



# User Manual

**Line Scan Camera**

**XCM40170DLMT2CXP**



**NIPPON ELECTRO-SENSORY DEVICES CORPORATION**

## **For Customers in U.S.A.**

This equipment has been tested and found to comply with the limits for a Class A digital device, in accordance with Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his or her own expense.

## **For Customers in the EU**

This equipment has been tested and found to comply with the essential requirements of the EMC Directive 2004/108/EC, based on the following specifications applied:

### **EU Harmonised Standards**

EN55022: 2010 Class A

EN61000-6-2: 2005

### **Warning**

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

### **Directive on Waste Electrical and Electronic Equipment (WEEE)**



Please return all End of Life NED products to the distributor from whom the product was purchased for adequate recycling and / or disposal. All costs of returning the Product to NED are borne by the shipper.

## Introduction

Thank you for purchasing NED's Line Scan Camera. We look forward to your continued custom in the future.

## For safety use

- ◆ For your protection, please read these safety instructions completely before operating the product and keep this manual for future reference.
- ◆ The following symbols appear next to important information regarding safe product handling.

|   |                |  |
|---|----------------|--|
|  | <b>Warning</b> | If the product is not handled properly, this may result in serious injury or possible death.         |
|  | <b>Caution</b> | If the product is not handled properly, this may result in physical injury or cause property damage. |

## Safety precaution

### Warning

- ◆ Never disassemble or modify this product, unless otherwise specified to do so in this manual.
- ◆ When hands are wet, avoid handling this product and do not touch any of the connection cable pins or other metallic components.
- ◆ Do not operate this product in an environment that is exposed to rain or other severe external elements, hazardous gases or chemicals.
- ◆ If the product is not to be used for an extended period of time, as a safety precaution, always unplug the connection cable from the camera unit.
- ◆ If the product installation or inspection must be executed in an overhead location, please take the necessary measures to prevent the camera unit and its components from accidentally falling to the ground.
- ◆ If smoke, an abnormal odor or strange noise is emitted from the camera unit, first turn OFF power, then unplug the cable from the camera unit.
- ◆ This product is not intended for use in a system configuration built for critical applications.

## Instructions before use

- ◆ Only operate this product within the recommended environmental temperature range.
- ◆ Use only the specified power source and voltage rating.
- ◆ Do not drop this product. Avoid exposure to strong impact and vibrations.
- ◆ Install the camera unit in a well-ventilated environment, in order to prevent the camera from overheating.
- ◆ If the camera must be installed in an environment containing dust or other particles, take required measures to protect the camera unit from dust adhesion.
- ◆ Do not unplug the cable while power is being supplied to the camera unit. To prevent product damage, always shut down the power supply before unplugging the power cable.
- ◆ When the surface of the camera window becomes dirty due to dust or grime, black smudges appear in the displayed image. Use an air blower to remove the dust particles. Dip a cotton swab into ethanol alcohol and clean the camera window. Be careful not to scratch the glass.
- ◆ Use of non-infrared lighting such as a daylight fluorescent lamp is recommended. If halogen lighting is employed, always install an infrared filter into your system configuration.
- ◆ Please note that exposure to long wavelength light outside of the sensors visible optical range can affect the image.
- ◆ Sensitivity may fluctuate depending on the spectral response level of the light source. In cases like this, changing the light source to one with a different spectral response level may reduce this problem.
- ◆ Please note that when the sensor is exposed to excessive quantities of light, blooming may occur because this product does not have a special Anti-Blooming function.
- ◆ For stabilized image capturing, turn on the power supply and execute aging for ten to twenty minutes before actually using the camera unit.
- ◆ Do not share the power supply with motor units or other devices that generate noise interference.
- ◆ Do not disconnect the camera while rewriting the embedded memory.
- ◆ When you change the exposure mode that is set at the NED factory, input control signal (Trigger packet) from the capture board.

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# Product Warranty

## Warranty Period

- ◆ The product warranty period, as a general rule, is two years from purchase; however, for detailed conditions please contact the sales representative for your region/country.
- ◆ However, in some cases due to the usage environment, usage conditions and/or frequency of use, this warranty period may not be applicable.

## Warranty Scope

- ◆ Product repair will be performed on a Return to Manufacturer basis. On-site maintenance will incur additional charges.
- ◆ If defects in material or workmanship occur during the warranty period, the faulty part will be replaced or repaired by us free of charge. Return shipping charges must be paid by the sender. However, the following cases fall outside of the scope of this warranty:

## Exclusions from Warranty Coverage

- ◆ We will under no circumstances assume responsibility for the following cases: damage caused by fire, earthquake, other acts of a third party, other accidents, negligent or intentional misuse by the user, or other usage under extraordinary circumstances.
- ◆ Damages (e.g. loss of business profits, business interruption, etc.) resulting from use or non-use.
- ◆ Damages caused by use other than as described in this document.
- ◆ Damages resulting from malfunction due to a connected device.
- ◆ Damages resulting from repairs or modifications performed by the customer.

## Fault Diagnosis

- ◆ As a general rule, in the first instance fault diagnosis should take the form of a telephone call or an email to enable us to assess the circumstances of the malfunction.
- ◆ However, depending on the customer's requests, we, or our agent, may require an additional fee for this service.

## Exclusion of Liability for Compensation for Missed Opportunities

- ◆ Regardless of whether within the warranty period or not, our warranty does not cover compensation for missed opportunities for our customers, or our customers' customers, caused by a fault of our products, nor for damage to products other than our own, or related business.

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**Note about Product Usage**

- ◆ This product has been designed and manufactured as a general-purpose product for general industry. In applications expected to be life-critical or safety-critical, the installer or user is requested to install double or triple failsafe systems.

**Repair Service Outline**

- ◆ The cost of dispatching engineers etc. for repair service is not included in the price of purchased and supplied goods. On request, arrangements can be made separately.

**Scope of Repair Service**

- ◆ The above assumes business dealings and usage to take place in the customer's region/country. In cases of business dealings and/or usage outside the customer's region/country, separate consultation is required.

