 connectors (D1-D12) if using Medium, Full, Deca Config.

Image data is outputted from max .6 connectors (D1,D3,D5,D7,D9,D11) if using Base Config.

Above output method is called “2ch output”.

【Remark】

1) When changing OutputCh_Select, this is reflected including slave channel.

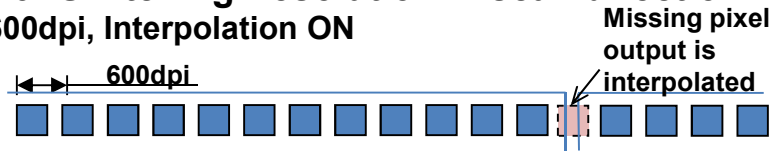
2) Because “Setting Number of Output Channel” interacts with Line Frequency and number of output pixel, please set this setting based on your calculation for each setting.

5-2 Setting⑦: Switching Resolution and Interpolation

Address	Register name	R/W	Parameter Data	Function	Initial
70B0h	ResolutionSetting	R/W	0 to 4	Set Resolution and Interpolation On/Off 0: 600dpi, Interpolation ON 1: 600dpi, Interpolation OFF 2: 300dpi mode 3: 200dpi mode 4: 150dpi mode ※Interpolation is not supported on 300,200, and 150dpi modes.	1

5-2-9 Switching Resolution in scan direction

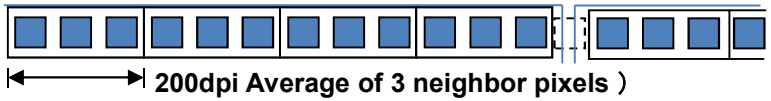
1）600dpi, Interpolation ON



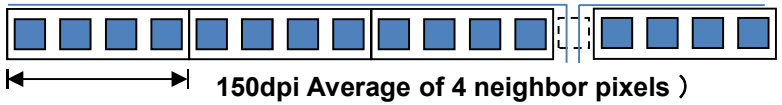
2）600dpi, Interpolation OFF

3）300dpi mode

4）200dpi mode



5）150dpi mode



[Function]
Change Resolution of image output, and switch Interpolation ON/OFF

Switching resolution is a function which is processed on each sensor IC by averaging analogue signals from neighboring pixels.
For more details about Interpolation, refer to Chapter 2-5.

[Remark]

1) If the reading resolution is lowered, change the relative transport speed of the reading medium according to the resolution.
2) Interpolation function estimates and creates a pixel data of a missing pixel or gap between Sensor ICs, while monitoring output information of neighboring pixels. Thus, it doesn't indicate any actual scanned data. Determine an applicability of this function to your equipment or devices through an appropriate analysis or evaluation by the designer of such equipment.

5-2 Setting⑧: Sync Signal Setting

Address	Register name	R/W	Parameter Data	Function	Initial
6028h	TriggerMode	R/W	0 or 1	Set Sync Signal input source 0: Internal Sync mode 1: External Sync mode	0
7000h	LinePeriodCounter	R/W	0 To 65535	Set Line Frequency (Internal Sync mode) $\text{Line Frequency}(usec) = \frac{(Register\ value) + 1}{35}$	5833

5-2-10 Sync Signal Setting

[Function]
Select a Sync Signal input source.

Select External Sync mode and provide sync signals to CIS, when your object transport speed is changeable. (For more details, please refer to Chapter 4-3.)

Select Internal Sync mode and control line frequency, when your object transport speed is fixed. You can change line frequency max. 1,872 usec/line.

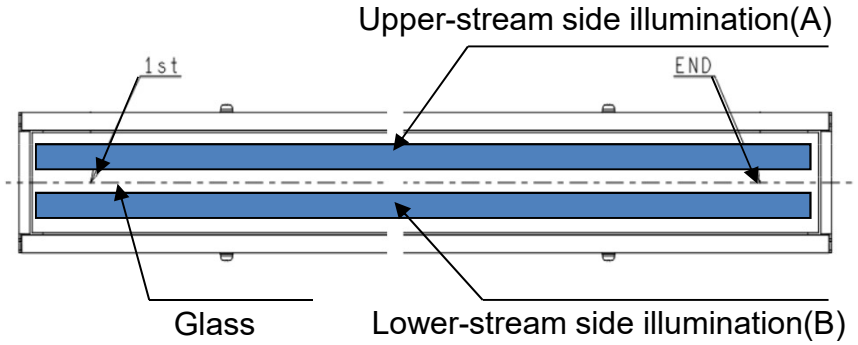
[Remark]
1) In the external synchronization mode, input a line synchronization signal with a reading frequency that matches the medium to be read or the CIS transport speed.

5-2 Setting⑨: Illumination(LED) Control

Address	Register name	R/W	Parameter Data	Function	Initial
7010h	LedSelector	R/W	0 to 3	Illumination (LED) control 0: OFF (Signal is **not** outputted from OUT PULSE1 and OUT PULSE2) 1: Upper-stream side illumination(A), one side lighting ON (Signal is outputted from OUT PULSE1) 2: Lower-stream side illumination(B), one side lighting ON (Signal is outputted from OUT PULSE2) 3: Both Upper-stream illumination(A) and Lower-stream illumination(B) ON (Signal is outputted from OUT PULSE1 and OUT PULSE2)	3

5-2-11 Illumination (LED) Control

[Function]
This product perform the control of a lighting pulse signal for outside illumination.
The format of output signals suppose the construction of illumination which is shown below.



[Remark]

1) Sequential multiple different illuminations are not supported by this product. In this case, White Correction cannot be operated, too. When you select one of the illumination control modes, you can save White Correction data and run White Correction.
2) As illumination Control function, This product outputs External illumination pulse signal over External Connector L1. For more details, refer to Page 52 and 58.

5-2 Setting⑩: Illumination (LED) Setting

Address	Register name	R/W	Parameter Data	Function	Initial
7014h	LedPulseDivision	R/W	0 to 3	Set illumination Pulse division 0:OFF, 1: 2 pulses, 2: 4 pulses, 3: 8 pulses	0
7018h	LedPulseWidthA	R/W	0 to 65535	Upper-stream side (A) illumination (OUT PULSE1) period setting $Lighting\ period\ (usec) = \frac{(Register\ value)}{35}$	450
701Ch	LedPulseWidthB	R/W	0 to 65535	Lower-stream side illumination (B) (OUT PULSE2) period setting	450
7020h	LedEffectivePeriod	R/W	0 to 65535	Set illumination Effective Period $Illumination\ Effective\ Period(usec) = \frac{(Register\ value)}{35}$	692

5-2-12 Illumination (LED) Control

[Function]

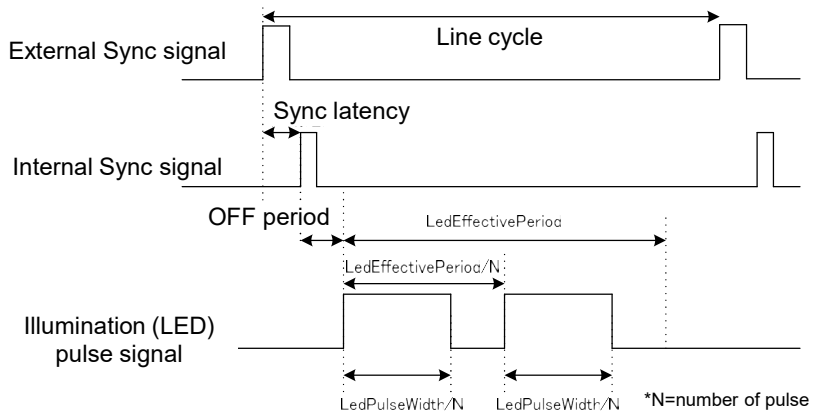
Set the output of the lighting pulse signal for external lighting control. By changing the pulse width of illumination, you can adjust the intensity of the illumination.

The controll of both Upper-stream side illumination(A) and Lower-stream side illumination(B) can be controlled independently.

You can also division the number of Lighting pulse signal 1 to 8 pulses within 1 line cycle of illumination.

[Remark]

1) Maximum illumination Pulse Width is equivalent to the setting value of illumination Effective Period. If you set illumination Pulse Width longer than illumination Effective Period, the illumination is NOT turned ON after the end of illumination Effective Period.
2) Please Include an appropriate margin of line frequency variation when you set illumination Effective Period.
3) If you set illumination Effective Period longer than Line Cycle, reset at Initialize the next sync signal or the next timing of illumination Effective Period.



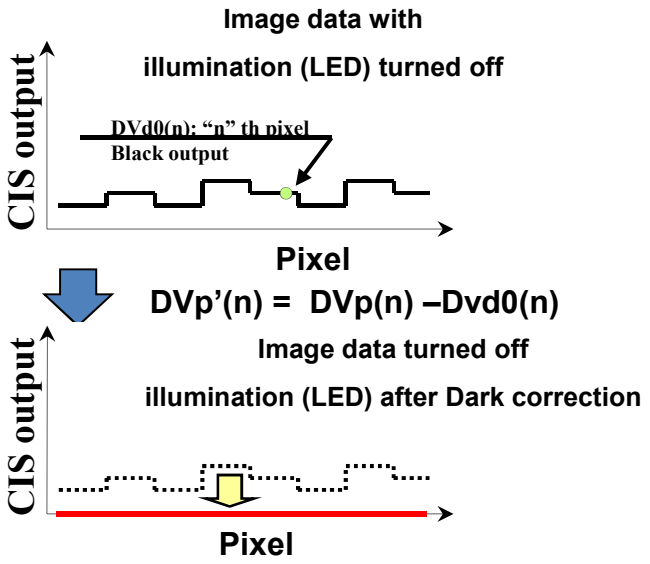
5-2 Setting⑪: Dark Correction

※When operating Dark/White correction, input external sync. signal continuously, or conduct with internal sync. mode.

Address	Register name	R/W	Parameter Data	Function	Initial
7050h	DarkCorrectionEnable	R/W	0 or 1	Dark correction On/Off setting 0:OFF /1:ON	0
7054h	DarkCorrectionExecute	R/W	1	Automatic generate Dark Correction Data	-

5-2-13 Dark correction

[Function]
Corrects the variation of the dark outputs pixel by pixel (Dark output: Output based on illumination (LED) OFF)
For more detail, refer Chapter 2-3.



The following procedures shows how to generate Dark correction data.

1) Normal Trigger mode: DarkCorrectionExecute
Dark correction generation sequence is started up by executing "DarkCorrection Execute". The Dark correction data (average of 32 lines of pixel data) is save on this product.

This product has memory for saving correction data every resolution. Correction data is saved in memory for current resolution by this operation. If using multiple resolution, execute this operation in each resolution. The correction data which is applied for CIS is automatically changed when resolution is changed.

[Remark]

1) At factory setting, CIS has an initial dark correction data for only 600dpi . After turning on power, the initial dark correction data are booted automatically and dark correction function becomes available.
2) Sensor black output is Fluctuated by temperature, reading cycle, electronic shutter exposure period. Please regeneration the black correction data at appropriate intervals.
3) If black correction is not performed correctly, streaky variations may appear in the image.
4) Turn off illumination when executing dark correction.

5-2 Setting⑫: White Correction

※When operating Dark/White correction, input external sync. signal continuously, or conduct with internal sync. mode.
※Turn on the Dark Correction for carrying out the White Correction.

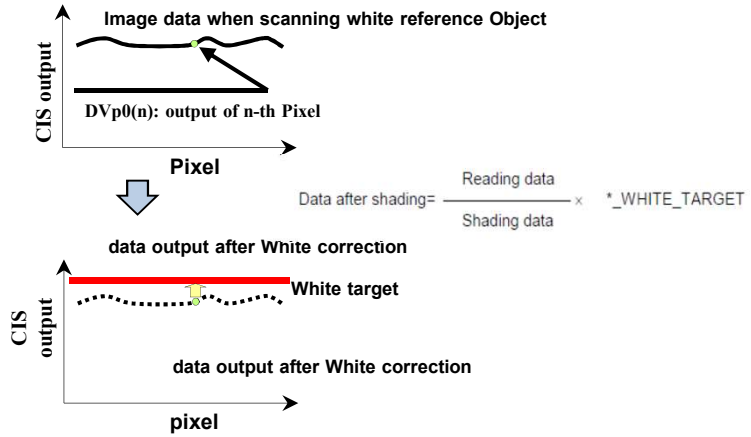
Address	Register name	R/W	Parameter Data	Function	Initial
7070h	WhiteCorrectionEnable	R/W	0 or 1	Set white Correction On/Off 0:OFF /1:ON	0
7074h	WhiteTarget_R	R/W	0 to 4095	Set red color's White Correction Target value	4000
7078h	WhiteTarget_G	R/W	0 to 4095	Set green color's White Correction Target value	4000
707Ch	WhiteTarget_B	R/W	0 to 4095	Set blue color's White Correction Target value	4000
7080h	WhiteCorrectionExecute	R/W	1	Generate White Correction data (Normal Trigger mode)	-
7084h	WhiteCorrectionExtraTriger	R/W	0 or 1	Generate White Correction data (External Trigger mode) 0:END / 1:START	0

5-2-14 White correction

[Funcion]

This function is to correct variation of output from sensor IC pixel by pixel caused by variation of illumination strength and Pixel sensitivities . It makes all output of pixels uniform.

Refer chapter 2-3. , “how to use CIS” .



There are two types of procedures to generate White correction data as follows.

1) Normal Trigger mode: WhiteCorrectionExecute

White correction data generation sequence is started up by executing “WhiteCorrection Execute”. The White correction data (average of 32 lines of pixel data) is save on the product.

2) External Trigger mode: WhiteCorrectionExtraTriger

White correction data generation sequence is started up by providing a start command at “WhiteCorrectionExtraTrigger”. The White correction data (maximum values of the average of 32 lines of pixel data until the end command is provided to CIS) are saved on this product.

“WhiteTarget_R,G,B” is a register to set a target value of the output of after White Correction when CIS scans a white chart. The target value is based on 12 bit depths.

[Remark]

1) At factory setting, CIS has an initial white correction data for only 600dpi .
2) To prepare new White correction data , start to send command after turning on dark correction function under scanning white reference object having uniform reflection ratio .
3) Scanning Image has some unusual strips possibility by using incorrect white correction data caused by scanning scratches , dirt and dusts on white reference object when re-generate white correction data .
4) This product has memory for saving correction data every resolution as same as dark correction. The white correction data which is applied for CIS is automatically changed when resolution is changed.

5-2 Setting⑬: PGA

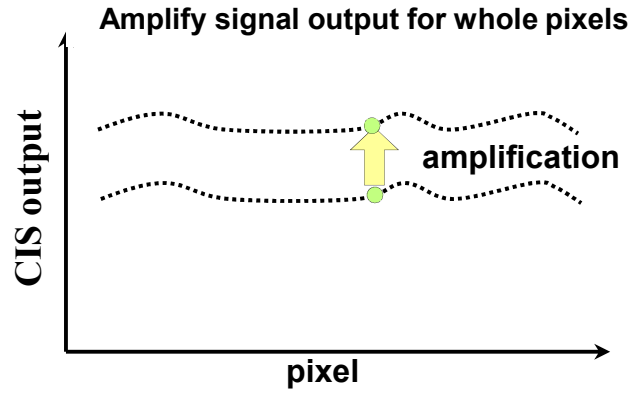
Address	Register name	R/W	Parameter Data	Function	Initial
70A0h	DegitalGainEnable	R/W	0 or 1	Set PGA On/Off 0:OFF /1:ON	0
70A4h	DegitalGain_R	R/W	-1024 to 3071	Set a value of Red PGA (0 to 4.0) $\text{Output data} = \text{Input data} \times \frac{1024 + \text{Register value}}{1024}$	0
70A8h	DegitalGain_G	R/W	-1024 to 3071	Set a value of Green PGA (0 to 4.0)	0
70ACh	DegitalGain_B	R/W	-1024 to 3071	Set a value of Blue PGA (0 to 4.0)	0

5-2-15 PGA

[Funcion]

Amplify image signals for whole pixels in a line by the designated magnification . Adjustable from 0 to 4.0 times for each color.

This amplification is performed by digital calculation. Thereby, Signal level increases by PGA function, but noise level also increases same as signal amplification.



[Remark]

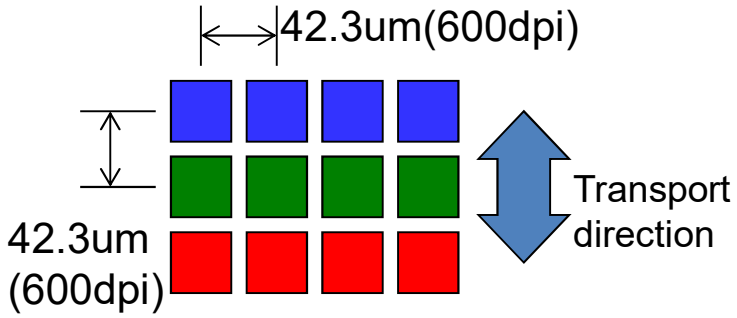
1) When you apply PGA with each color's output, be careful about White balance of color scanning.
2) The register value at "DegitalGain_R,G,B" is defined to be a "Signed integer". When you set the register values based on hex number, make sure the sign of "Positive (+) " or "Negative (-)" of the register value.

A setting example: Register parameter data
= -2（decimal digit）= FFFFFFFEh(hex digit)

5-2 Setting⑭: Line Adjustment

Address	Register name	R/W	Parameter Data	Function	Initial
70C0h	LineAdjustment Enable	R/W	0 or 1	Set Line adjustment On/Off 0:OFF /1:ON	1
70C4h	LineAdjustmentDirection	R/W	0 or 1	Set transportation direction 0: Normal (B → G → R :B-line first) 1: Opposit (R → G → B :R-line first)	0
70C8h	LineAdjustmentRatio	R/W	1 to 16384	Resolution in transportation direction／600dpi Ratio (0.03 to 4.0) LineAdjustmentRatio =Resolution(transportation direction)/600dpi × 4096	4096
70CCh	LineAdjustmentOfset	R/W	0 to 4096	Offset setting of Green pixel (0 to 1.0) $Offset = \frac{(Register\ value)}{4096}$	0

5-2-16 Line adjustment



Each line of RGB photo-diodes on Sensor IC is assembled based on 600 dpi as described above. Line adjustment function creates internal line delay by using embedded line memory and adjust each line data position. (at initial setting)

[Function]
This function adjusts the different position of each RGB line into a certain position that scans same area of object.