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# 1 Product Outline

## 1.1 Features

- 4096pixels x 2 Dual line sensor, Data Rate 340MHz
- Pixel format 8bit/10bit conversion
- CoaXPress interface
- CXP-2(2.5 Gbps). Cable length up to about 100 m
- High-integrity data
- Real-time action
- Up Link trigger semantics
- Device Discovery
- GenICam correspondence

## 1.2 Application

- Inspection of Transparent panels and PCBs
- Flat panel display inspection
- Inspection of glass and sheet-like objects
- Inspection of high speed moving objects
- This camera utilizes an Intelligent Transportation System
- Outdoor surveillance

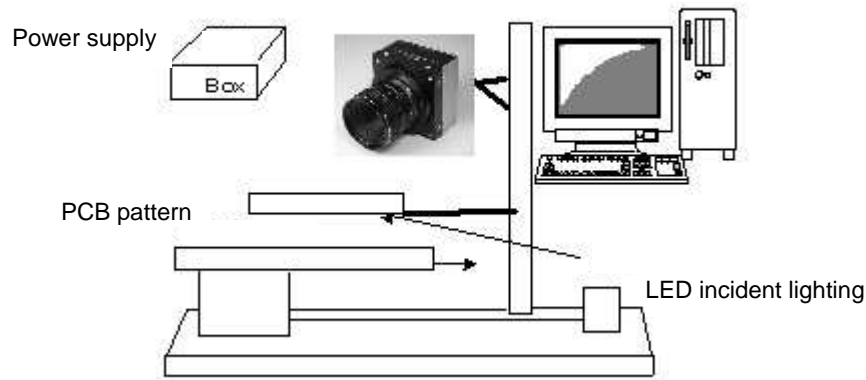


Figure 1-2-1 Visual Inspection of PCBs

**Applicable Object**

COB, BGA and MCM printed circuit boards

**System Configuration**

1. Camera: Line scan camera
2. Controller: Dedicated software for PC system

**Applicable Fields**

Inspection of patterns on film PCBs

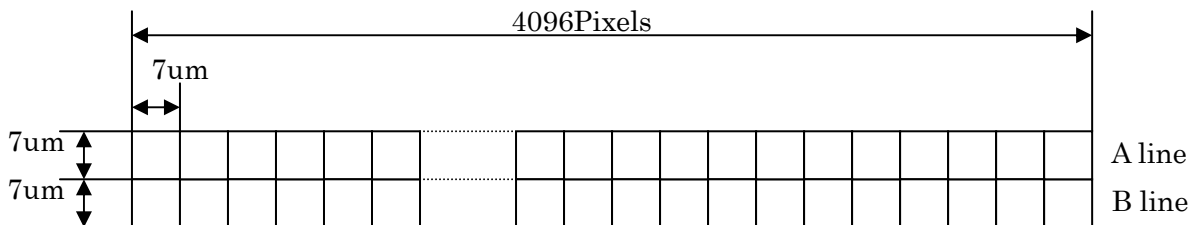
**1.3 Image Sensor**

The camera uses a CMOS sensor with a maximum data rate of 340MHz to acquire high responsivity and superior quality images.

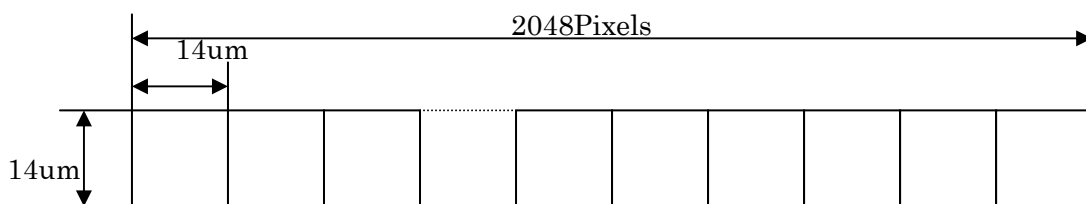
The sensor has pixels of 7µm x 7µm in size and dual lines.

At TDI mode, the camera outputs 4096 pixels data through 340MHz-Dual, 170MHz-Single.

Also, it comes as the output data of 2048 pixels with 14µm-square pixel equivalent from 170MHz by 2x2 pixels binning.



2048 pixels with 14µm-square pixel equivalent by 2x2 pixels binning



## 1.4 Performance specifications

The Performance Specifications are shown in Table 1-4-1. It shows the data when the camera is operating at maximum scan rate, unless otherwise specified.

**Table 1-4-1 Performance Specifications**

| Items   | Specifications   |                           |
|---|--|---------------------------|
|   | XCM40170DLMT2CXP   |                           |
| Number of Pixels  | 4096x2 (Dual line)   |                           |
| Pixel Size H x V (μm)   | 7 x 7  |                           |
| Sensor Length (mm)  | 28.672   |                           |
| Data Rate (MHz)   | 340 (Dual)/ 170 (Single)   |                           |
| Scan Rate<br>(kHz) /(μs)  | 4096pixels/Dual  | 77.555 / 12.894           |
|   | 4096pixels/Single  | 39.795 / 25.129           |
|   | 2048pixels/Dual  | 76.505 / 13.071           |
|   | 2048pixels/Single  | 76.505 / 13.071           |
| Responsivity (V/[lx·s])typ.<br>[Minimum Gain, Pixel Correction Initial Value] | 100 * Daylight Fluorescent Light<br>* Analog 5V Conversion Sensitivity                     |                           |
| Gain Adjustable Range<br>*Analog Amplifier +Digital                           | Analog Amplifier : x 1 to x 17.8 (8 Steps)<br>Digital : x 1 to x 2 (512 Steps)             |                           |
| Digital Offset Adjustable Range<br>*Digital                                   | -127 to 127 (0.5DN / Steps): 8bit  |                           |
| FPN<br>(Fixed Pattern Noise)  | Typically 5%(without correction, at minimum gain)<br>2%(with correction, at minimum gain)  |                           |
| PRNU<br>(Photo Response Non Uniformity)                                       | Typically 8% (without correction, at minimum gain)<br>4%(with correction, at minimum gain) |                           |
| Random Noise  | Typically 10DN<br>(peak value at minimum gain)   |                           |
| Video output  | CoaXPress Ver.1.0  |                           |
| Control Input   | Control Packet (Camera control) / Trigger Packet   |                           |
| Connectors  | Data/Controller  | Canare : BCJ-FPC (75Ω) x2 |
|   | Power Supply   | Hirose : HR10A (6Pin)     |
| Lens Mount  | Standard: F Mount  |                           |
| Operating Temperature (°C)<br>No Condensation                                 | 0 to 50  |                           |
| Power Supply Voltage (V)  | DC12~15[±5%]   |                           |
| Consumption Current (mA)<br>(typically)                                       | 400(DC12V)   |                           |
| Size W x H x D (mm)   | 60 x 100 x 36  |                           |
| Mass (g) (Camera only)  | Approx. 340(without Lens mount)  |                           |

|                     |  |
|---------------------|--|
| Additional Function | <ol style="list-style-type: none"> <li>1. Two-line TDI</li> <li>2. Gain/Offset Adjustable</li> <li>3. Test Pattern Output On / Off</li> <li>4. Programmable Exposure Control</li> <li>5. Scan Direction Switching</li> </ol> |
|---------------------|--|

Note:

\*1) DN : Digital Number (8bit : 0-255)

\*2) Measurements were made at room temperature.

| Items                  | Interface specifications                      |                          |
|------------------------|---|--------------------------|
|                        | XCM40170DLMT2CXP                              |                          |
| Bit Rate               | 2.5Gbps (CXP-2)                               |                          |
| Discovery Rate         | 1.25Gbps (CXP-1) (at Device discovery)        |                          |
| Number of Links        | 2(2 cables) : Dual mode                       | 1(1 cable) : Single mode |
| PoCXP                  | Not Used                                      |                          |
| Pixel Format           | Mono8, Mono10                                 |                          |
| Image Type             | Rectangular                                   |                          |
| Low Speed Link Trigger | Grabber (Host) → Camera (Device), Jitter ±8ns |                          |

The spectral responsivity is shown below.

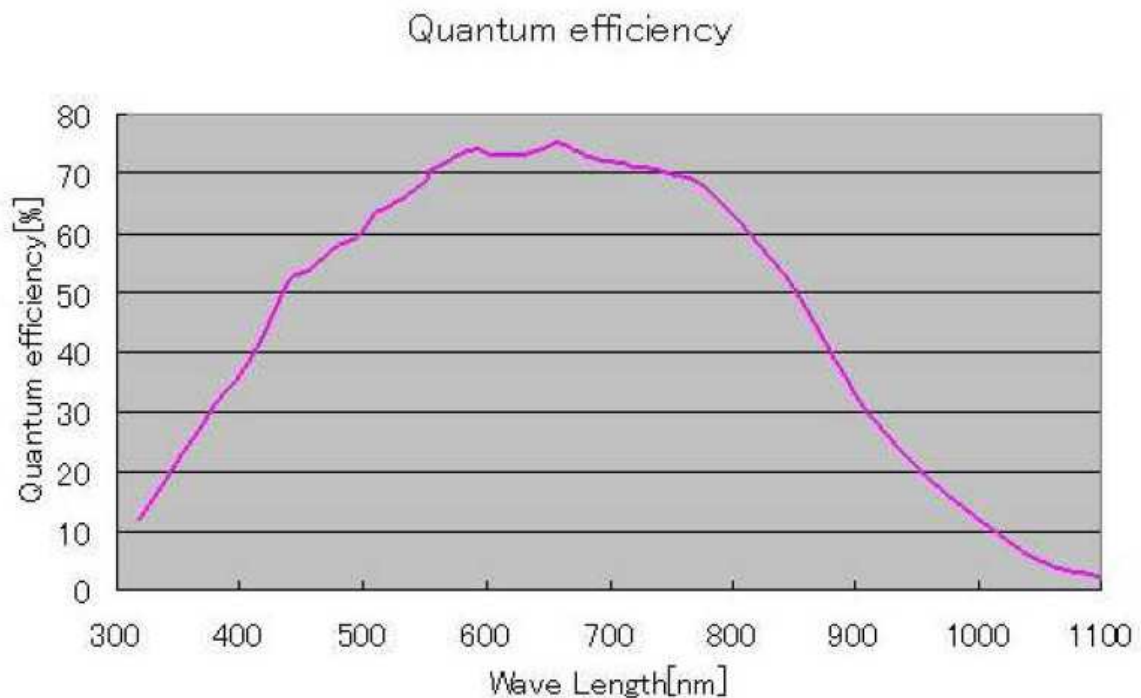


Figure 1-4-1 Spectral Responsivity

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## 2 Camera Setting and Optical Interface

### 2.1 Setting the Camera

Use the M4 screw holes or the tripod screw hole to set the camera.

### 2.2 Fixing the Camera

Use the M4 screw holes (4 places at the front, 8 places at the side) to set the camera.

Or use the 1/4"-20UNC screw hole for a tripod (1 place at side).

If using the front panel M4 mounting holes (4 places at the front, 8 places at the side), the screw length for fixing the camera should be less than 6mm.

No X-, Y-axis orientation and tilt adjustment mechanism is available. Please prepare an adjustment mechanism if required.

The dimensions of the camera are shown below.