Set the value of LineAdjustmentRatio according to the ratio of the resolution in transportation direction.
Example:Reslution in transportation direction 300dpi
LineAdjustmentRatio =300dpi/600dpi × 4096=2048

[Remark]
1) An unstable transportation speed may cause a color bleeding or blurring.
2)This function is not to completely control a color bleeding or blurring. Use the effect of this function after confirmation enough.
3)When you organize Line adjustment by your system, use this product as Line adjustment OFF.
4)For more details, please refer to Function Specification.

5-2 Setting⑮: Gamma Correction

Address	Register name	R/W	Parameter Data	Function	Initial
70E0h	GammaCorrectionEnable	R/W	0 or 1	Set γ correction On/Off 0:OFF /1:ON	0

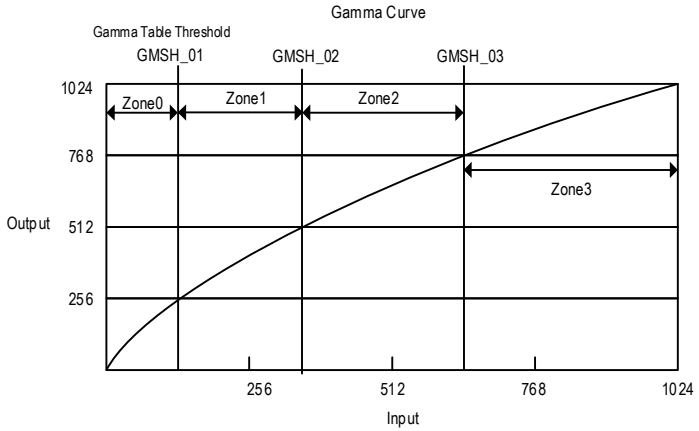
5-2-17 γ correction function

[Function]
Change output linearity based on Look-up table (γ correction table).
The initial setting is γ=1 (γ correction OFF).

[Factory setting at look-up table]
γ table : γ=2.2

[Remark]

1)γ correction selects or specifies a gradation of 256 steps (8 bit length), that is one of 4 blocks that 1024 steps (10bit length) are divided by 4.
2)For more details of γ correction, refer to the Function Specification.



Data after Conversion	Zone0 0-128 gradations	Zone1 129-346 gradations	Zone2 347-640 gradations	Zone3 641-1023 gradations
9	0	0	1	1
8	0	1	0	1
7	8bit-SRAM FFh-00h	8bit-SRAM FFh-00h	8bit-SRAM FFh-00h	8bit-SRAM FFh-00h
6				
5				
4				
3				
2				
1				
0 LSB				

5-2 Setting⑯: Mono mode Setting

Address	Register name	R/W	Parameter Data	Function	Initial
7110h	MonoModeSelect	R/W	0 to 3	Select Mono mode (This function can change the output of RGB color mode.) Mono mode 0: Green pixel output, 1: Luminance value output 2:Red pixel output, 3:Blue pixel output RGB color mode 0: Color output, 1: Luminance value output 2: prohibit selection, 3: prohibit selection	0

5-2-18 Mono mode Setting

[Function]
Select and switch a type of output image data when output format when you set Output format to be Mono mode.

Output data : Red , Green or Blue pixel output,
Luminance value output

Luminance value＝77/256×R＋150/256×G＋29/256×B

[Remark]
When you select RGB color mode and set “MonoModeSelect=1” (Luminance value), each of R, G, and B pixels outputs becomes the above value, providing monochrome image.

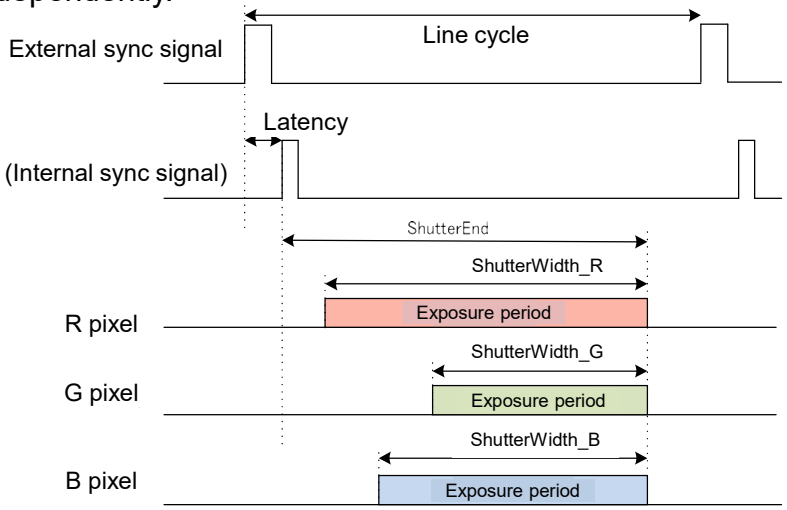
5-2 Setting⑰: Electronic Shutter

Address	Register name	R/W	Parameter Data	Function	Initial
7030h	ShutterEnable	R/W	0 or 1	Set Electric shutter On/Off 0:OFF /1:ON	0
7034h	ShutterEnd	R/W	0 to 32765	Set exposure end timing	130
7038h	ShutterWidth_R	R/W	1 to 32764	Set Red exposure period	1
703Ch	ShutterWidth_G	R/W	1 to 32764	Set Green exposure period	1
7040h	ShutterWidth_B	R/W	1 to 32764	Set Blue exposure period	1

5-2-19 Electric Shutter

[Function]

Control exposure period of sensor IC for R, G and B independently.



ShutterEnd: Set end timing of exposure for RGB common

End timing[us]=ShutterEnd ×35

ShutterWidth_R,G,B : Set exposure period of RGB individually

Exposure period[us]= ShutterWidth_R,G,B ×35

[Remark]

1)This function is supposed to be used when you use an external illumination (continuous-wave mode) with this product. When you use illumination(LED) control signal from CIS, illumination(LED) control function to adjust exposure period is recommended without using this function.

2)Set the value of “ShutterEnd,ShutterWidth” fulfilling with the following formula. (When setting Electric shutter ON, you need to control each exposure period of RGB according to your application.)

①Electric shutter ON (ShutterEnable=‘1’)

A≦ShutterEnd ≦Line cycle (usec)×35 −6

A=620@600dpi, 358@300dpi, 262@200dpi, 214@150dpi

②Electric shutter OFF (ShutterEnable=‘0’)

130≦ ShutterEnd ≦Line cycle (usec)×35 −6

※When you set the value of “ShutterEnd” is less than “①A” or “②130”, some defective images are output.

※When you set the value of “ShutterEnd” greater than “Line cycle x35-6”, a sync signal might be ignored and the number of the output line may not correspond to the line cycle. When you use external trigger mode, keep a margin between the value of “ShutterEnd” and Line cycle.

3)Set the value of “ShutterWidth_R,G,B” filfilling with the following formula.

1≦ ShutterWidth_R,G,B ≦ ShutterEnd −1

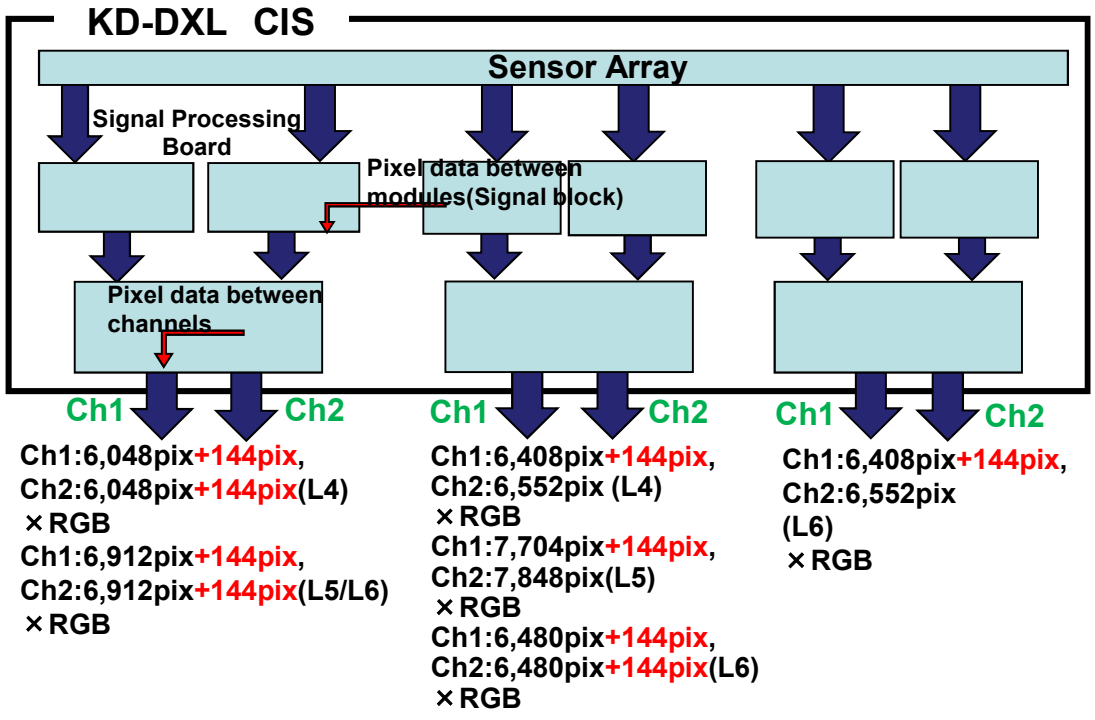
4) Electronic Shutter settings affect sensor outputs. When changing Electronic Shutter settings, recommend to generate Dark /White correction data again.

5-2 Setting⑱: Overwrap Output

Address	Register name	R/W	Parameter Data	Function	Initial
7120h	OverlapEnable	R/W	0 or 1	Set Overwrap output(between the multi signal blocks , and between the multi channels) On/Off 0:OFF /1:ON	0

5-2-20 Overwrap output

This function enables to add first 144 pixels data@600dpi (6.1mm width of image) of a next module on the output of a module.



[Function]
This product have 2 or 3 signal blocks of Camera Link ® and output image data at parallel. This product can output image data from 2 or 3 different signal blocks, which the image data are overwrapped partially. This function contribute to acquire the image data between the multi channels of Camera Link ® .

By this function, image data near the connection point can be confirmed correctly even if using multiple PCs to acquire image.

The number of the added or overwrapped pixels depend of the output resolution. (The total overwrapped image data correspond to the 6.1mm width of the acquired image.)

Number of the added pixels :
144 pixels @600dpi
72 pixels @300dpi
48 pixels @200dpi
36 pixels @150dpi

5-2 Setting⑲: Output Width Setting

Address	Register name	R/W	Parameter Data	Function	Initial
6034h	Width_1	R/W	0 to 16380	Setting output resolution of main scanning direction output from Camera Link® connector(D1 ~ D4) (L4/L5/L6 commonly use)	L4:12096 L5:13824 L6:13824
6038h	Width_2	R/W	0 to 16380	Setting output resolution of main scanning direction from Camera Link® connector(D5 ~ D8) (L4/L5/L6 commonly use)	L4:12960 L5:15552 L6:12960
603Ch	Width_3	R/W	0 to 16380	Setting output resolution of main scanning direction output from Camera Link® connector(D9 ~ D12) (for L6 use only)	L6:12960

5-2-21 Output width setting

[Function]

Setting output resolution of main scanning direction from CIS.

The value of Width is defined number of the output pixels in 1ch output.

Number of the output pixels of each ch in 2ch output is depended on overlap setting and as follows.

Overlap “disable” : Number of the output pixels = Width/2.

Overlap “Enable” : Number of the output pixels
= Width/2 ＋A/2.

* A = The addition pixels by the overlap
144pixels@600dpi, 72pixels@300dpi,
48pixels@200dpi, 36pixels@150dpi

*Position of the output pixel:
Ch1 = 1 to Width/2＋A/2
Ch2 = Width/2-A/2+1 to Width

【Remark】

1) When you select lower resolution and operate high-speed line rate, this register values need to be changed from initial settings.
2) The value of “Width” has to be greater than the actual number of output pixel.
The minimum of Width changes by resolution setting, interpolation setting, overlap setting. Refer to Appendix E(1) for the minimum of Width every each setting.
When a value of Width is bigger than the number of the pixels that CIS really outputs, the data of the dummy pixel are output at the end.
*There are no 600dpi, pixel interpolation, and the initial value of Width of each model sets the value that supported without overlap.
3) Please set an even number when the output pixels is set at the 2ch setting.(The setting with the odd number is possible, but works an even number in the CIS inside)

5-2 Setting(others): Test Pattern

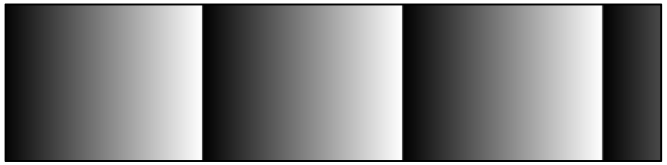
Address	Register name	R/W	Parameter Data	Function	Initial
6020h	TestImageSelector	R/W	0 to 3	Set test pattern 0:OFF /1:Grey ramp horizontal 2:Grey ramp vertical /3:RGBW	0
6024h	TestLineRate	R/W	0 to 55000	Set line rate for test pattern $Line\ Rate[Hz]$ = (register value)	55000
602Ch	TestTriggerMode	R/W	0 or 1	Set source of sync signal 0:Internal sync mode (output test pattern based on TestLineRate), 1: External sync mode	0

5-2-22 Test pattern

[Function]

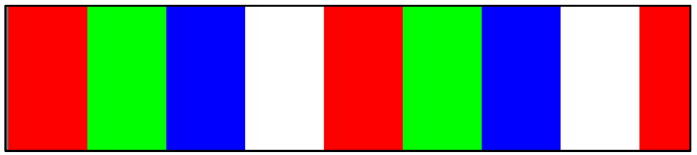
Output a test pattern over Camera Link® in order to make sure image data communication from CIS to frame grabber. Please use this function when you setup your system.

1) Grey ramp horizontal



2) Grey ramp vertical

3) RGBW



[Remark]

1) When you use this function based on Internal sync mode, you need to set line rate with “TestLineRate”.
2) The purpose of this function is to make sure if the data transfer is appropriated operated. When you use this function, the image data is not output.
3) After using Test pattern function, please turn off & turn on CIS prior to operate CIS to take the image. (If without turn off CIS, incorrect picture is output from CIS.)

5-2 Setting(others): Error and Temperature Indications

Address	Register name	R/W	Parameter Data	Function	Initial
7224h	DeviceTemperature Mainboard	R	-	Indicate an internal temperature (℃) of FPGA on Image processing board (When using multiple image processing boards, this function indicates the maximum value.)	-
7228h	DeviceTemperature Ifboard	R	-	Indicate an internal temperature (℃) of FPGA on I/F board. (When using multiple image processing boards, this function indicates the maximum value.)	-
7230h	DeviceError	R	0 to 7	Return “Error” indications about cooling fan and FPGA temperature. 0 : Operating normally ’1’ at bit0: Error of cooling fan. ’1’ at bit1: Abnormal temperature of FPGA on Image processing board ’1’ at bit2: Abnormal temperature of FPGA on I/F board	-

5-2-23 Error and temperature indications

[Function]

This function enables to provide some indications of errors, when cooling fan is stopped or operates at slow speed or a temperature of internal FPGA becomes abnormally high. Additionally, this function can provide an information of the temperature of the internal FPGA.

The unit of reading data is Centigrade degree.

Example: Reading data 1Eh(hex digit)

= Temperature of the internal FPGA

30 Centigrade degree.

[Remark]

1) When you read the registers, this product returns a value which shows the internal status of this product. Please confirm by reading the registers if there is an error or not. (On your control software attached with your frame grabber, the software indicates the last value you operated “read”. This value will not be updated until you will operate “read” again.

5-2 Setting(others):Prevention for Exposure Saturation

Address	Register name	R/W	Parameter Data	Function	Initial
7400h	PES_Enable	R/W	0 to 1	Switching prevention for exposure saturation On/Off 0:OFF /1:ON	0
7404h	PES_MaxLinePeriod	R/W	0 to 65535	Setting the period to judge whether occurring the condition without external sync. signal or not. $Setting\ Period(usec) = \frac{(register\ value)+1}{35}$	3840
7408h	PES_ProhibitedTime	R/W	0 to 65535	Setting prohibited period for resuming to input sync. signal $Setting\ Period(usec) = \frac{(register\ value)+1}{35}$	1280

5-2-24 Prevention for Exposure Saturation

[Function]

In case of external sync mode, if you start CIS operating again with no external sync signal cannot be input while CIS operating, image will be flare or underexposed.

If the following settings are made when the function is on, image flare and under exposure will be suppressed when you re-operate.

1) Setting the period to judge whether occurring the condition without external sync. signal or not in operating condition of CIS shown in above.

2) When you restart CIS to take image, output image data from CIS taken on first sync signal may be incorrect due to previous shutter is taken automatically and exposure period is not sure.
Therefore, it sets the period to prohibit reinputting sync signal.

【Remark】

1）Set the PES Max Line Period is longer than cycle time of input sync. signal.

2) Set the PES Prohibited Time according to below range.

1/max. line rate≦ **Prohibited Time**≦ cycle time of input sync. signal

※Max. line rate is change by data output format, output frequency, output resolution. Refer to p.31 for detail.