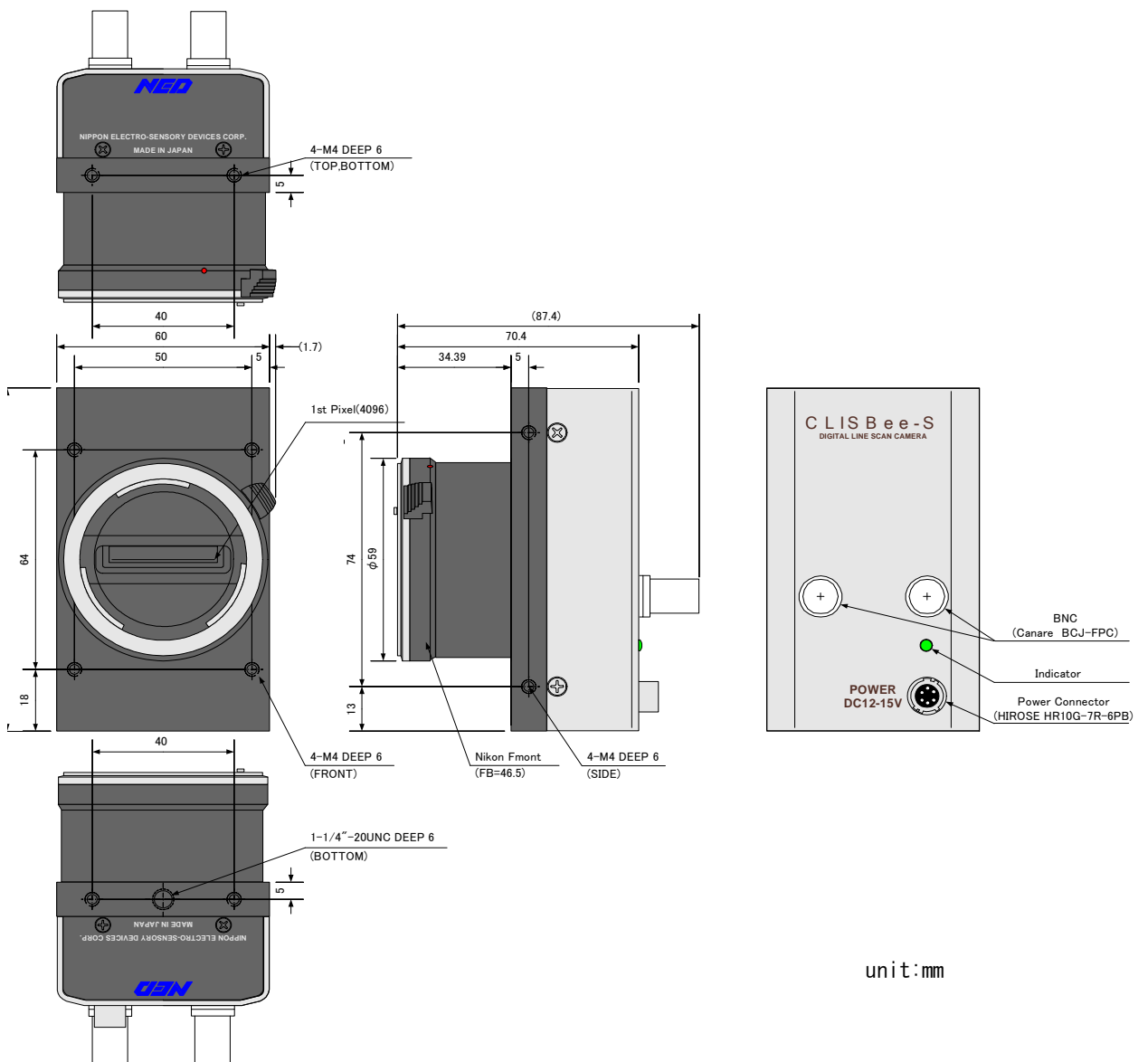


Figure 2-2-1 Dimensions of the Camera

## 2.3 Optical Interface

The XCM40170DLMT2CXP comes with an F-Mount as standard.

1) Quantities of light and the wavelength etc. of a source of light necessary to take the image for which the customer hopes are different according to the usage. The factor to decide these contains physical properties, the speed, the spectrum characteristic of the object taken a picture of, the exposure time, and the characteristic of the source of light and the specification etc. of the taking system.

It is a luminous exposure (exposure time × quantities of light) that it is important because an appropriate image is obtained. Please decide the exposure time and quantities of light after examining which element the customer values enough.

2) Keep these guidelines in mind when setting up your light source:

- LED light sources are relatively inexpensive, provide a uniform field and longer life span compared to other light sources. However, they also require a camera with excellent sensitivity.
- Halogen light sources generally provide very little blue light but have high infrared light (IR) proportions.
- Fiber-optic light distribution systems generally transmit very little blue light relative to IR.
- Metal halide light sources are very bright but have a shorter life span compared to other light sources.

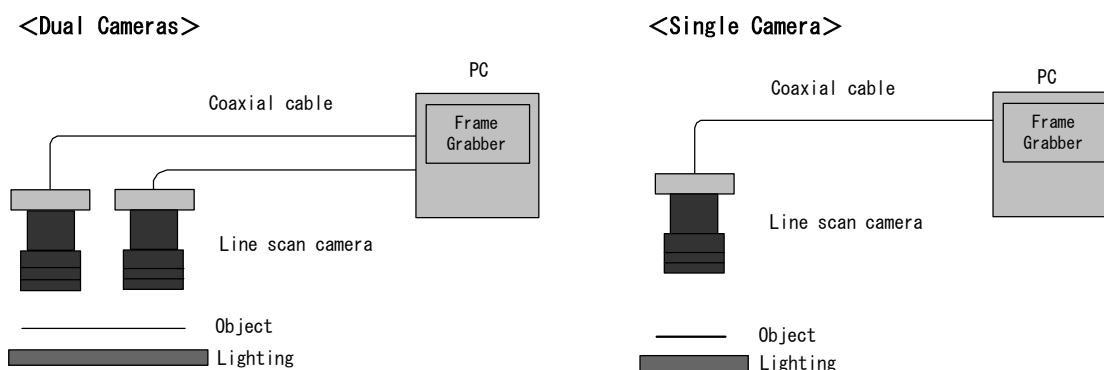
3) Generally speaking, the brighter light sources, the shorter life span.

CMOS image sensors are sensitive to infrared (IR). We recommend using daylight color fluorescent lamps that have low IR emissions. If you use a halogen light source, to prevent infrared from distorting the images use an IR cut off filter that does not transmit wavelengths.



## 3 Hardware

### 3.1 Camera Connection



**Figure 3-1-1 Connections between Camera and Frame Grabber Board**

- ◆ Depending on the frame grabber board, up to two cameras can be connected.

<Note : Choosing a suitable coaxial cable >

Please use a 75Ω coaxial cable with a BNC connector according to the CoaXPress standard. The maximum cable length is not prescribed by the standard. The maximum cable length to be able to transfer data depends on factors such as attenuation, diameter and manufacturer.

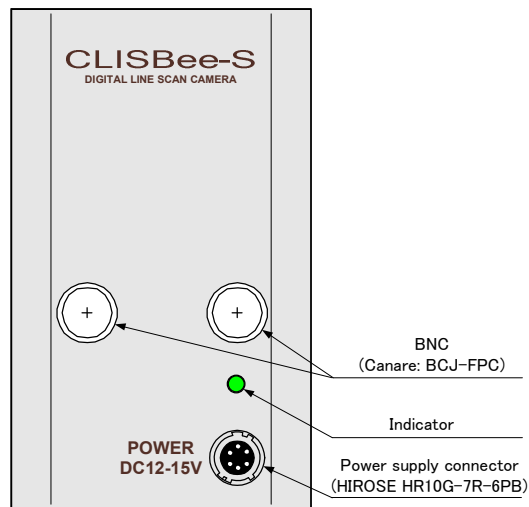
We recommend that you use a standard approved cable.

Refer to JIIA (<http://jiia.org/cxp/>) for more information about standard approved cables.

As specifications for each manufacturer differs, please contact the cable manufacturer directly for details.

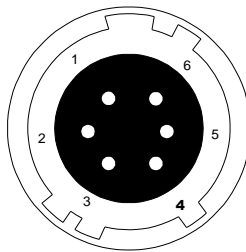
### 3.2 Input / Output Connectors and Indicator

The layout of input /output connectors and the indicator lamp are as follows.



**Figure 3-2-1 Input/output Connectors and Indicator**

The pin assignment of the power supply connector is shown below.



**Figure 3-2-2 Power Supply Connector (HIROSE: HR10G -7R- 6PB)**

- Round shape push-pull lock type

**Table 3-2-1 Pin Assignment of Power Supply Connector**

| No | Name   |
|----|--------|
| 1  | 12-15V |
| 2  | 12-15V |
| 3  | 12-15V |
| 4  | GND    |
| 5  | GND    |
| 6  | GND    |

### 3.3 Power Supply

The camera requires a single power supply (DC+12 to +15V).

When selecting a power source, choose one with the capacity to allow for inrush current. (10W or more recommended)

- ◆ Insert the cable plug securely until it locks into position. This is to prevent the connector from coming loose during power transmission.

Compatible Cable (Compatible plug): DGPSH-10 (HIROSE: HR10A-7P-6S)

Power supply voltage: DC+12-+15V (+/-5%)

Consumption Current (rated): DC+12V: 400mA

- ◆ The LED lamp illuminates when +12V to +15V power is being supplied to the camera.
- ◆ If the lamp fails to illuminate even after power is supplied, turn off power immediately. Inspect wiring. Check the voltage and capacity of the supplied power source.

### 3.4 LED Indicator Status

|  |                                       |
|--|---------------------------------------|
| Camera Power Supply is off                           | : LED off                             |
| Camera Booting Up (Power On)                         | : Lights orange                       |
| Device Discovery                                     | : Lights orange for 0.5s              |
| Scan rate > about 1.5s*                              | : Blinks orange (Except ExtEdge Mode) |
| Low Speed Link disconnected (Cable disconnected)     | : Lights red                          |
| Unable to process commands (System crash)            | : Blinks red                          |
| Transmitting image packets (Acquisition Start =1)    | : Lights green                        |
| Not transmitting image packets (Acquisition Stop =1) | : Blinks green                        |

- \* When the scan rate is close to 1.6s, the LED may flash orange and green alternately. When Acquisition Start and Stop are performed repeatedly, the green LED may appear to be flashing.

- \* Moreover, when repeating the operation rapidly, the green LED may appear dark.

## 4 Camera Startup

### 4.1 Camera Startup Procedure

This camera does not immediately output stream data packets (image data) after powering on. In order to output stream data packets, it is necessary to perform Device Discovery (Camera and Frame Grabber connection).

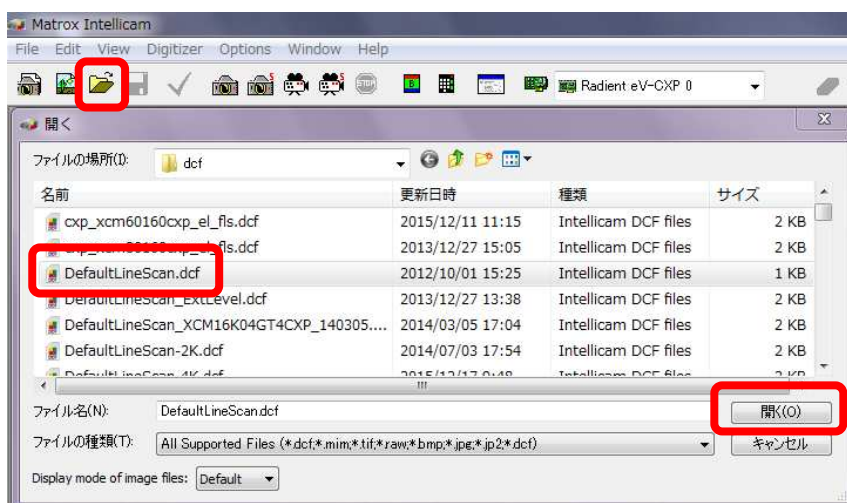
Please check your frame grabber's manual for how to perform device discovery.

The below example uses Matrox's Radiant eV-CXP as an example. The Radiant eV-CXP performs device discovery on opening a "DCF" file.

① Open Intellicam from the Matrox Imaging Library



② From the Intellicam "File/Open" Menu, open "DefaultLineScan"



③ If the contents of the DCF file are displayed, then discovery has been performed successfully.

## 5 Camera Control

The camera can be controlled by the frame grabber board through the camera's control registers. The camera supports GenICam, and so can be easily controlled by a GenICam-compatible frame grabber. The camera control software which came with your frame grabber should be used for camera control.

Once the camera settings have been made and saved, the camera will operate without further setting.