Appendix A: Control register list ①

Address	Register name	R/W	Parameter Data	Function	Initial
6008h	CameraLink Clock_Select	R/W	0 to 28	Switch Camera Link® output frequency Refer to P.72 for frequency conversion table	28
600Ch	CameraLink Config	R/W	0 to 3	Switch configuration of Camera Link® output 0:Base Configuration , 1:Medium Configuration , 2:Full Configuration , 3:Deca Configuration	0
6010h	PixelFormat	R/W	0401h, 0402h, 0101h, 0102h	Switch image output format 0401h: 24bit RGB Color, 0402h: 30bit RGB Color 0101h: 8bit Mono , 0102h: 10bit Mono	0401h
6014h	AcquisitionStart	R/W	1	AcqisitionStart 1 : Start	-
6018h	AcquisitionStop	R/W	1	AcqisitionStop 1 : Stop	-
6020h	TestImageSelector	R/W	0 to 3	Setting test pattern 0:OFF /1:Grey ramp horizontal 2:Grey ramp vertical /3:RGBW	0
6024h	TestLineRate	R/W	0 to 55000	Setting line rate for test pattern $Line\ Rate[Hz]$ = (register value)	55000
6028h	TriggerMode	R/W	0 or 1	Setting source of sync. Signal 0:Internal Sync. Mode 1:External Sync. Mode	0
602Ch	TestTriggerMode	R/W	0 or 1	Setting source of sync. Signal 0:External Sync. Signal 1:Internal Sync. Mode (operate based on TestLineRate)	0
6034h	Width_1	R/W	0 to 16380	Setting number of output pixels of main scanning direction output from Camera Link® connector(D1 ~ D4) (L4/L5/L6 commonly use)	L4:12096 L5:13824 L6:13824
6038h	Width_2	R/W	0 to 16380	Setting number of output pixels of main scanning direction output from Camera Link® connector(D5 ~ D8) (L4/L5/L6 commonly use)	L4:12960 L5:15552 L6:12960

Appendix A: Control register list ②

Address	Register name	R/W	Parameter Data	Function	Initial
603Ch	Width_3	R/W	0 to 16380	Setting number of output pixels of main scanning direction output from Camera Link® connector(D9～D12) (L6 use only)	L6:12960
6044h	OffsetX_1	R/W	0	Setting the number of offset pixels for main scanning direction outputted from Camera Link® Connector (D1～D4). (L4/L5/L6 commonly use) Fixed to 0.	0
6048h	OffsetX_2	R/W	0	Setting the number of offset pixels for main scanning direction outputted from Camera Link® Connector (D5～D8). (L4/L5/L6 commonly use) Fixed to 0.	0
6048h	OffsetX_3	R/W	0	Setting the number of offset pixels for main scanning direction outputted from Camera Link® Connector (D9～D12). (L6 use only) Fixed to 0.	0
6054h	OutputCh_Select	R/W	0 to 1	Setting number of output channel 0: Ch1 only 1: Ch1 and Ch2	0
6058h	CLPLLLockStatus_1	R	0 to 1	PLL lock status of clock signal for output image from Camera Link® Connector (D1～D4). 0:Locked 、 1:Unlocked	0
605Ch	CLPLLLockStatus_2	R	0 to 1	PLL lock status of clock signal for output image from Camera Link® Connector (D5～D8). 0:Locked 、 1:Unlocked	0
6060h	CLPLLLockStatus_3	R	0 to 1	PLL lock status of clock signal for output image from Camera Link® Connector (D9～D12). (L6 use only) 0:Locked 、 1:Unlocked	0
6068h	CLPLLLockRst	R/W	0 to 1	Setting PLL clock signal for output image from Camera Link® Connector (D1～D12) in same time. 0:initial condition 、 1: Reset	0
7000h	LinePeriodCounter	R/W	0 to 65535	Setting line rate (for internal sync. mode)	5833

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Appendix A: Control register list ③

Address	Register name	R/W	Parameter Data	Function	Initial
7004h	BaudRateSelect	R/W	0 to 2	Switch baud rate of Serial communication in Camera Link® 0: 9.6kbps, 1: 19.2kbps, 2: 115.2kbps	0
7008h	ContTimeOut	R/W	0 to 65535	Setting time of time out for Serial communication in Camera Link® 0:Disable, 1:0.2seconds afterwards every 0.2seconds	150
7010h	LedSelector	R/W	0 to 3	Illumination(LED) control 0:OFF 1: Upper-stream Illumination(A) ON 2: Down-stream Illumination(B) ON 3: Both Upper-stream (A) and Down-stream (B) ON	3
7014h	LedPulseDivision	R/W	0 to 3	Set illumination(LED) Pulse division 0:OFF, 1: 2 pulses, 2: 4 pulses, 3: 8 pulses	0
7018h	LedPulseWidthA	R/W	0 to 65535	Upper-stream illumination(A) period or pulse width	450
701Ch	LedPulseWidthB	R/W	0 to 65535	Down-stream illumination(B) period or pulse width	450
7020h	LedEffectivePeriod	R/W	0 to 65535	Set illumination(LED) Effective Period	692
7030h	ShutterEnable	R/W	0 or 1	Set Electric shutter On/Off 0:OFF /1:ON	0
7034h	ShutterEnd	R/W	0 to 32765	Set exposure end timing	130
7038h	ShutterWidth_R	R/W	1 to 32764	Set Red exposure period	1
703Ch	ShutterWidth_G	R/W	1 to 32764	Set Green exposure period	1
7040h	ShutterWidth_B	R/W	1 to 32764	Set Blue exposure period	1
7050h	DarkCorrectionEnable	R/W	0 or 1	Set Dark correction On/Off 0:OFF /1:ON	0
7054h	DarkCorrectionExecute	R/W	1	Generate Dark correction data	-
7070h	WhiteCorrectionEnable	R/W	0 or 1	Set White correction On/Off 0:OFF /1:ON	0
7074h	WhiteTarget_R	R/W	0 to 4095	Set Red White Correction Target value	4000
7078h	WhiteTarget_G	R/W	0 to 4095	Set Green White Correction Target value	4000
707Ch	WhiteTarget_B	R/W	0 to 4095	Set Blue White Correction Target value	4000

Appendix A: Control register list ④

Address	Register name	R/W	Parameter Data	Function	Initial
7080h	WhiteCorrectionExecute	R/W	1	Generate White Correction data (Normal Trigger mode)	-
7084h	WhiteCorrectionExtra Triger	R/W	0 or 1	Generate White Correction data (External Trigger mode) 0:END / 1:START	0
70A0h	DegitalGainEnable	R/W	0 or 1	Set Degital Gain On/Off 0:OFF /1:ON	0
70A4h	DegitalGain_R	R/W	-1024 to 3071	Set a value of Red PGA (0 to 4.0)	0
70A8h	DegitalGain_G	R/W	-1024 to 3071	Set a value of Green PGA (0 to 4.0)	0
70ACh	DegitalGain_B	R/W	-1024 to 3071	Set a value of Blue PGA (0 to 4.0)	0
70B0h	ResolutionSetting	R/W	0 to 4	Set Resolution and Interpolation On/Off 0: 600dpi, Interpolation ON 1: 600dpi, Interpolation OFF 2: 300dpi mode 3: 200dpi mode 4: 150dpi mode ※Interpolation is not supported on 300,200, and 150dpi modes.	1
70C0h	LineAdjustment Enable	R/W	0 or 1	Set Line adjustment On/Off 0:OFF /1:ON	1
70C4h	LineAdjustmentDirection	R/W	0 or 1	Set transport direction 0: Normal (B → G → R :B-line first) 1: Opposit (R → G → B :R-line first)	0
70C8h	LineAdjustmentRatio	R/W	1 to 16384	Resolution in transport direction／600dpi Ratio (0.03 to 4.0) LineAdjustmentRatio =Resolution(transport direction)/600dpi × 4096	4096
70CCh	LineAdjustmentOfset	R/W	0 to 4096	Offset setting of Green pixel (0 to 1.0) $Offset = \frac{(Register\ value)}{4096}$	0

Appendix A: Control register list ⑤

Address	Register name	R/W	Parameter Data	Function	Initial
70E0h	GammaCorrectionEnable	R/W	0 or 1	Set γ correction On/Off 0:OFF /1:ON	0
70E4h	GammaThreshhold1_R	R/W	0 to 1023	Set Threshold value 1 of γ correction for Red	49
70E8h	GammaThreshhold2_R	R/W	0 to 1023	Set Threshold value 2 of γ correction for Red	223
70ECh	GammaThreshhold3_R	R/W	0 to 1023	Set Threshold value 3 of γ correction for Red	544
70F0h	GammaThreshhold1_G	R/W	0 to 1023	Set Threshold value 1 of γ correction for Green	49
70F4h	GammaThreshhold2_G	R/W	0 to 1023	Set Threshold value 2 of γ correction for Green	223
70F8h	GammaThreshhold3_G	R/W	0 to 1023	Set Threshold value 3 of γ correction for Green	544
70FCh	GammaThreshhold1_B	R/W	0 to 1023	Set Threshold value 1 of γ correction for Blue	49
7100h	GammaThreshhold2_B	R/W	0 to 1023	Set Threshold value 2 of γ correction for Blue	223
7104h	GammaThreshhold3_B	R/W	0 to 1023	Set Threshold value 3 of γ correction for Blue	544
7110h	MonoModeSelect	R/W	0 or 1	Select Mono mode (This function can change the output of RGB color mode.) Mono mode 0: Green pixel output, 1: Luminance value output 2:Red pixel output, 3:Blue pixel output RGB color mode 0: Color output, 1: Luminance value output 2: prohibit selection, 3: prohibit selection	0
7120h	OverlapEnable	R/W	0 or 1	Set Overwrap output On/Off 0:OFF /1:ON	0
7200h	UserSet_1_Save	R/W	1	Save CIS settings to User Setting 1 on Flush Memory.	-
7204h	UserSet_2_Save	R/W	1	Save CIS settings to User Setting 2 on Flush Memory.	-
7208h	UserSet_3_Save	R/W	1	Save CIS settings to User Setting 3 on Flush Memory.	-
720Ch	UserSet_1_Load	R/W	1	Read out CIS settings on User Setting 1.	-
7210h	UserSet_2_Load	R/W	1	Read out CIS settings on User Setting 2.	-
7214h	UserSet_3_Load	R/W	1	Read out CIS settings on User Setting 3.	-
7218h	UserSet_Load_Factory Defalut	R/W	1	Read out CIS settings on Factory Setting (Initial Setting).	-

Appendix A: Control register list ⑥

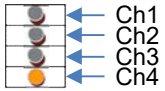
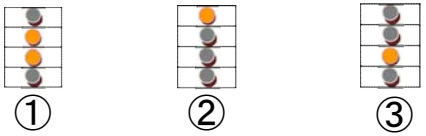
Address	Register name	R/W	Parameter Data	Function	Initial
7224h	DeviceTemperature Mainboard	R	-	Indicate an internal temperature (℃) of FPGA on Image processing board (When using multiple image processing boards, this function indicates the maximum value.)	-
7228h	DeviceTemperature Ifboard	R	-	Indicate an internal temperature (℃) of FPGA on I/F board. (When using multiple image processing boards, this function indicates the maximum value.)	-
7230h	DeviceError	R	0 to 7	Return “Error” indications about cooling fan and FPGA temperature. 0 : Operating normally ’1’ at bit0: Error of cooling fan. ’1’ at bit1: Abnormal temperature of FPGA on image processing board ’1’ at bit2: Abnormal temperature of FPGA on I/F board	-
7240h	UserSet_BootSet_select	R/W	0 to 3	Select a setting to boot after power-ON. 0:Factory Setting, 1:User Setting 1, 2:User Setting 2, 3:User setting 3	0
7244h	UserSet_Boot_Error	R	0 to 7	Error flag of booting CIS ‘0’ or ‘1’ at bit0 :normal operation, ‘1’ at bit1 :Error of User setting value, ‘1’ at bit2 :Error of FPGA starting.	-
7248h	UserSet_Use_600dpi	R/W	0 to 1	Correction data for 600dpi resolution 0:Disable / 1:Activete	1
724Ch	UserSet_Use_300dpi	R/W	0 to 1	Correction data for 300dpi resolution 0:Disable / 1:Activete	0
7250h	UserSet_Use_200dpi	R/W	0 to 1	Correction data for 200dpi resolution 0:Disable / 1:Activete	0
7254h	UserSet_Use_150dpi	R/W	0 to 1	Correction data for 150dpi resolution 0:Disable / 1:Activete	0
7300h	DevicePassward	R/W	0 to 65535	To access Dark/White correction data and γ-correction data	-

Appendix A: Control register list ⑦

Address	Register name	R/W	Parameter Data	Function	Initial
7400h	PES_Enable	R/W	0 to 1	Switching prevention for exposure saturation On/Off 0:OFF /1:ON	0
7404h	PES_MaxLinePeriod	R/W	0 to 65535	Setting the period to judge whether occurring the condition without external sync. signal or not.	3840
7408h	PES_ProhibitedTime	R/W	0 to 65535	Setting prohibited period for resuming to input sync. signal	1280
20B0	DeviceID	R	ASCII Code	The serial number is stored. example:1909360001	-

Appendix B: Error indicator

LED indicator on this product shows this product's status (refer to Chapter 4-2) and Error indications based on register values (refer to Chapter 5-2-23).
The details of this error indicator and counterplan are described in below.

Item	Status	Contents of errors and counterplan
1	Status LED indicates Orange after turn on CIS 	This status shows that DC5V power supply voltage down to 3.4V on CIS internal board. Change power supply voltage to maximum voltage within Standard Operating Conditions and Check the voltage is 5V near the power supply connector on CIS. If voltage is 5V, CIS might be broken or damaged.
2	Status LED indicates Orange after turn on CIS. （①Ch1,4: OFF Ch2,3 Orange ②Ch1: Orange Ch2～4: OFF ③Ch1～2,4: OFF　Ch3: Orange） 	This status shows a failure of System-boot operation of this product. If an appropriate voltage is not provided to CIS, this status happens. Please check the following points. ①Is the same voltage supplied as the pin assignment table supplied to each terminal of the V1V3 connector that supplies DC5V? (If +5V and GND pins specified on the pin assignment table are not connected, the sensor board cannot operate correctly.) ②Is the current limiter setting of your DC5V power unit　too low when power on? ③Is the voltage of DC5V less than 4.75V? If not above, CIS might be broken or damaged.
3	Ch1-Ch3 of status LED indicate Solid RED （Ch1～3: Red LED ON） 	This status shows an abnormal temperature of FPGA on I/F board. Make sure if the surrounding temperature of this product is　high or not. When necessary, please carry out additional cooling solution to this product.

Appendix B: Error indicator

Item	Status	Contents of errors and counterplan
4	Error indicator register '1' at 0bit of DeviceError (DeviceError = 1,3,5,7)	This status indicates that the cooling fan is stopped or operates at slow speed. Please check the following point. ①Is there anything that bothers cooling fan? If there is nothing that bothers the cooling fan's operations, the cooling fan may be broken or at the end of the life time.
5	Error indication register "DeviceError" "1" at 1bit (DeviceError = 2,3,6,7) Error indication register "DeviceError" "1" at 2bit (DeviceError = 4,5,6,7)	This status indicates an abnormal temperature of FPGA. Make sure if the surrounding temperature of this product is high or not. When necessary, please carry out additional cooling solution to this product.

Appendix C:
Connector List by Number of Output Channel

①Connector List by Number of Output Channel(a)　(for KD6R1064/1247DXL-NL)

Camera Link® Configuration		Output ch	Image Data Output Connector
Base	24bit RGB Color, 8bitMono, 10bit Mono	2ch Output	D1,D3,D5,D7
		1ch Output	D1,D5
Medium	24bit RGB Color, 30bit RGB Color 8bit Mono, 10bit Mono	2ch Output	(D1,D2),(D3,D4),(D5,D6),(D7,D8)※
		1ch Output	(D1,D2),(D5,D6)※
Full	24bit RGB Color, 30bit RGB Color, 10bit Mono	2ch Output	(D1,D2),(D3,D4),(D5,D6),(D7,D8)※
		1ch Output	(D1,D2),(D5,D6)※
Deca	8bit Mono, 10bit Mono	2ch Output	(D1,D2),(D3,D4),(D5,D6),(D7,D8)※
		1ch Output	(D1,D2),(D5,D6)※

※Image data is outputted from I/F of Camera Link® connector marked by “(　)”. (Refer to p.34-36)

・D1 connector is the Master port which is able to do Serial communication.

②Connector List by Number of Output Channel(b)　(for KD6R1688DXL-NL)

Camera Link® Configuration		Output ch	Image Data Output Connector
Base	24bit RGB Color, 8bitMono, 10bit Mono	2ch Output	D1,D3,D5,D7,D9,D11
		1ch Output	D1,D5,D9
Medium	24bit RGB Color, 30bit RGB Color 8bit Mono, 10bit Mono	2ch Output	(D1,D2),(D3,D4),(D5,D6),(D7,D8), (D9,D10),(D11,D12)※
		1ch Output	(D1,D2),(D5,D6),(D9,D10)※
Full	24bit RGB Color, 30bit RGB Color, 10bit Mono	2ch Output	(D1,D2),(D3,D4),(D5,D6),(D7,D8), (D9,D10),(D11,D12)※
		1ch Output	(D1,D2),(D5,D6),(D9,D10)※
Deca	8bit Mono, 10bit Mono	2ch Output	(D1,D2),(D3,D4),(D5,D6),(D7,D8), (D9,D10),(D11,D12)※
		1ch Output	(D1,D2),(D5,D6),(D9,D10)※

※Image data is output from I/F of Camera Link® connector marked by “(　)”. (Refer to p.34-36)

・D5 connector is the Master port which is able to do Serial communication.