### 5.1 Flow of Camera Control

#### 5.1.1 GenICam overview

- The camera control register information is saved inside the camera (XML file)
- The frame grabber board reads the XML file during Discovery, and acquires the register information.
- Camera control is enabled after Discovery.

#### 5.1.2 Camera Control registers

The camera can be controlled the function through camera register by frame grabber board.

**Table 5-1-2-1 List of Camera Control Registers**

| Control Item                           | Address                         | R/W | VAL             | Control Description  |
|--|---------------------------------|-----|-----------------|--|
| <i>Category : Device Control</i>       |                                 |     |                 |  |
| Device User ID                         | 0x0000_20C0<br>~<br>0x0000_20CF | R/W | (ASCII code)    | User define ASCII code   |
| <i>Category : CoaXPress</i>            |                                 |     |                 |  |
| CxpLinkConfig                          | 0x0000_4014                     | R/W | 0x10030/0x20030 | Single CXP-2 / Dual CXP-2  |
| <i>Category : Image Format Control</i> |                                 |     |                 |  |
| Width                                  | 0x0000_A000                     | R   | 2048 / 4096     | Binning Horizontal=2, 2048 Pixels<br>Binning Horizontal=1, 4096 Pixels |
| Height                                 | 0x0000_A004                     | R   | 1               | 1 Line   |
| Binning Horizontal                     | 0x0000_A280                     | R/W | 1 / 2           | 1=Off / 2=2 Pixels binning<br>See 5.3.22                               |

|                                       |             |     |                    |   |
|---------------------------------------|-------------|-----|--------------------|---|
| NED_TDIMode                           | 0x0000_A254 | R/W | 0 / 1 / 2 / 3      | 0=Dual line(average) /<br>1=Single line A /<br>2=Dual line(addition) /<br>3=Single line B<br>See 5.3.22 |
| PixelFormat                           | 0x0000_A014 | R/W | 0x101 / 0x102      | 0x101=Mono8 / 0x102=Mono10  |
| <i>Category : Acquisition Control</i> |             |     |                    |   |
| Acquisition Mode                      | 0x0000_A008 | R   | 0                  | Continuous  |
| Acquisition Start                     | 0x0000_A00C | R/W | 0 to 1             | 0=Stop / 1=Start  |
| Acquisition Stop                      | 0x0000_A010 | R/W | 0 to 1             | 0=Start / 1=Stop  |
| <i>Category : Analog Control</i>      |             |     |                    |   |
| NED_GammaMode                         | 0x0000_A258 | R/W | 0/1/2/3/4          | 0=Off(1.00) /<br>1=Gamma 0.45 /<br>2=Gamma 0.56 /<br>3=Negative Positive inversion /<br>4=Custom        |
| Gamma                                 | 0x0000_A25C | R/W | 250 to 4000        | $\gamma$ 0.250~4.000  |
| <i>Category : NED Camera features</i> |             |     |                    |   |
| AnalogGain                            | 0x0000_A080 | R/W | 0 to 7             | x1.00...x17.8<br>See 5.11   |
| DigitalGain                           | 0x0000_A084 | R/W | 0 to 511           | x1...x2(x0.003906/step)<br>See 5.11   |
| DigitalOffset                         | 0x0000_A088 | R/W | -127 to 127        | -63...63(0.5DN/step at 8bit)<br>-254...254(2DN/step at 10bit)<br>See 5.10                               |
| ExposureMode                          | 0x0000_A08C | R/W | 0 / 1 / 2          | 0=FreeRun / 1=ExtEdge / 2=ExtLevel  |
| ExposureTimeCounter                   | 0x0000_A094 | R/W | 915 to<br>1048575  | Dual CXP-2 Binning Horizontal=1,<br>10.765~12336.176 $\mu$ s  |
|                                       |             |     | 1955 to<br>1048575 | Single CXP-2 Binning Horizontal=1,<br>23.000~12336.176 $\mu$ s  |
|                                       |             |     | 930 to<br>1048575  | Dual CXP-2 Binning Horizontal=2,<br>10.941~12336.176 $\mu$ s  |
|                                       |             |     | 930 to<br>1048575  | Single CXP-2 Binning Horizontal=2,<br>10.941~12336.176 $\mu$ s  |
| Padding                               | 0x0000_A098 | R/W | 0 to 1048575       | 2.129~12338.305 $\mu$ s   |
| TestImageSelector                     | 0x0000_A0A4 | R/W | 0 / 1              | 0=Off / 1=GreyHorizontalRamp<br>See 5.13  |
| ReverseX                              | 0x0000_A0B4 | R/W | 0 / 1              | 0=Forward / 1=Reverse   |

## NED

|  |             |     |                   |  |
|--|-------------|-----|-------------------|--|
| LineDelay                              | 0x0000_A0E4 | R/W | -1 / 0 / 1        | Output delay adjustment between line datas Amount of line data<br>-1/0/1<br>Note:<br>when using line delay mode setting at -1 or1, NED_TDIMode must be set at 0 or 2<br>See 5.3.22 |
| PixelCorrectSetMode                    | 0x0000_A0A8 | R/W | 0 / 1 / 2 / 4 / 5 | 0=Disable (Factory Black) /<br>1=Factory white (Factory Black) /<br>2=User White (Factory Black) /<br>4=User Black + Factory white /<br>5=User Black + User white                  |
| PixelCorrectSetLevel                   | 0x0000_A0AC | R/W | 0 to 255          | Correction Level(8bit)   |
| PixelCorrectDataSave                   | 0x0000_A0B0 | W   | 1                 | Store pixel correction data in memory (White)  |
| PixelCorrectDataSave Black             | 0x0000_A11C | W   | 1                 | Store pixel correction data in memory (Black)  |
| PixelCorrectData_ResetToFactoryDefault | 0x0000_A260 | W   | 1                 | Pixel correction data reset to factory settings  |
| <i>Category : User Set Control</i>     |             |     |                   |  |
| UserSet_ResetToFactoryDefault          | 0x0000_A0B8 | W   | 1                 | UserSet data reset to factory settings   |
| UserSet_Load                           | 0x0000_A0BC | W   | 1                 | Readout setup data in memory   |
| UserSet_Save                           | 0x0000_A0C0 | W   | 1                 | Store present setup data in memory   |

### 5.1.3 Memory Setup Values (Factory Settings)

The memory setup values (factory settings) are shown below.