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Appendix D: Camera Link® Configuration Bit Assignment

（1） Camera Link® Port Name and Camera Pin-Name for each configuration

	8bit/10bit Base,Medium,Full		Deca-8bit		Deca-10bit	
	Port	Camera (Pin-Name)	Port	Camera (Pin-Name)	Port	Camera (Pin-Name)
X-chip	Port A0	Tx0	Port A0'	TxIN0	Port A0''	TxIN0
	Port A1	Tx1	Port A1'	TxIN1	Port A1''	TxIN1
	Port A2	Tx2	Port A2'	TxIN2	Port A2''	TxIN2
	Port A3	Tx3	Port A3'	TxIN3	Port A3''	TxIN3
	Port A4	Tx4	Port A4'	TxIN4	Port A4''	TxIN4
	Port A5	Tx6	Port A5'	TxIN5	Port A5''	TxIN6
	Port A6	Tx27	Port A6'	TxIN6	Port A6''	TxIN27
	Port A7	Tx5	Port A7'	TxIN7	Port A7''	TxIN5
	Port B0	Tx7	Port B0'	TxIN8	Port B0''	TxIN7
	Port B1	Tx8	Port B1'	TxIN9	Port B1''	TxIN8
	Port B2	Tx9	Port B2'	TxIN10	Port B2''	TxIN9
	Port B3	Tx12	Port B3'	TxIN11	Port B3''	TxIN12
	Port B4	Tx13	Port B4'	TxIN12	Port B4''	TxIN13
	Port B5	Tx14	Port B5'	TxIN13	Port B5''	TxIN14
	Port B6	Tx10	Port B6'	TxIN14	Port B6''	TxIN10
	Port B7	Tx11	Port B7'	TxIN15	Port B7''	TxIN11
	Port C0	Tx15	Port C0'	TxIN16	Port C0''	TxIN15
	Port C1	Tx18	Port C1'	TxIN17	Port C1''	TxIN18
	Port C2	Tx19	Port C2'	TxIN18	Port C2''	TxIN19
	Port C3	Tx20	Port C3'	TxIN19	Port C3''	TxIN20
	Port C4	Tx21	Port C4'	TxIN20	Port C4''	TxIN21
	Port C5	Tx22	Port C5'	TxIN21	Port C5''	TxIN22
	Port C6	Tx16	Port C6'	TxIN22	Port C6''	TxIN16
	Port C7	Tx17	Port C7'	TxIN23	Port C7''	TxIN17
	LVAL	Tx24	LVAL'	TxIN24	LVAL''	TxIN24
	FVAL	Tx25	FVAL'	TxIN25	FVAL''	TxIN25
	DVAL	Tx26	Port D0'	TxIN26	Port I0''	TxIN26
	(Spare)	Tx23	Port D1'	TxIN27	Port I1''	TxIN23

	8bit/10bit Base,Medium,Full		Deca-8bit		Deca-10bit	
	Port	Camera (Pin-Name)	Port	Camera (Pin-Name)	Port	Camera (Pin-Name)
Y-chip	Port D0	Tx0	Port D2'	TxIN0	Port D0''	TxIN0
	Port D1	Tx1	Port D3'	TxIN1	Port D1''	TxIN1
	Port D2	Tx2	Port D4'	TxIN2	Port D2''	TxIN2
	Port D3	Tx3	Port D5'	TxIN3	Port D3''	TxIN3
	Port D4	Tx4	Port D6'	TxIN4	Port D4''	TxIN4
	Port D5	Tx6	Port D7'	TxIN5	Port D5''	TxIN6
	Port D6	Tx27	Port E0'	TxIN6	Port D6''	TxIN27
	Port D7	Tx5	Port E1'	TxIN7	Port D7''	TxIN5
	Port E0	Tx7	Port E2'	TxIN8	Port E0''	TxIN7
	Port E1	Tx8	Port E3'	TxIN9	Port E1''	TxIN8
	Port E2	Tx9	Port E4'	TxIN10	Port E2''	TxIN9
	Port E3	Tx12	Port E5'	TxIN11	Port E3''	TxIN12
	Port E4	Tx13	Port E6'	TxIN12	Port E4''	TxIN13
	Port E5	Tx14	Port E7'	TxIN13	Port E5''	TxIN14
	Port E6	Tx10	Port F0'	TxIN14	Port E6''	TxIN10
	Port E7	Tx11	Port F1'	TxIN15	Port E7''	TxIN11
	Port F0	Tx15	Port F2'	TxIN16	Port F0''	TxIN15
	Port F1	Tx18	Port F3'	TxIN17	Port F1''	TxIN18
	Port F2	Tx19	Port F4'	TxIN18	Port F2''	TxIN19
	Port F3	Tx20	Port F5'	TxIN19	Port F3''	TxIN20
	Port F4	Tx21	Port F6'	TxIN20	Port F4''	TxIN21
	Port F5	Tx22	Port F7'	TxIN21	Port F5''	TxIN22
	Port F6	Tx16	Port G0'	TxIN22	Port F6''	TxIN16
	Port F7	Tx17	Port G1'	TxIN23	Port F7''	TxIN17
	LVAL	Tx24	Port G2'	TxIN24	LVAL''	TxIN24
	FVAL	Tx25	Port G3'	TxIN25	Port I2''	TxIN25
	DVAL	Tx26	Port G4'	TxIN26	Port I3''	TxIN26
	(Spare)	Tx23	LVAL'	TxIN27	Port I4''	TxIN23

	8bit/10bit Base,Medium,Full		Deca-8bit		Deca-10bit	
	Port	Camera (Pin-Name)	Port	Camera (Pin-Name)	Port	Camera (Pin-Name)
Z-chip	Port G0	Tx0	Port G5'	TxIN0	Port G0''	TxIN0
	Port G1	Tx1	Port G6'	TxIN1	Port G1''	TxIN1
	Port G2	Tx2	Port G7'	TxIN2	Port G2''	TxIN2
	Port G3	Tx3	Port H0'	TxIN3	Port G3''	TxIN3
	Port G4	Tx4	Port H1'	TxIN4	Port G4''	TxIN4
	Port G5	Tx6	Port H2'	TxIN5	Port G5''	TxIN6
	Port G6	Tx27	Port H3'	TxIN6	Port G6''	TxIN27
	Port G7	Tx5	Port H4'	TxIN7	Port G7''	TxIN5
	Port H0	Tx7	Port H5'	TxIN8	Port H0''	TxIN7
	Port H1	Tx8	Port H6'	TxIN9	Port H1''	TxIN8
	Port H2	Tx9	Port H7'	TxIN10	Port H2''	TxIN9
	Port H3	Tx12	Port I0'	TxIN11	Port H3''	TxIN12
	Port H4	Tx13	Port I1'	TxIN12	Port H4''	TxIN13
	Port H5	Tx14	Port I2'	TxIN13	Port H5''	TxIN14
	Port H6	Tx10	Port I3'	TxIN14	Port H6''	TxIN10
	Port H7	Tx11	Port I4'	TxIN15	Port H7''	TxIN11
	Port I0	Tx15	Port I5'	TxIN16	Port I5''	TxIN15
	Port I1	Tx18	Port I6'	TxIN17	Port I6''	TxIN18
	Port I2	Tx19	Port I7'	TxIN18	Port I7''	TxIN19
	Port I3	Tx20	Port J0'	TxIN19	Port K0''	TxIN20
	Port I4	Tx21	Port J1'	TxIN20	Port K1''	TxIN21
	Port I5	Tx22	Port J2'	TxIN21	Port K2''	TxIN22
	Port I6	Tx16	Port J3'	TxIN22	Port K3''	TxIN16
	Port I7	Tx17	Port J4'	TxIN23	Port K4''	TxIN17
	LVAL	Tx24	Port J5'	TxIN24	LVAL''	TxIN24
	FVAL	Tx25	Port J6'	TxIN25	Port K5''	TxIN25
	DVAL	Tx26	Port J7'	TxIN26	Port K6''	TxIN26
	(Spare)	Tx23	LVAL'	TxIN27	Port K7''	TxIN23

Appendix D:
Camera Link® Configuration Bit Assignment

（2） **Base Configuration**①(24bit RGB Color) (for KD6R1064/1247/1688DXL-NL)

1ch Output			2ch Output		
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D1, D5, D9	Connector D3, D7, D11
Port A0	R1[0](LSB)	nc	Port A0	R1[0](LSB)	R2[0](LSB)
Port A1	R1[1]	nc	Port A1	R1[1]	R2[1]
Port A2	R1[2]	nc	Port A2	R1[2]	R2[2]
Port A3	R1[3]	nc	Port A3	R1[3]	R2[3]
Port A4	R1[4]	nc	Port A4	R1[4]	R2[4]
Port A5	R1[5]	nc	Port A5	R1[5]	R2[5]
Port A6	R1[6]	nc	Port A6	R1[6]	R2[6]
Port A7	R1[7](MSB)	nc	Port A7	R1[7](MSB)	R2[7](MSB)
Port B0	G1[0](LSB)	nc	Port B0	G1[0](LSB)	G2[0](LSB)
Port B1	G1[1]	nc	Port B1	G1[1]	G2[1]
Port B2	G1[2]	nc	Port B2	G1[2]	G2[2]
Port B3	G1[3]	nc	Port B3	G1[3]	G2[3]
Port B4	G1[4]	nc	Port B4	G1[4]	G2[4]
Port B5	G1[5]	nc	Port B5	G1[5]	G2[5]
Port B6	G1[6]	nc	Port B6	G1[6]	G2[6]
Port B7	G1[7](MSB)	nc	Port B7	G1[7](MSB)	G2[7](MSB)
Port C0	B1[0](LSB)	nc	Port C0	B1[0](LSB)	B2[0](LSB)
Port C1	B1[1]	nc	Port C1	B1[1]	B2[1]
Port C2	B1[2]	nc	Port C2	B1[2]	B2[2]
Port C3	B1[3]	nc	Port C3	B1[3]	B2[3]
Port C4	B1[4]	nc	Port C4	B1[4]	B2[4]
Port C5	B1[5]	nc	Port C5	B1[5]	B2[5]
Port C6	B1[6]	nc	Port C6	B1[6]	B2[6]
Port C7	B1[7](MSB)	nc	Port C7	B1[7](MSB)	B2[7](MSB)
LVAL	LVAL	nc	LVAL	LVAL	LVAL
FVAL	FVAL	nc	FVAL	FVAL	FVAL
DVAL	DVAL	nc	DVAL	DVAL	DVAL

Signal Name	Logical	IN/OUT	Function
R1,2[7:0]	Positive	OUT	Red Output Data (R1,2[0]:LSB、R1,2[7]:MSB)、8bit
G1,2[7:0]	Positive	OUT	Green Output Data (G1,2[0]:LSB、G1,2[7]:MSB)、8bit
B1,2[7:0]	Positive	OUT	Blue Output Data (B1,2[0]:LSB、B1,2[7]:MSB)、8bit
LVAL	Positive	OUT	Line Valid Signal（Valid Line）
FVAL	Positive	OUT	Frame Valid Signal（Valid Frame）
DVAL	Positive	OUT	Data Valid Signal

Appendix D:
Camera Link® Configuration Bit Assignment

（3） **Base Configuration**②(8bit Mono) (for KD6R1064/1247/1688DXL-NL)

1ch Output			2ch Output		
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D1, D5, D9	Connector D3, D7, D11
Port A0	M1[0](LSB)	nc	Port A0	M1[0](LSB)	M3[0](LSB)
Port A1	M1[1]	nc	Port A1	M1[1]	M3[1]
Port A2	M1[2]	nc	Port A2	M1[2]	M3[2]
Port A3	M1[3]	nc	Port A3	M1[3]	M3[3]
Port A4	M1[4]	nc	Port A4	M1[4]	M3[4]
Port A5	M1[5]	nc	Port A5	M1[5]	M3[5]
Port A6	M1[6]	nc	Port A6	M1[6]	M3[6]
Port A7	M1[7](MSB)	nc	Port A7	M1[7](MSB)	M3[7](MSB)
Port B0	M2[0](LSB)	nc	Port B0	M2[0](LSB)	M4[0](LSB)
Port B1	M2[1]	nc	Port B1	M2[1]	M4[1]
Port B2	M2[2]	nc	Port B2	M2[2]	M4[2]
Port B3	M2[3]	nc	Port B3	M2[3]	M4[3]
Port B4	M2[4]	nc	Port B4	M2[4]	M4[4]
Port B5	M2[5]	nc	Port B5	M2[5]	M4[5]
Port B6	M2[6]	nc	Port B6	M2[6]	M4[6]
Port B7	M2[7](MSB)	nc	Port B7	M2[7](MSB)	M4[7](MSB)
Port C0	nc	nc	Port C0	nc	nc
Port C1	nc	nc	Port C1	nc	nc
Port C2	nc	nc	Port C2	nc	nc
Port C3	nc	nc	Port C3	nc	nc
Port C4	nc	nc	Port C4	nc	nc
Port C5	nc	nc	Port C5	nc	nc
Port C6	nc	nc	Port C6	nc	nc
Port C7	nc	nc	Port C7	nc	nc
LVAL	LVAL	nc	LVAL	LVAL	LVAL
FVAL	FVAL	nc	FVAL	FVAL	FVAL
DVAL	DVAL	nc	DVAL	DVAL	DVAL

Signal Name	Logical	IN/OUT	Function
M1-4[7:0]	Positive	OUT	Monochrome Output Data (M1-4[0]:LSB、M1-4[7]:MSB)、8bit
LVAL	Positive	OUT	Line Valid Signal（Valid Line）
FVAL	Positive	OUT	Frame Valid Signal（Valid Frame）
DVAL	Positive	OUT	Data Valid Signal

Appendix D:
Camera Link® Configuration Bit Assignment

（4） **Base Configuration**③(10bit Mono) (for KD6R1064/1247/1688DXL-NL)

1ch Output			2ch Output		
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D1, D5, D9	Connector D3, D7, D11
Port A0	M1[0](LSB)	nc	Port A0	M1[0](LSB)	M3[0](LSB)
Port A1	M1[1]	nc	Port A1	M1[1]	M3[1]
Port A2	M1[2]	nc	Port A2	M1[2]	M3[2]
Port A3	M1[3]	nc	Port A3	M1[3]	M3[3]
Port A4	M1[4]	nc	Port A4	M1[4]	M3[4]
Port A5	M1[5]	nc	Port A5	M1[5]	M3[5]
Port A6	M1[6]	nc	Port A6	M1[6]	M3[6]
Port A7	M1[7]	nc	Port A7	M1[7]	M3[7]
Port B0	M1[8]	nc	Port B0	M1[8]	M3[8]
Port B1	M1[9](MSB)	nc	Port B1	M1[9](MSB)	M3[9](MSB)
Port B2	nc	nc	Port B2	nc	nc
Port B3	nc	nc	Port B3	nc	nc
Port B4	M2[8]	nc	Port B4	M2[8]	M4[8]
Port B5	M2[9](MSB)	nc	Port B5	M2[9](MSB)	M4[9](MSB)
Port B6	nc	nc	Port B6	nc	nc
Port B7	nc	nc	Port B7	nc	nc
Port C0	M2[0](LSB)	nc	Port C0	M2[0](LSB)	M4[0](LSB)
Port C1	M2[1]	nc	Port C1	M2[1]	M4[1]
Port C2	M2[2]	nc	Port C2	M2[2]	M4[2]
Port C3	M2[3]	nc	Port C3	M2[3]	M4[3]
Port C4	M2[4]	nc	Port C4	M2[4]	M4[4]
Port C5	M2[5]	nc	Port C5	M2[5]	M4[5]
Port C6	M2[6]	nc	Port C6	M2[6]	M4[6]
Port C7	M2[7]	nc	Port C7	M2[7]	M4[7]
LVAL	LVAL	nc	LVAL	LVAL	LVAL
FVAL	FVAL	nc	FVAL	FVAL	FVAL
DVAL	DVAL	nc	DVAL	DVAL	DVAL

Signal Name	Logical	IN/OUT	Function
M1-4[7:0]	Positive	OUT	Monochrome Output Data (M1-4[0]:LSB、M1-4[9]:MSB)、10bit
LVAL	Positive	OUT	Line Valid Signal（Valid Line）
FVAL	Positive	OUT	Frame Valid Signal（Valid Frame）
DVAL	Positive	OUT	Data Valid Signal

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Appendix D: Camera Link® Configuration Bit Assignment

（5） **Medium Configuration①(24bit RGB Color)** (for KD6R1064/1247/1688DXL-NL)

Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	R1[0](LSB)	nc	Port D0	R2[0](LSB)	nc
Port A1	R1[1]	nc	Port D1	R2[1]	nc
Port A2	R1[2]	nc	Port D2	R2[2]	nc
Port A3	R1[3]	nc	Port D3	R2[3]	nc
Port A4	R1[4]	nc	Port D4	R2[4]	nc
Port A5	R1[5]	nc	Port D5	R2[5]	nc
Port A6	R1[6]	nc	Port D6	R2[6]	nc
Port A7	R1[7](MSB)	nc	Port D7	R2[7](MSB)	nc
Port B0	G1[0](LSB)	nc	Port E0	G2[0](LSB)	nc
Port B1	G1[1]	nc	Port E1	G2[1]	nc
Port B2	G1[2]	nc	Port E2	G2[2]	nc
Port B3	G1[3]	nc	Port E3	G2[3]	nc
Port B4	G1[4]	nc	Port E4	G2[4]	nc
Port B5	G1[5]	nc	Port E5	G2[5]	nc
Port B6	G1[6]	nc	Port E6	G2[6]	nc
Port B7	G1[7](MSB)	nc	Port E7	G2[7](MSB)	nc
Port C0	B1[0](LSB)	nc	Port F0	B2[0](LSB)	nc
Port C1	B1[1]	nc	Port F1	B2[1]	nc
Port C2	B1[2]	nc	Port F2	B2[2]	nc
Port C3	B1[3]	nc	Port F3	B2[3]	nc
Port C4	B1[4]	nc	Port F4	B2[4]	nc
Port C5	B1[5]	nc	Port F5	B2[5]	nc
Port C6	B1[6]	nc	Port F6	B2[6]	nc
Port C7	B1[7](MSB)	nc	Port F7	B2[7](MSB)	nc
LVAL	LVAL	nc	LVAL	LVAL	nc
FVAL	FVAL	nc	FVAL	FVAL	nc
DVAL	DVAL	nc	DVAL	DVAL	nc

Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	R1[0](LSB)	R3[0](LSB)	Port D0	R2[0](LSB)	R4[0](LSB)
Port A1	R1[1]	R3[1]	Port D1	R2[1]	R4[1]
Port A2	R1[2]	R3[2]	Port D2	R2[2]	R4[2]
Port A3	R1[3]	R3[3]	Port D3	R2[3]	R4[3]
Port A4	R1[4]	R3[4]	Port D4	R2[4]	R4[4]
Port A5	R1[5]	R3[5]	Port D5	R2[5]	R4[5]
Port A6	R1[6]	R3[6]	Port D6	R2[6]	R4[6]
Port A7	R1[7](MSB)	R3[7](MSB)	Port D7	R2[7](MSB)	R4[7](MSB)
Port B0	G1[0](LSB)	G3[0](LSB)	Port E0	G2[0](LSB)	G4[0](LSB)
Port B1	G1[1]	G3[1]	Port E1	G2[1]	G4[1]
Port B2	G1[2]	G3[2]	Port E2	G2[2]	G4[2]
Port B3	G1[3]	G3[3]	Port E3	G2[3]	G4[3]
Port B4	G1[4]	G3[4]	Port E4	G2[4]	G4[4]
Port B5	G1[5]	G3[5]	Port E5	G2[5]	G4[5]
Port B6	G1[6]	G3[6]	Port E6	G2[6]	G4[6]
Port B7	G1[7](MSB)	G3[7](MSB)	Port E7	G2[7](MSB)	G4[7](MSB)
Port C0	B1[0](LSB)	B3[0](LSB)	Port F0	B2[0](LSB)	B4[0](LSB)
Port C1	B1[1]	B3[1]	Port F1	B2[1]	B4[1]
Port C2	B1[2]	B3[2]	Port F2	B2[2]	B4[2]
Port C3	B1[3]	B3[3]	Port F3	B2[3]	B4[3]
Port C4	B1[4]	B3[4]	Port F4	B2[4]	B4[4]
Port C5	B1[5]	B3[5]	Port F5	B2[5]	B4[5]
Port C6	B1[6]	B3[6]	Port F6	B2[6]	B4[6]
Port C7	B1[7](MSB)	B3[7](MSB)	Port F7	B2[7](MSB)	B4[7](MSB)
LVAL	LVAL	LVAL	LVAL	LVAL	LVAL
FVAL	FVAL	FVAL	FVAL	FVAL	FVAL
DVAL	DVAL	DVAL	DVAL	DVAL	DVAL

Signal Name	Logical	IN/OUT	Function
R1-4[7:0]	Positive	OUT	Red Output Data (R1-4[0]:LSB、R1-4[7]:MSB)、8bit
G1-4[7:0]	Positive	OUT	Green Output Data (G1-4[0]:LSB、G1-4[7]:MSB)、8bit
B1-4[7:0]	Positive	OUT	Blue Output Data (B1-4[0]:LSB、B1-4[7]:MSB)、8bit
LVAL	Positive	OUT	Line Valid Signal（Valid Line）
FVAL	Positive	OUT	Frame Valid Signal（Valid Frame）
DVAL	Positive	OUT	Data Valid Signal

Appendix D:
Camera Link® Configuration Bit Assignment

（6） **Medium Configuration②(30bit RGB Color)** (for KD6R1064/1247/1688DXL-NL)

1ch Output					
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	R1[0](LSB)	nc	Port D0	nc	nc
Port A1	R1[1]	nc	Port D1	nc	nc
Port A2	R1[2]	nc	Port D2	nc	nc
Port A3	R1[3]	nc	Port D3	nc	nc
Port A4	R1[4]	nc	Port D4	nc	nc
Port A5	R1[5]	nc	Port D5	nc	nc
Port A6	R1[6]	nc	Port D6	nc	nc
Port A7	R1[7]	nc	Port D7	nc	nc
Port B0	R1[8]	nc	Port E0	G1[0](LSB)	nc
Port B1	R1[9](MSB)	nc	Port E1	G1[1]	nc
Port B2	nc	nc	Port E2	G1[2]	nc
Port B3	nc	nc	Port E3	G1[3]	nc
Port B4	B1[8]	nc	Port E4	G1[4]	nc
Port B5	B1[9](MSB)	nc	Port E5	G1[5]	nc
Port B6	nc	nc	Port E6	G1[6]	nc
Port B7	nc	nc	Port E7	G1[7]	nc
Port C0	B1[0](LSB)	nc	Port F0	G1[8]	nc
Port C1	B1[1]	nc	Port F1	G1[9](MSB)	nc
Port C2	B1[2]	nc	Port F2	nc	nc
Port C3	B1[3]	nc	Port F3	nc	nc
Port C4	B1[4]	nc	Port F4	nc	nc
Port C5	B1[5]	nc	Port F5	nc	nc
Port C6	B1[6]	nc	Port F6	nc	nc
Port C7	B1[7]	nc	Port F7	nc	nc
LVAL	LVAL	nc	LVAL	LVAL	nc
FVAL	FVAL	nc	FVAL	FVAL	nc
DVAL	DVAL	nc	DVAL	DVAL	nc

Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	R1[0](LSB)	R2[0](LSB)	Port D0	nc	nc
Port A1	R1[1]	R2[1]	Port D1	nc	nc
Port A2	R1[2]	R2[2]	Port D2	nc	nc
Port A3	R1[3]	R2[3]	Port D3	nc	nc
Port A4	R1[4]	R2[4]	Port D4	nc	nc
Port A5	R1[5]	R2[5]	Port D5	nc	nc
Port A6	R1[6]	R2[6]	Port D6	nc	nc
Port A7	R1[7]	R2[7]	Port D7	nc	nc
Port B0	R1[8]	R2[8]	Port E0	G1[0](LSB)	G2[0](LSB)
Port B1	R1[9](MSB)	R2[9](MSB)	Port E1	G1[1]	G2[1]
Port B2	nc	nc	Port E2	G1[2]	G2[2]
Port B3	nc	nc	Port E3	G1[3]	G2[3]
Port B4	B1[8]	B2[8]	Port E4	G1[4]	G2[4]
Port B5	B1[9](MSB)	B2[9](MSB)	Port E5	G1[5]	G2[5]
Port B6	nc	nc	Port E6	G1[6]	G2[6]
Port B7	nc	nc	Port E7	G1[7]	G2[7]
Port C0	B1[0](LSB)	B2[0](LSB)	Port F0	G1[8]	G2[8]
Port C1	B1[1]	B2[1]	Port F1	G1[9](MSB)	G2[9](MSB)
Port C2	B1[2]	B2[2]	Port F2	nc	nc
Port C3	B1[3]	B2[3]	Port F3	nc	nc
Port C4	B1[4]	B2[4]	Port F4	nc	nc
Port C5	B1[5]	B2[5]	Port F5	nc	nc
Port C6	B1[6]	B2[6]	Port F6	nc	nc
Port C7	B1[7]	B2[7]	Port F7	nc	nc
LVAL	LVAL	LVAL	LVAL	LVAL	LVAL
FVAL	FVAL	FVAL	FVAL	FVAL	FVAL
DVAL	DVAL	DVAL	DVAL	DVAL	DVAL

Signal Name	Logical	IN/OUT	Function
R1,2[9:0]	Positive	OUT	Red Output Data (R1,2[0]:LSB、R1,2[9]:MSB)、10bit
G1,2[9:0]	Positive	OUT	Green Output Data (G1,2[0]:LSB、G1,2[9]:MSB)、10bit
B1,2[9:0]	Positive	OUT	Blue Output Data (B1,2[0]:LSB、B1,2[9]:MSB)、10bit
LVAL	Positive	OUT	Line Valid Signal（Valid Line）
FVAL	Positive	OUT	Frame Valid Signal（Valid Frame）
DVAL	Positive	OUT	Data Valid Signal

Appendix D:
Camera Link® Configuration Bit Assignment

（7） **Medium Configuration③(8bit Mono)** (for KD6R1064/1247/1688DXL-NL)

1ch Output						2ch Output					
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12	Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	M1[0](LSB)	nc	Port D0	M4[0](LSB)	nc	Port A0	M1[0](LSB)	M5[0](LSB)	Port D0	M4[0](LSB)	M8[0](LSB)
Port A1	M1[1]	nc	Port D1	M4[1]	nc	Port A1	M1[1]	M5[1]	Port D1	M4[1]	M8[1]
Port A2	M1[2]	nc	Port D2	M4[2]	nc	Port A2	M1[2]	M5[2]	Port D2	M4[2]	M8[2]
Port A3	M1[3]	nc	Port D3	M4[3]	nc	Port A3	M1[3]	M5[3]	Port D3	M4[3]	M8[3]
Port A4	M1[4]	nc	Port D4	M4[4]	nc	Port A4	M1[4]	M5[4]	Port D4	M4[4]	M8[4]
Port A5	M1[5]	nc	Port D5	M4[5]	nc	Port A5	M1[5]	M5[5]	Port D5	M4[5]	M8[5]
Port A6	M1[6]	nc	Port D6	M4[6]	nc	Port A6	M1[6]	M5[6]	Port D6	M4[6]	M8[6]
Port A7	M1[7](MSB)	nc	Port D7	M4[7](MSB)	nc	Port A7	M1[7](MSB)	M5[7](MSB)	Port D7	M4[7](MSB)	M8[7](MSB)
Port B0	M2[0](LSB)	nc	Port E0	nc	nc	Port B0	M2[0](LSB)	M6[0](LSB)	Port E0	nc	nc
Port B1	M2[1]	nc	Port E1	nc	nc	Port B1	M2[1]	M6[1]	Port E1	nc	nc
Port B2	M2[2]	nc	Port E2	nc	nc	Port B2	M2[2]	M6[2]	Port E2	nc	nc
Port B3	M2[3]	nc	Port E3	nc	nc	Port B3	M2[3]	M6[3]	Port E3	nc	nc
Port B4	M2[4]	nc	Port E4	nc	nc	Port B4	M2[4]	M6[4]	Port E4	nc	nc
Port B5	M2[5]	nc	Port E5	nc	nc	Port B5	M2[5]	M6[5]	Port E5	nc	nc
Port B6	M2[6]	nc	Port E6	nc	nc	Port B6	M2[6]	M6[6]	Port E6	nc	nc
Port B7	M2[7](MSB)	nc	Port E7	nc	nc	Port B7	M2[7](MSB)	M6[7](MSB)	Port E7	nc	nc
Port C0	M3[0](LSB)	nc	Port F0	nc	nc	Port C0	M3[0](LSB)	M7[0](LSB)	Port F0	nc	nc
Port C1	M3[1]	nc	Port F1	nc	nc	Port C1	M3[1]	M7[1]	Port F1	nc	nc
Port C2	M3[2]	nc	Port F2	nc	nc	Port C2	M3[2]	M7[2]	Port F2	nc	nc
Port C3	M3[3]	nc	Port F3	nc	nc	Port C3	M3[3]	M7[3]	Port F3	nc	nc
Port C4	M3[4]	nc	Port F4	nc	nc	Port C4	M3[4]	M7[4]	Port F4	nc	nc
Port C5	M3[5]	nc	Port F5	nc	nc	Port C5	M3[5]	M7[5]	Port F5	nc	nc
Port C6	M3[6]	nc	Port F6	nc	nc	Port C6	M3[6]	M7[6]	Port F6	nc	nc
Port C7	M3[7](MSB)	nc	Port F7	nc	nc	Port C7	M3[7](MSB)	M7[7](MSB)	Port F7	nc	nc
LVAL	LVAL	nc	LVAL	LVAL	nc	LVAL	LVAL	LVAL	LVAL	LVAL	LVAL
FVAL	FVAL	nc	FVAL	FVAL	nc	FVAL	FVAL	FVAL	FVAL	FVAL	FVAL
DVAL	DVAL	nc	DVAL	DVAL	nc	DVAL	DVAL	DVAL	DVAL	DVAL	DVAL

Signal Name	Logical	IN/OUT	Function
M1-8[7:0]	Positive	OUT	Monochrome Output Data (M1-8[0]:LSB、M1-8[7]:MSB)、8bit
LVAL	Positive	OUT	Line Valid Signal（Valid Line）
FVAL	Positive	OUT	Frame Valid Signal（Valid Frame）
DVAL	Positive	OUT	Data Valid Signal

Appendix D:
Camera Link® Configuration Bit Assignment

（8） **Medium Configuration④(10bit Mono)** (for KD6R1064/1247/1688DXL-NL)

Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	M1[0](LSB)	nc	Port D0	M4[0](LSB)	nc
Port A1	M1[1]	nc	Port D1	M4[1]	nc
Port A2	M1[2]	nc	Port D2	M4[2]	nc
Port A3	M1[3]	nc	Port D3	M4[3]	nc
Port A4	M1[4]	nc	Port D4	M4[4]	nc
Port A5	M1[5]	nc	Port D5	M4[5]	nc
Port A6	M1[6]	nc	Port D6	M4[6]	nc
Port A7	M1[7]	nc	Port D7	M4[7](MSB)	nc
Port B0	M1[8]	nc	Port E0	M3[0](LSB)	nc
Port B1	M1[9](MSB)	nc	Port E1	M3[1]	nc
Port B2	nc	nc	Port E2	M3[2]	nc
Port B3	nc	nc	Port E3	M3[3]	nc
Port B4	M2[8]	nc	Port E4	M3[4]	nc
Port B5	M2[9](MSB)	nc	Port E5	M3[5]	nc
Port B6	nc	nc	Port E6	M3[6]	nc
Port B7	nc	nc	Port E7	M3[7]	nc
Port C0	M2[0](LSB)	nc	Port F0	M3[8]	nc
Port C1	M2[1]	nc	Port F1	M3[9](MSB)	nc
Port C2	M2[2]	nc	Port F2	nc	nc
Port C3	M2[3]	nc	Port F3	nc	nc
Port C4	M2[4]	nc	Port F4	M4[8]	nc
Port C5	M2[5]	nc	Port F5	M4[9](MSB)	nc
Port C6	M2[6]	nc	Port F6	nc	nc
Port C7	M2[7]	nc	Port F7	nc	nc
LVAL	LVAL	nc	LVAL	LVAL	nc
FVAL	FVAL	nc	FVAL	FVAL	nc
DVAL	DVAL	nc	DVAL	DVAL	nc

2ch Output					
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	M1[0](LSB)	M5[0](LSB)	Port D0	M4[0](LSB)	M8[0](LSB)
Port A1	M1[1]	M5[1]	Port D1	M4[1]	M8[1]
Port A2	M1[2]	M5[2]	Port D2	M4[2]	M8[2]
Port A3	M1[3]	M5[3]	Port D3	M4[3]	M8[3]
Port A4	M1[4]	M5[4]	Port D4	M4[4]	M8[4]
Port A5	M1[5]	M5[5]	Port D5	M4[5]	M8[5]
Port A6	M1[6]	M5[6]	Port D6	M4[6]	M8[6]
Port A7	M1[7]	M5[7]	Port D7	M4[7](MSB)	M8[7](MSB)
Port B0	M1[8]	M5[8]	Port E0	M3[0](LSB)	M7[0](LSB)
Port B1	M1[9](MSB)	M5[9](MSB)	Port E1	M3[1]	M7[1]
Port B2	nc	nc	Port E2	M3[2]	M7[2]
Port B3	nc	nc	Port E3	M3[3]	M7[3]
Port B4	M2[8]	M6[8]	Port E4	M3[4]	M7[4]
Port B5	M2[9](MSB)	M6[9](MSB)	Port E5	M3[5]	M7[5]
Port B6	nc	nc	Port E6	M3[6]	M7[6]
Port B7	nc	nc	Port E7	M3[7]	M7[7]
Port C0	M2[0](LSB)	M6[0](LSB)	Port F0	M3[8]	M7[8]
Port C1	M2[1]	M6[1]	Port F1	M3[9](MSB)	M7[9](MSB)
Port C2	M2[2]	M6[2]	Port F2	nc	nc
Port C3	M2[3]	M6[3]	Port F3	nc	nc
Port C4	M2[4]	M6[4]	Port F4	M4[8]	M8[8]
Port C5	M2[5]	M6[5]	Port F5	M4[9](MSB)	M8[9](MSB)
Port C6	M2[6]	M6[6]	Port F6	nc	nc
Port C7	M2[7]	M6[7]	Port F7	nc	nc
LVAL	LVAL	LVAL	LVAL	LVAL	LVAL
FVAL	FVAL	FVAL	FVAL	FVAL	FVAL
DVAL	DVAL	DVAL	DVAL	DVAL	DVAL

Signal Name	Logical	IN/OUT	Function
M1-8[9:0]	Positive	OUT	Monochrome Output Data (M1-8[0]:LSB、M1-8[9]:MSB)、10bit
LVAL	Positive	OUT	Line Valid Signal（Valid Line）
FVAL	Positive	OUT	Frame Valid Signal（Valid Frame）
DVAL	Positive	OUT	Data Valid Signal

Appendix D:
Camera Link® Configuration Bit Assignment

（9） **Full Configuration①(24bit RGB Color)** (for KD6R1064/1247/1688DXL-NL)