**Table 5-1-3-1 Memory Setup Values (Factory Settings)**

| Control Item         | Address     | VAL     | Control Description                  |
|----------------------|-------------|---------|--------------------------------------|
| Device User ID       | 0x0000_20C0 | 0x00    |                                      |
| CxpLinkConfig        | 0x0000_4014 | 0x20030 | Dual CXP-2                           |
| Width                | 0x0000_A000 | 4096    | 4096 Pixels                          |
| Binning Horizontal   | 0x0000_A280 | 1       | Horizontal Binning OFF               |
| NED_TDIMode          | 0x0000_A254 | 0       | Dual line(average)                   |
| PixelFormat          | 0x0000_A014 | 0x101   | Mono8(8bit)                          |
| Acquisition Start    | 0x0000_A00C | 0       | Stop                                 |
| Acquisition Stop     | 0x0000_A010 | 1       | Stop                                 |
| NED_GammaMode        | 0x0000_A258 | 0       | Off( $\gamma$ 1.00)                  |
| Gamma                | 0x0000_A25C | 1000    | $\gamma$ 1.000                       |
| AnalogGain           | 0x0000_A080 | 0       | x1.00                                |
| DigitalGain          | 0x0000_A084 | 0       | x1.00                                |
| DigitalOffset        | 0x0000_A088 | 0       | 0                                    |
| ExposureMode         | 0x0000_A08C | 0       | FreeRun                              |
| ExposureTimeCounter  | 0x0000_A094 | 10000   | 117.647 $\mu$ s                      |
| Padding              | 0x0000_A098 | 0       | 2.129 $\mu$ s                        |
| TestImageSelector    | 0x0000_A0A4 | 0       | Off                                  |
| ReverseX             | 0x0000_A0B4 | 0       | Forward                              |
| LineDelay            | 0x0000_A0E4 | 0       | Line Delay 0<br>(Not use line delay) |
| PixelCorrectSetMode  | 0x0000_A0A8 | 1       | Factory white (Factory Black)        |
| PixelCorrectSetLevel | 0x0000_A0AC | 200     |                                      |



## 5.2 Programmable Exposure Time • Exposure-Readout Time calculation procedure

Programmable Exposure Time ( $\mu\text{s}$ ) =  $\text{ExposureTimeCounter} \div 85.0$

Exposure-Readout Time ( $\mu\text{s}$ ) =  $2.129 + \{ \text{Padding} \div 85.0 \}$

Scan Rate ( $\mu\text{s}$ ) =  $\text{Programmable Exposure Time} + (\text{Exposure-Readout Time})$

Calculated example)

ExposureTimeCounter : (0x0000\_A094) = 10000

Padding : (0x0000\_A098) = 0

Programmable Exposure Time =  $10000 \div 85.0 = 117.647 \mu\text{s}$

Exposure-Readout Time =  $2.129 + (0 \div 85.0) = 2.129 \mu\text{s}$

Scan Rate =  $117.647 + 2.129 = 119.776 \mu\text{s}$

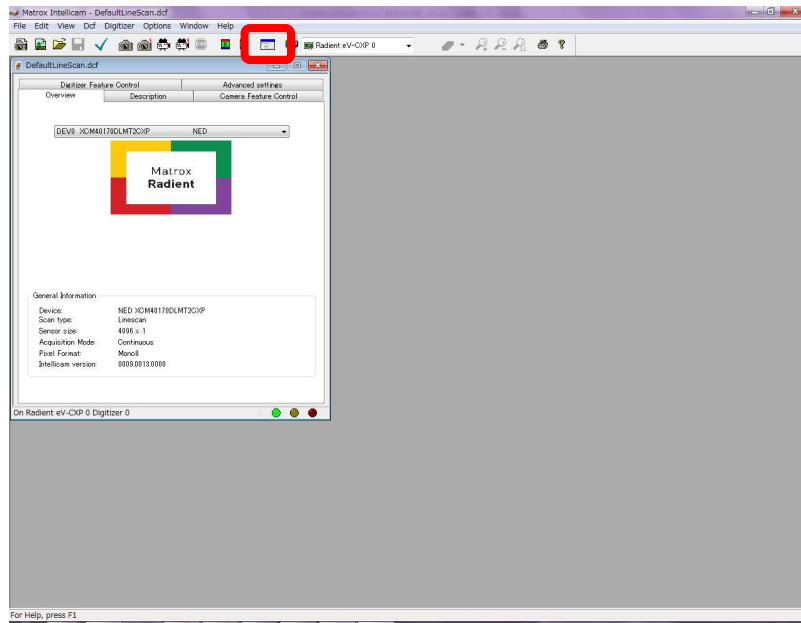
## 5.3 Details on register system

This explanation uses the Matrox Radiant eV-CXP as an example.

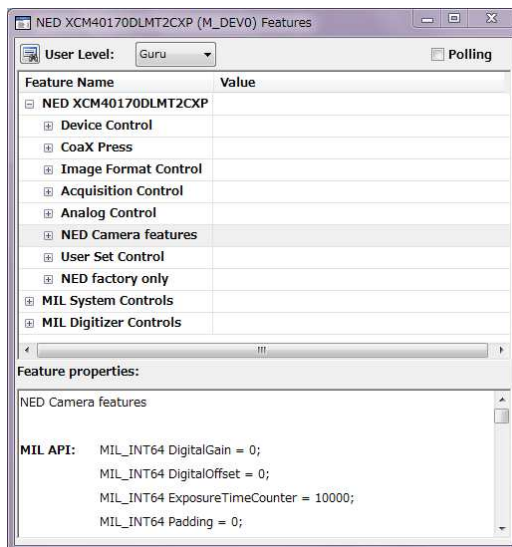
① Run Intellicam (part of Matrox Imaging Library).



② Open the DCF file and the Feature Browser.