1ch Output								
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	R1[0](LSB)	nc	Port D0	R2[0](LSB)	nc	Port G0	R3[0](LSB)	nc
Port A1	R1[1]	nc	Port D1	R2[1]	nc	Port G1	R3[1]	nc
Port A2	R1[2]	nc	Port D2	R2[2]	nc	Port G2	R3[2]	nc
Port A3	R1[3]	nc	Port D3	R2[3]	nc	Port G3	R3[3]	nc
Port A4	R1[4]	nc	Port D4	R2[4]	nc	Port G4	R3[4]	nc
Port A5	R1[5]	nc	Port D5	R2[5]	nc	Port G5	R3[5]	nc
Port A6	R1[6]	nc	Port D6	R2[6]	nc	Port G6	R3[6]	nc
Port A7	R1[7](MSB)	nc	Port D7	R2[7](MSB)	nc	Port G7	R3[7](MSB)	nc
Port B0	G1[0](LSB)	nc	Port E0	G2[0](LSB)	nc	Port H0	G3[0](LSB)	nc
Port B1	G1[1]	nc	Port E1	G2[1]	nc	Port H1	G3[1]	nc
Port B2	G1[2]	nc	Port E2	G2[2]	nc	Port H2	G3[2]	nc
Port B3	G1[3]	nc	Port E3	G2[3]	nc	Port H3	G3[3]	nc
Port B4	G1[4]	nc	Port E4	G2[4]	nc	Port H4	G3[4]	nc
Port B5	G1[5]	nc	Port E5	G2[5]	nc	Port H5	G3[5]	nc
Port B6	G1[6]	nc	Port E6	G2[6]	nc	Port H6	G3[6]	nc
Port B7	G1[7](MSB)	nc	Port E7	G2[7](MSB)	nc	Port H7	G3[7](MSB)	nc
Port C0	B1[0](LSB)	nc	Port F0	B2[0](LSB)	nc	Port I0	B3[0](LSB)	nc
Port C1	B1[1]	nc	Port F1	B2[1]	nc	Port I1	B3[1]	nc
Port C2	B1[2]	nc	Port F2	B2[2]	nc	Port I2	B3[2]	nc
Port C3	B1[3]	nc	Port F3	B2[3]	nc	Port I3	B3[3]	nc
Port C4	B1[4]	nc	Port F4	B2[4]	nc	Port I4	B3[4]	nc
Port C5	B1[5]	nc	Port F5	B2[5]	nc	Port I5	B3[5]	nc
Port C6	B1[6]	nc	Port F6	B2[6]	nc	Port I6	B3[6]	nc
Port C7	B1[7](MSB)	nc	Port F7	B2[7](MSB)	nc	Port I7	B3[7](MSB)	nc
LVAL	LVAL	nc	LVAL	LVAL	nc	LVAL	LVAL	nc
FVAL	FVAL	nc	FVAL	FVAL	nc	FVAL	FVAL	nc
DVAL	DVAL	nc	DVAL	DVAL	nc	DVAL	DVAL	nc

2ch Output								
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	R1[0](LSB)	R4[0](LSB)	Port D0	R2[0](LSB)	R5[0](LSB)	Port G0	R3[0](LSB)	R6[0](LSB)
Port A1	R1[1]	R4[1]	Port D1	R2[1]	R5[1]	Port G1	R3[1]	R6[1]
Port A2	R1[2]	R4[2]	Port D2	R2[2]	R5[2]	Port G2	R3[2]	R6[2]
Port A3	R1[3]	R4[3]	Port D3	R2[3]	R5[3]	Port G3	R3[3]	R6[3]
Port A4	R1[4]	R4[4]	Port D4	R2[4]	R5[4]	Port G4	R3[4]	R6[4]
Port A5	R1[5]	R4[5]	Port D5	R2[5]	R5[5]	Port G5	R3[5]	R6[5]
Port A6	R1[6]	R4[6]	Port D6	R2[6]	R5[6]	Port G6	R3[6]	R6[6]
Port A7	R1[7](MSB)	R4[7](MSB)	Port D7	R2[7](MSB)	R5[7](MSB)	Port G7	R3[7](MSB)	R6[7](MSB)
Port B0	G1[0](LSB)	G4[0](LSB)	Port E0	G2[0](LSB)	G5[0](LSB)	Port H0	G3[0](LSB)	G6[0](LSB)
Port B1	G1[1]	G4[1]	Port E1	G2[1]	G5[1]	Port H1	G3[1]	G6[1]
Port B2	G1[2]	G4[2]	Port E2	G2[2]	G5[2]	Port H2	G3[2]	G6[2]
Port B3	G1[3]	G4[3]	Port E3	G2[3]	G5[3]	Port H3	G3[3]	G6[3]
Port B4	G1[4]	G4[4]	Port E4	G2[4]	G5[4]	Port H4	G3[4]	G6[4]
Port B5	G1[5]	G4[5]	Port E5	G2[5]	G5[5]	Port H5	G3[5]	G6[5]
Port B6	G1[6]	G4[6]	Port E6	G2[6]	G5[6]	Port H6	G3[6]	G6[6]
Port B7	G1[7](MSB)	G4[7](MSB)	Port E7	G2[7](MSB)	G5[7](MSB)	Port H7	G3[7](MSB)	G6[7](MSB)
Port C0	B1[0](LSB)	B4[0](LSB)	Port F0	B2[0](LSB)	B5[0](LSB)	Port I0	B3[0](LSB)	B6[0](LSB)
Port C1	B1[1]	B4[1]	Port F1	B2[1]	B5[1]	Port I1	B3[1]	B6[1]
Port C2	B1[2]	B4[2]	Port F2	B2[2]	B5[2]	Port I2	B3[2]	B6[2]
Port C3	B1[3]	B4[3]	Port F3	B2[3]	B5[3]	Port I3	B3[3]	B6[3]
Port C4	B1[4]	B4[4]	Port F4	B2[4]	B5[4]	Port I4	B3[4]	B6[4]
Port C5	B1[5]	B4[5]	Port F5	B2[5]	B5[5]	Port I5	B3[5]	B6[5]
Port C6	B1[6]	B4[6]	Port F6	B2[6]	B5[6]	Port I6	B3[6]	B6[6]
Port C7	B1[7](MSB)	B4[7](MSB)	Port F7	B2[7](MSB)	B5[7](MSB)	Port I7	B3[7](MSB)	B6[7](MSB)
LVAL	LVAL	LVAL	LVAL	LVAL	LVAL	LVAL	LVAL	LVAL
FVAL	FVAL	FVAL	FVAL	FVAL	FVAL	FVAL	FVAL	FVAL
DVAL	DVAL	DVAL	DVAL	DVAL	DVAL	DVAL	DVAL	DVAL

Signal Name	Logical	IN/OUT	Function
R1-6[7:0]	Positive	OUT	Red Output Data (R1-6[0]:LSB、R1-6[7]:MSB)、8bit
G1-6[7:0]	Positive	OUT	Green Output Data (G1-6[0]:LSB、G1-6[7]:MSB)、8bit
B1-6[7:0]	Positive	OUT	Blue Output Data (B1-6[0]:LSB、B1-6[7]:MSB)、8bit
LVAL	Positive	OUT	Line Valid Signal（Valid Line）
FVAL	Positive	OUT	Frame Valid Signal（Valid Frame）
DVAL	Positive	OUT	Data Valid Signal

Appendix D:
Camera Link® Configuration Bit Assignment

（10） **Full Configuration②(30bit RGB Color)** (for KD6R1064/1247/1688DXL-NL)

1ch Output								
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	R1[0](LSB)	nc	Port D0	B1[0](LSB)	nc	Port G0	G2[4]	nc
Port A1	R1[1]	nc	Port D1	B1[1]	nc	Port G1	G2[5]	nc
Port A2	R1[2]	nc	Port D2	B1[2]	nc	Port G2	G2[6]	nc
Port A3	R1[3]	nc	Port D3	B1[3]	nc	Port G3	G2[7]	nc
Port A4	R1[4]	nc	Port D4	B1[4]	nc	Port G4	G2[8]	nc
Port A5	R1[5]	nc	Port D5	B1[5]	nc	Port G5	G2[9](MSB)	nc
Port A6	R1[6]	nc	Port D6	B1[6]	nc	Port G6	B2[0](LSB)	nc
Port A7	R1[7]	nc	Port D7	B1[7]	nc	Port G7	B2[1]	nc
Port B0	R1[8]	nc	Port E0	B1[8]	nc	Port H0	B2[2]	nc
Port B1	R1[9](MSB)	nc	Port E1	B1[9](MSB)	nc	Port H1	B2[3]	nc
Port B2	nc	nc	Port E2	R2[0](LSB)	nc	Port H2	B2[4]	nc
Port B3	nc	nc	Port E3	R2[1]	nc	Port H3	B2[5]	nc
Port B4	G1[8]	nc	Port E4	R2[2]	nc	Port H4	B2[6]	nc
Port B5	G1[9](MSB)	nc	Port E5	R2[3]	nc	Port H5	B2[7]	nc
Port B6	nc	nc	Port E6	R2[4]	nc	Port H6	B2[8]	nc
Port B7	nc	nc	Port E7	R2[5]	nc	Port H7	B2[9](MSB)	nc
Port C0	G1[0](LSB)	nc	Port F0	R2[6]	nc	Port I0	nc	nc
Port C1	G1[1]	nc	Port F1	R2[7]	nc	Port I1	nc	nc
Port C2	G1[2]	nc	Port F2	R2[8]	nc	Port I2	nc	nc
Port C3	G1[3]	nc	Port F3	R2[9](MSB)	nc	Port I3	nc	nc
Port C4	G1[4]	nc	Port F4	G2[0](LSB)	nc	Port I4	nc	nc
Port C5	G1[5]	nc	Port F5	G2[1]	nc	Port I5	nc	nc
Port C6	G1[6]	nc	Port F6	G2[2]	nc	Port I6	nc	nc
Port C7	G1[7]	nc	Port F7	G2[3]	nc	Port I7	nc	nc
LVAL	LVAL	nc	LVAL	LVAL	nc	LVAL	LVAL	nc
FVAL	FVAL	nc	FVAL	FVAL	nc	FVAL	FVAL	nc
DVAL	DVAL	nc	DVAL	DVAL	nc	DVAL	DVAL	nc

2ch Output								
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	R1[0](LSB)	R3[0](LSB)	Port D0	B1[0](LSB)	B3[0](LSB)	Port G0	G2[4]	G4[4]
Port A1	R1[1]	R3[1]	Port D1	B1[1]	B3[1]	Port G1	G2[5]	G4[5]
Port A2	R1[2]	R3[2]	Port D2	B1[2]	B3[2]	Port G2	G2[6]	G4[6]
Port A3	R1[3]	R3[3]	Port D3	B1[3]	B3[3]	Port G3	G2[7]	G4[7]
Port A4	R1[4]	R3[4]	Port D4	B1[4]	B3[4]	Port G4	G2[8]	G4[8]
Port A5	R1[5]	R3[5]	Port D5	B1[5]	B3[5]	Port G5	G2[9](MSB)	G4[9](MSB)
Port A6	R1[6]	R3[6]	Port D6	B1[6]	B3[6]	Port G6	B2[0](LSB)	B4[0](LSB)
Port A7	R1[7]	R3[7]	Port D7	B1[7]	B3[7]	Port G7	B2[1]	B4[1]
Port B0	R1[8]	R3[8]	Port E0	B1[8]	B3[8]	Port H0	B2[2]	B4[2]
Port B1	R1[9](MSB)	R3[9](MSB)	Port E1	B1[9](MSB)	B3[9](MSB)	Port H1	B2[3]	B4[3]
Port B2	nc	nc	Port E2	R2[0](LSB)	R4[0](LSB)	Port H2	B2[4]	B4[4]
Port B3	nc	nc	Port E3	R2[1]	R4[1]	Port H3	B2[5]	B4[5]
Port B4	G1[8]	G3[8]	Port E4	R2[2]	R4[2]	Port H4	B2[6]	B4[6]
Port B5	G1[9](MSB)	G3[9](MSB)	Port E5	R2[3]	R4[3]	Port H5	B2[7]	B4[7]
Port B6	nc	nc	Port E6	R2[4]	R4[4]	Port H6	B2[8]	B4[8]
Port B7	nc	nc	Port E7	R2[5]	R4[5]	Port H7	B2[9](MSB)	B4[9](MSB)
Port C0	G1[0](LSB)	G3[0](LSB)	Port F0	R2[6]	R4[6]	Port I0	nc	nc
Port C1	G1[1]	G3[1]	Port F1	R2[7]	R4[7]	Port I1	nc	nc
Port C2	G1[2]	G3[2]	Port F2	R2[8]	R4[8]	Port I2	nc	nc
Port C3	G1[3]	G3[3]	Port F3	R2[9](MSB)	R4[9](MSB)	Port I3	nc	nc
Port C4	G1[4]	G3[4]	Port F4	G2[0](LSB)	G4[0](LSB)	Port I4	nc	nc
Port C5	G1[5]	G3[5]	Port F5	G2[1]	G4[1]	Port I5	nc	nc
Port C6	G1[6]	G3[6]	Port F6	G2[2]	G4[2]	Port I6	nc	nc
Port C7	G1[7]	G3[7]	Port F7	G2[3]	G4[3]	Port I7	nc	nc
LVAL	LVAL	LVAL	LVAL	LVAL	LVAL	LVAL	LVAL	LVAL
FVAL	FVAL	FVAL	FVAL	FVAL	FVAL	FVAL	FVAL	FVAL
DVAL	DVAL	DVAL	DVAL	DVAL	DVAL	DVAL	DVAL	DVAL

Signal Name	Logical	IN/OUT	Function
R1-4[9:0]	Positive	OUT	Red Output Data (R1-4[0]:LSB、R1-4[9]:MSB)、10bit
G1-4[9:0]	Positive	OUT	Green Output Data (G1-4[0]:LSB、G1-4[9]:MSB)、10bit
B1-4[9:0]	Positive	OUT	Blue Output Data (B1-4[0]:LSB、B1-4[9]:MSB)、10bit
LVAL	Positive	OUT	Line Valid Signal（Valid Line）
FVAL	Positive	OUT	Frame Valid Signal（Valid Frame）
DVAL	Positive	OUT	Data Valid Signal

Appendix D:
Camera Link® Configuration Bit Assignment

（11） **Full Configuration③(10bit Mono)** (for KD6R1064/1247/1688DXL-NL)

1ch Output								
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	M1[0](LSB)	nc	Port D0	M3[0](LSB)	nc	Port G0	M5[4]	nc
Port A1	M1[1]	nc	Port D1	M3[1]	nc	Port G1	M5[5]	nc
Port A2	M1[2]	nc	Port D2	M3[2]	nc	Port G2	M5[6]	nc
Port A3	M1[3]	nc	Port D3	M3[3]	nc	Port G3	M5[7]	nc
Port A4	M1[4]	nc	Port D4	M3[4]	nc	Port G4	M5[8]	nc
Port A5	M1[5]	nc	Port D5	M3[5]	nc	Port G5	M5[9](MSB)	nc
Port A6	M1[6]	nc	Port D6	M3[6]	nc	Port G6	M6[0](LSB)	nc
Port A7	M1[7]	nc	Port D7	M3[7]	nc	Port G7	M6[1]	nc
Port B0	M1[8]	nc	Port E0	M3[8]	nc	Port H0	M6[2]	nc
Port B1	M1[9](MSB)	nc	Port E1	M3[9](MSB)	nc	Port H1	M6[3]	nc
Port B2	nc	nc	Port E2	M4[0](LSB)	nc	Port H2	M6[4]	nc
Port B3	nc	nc	Port E3	M4[1]	nc	Port H3	M6[5]	nc
Port B4	M2[8]	nc	Port E4	M4[2]	nc	Port H4	M6[6]	nc
Port B5	M2[9](MSB)	nc	Port E5	M4[3]	nc	Port H5	M6[7]	nc
Port B6	nc	nc	Port E6	M4[4]	nc	Port H6	M6[8]	nc
Port B7	nc	nc	Port E7	M4[5]	nc	Port H7	M6[9](MSB)	nc
Port C0	M2[0](LSB)	nc	Port F0	M4[6]	nc	Port I0	nc	nc
Port C1	M2[1]	nc	Port F1	M4[7]	nc	Port I1	nc	nc
Port C2	M2[2]	nc	Port F2	M4[8]	nc	Port I2	nc	nc
Port C3	M2[3]	nc	Port F3	M4[9](MSB)	nc	Port I3	nc	nc
Port C4	M2[4]	nc	Port F4	M5[0](LSB)	nc	Port I4	nc	nc
Port C5	M2[5]	nc	Port F5	M5[1]	nc	Port I5	nc	nc
Port C6	M2[6]	nc	Port F6	M5[2]	nc	Port I6	nc	nc
Port C7	M2[7]	nc	Port F7	M5[3]	nc	Port I7	nc	nc
LVAL	LVAL	nc	LVAL	LVAL	nc	LVAL	LVAL	nc
FVAL	FVAL	nc	FVAL	FVAL	nc	FVAL	FVAL	nc
DVAL	DVAL	nc	DVAL	DVAL	nc	DVAL	DVAL	nc

2ch Output								
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0	M1[0](LSB)	M7[0](LSB)	Port D0	M3[0](LSB)	M9[0](LSB)	Port G0	M5[4]	M11[4]
Port A1	M1[1]	M7[1]	Port D1	M3[1]	M9[1]	Port G1	M5[5]	M11[5]
Port A2	M1[2]	M7[2]	Port D2	M3[2]	M9[2]	Port G2	M5[6]	M11[6]
Port A3	M1[3]	M7[3]	Port D3	M3[3]	M9[3]	Port G3	M5[7]	M11[7]
Port A4	M1[4]	M7[4]	Port D4	M3[4]	M9[4]	Port G4	M5[8]	M11[8]
Port A5	M1[5]	M7[5]	Port D5	M3[5]	M9[5]	Port G5	M5[9](MSB)	M11[9](MSB)
Port A6	M1[6]	M7[6]	Port D6	M3[6]	M9[6]	Port G6	M6[0](LSB)	M12[0](LSB)
Port A7	M1[7]	M7[7]	Port D7	M3[7]	M9[7]	Port G7	M6[1]	M12[1]
Port B0	M1[8]	M7[8]	Port E0	M3[8]	M9[8]	Port H0	M6[2]	M12[2]
Port B1	M1[9](MSB)	M7[9](MSB)	Port E1	M3[9](MSB)	M9[9](MSB)	Port H1	M6[3]	M12[3]
Port B2	nc	nc	Port E2	M4[0](LSB)	M10[0](LSB)	Port H2	M6[4]	M12[4]
Port B3	nc	nc	Port E3	M4[1]	M10[1]	Port H3	M6[5]	M12[5]
Port B4	M2[8]	M8[8]	Port E4	M4[2]	M10[2]	Port H4	M6[6]	M12[6]
Port B5	M2[9](MSB)	M8[9](MSB)	Port E5	M4[3]	M10[3]	Port H5	M6[7]	M12[7]
Port B6	nc	nc	Port E6	M4[4]	M10[4]	Port H6	M6[8]	M12[8]
Port B7	nc	nc	Port E7	M4[5]	M10[5]	Port H7	M6[9](MSB)	M12[9](MSB)
Port C0	M2[0](LSB)	M8[0](LSB)	Port F0	M4[6]	M10[6]	Port I0	nc	nc
Port C1	M2[1]	M8[1]	Port F1	M4[7]	M10[7]	Port I1	nc	nc
Port C2	M2[2]	M8[2]	Port F2	M4[8]	M10[8]	Port I2	nc	nc
Port C3	M2[3]	M8[3]	Port F3	M4[9](MSB)	M10[9](MSB)	Port I3	nc	nc
Port C4	M2[4]	M8[4]	Port F4	M5[0](LSB)	M11[0](LSB)	Port I4	nc	nc
Port C5	M2[5]	M8[5]	Port F5	M5[1]	M11[1]	Port I5	nc	nc
Port C6	M2[6]	M8[6]	Port F6	M5[2]	M11[2]	Port I6	nc	nc
Port C7	M2[7]	M8[7]	Port F7	M5[3]	M11[3]	Port I7	nc	nc
LVAL	LVAL	LVAL	LVAL	LVAL	LVAL	LVAL	LVAL	LVAL
FVAL	FVAL	FVAL	FVAL	FVAL	FVAL	FVAL	FVAL	FVAL
DVAL	DVAL	DVAL	DVAL	DVAL	DVAL	DVAL	DVAL	DVAL

Signal Name	Logical	IN/OUT	Function
M1-12[9:0]	Positive	OUT	Monochrome Output Data (M1-12[0]:LSB、M1-12[9]:MSB)、10bit
LVAL	Positive	OUT	Line Valid Signal（Valid Line）
FVAL	Positive	OUT	Frame Valid Signal（Valid Frame）
DVAL	Positive	OUT	Data Valid Signal

Appendix D:
Camera Link® Configuration Bit Assignment

（12） **Deca Configuration①(8bit Mono)** (for KD6R1064/1247/1688DXL-NL)

1ch Output								
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0'	M1[0]	nc	Port D2'	M4[2]	nc	Port G5'	M7[5]	nc
Port A1'	M1[1]	nc	Port D3'	M4[3]	nc	Port G6'	M7[6]	nc
Port A2'	M1[2]	nc	Port D4'	M4[4]	nc	Port G7'	M7[7](MSB)	nc
Port A3'	M1[3]	nc	Port D5'	M4[5]	nc	Port H0'	M8[0]	nc
Port A4'	M1[4]	nc	Port D6'	M4[6]	nc	Port H1'	M8[1]	nc
Port A5'	M1[5]	nc	Port D7'	M4[7](MSB)	nc	Port H2'	M8[2]	nc
Port A6'	M1[6]	nc	Port E0'	M5[0]	nc	Port H3'	M8[3]	nc
Port A7'	M1[7](MSB)	nc	Port E1'	M5[1]	nc	Port H4'	M8[4]	nc
Port B0'	M2[0]	nc	Port E2'	M5[2]	nc	Port H5'	M8[5]	nc
Port B1'	M2[1]	nc	Port E3'	M5[3]	nc	Port H6'	M8[6]	nc
Port B2'	M2[2]	nc	Port E4'	M5[4]	nc	Port H7'	M8[7](MSB)	nc
Port B3'	M2[3]	nc	Port E5'	M5[5]	nc	Port I0'	M9[0]	nc
Port B4'	M2[4]	nc	Port E6'	M5[6]	nc	Port I1'	M9[1]	nc
Port B5'	M2[5]	nc	Port E7'	M5[7](MSB)	nc	Port I2'	M9[2]	nc
Port B6'	M2[6]	nc	Port F0'	M6[0]	nc	Port I3'	M9[3]	nc
Port B7'	M2[7](MSB)	nc	Port F1'	M6[1]	nc	Port I4'	M9[4]	nc
Port C0'	M3[0]	nc	Port F2'	M6[2]	nc	Port I5'	M9[5]	nc
Port C1'	M3[1]	nc	Port F3'	M6[3]	nc	Port I6'	M9[6]	nc
Port C2'	M3[2]	nc	Port F4'	M6[4]	nc	Port I7'	M9[7](MSB)	nc
Port C3'	M3[3]	nc	Port F5'	M6[5]	nc	Port J0'	M10[0]	nc
Port C4'	M3[4]	nc	Port F6'	M6[6]	nc	Port J1'	M10[1]	nc
Port C5'	M3[5]	nc	Port F7'	M6[7](MSB)	nc	Port J2'	M10[2]	nc
Port C6'	M3[6]	nc	Port G0'	M7[0]	nc	Port J3'	M10[3]	nc
Port C7'	M3[7](MSB)	nc	Port G1'	M7[1]	nc	Port J4'	M10[4]	nc
LVAL'	LVAL	nc	Port G2'	M7[2]	nc	Port J5'	M10[5]	nc
FVAL'	FVAL	nc	Port G3'	M7[3]	nc	Port J6'	M10[6]	nc
Port D0'	M4[0]	nc	Port G4'	M7[4]	nc	Port J7'	M10[7](MSB)	nc
Port D1'	M4[1]	nc	LVAL'	LVAL	nc	LVAL'	LVAL	nc

2ch Output								
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0'	M1[0]	M11[0]	Port D2'	M4[2]	M14[2]	Port G5'	M7[5]	M17[5]
Port A1'	M1[1]	M11[1]	Port D3'	M4[3]	M14[3]	Port G6'	M7[6]	M17[6]
Port A2'	M1[2]	M11[2]	Port D4'	M4[4]	M14[4]	Port G7'	M7[7](MSB)	M17[7](MSB)
Port A3'	M1[3]	M11[3]	Port D5'	M4[5]	M14[5]	Port H0'	M8[0]	M18[0]
Port A4'	M1[4]	M11[4]	Port D6'	M4[6]	M14[6]	Port H1'	M8[1]	M18[1]
Port A5'	M1[5]	M11[5]	Port D7'	M4[7](MSB)	M14[7](MSB)	Port H2'	M8[2]	M18[2]
Port A6'	M1[6]	M11[6]	Port E0'	M5[0]	M15[0]	Port H3'	M8[3]	M18[3]
Port A7'	M1[7](MSB)	M11[7](MSB)	Port E1'	M5[1]	M15[1]	Port H4'	M8[4]	M18[4]
Port B0'	M2[0]	M12[0]	Port E2'	M5[2]	M15[2]	Port H5'	M8[5]	M18[5]
Port B1'	M2[1]	M12[1]	Port E3'	M5[3]	M15[3]	Port H6'	M8[6]	M18[6]
Port B2'	M2[2]	M12[2]	Port E4'	M5[4]	M15[4]	Port H7'	M8[7](MSB)	M18[7](MSB)
Port B3'	M2[3]	M12[3]	Port E5'	M5[5]	M15[5]	Port I0'	M9[0]	M19[0]
Port B4'	M2[4]	M12[4]	Port E6'	M5[6]	M15[6]	Port I1'	M9[1]	M19[1]
Port B5'	M2[5]	M12[5]	Port E7'	M5[7](MSB)	M15[7](MSB)	Port I2'	M9[2]	M19[2]
Port B6'	M2[6]	M12[6]	Port F0'	M6[0]	M16[0]	Port I3'	M9[3]	M19[3]
Port B7'	M2[7](MSB)	M12[7](MSB)	Port F1'	M6[1]	M16[1]	Port I4'	M9[4]	M19[4]
Port C0'	M3[0]	M13[0]	Port F2'	M6[2]	M16[2]	Port I5'	M9[5]	M19[5]
Port C1'	M3[1]	M13[1]	Port F3'	M6[3]	M16[3]	Port I6'	M9[6]	M19[6]
Port C2'	M3[2]	M13[2]	Port F4'	M6[4]	M16[4]	Port I7'	M9[7](MSB)	M19[7](MSB)
Port C3'	M3[3]	M13[3]	Port F5'	M6[5]	M16[5]	Port J0'	M10[0]	M20[0]
Port C4'	M3[4]	M13[4]	Port F6'	M6[6]	M16[6]	Port J1'	M10[1]	M20[1]
Port C5'	M3[5]	M13[5]	Port F7'	M6[7](MSB)	M16[7](MSB)	Port J2'	M10[2]	M20[2]
Port C6'	M3[6]	M13[6]	Port G0'	M7[0]	M17[0]	Port J3'	M10[3]	M20[3]
Port C7'	M3[7](MSB)	M13[7](MSB)	Port G1'	M7[1]	M17[1]	Port J4'	M10[4]	M20[4]
LVAL'	LVAL	LVAL	Port G2'	M7[2]	M17[2]	Port J5'	M10[5]	M20[5]
FVAL'	FVAL	FVAL	Port G3'	M7[3]	M17[3]	Port J6'	M10[6]	M20[6]
Port D0'	M4[0]	M14[0]	Port G4'	M7[4]	M17[4]	Port J7'	M10[7](MSB)	M20[7](MSB)
Port D1'	M4[1]	M14[1]	LVAL'	LVAL	LVAL	LVAL'	LVAL	LVAL

Signal Name	Logical	IN/OUT	Function
M1-20[7:0]	Positive	OUT	Monochrome Output Data (M1-20[0]:LSB、M1-20[7]:MSB)、8bit
LVAL	Positive	OUT	Line Valid Signal（Valid Line）
FVAL	Positive	OUT	Frame Valid Signal（Valid Frame）

Appendix D:
Camera Link® Configuration Bit Assignment

（13） **Deca Configuration②(10bit Mono)** (for KD6R1064/1247/1688DXL-NL)

1ch Output								
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0"	M1[2]	nc	Port D0"	M4[2]	nc	Port G0"	M7[2]	nc
Port A1"	M1[3]	nc	Port D1"	M4[3]	nc	Port G1"	M7[3]	nc
Port A2"	M1[4]	nc	Port D2"	M4[4]	nc	Port G2"	M7[4]	nc
Port A3"	M1[5]	nc	Port D3"	M4[5]	nc	Port G3"	M7[5]	nc
Port A4"	M1[6]	nc	Port D4"	M4[6]	nc	Port G4"	M7[6]	nc
Port A5"	M1[7]	nc	Port D5"	M4[7]	nc	Port G5"	M7[7]	nc
Port A6"	M1[8]	nc	Port D6"	M4[8]	nc	Port G6"	M7[8]	nc
Port A7"	M1[9](MSB)	nc	Port D7"	M4[9](MSB)	nc	Port G7"	M7[9](MSB)	nc
Port B0"	M2[2]	nc	Port E0"	M5[2]	nc	Port H0"	M8[2]	nc
Port B1"	M2[3]	nc	Port E1"	M5[3]	nc	Port H1"	M8[3]	nc
Port B2"	M2[4]	nc	Port E2"	M5[4]	nc	Port H2"	M8[4]	nc
Port B3"	M2[5]	nc	Port E3"	M5[5]	nc	Port H3"	M8[5]	nc
Port B4"	M2[6]	nc	Port E4"	M5[6]	nc	Port H4"	M8[6]	nc
Port B5"	M2[7]	nc	Port E5"	M5[7]	nc	Port H5"	M8[7]	nc
Port B6"	M2[8]	nc	Port E6"	M5[8]	nc	Port H6"	M8[8]	nc
Port B7"	M2[9](MSB)	nc	Port E7"	M5[9](MSB)	nc	Port H7"	M8[9](MSB)	nc
Port C0"	M3[2]	nc	Port F0"	M6[2]	nc	Port I5"	M3[1]	nc
Port C1"	M3[3]	nc	Port F1"	M6[3]	nc	Port I6"	M4[0]	nc
Port C2"	M3[4]	nc	Port F2"	M6[4]	nc	Port I7"	M4[1]	nc
Port C3"	M3[5]	nc	Port F3"	M6[5]	nc	Port K0"	M5[0]	nc
Port C4"	M3[6]	nc	Port F4"	M6[6]	nc	Port K1"	M5[1]	nc
Port C5"	M3[7]	nc	Port F5"	M6[7]	nc	Port K2"	M6[0]	nc
Port C6"	M3[8]	nc	Port F6"	M6[8]	nc	Port K3"	M6[1]	nc
Port C7"	M3[9](MSB)	nc	Port F7"	M6[9](MSB)	nc	Port K4"	M7[0]	nc
LVAL"	LVAL	nc	LVAL"	LVAL	nc	LVAL"	LVAL	nc
FVAL"	FVAL	nc	Port I2"	M2[0]	nc	Port K5"	M7[1]	nc
Port I0"	M1[1]	nc	Port I3"	M2[1]	nc	Port K6"	M8[0]	nc
Port I1"	M1[2]	nc	Port I4"	M3[0]	nc	Port K7"	M8[1]	nc

2ch Output								
Port	Connector D1, D5, D9	Connector D3, D7, D11	Port	Connector D2, D6, D10	Connector D4, D8, D12	Port	Connector D2, D6, D10	Connector D4, D8, D12
Port A0"	M1[2]	M9[2]	Port D0"	M4[2]	M12[2]	Port G0"	M7[2]	M15[2]
Port A1"	M1[3]	M9[3]	Port D1"	M4[3]	M12[3]	Port G1"	M7[3]	M15[3]
Port A2"	M1[4]	M9[4]	Port D2"	M4[4]	M12[4]	Port G2"	M7[4]	M15[4]
Port A3"	M1[5]	M9[5]	Port D3"	M4[5]	M12[5]	Port G3"	M7[5]	M15[5]
Port A4"	M1[6]	M9[6]	Port D4"	M4[6]	M12[6]	Port G4"	M7[6]	M15[6]
Port A5"	M1[7]	M9[7]	Port D5"	M4[7]	M12[7]	Port G5"	M7[7]	M15[7]
Port A6"	M1[8]	M9[8]	Port D6"	M4[8]	M12[8]	Port G6"	M7[8]	M15[8]
Port A7"	M1[9](MSB)	M9[9](MSB)	Port D7"	M4[9](MSB)	M12[9](MSB)	Port G7"	M7[9](MSB)	M15[9](MSB)
Port B0"	M2[2]	M10[2]	Port E0"	M5[2]	M13[2]	Port H0"	M8[2]	M16[2]
Port B1"	M2[3]	M10[3]	Port E1"	M5[3]	M13[3]	Port H1"	M8[3]	M16[3]
Port B2"	M2[4]	M10[4]	Port E2"	M5[4]	M13[4]	Port H2"	M8[4]	M16[4]
Port B3"	M2[5]	M10[5]	Port E3"	M5[5]	M13[5]	Port H3"	M8[5]	M16[5]
Port B4"	M2[6]	M10[6]	Port E4"	M5[6]	M13[6]	Port H4"	M8[6]	M16[6]
Port B5"	M2[7]	M10[7]	Port E5"	M5[7]	M13[7]	Port H5"	M8[7]	M16[7]
Port B6"	M2[8]	M10[8]	Port E6"	M5[8]	M13[8]	Port H6"	M8[8]	M16[8]
Port B7"	M2[9](MSB)	M10[9](MSB)	Port E7"	M5[9](MSB)	M13[9](MSB)	Port H7"	M8[9](MSB)	M16[9](MSB)
Port C0"	M3[2]	M11[2]	Port F0"	M6[2]	M14[2]	Port I5"	M3[1]	M11[1]
Port C1"	M3[3]	M11[3]	Port F1"	M6[3]	M14[3]	Port I6"	M4[0]	M12[0]
Port C2"	M3[4]	M11[4]	Port F2"	M6[4]	M14[4]	Port I7"	M4[1]	M12[1]
Port C3"	M3[5]	M11[5]	Port F3"	M6[5]	M14[5]	Port K0"	M5[0]	M13[0]
Port C4"	M3[6]	M11[6]	Port F4"	M6[6]	M14[6]	Port K1"	M5[1]	M13[1]
Port C5"	M3[7]	M11[7]	Port F5"	M6[7]	M14[7]	Port K2"	M6[0]	M14[0]
Port C6"	M3[8]	M11[8]	Port F6"	M6[8]	M14[8]	Port K3"	M6[1]	M14[1]
Port C7"	M3[9](MSB)	M11[9](MSB)	Port F7"	M6[9](MSB)	M14[9](MSB)	Port K4"	M7[0]	M15[0]
LVAL"	LVAL	LVAL	LVAL"	LVAL	LVAL	LVAL"	LVAL	LVAL
FVAL"	FVAL	FVAL	Port I2"	M2[0]	M10[0]	Port K5"	M7[1]	M15[1]
Port I0"	M1[1]	M9[1]	Port I3"	M2[1]	M10[1]	Port K6"	M8[0]	M16[0]
Port I1"	M1[2]	M9[2]	Port I4"	M3[0]	M11[0]	Port K7"	M8[1]	M16[1]

Signal Name	Logical	IN/OUT	Function
M1-16[9:0]	Positive	OUT	Monochrome Output Data (M1-16[0]:LSB、M1-16[9]:MSB)、10bit
LVAL	Positive	OUT	Line Valid Signal（Valid Line）
FVAL	Positive	OUT	Frame Valid Signal（Valid Frame）

Appendix E:List of Output Pixels by Connector Sets

（1） L4/L5/L6 Minimum pixel table of Width

Item name of CIS				L4(KD6R1064DXL-NL)		L5(KD6R1247DXL-NL)		L6(KD6R1688DXL-NL)		
Minimum pixel table of Width	Number of Ch	Overlap	Resolution	Width_1 (Signal block 1) (Pixel)	Width_2 (Signal block 2) (Pixel)	Width_1 (Signal block 1) (Pixel)	Width_2 (Signal block 2) (Pixel)	Width_1 (Signal block 1) (Pixel)	Width_2 (Signal block 2) (Pixel)	Width_3 (Signal block 3) (Pixel)
	1ch	Overlap "Disable"	600dpi Interpolation "Enable"	12145	12998	13872	15606	13872	13012	12998
			600dpi Interpolation "Disable"	12096	12960	13824	15552	13824	12960	12960
			300dpi	6048	6480	6912	7776	6912	6480	6480
			200dpi	4032	4320	4608	5184	4608	4320	4320
			150dpi	3024	3240	3456	3888	3456	3240	3240
		Overlap "Enable" (@600dpi)	600dpi Interpolation "Enable"	12289	Pixels on no overlap of Ch1 in Signal block2, it is the same	14016	Pixels on no overlap of Ch1 in Signal block2, it is the same	14016	13156	Pixels on no overlap of Ch1 in Signal block3, it is the same
			600dpi Interpolation "Disable"	12240		13968		13968	13104	
			300dpi	6120		6984		6984	6552	
			200dpi	4080		4656		4656	4368	
			150dpi	3060		3492		3492	3276	

*As for the minimal pixel of Width in 2ch,
In the case of an even number, Width is the value of the list mentioned above.
In the case of an odd number, Width is the value + 1 of the list mentioned above.

Appendix E:List of Output Pixels by Connector Sets

（2） L4/L5/L6 Output pixels at the minimal pixel table of Width setting

Item name of CIS				L4(KD6R1064DXL-NL)				L5(KD6R1247DXL-NL)			
				Signal block 1 (Pixel)		Signal block 2(Pixel)		Signal block 1 (Pixel)		Signal block 2(Pixel)	
Output pixels at the minimal pixel table of Width setting	Number of Ch	Overlap	Resolution	Ch1 (Connector D1,D2)	Ch2 (Connector D3,D4)	Ch1 (Connector D5,D6)	Ch2 (Connector D7,D8)	Ch1 (Connector D1,D2)	Ch2 (Connector D3,D4)	Ch1 (Connector D5,D6)	Ch2 (Connector D7,D8)
	1ch	Overlap "Disable"	600dpi Interpolation "Enable"	12145	—	12998	—	13872	—	15606	—
			600dpi Interpolation "Disable"	12096	—	12960	—	13824	—	15552	—
			300dpi	6048	—	6480	—	6912	—	7776	—
			200dpi	4032	—	4320	—	4608	—	5184	—
			150dpi	3024	—	3240	—	3456	—	3888	—
		Overlap "Enable" (@600dpi)	600dpi Interpolation "Enable"	12289	—	Pixels on no overlap of Ch1 in Signal block2, it is the same	—	14016	—	Pixels on no overlap of Ch1 in Signal block2, it is the same	—
			600dpi Interpolation "Disable"	12240	—		—	13968	—		—
			300dpi	6120	—		—	6984	—		—
			200dpi	4080	—		—	4656	—		—
			150dpi	3060	—		—	3492	—		—
	2ch	Overlap "Disable"	600dpi Interpolation "Enable"	6073	6072	6499	←	6936	←	7803	←
			600dpi Interpolation "Disable"	6048	←	6480	←	6912	←	7776	←
			300dpi	3024	←	3240	←	3456	←	3888	←
			200dpi	2016	←	2160	←	2304	←	2592	←
			150dpi	1512	←	1620	←	1728	←	1944	←
		Overlap "Enable" (@600dpi)	600dpi Interpolation "Enable"	6217	6216	6571	←	7080	←	7875	←
			600dpi Interpolation "Disable"	6192	←	6552	←	7056	←	7848	←
			300dpi	3096	←	3276	←	3528	←	3924	←
			200dpi	2064	←	2184	←	2352	←	2616	←
			150dpi	1548	←	1638	←	1764	←	1962	←

Item name of CIS				L6(KD6R1688DXL-NL)					
				Signal block 1 (Pixel)		Signal block 2(Pixel)		Signal block 3(Pixel)	
Output pixels at the minimal pixel table of Width setting	Number of Ch	Overlap	Resolution	Ch1 (Connector D1,D2)	Ch2 (Connector D3,D4)	Ch1 (Connector D5,D6)	Ch2 (Connector D7,D8)	Ch1 (Connector D9,D10)	Ch2 (Connector D11,D12)
	1ch	Overlap "Disable"	600dpi Interpolation "Enable"	13872	—	13012	—	12998	—
			600dpi Interpolation "Disable"	13824	—	12960	—	12960	—
			300dpi	6912	—	6480	—	6480	—
			200dpi	4608	—	4320	—	4320	—
			150dpi	3456	—	3240	—	3240	—
		Overlap "Enable" (@600dpi)	600dpi Interpolation "Enable"	14016	—	13156	—	Pixels on no overlap of Ch1 in Signal block3, it is the same	—
			600dpi Interpolation "Disable"	13968	—	13104	—		—
			300dpi	6984	—	6552	—		—
			200dpi	4656	—	4368	—		—
			150dpi	3492	—	3276	—		—
	2ch	Overlap "Disable"	600dpi Interpolation "Enable"	6936	←	6506	←	6499	←
			600dpi Interpolation "Disable"	6912	←	6480	←	6480	←
			300dpi	3456	←	3240	←	3240	←
			200dpi	2304	←	2160	←	2160	←
			150dpi	1728	←	1620	←	1620	←
		Overlap "Enable" (@600dpi)	600dpi Interpolation "Enable"	7080	←	6650	←	6571	←
			600dpi Interpolation "Disable"	7056	←	6624	←	6552	←
			300dpi	3528	←	3312	←	3276	←
			200dpi	3252	←	2208	←	2184	←
			150dpi	1764	←	1656	←	1638	←

Explanatory notes

← : Same value at left

- : Not Used

*A value in 2ch is a setting minimum Width.

Appendix E:List of Output Pixels by Connector Sets

（3） L4（KD6R1064DXL-NL）1ch Output

①In case of ”Disable” overlap

Resolution	Interpolation	Output Pixels by Connector Sets when using “1ch Output”(pixel)	
		D1,D2 （D1 for Base Config. Only）	D5,D6 （D5 for Base Config. Only）
600dpi	Disable	1～12096	12097～25056
	Enable	1～12145	12146～25143
300dpi	Disable	1～6048	6049～12528
200dpi	Disable	1～4032	4033～8352
150dpi	Disable	1～3024	3025～6264

②In case of ”Enable” overlap

Resolution	Interpolation	Output Pixels by Connector Sets when using “1ch Output”(pixel)	
		D1,D2 （D1 for Base Config. Only）	D5,D6 （D5 for Base Config. Only）
600dpi	Disable	1～12240 (12096+Overlap 144 pixel)	12097～25056 (No overlapped)
	Enable	1～12289 (12145+Overlap 144 pixel)	12146～25143 (No overlapped)
300dpi	Disable	1～6120 (6048+Overlap 72 pixel)	6049～12600 (No overlapped)
200dpi	Disable	1～4080 (4032+Overlap 48 pixel)	4033～8352 (No overlapped)
150dpi	Disable	1～3060 (3024+Overlap 36 pixel)	3025～6264 (No overlapped)

（2） L4（KD6R1064DXL-NL）2ch Output

①In case of ”Disable” overlap

Resolutions	Interpolation	Output Pixels by Connector Sets when using “2ch Output”(pixel)			
		D1,D2 （D1 for Base Config. Only）	D3,D4 （D3 for Base Config. Only）	D5,D6 （D5 for Base Config. Only）	D7,D8 （D7 for Base Config. Only）
600dpi	Disable	1～6048	6049～12096	12097～18576	18577～25056
	Enable	1～6073	6074～12145	12146～18644	18645～25143
300dpi	Disable	1～3024	3025～6048	6049～9288	9289～12528
200dpi	Disable	1～2016	2017～4032	4033～6192	6193～8352
150dpi	Disable	1～1512	1513～3024	3025～4644	4645～6264

② In case of ”Enable” overlap

Resolutions	Interpolation	Output Pixels by Connector Sets when using “2ch Output”(pixel)			
		D1,D2 （D1 for Base Config. Only）	D3,D4 （D3 for Base Config. Only）	D5,D6 （D5 for Base Config. Only）	D7,D8 （D7 for Base Config. Only）
600dpi	Disable	1～6192 (6048+Overlap 144 pixel)	6049～12240 (12096+Overlap 144 pixel)	12097～18648 (18504+Overlap 144 pixel)	18505～25056 (No overlapped)
	Enable	1～6217 (6073+Overlap 144 pixel)	6074～12289 (12145+Overlap 144 pixel)	12146～18716 (18572+Overlap 144 pixel)	18573～25143 (No overlapped)
300dpi	Disable	1～3096 (3024+Overlap 72 pixel)	3025～6120 (6048+Overlap 72 pixel)	6049～9324 (9252+Overlap 72 pixel)	9253～12528 (No overlapped)
200dpi	Disable	1～2064 (2016+Overlap 48pixel)	2017～4080 (4032+Overlap 48pixel)	4033～6216 (6168+Overlap 48pixel)	6169～8352 (No overlapped)
150dpi	Disable	1～1548 (1512+Overlap 36pixel)	1513～3060 (3024+Overlap 36pixel)	3025～4662 (4626+Overlap 36pixel)	4627～6264 (No overlapped)

Appendix E:List of Output Pixels by Connector Sets

（4） L5（KD6R1247DXL-NL）1ch Output

①In case of ”Disable” overlap

Resolution	Interpolation	Output Pixels by Connector Sets when using “1ch Output”(pixel)	
		D1,D2 （D1 for Base Config. Only）	D5,D6 （D5 for Base Config. Only）
600dpi	Disable	1～13824	13825～29376
	Enable	1～13872	13873～29478
300dpi	Disable	1～6912	6913～14688
200dpi	Disable	1～4608	4609～9792
150dpi	Disable	1～3456	3457～7344

②In case of ”Enable” overlap

Resolution	Interpolation	Output Pixels by Connector Sets when using “1ch Output”(pixel)	
		D1,D2 （D1 for Base Config. Only）	D5,D6 （D5 for Base Config. Only）
600dpi	Disable	1～13968 (13824+Overlap 144 pixel)	13825～29376 (No overlapped)
	Enable	1～14016 (13872+Overlap 144 pixel)	13873～29478 (No overlapped)
300dpi	Disable	1～6984 (6912+Overlap 72 pixel)	6913～14688 (No overlapped)
200dpi	Disable	1～4656 (4608+Overlap 48 pixel)	4609～9792 (No overlapped)
150dpi	Disable	1～3492 (3456+Overlap 36pixel)	3457～7344 (No overlapped)

（5） L5（KD6R1247DXL-NL）2ch Output

①In case of ”Disable” overlap

Resolutions	Interpolation	Output Pixels by Connector Sets when using “2ch Output”(pixel)			
		D1,D2 （D1 for Base Config. Only）	D3,D4 （D3 for Base Config. Only）	D5,D6 （D5 for Base Config. Only）	D7,D8 （D7 for Base Config. Only）
600dpi	Disable	1～6912	6913～13824	13825～21600	21601～29376
	Enable	1～6936	6937～13872	13873～21675	21676～29478
300dpi	Disable	1～3456	3457～6912	6913～10800	10801～14688
200dpi	Disable	1～2304	2305～4608	4609～7200	7201～9792
150dpi	Disable	1～1728	1729～3456	3457～5400	5401～7344

② In case of ”Enable” overlap

Resolutions	Interpolation	Output Pixels by Connector Sets when using “2ch Output”(pixel)			
		D1,D2 （D1 for Base Config. Only）	D3,D4 （D3 for Base Config. Only）	D5,D6 （D5 for Base Config. Only）	D7,D8 （D7 for Base Config. Only）
600dpi	Disable	1～7058 (6912+Overlap 144 pixel)	6913～13968 (13824+Overlap 144 pixel)	13825～21672 (21528+Overlap 144 pixel)	21529～29376 (No overlapped)
	Enable	1～7080 (6936+Overlap 144 pixel)	6937～14016 (13872+Overlap 144 pixel)	13873～21747 (21603+Overlap 144 pixel)	21604～29478 (No overlapped)
300dpi	Disable	1～3528 (3456+Overlap 72 pixel)	3457～6984 (6912+Overlap 72 pixel)	6913～10836 (10764+Overlap 72 pixel)	10765～14688 (No overlapped)
200dpi	Disable	1～2352 (2304+Overlap 48pixel)	2305～4656 (4608+Overlap 48pixel)	4609～7224 (7176+Overlap 48pixel)	7177～9792 (No overlapped)
150dpi	Disable	1～1764 (1728+Overlap 36pixel)	1729～3492 (3456+Overlap 36pixel)	3457～5418 (5382+Overlap 36pixel)	5383～7344 (No overlapped)

Appendix E:List of Output Pixels by Connector Sets

（6） L6(KD6R1688DXL-NL）1ch Output

①In case of ”Disable” overlap

Resolution	Interpolation	Output Pixels by Connector Sets when using “1ch Output”(pixel)		
		D1,D2 (D1 for Base Config. Only)	D5,D6 (D5 for Base Config. Only)	D9,D10 (D9 for Base Config. Only)
600dpi	Disable	1～13824	13825～26784	26785～39744
	Enable	1～13872	13873～26884	26885～39882
300dpi	Disable	1～6912	6913～13392	13393～19872
200dpi	Disable	1～4608	4609～8928	8929～13248
150dpi	Disable	1～3456	3457～6696	6697～9936

②In case of ”Enable” overlap

Resolution	Interpolation	Output Pixels by Connector Sets when using “1ch Output”(pixel)		
		D1,D2 (D1 for Base Config. Only)	D5,D6 (D5 for Base Config. Only)	D9,D10 (D9 for Base Config. Only)
600dpi	Disable	1～13968 (13824+Overlap 144 pixel)	13825～26928 (26784+Overlap 144 pixel)	26785～39744 (No overlapped)
	Enable	1～14016 (13872+Overlap 144 pixel)	13873～27028 (26884+Overlap 144 pixel)	26885～39882 (No overlapped)
300dpi	Disable	1～6984 (6912+Overlap 72 pixel)	6913～13464 (13392+Overlap 72 pixel)	13393～19872 (No overlapped)
200dpi	Disable	1～4656 (4608+Overlap 48 pixel)	4609～8976 (8928+Overlap 48 pixel)	8929～13248 (No overlapped)
150dpi	Disable	1～3492 (3456+Overlap 36 pixel)	3457～6732 (6696+Overlap 36 pixel)	6697～9936 (No overlapped)

Appendix E:List of Output Pixels by Connector Sets

（7） L6(KD6R1688DXL-NL) 2ch Output

①In case of ”Disable” overlap

Resolution	Interpolation	Output Pixels by Connector Sets when using “2ch Output”(pixel)					
		D1,D2 （D1 for Base Config. Only）	D3,D4 （D3 for Base Config. Only）	D5,D6 （D5 for Base Config. Only）	D7,D8 （D7 for Base Config. Only）	D9,D10 （D9 for Base Config. Only）	D11,D12 （D11 for Base Config. Only）
600dpi	Disable	1～6912	6913～13824	13825～20304	20305～26784	26785～33264	33265～39744
	Enable	1～6936	6937～13872	13873～20378	20379～26884	26885～33383	33384～39882
300dpi	Disable	1～3456	3457～6912	6913～10152	10153～13392	13393～16632	16633～19872
200dpi	Disable	1～2304	2305～4608	4609～6768	6769～8928	8929～11088	11089～13248
150dpi	Disable	1～1728	1729～3456	3457～5076	5077～6696	6697～8316	8317～9936

②In case of ”Enable” overlap

Resolution	Interpolation	Output Pixels by Connector Sets when using “2ch Output”(pixel)					
		D1,D2 （D1 for Base Config. Only）	D3,D4 （D3 for Base Config. Only）	D5,D6 （D5 for Base Config. Only）	D7,D8 （D7 for Base Config. Only）	D9,D10 （D9 for Base Config. Only）	D11,D12 （D11 for Base Config. Only）
600dpi	Disable	1～7056 (6912+Overlap 144 pixel)	6913～13968 (13824+Overlap 144 pixel)	13825～20448 (20304+Overlap 144 pixel)	20305～26928 (26784+Overlap 144 pixel)	26785～33336 (33192+Overlap 144 pixel)	33193～39744 (No overlapped)
	Enable	1～7080 (6936+Overlap 144 pixel)	6937～14016 (13872+Overlap 144 pixel)	13873～20522 (20378+Overlap 144 pixel)	20379～27028 (26884+Overlap 144 pixel)	26885～33455 (33311+Overlap 144 pixel)	33312～39882 (No overlapped)
300dpi	Disable	1～3528 (3456+Overlap 72 pixel)	3457～6984 (6912+Overlap 72 pixel)	6913～10224 (10152+Overlap 72 pixel)	10153～13464 (13392+Overlap 72 pixel)	13393～16668 (16596+Overlap 72 pixel)	16597～19872 (No overlapped)
200dpi	Disable	1～2352 (2304+Overlap 48 pixel)	2305～4656 (4608+Overlap 48 pixel)	4609～6816 (6768+Overlap 48 pixel)	6769～8976 (8928+Overlap 48 pixel)	8929～11112 (11064+Overlap 48 pixel)	11065～13248 (No overlapped)
150dpi	Disable	1～1764 (1728+Overlap 36 pixel)	1729～3492 (3456+Overlap 36 pixel)	3457～5112 (5076+Overlap 36 pixel)	5077～6632 (6696+Overlap 36 pixel)	6697～8334 (8298+Overlap 36 pixel)	8299～9936 (No overlapped)