③ Control the camera from the Features box.

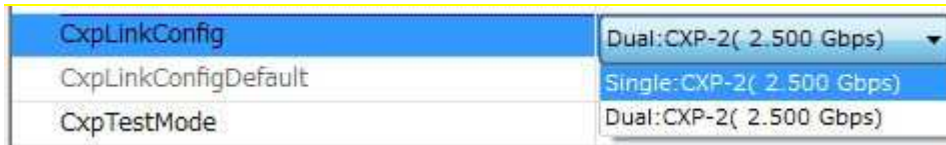


- ◆ In the case of the Matrox Radient, the list of registers is displayed in the window. Change the settings via the dropdown list or spinners.

### 5.3.1 Setting LinkConfig

Sets Links of camera、Dual(2 cables)/Single(1 cable)

- Register name CxpLinkConfig
- VAL Single:CXP-2(2.500Gbps) / Dual: CXP-2(2.500Gbps)  
 (Example) Single(1 cable)  
 CxpLinkConfig : Single:CXP-2(2.500Gbps)



After setting, run the memory save function in 5.3.21.

Also, need to re-discovery.

If you did not the memory saving, it will go back to the original setting value when the power is turned on again.

### 5.3.2 Setting Horizontal Binning

Sets horizontal binning.

- Register name Binning Horizontal
- VAL 1 / 2 (Binning Off : 4096pixels / 2px Binning : 2048pixels)  
 (Example) 2px Binning (2048 pixels)  
 Binning Horizontal : 2  
 By setting value, it will change the width.



### 5.3.3 Setting TDI mode

Sets TDI mode.

- Register name NED\_TDIMode
- VAL 0 / 1 / 2 / 3  
(Dual line(average) / Single line A / Dual line(addition) / Single line B)
- (Example) Dual line mode(Additional average)  
NED\_TDIMode : Dual line(average)

| Image Format Control |                      |
|----------------------|----------------------|
| Width                | 2048                 |
| Height               | 1                    |
| Binning Horizontal   | 2                    |
| NED_TDIMode          | Dual line(average) ▼ |
| PixelFormat          | Dual line(average)   |
| Tap Geometry         | Single line A        |
| Image1StreamID       | Dual line(addition)  |
| Image2StreamID       | Single line B        |

### 5.3.4 Setting Pixel Format

Sets pixel format of camera.

- Register name PixelFormat
- VAL Mono8 / Mono10  
(Example) Mono 8bit  
Pixel Format : Mono8

|                |         |
|----------------|---------|
| PixelFormat    | Mono8 ▼ |
| Tap Geometry   | Mono8   |
| Image1StreamID | Mono10  |

### 5.3.5 Setting Gamma Correction

Sets gamma correction.

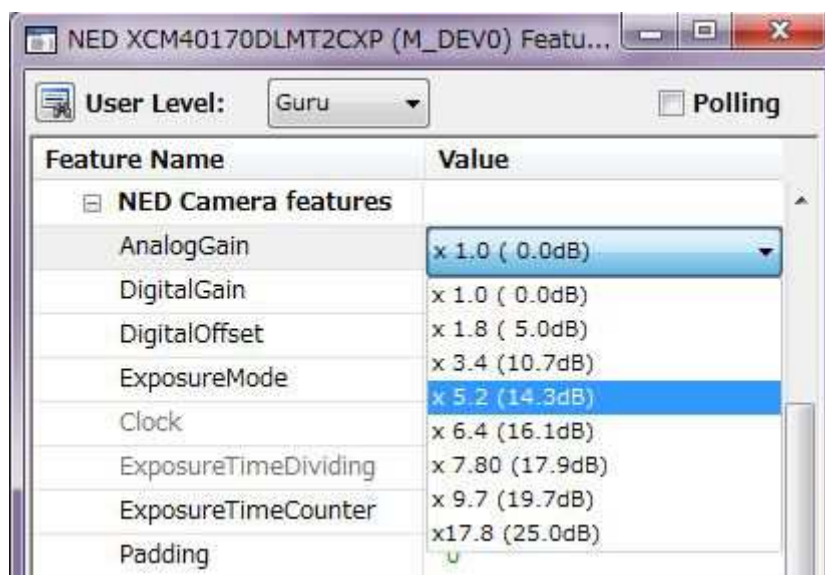
- Register name NED\_GammaMode
- VAL 0 / 1 / 2 / 3 / 4  
(Off( $\gamma$ 1.00) /  $\gamma$ 0.45 /  $\gamma$ 0.56 / Negative Positive inversion / Custom)
- Register name Gamma (Custom mode only)
- VAL 0.250 to 4.000 ( $\gamma$ 0.250~4.000)  
(Example) Custom  $\gamma$ 0.3  
NED\_GammaMode : Custom  
Gamma : 0.3



### 5.3.6 Setting Analog Gain

Sets analog gain between x1 and x17.8.

- Register name AnalogGain
- VAL x 1 ~ x 17.8  
(Example) Setting analog gain[X 5.2]  
AnalogGain : x 5.2(14.3dB)



### 5.3.7 Setting Digital Gain


Sets digital gain in 512 steps between x1 and x2

Digital Gain :  $1023 / (1023 - \text{VAL})$

- Register name Digital Gain
- VAL 0 (x1)~511 (x2)

(Example)

Digital Gain: 255 (Setting digital gain  $255(1023/(1023-255))=x1.33$ )

| NED Camera features |  |
|---------------------|--|
| AnalogGain          | x 1.0 ( 0.0dB)   |
| DigitalGain         | 255  |
| DigitalOffset       | 5  |
| ExposureMode        | Free run   |
| Clock               | 85.0   |


### 5.3.8 Setting Digital Offset

Sets digital offset -127~+127(8bit : 0.5DN/Step), -127~+127(10bit : 2DN/Step)

- Register name DigitalOffset
- VAL -127 ~ +127

(Example)

Digital Offset: 5

| NED Camera features |  |
|---------------------|--|
| AnalogGain          | x 1.0 ( 0.0dB)   |
| DigitalGain         | 255  |
| DigitalOffset       | 5  |
| ExposureMode        | Free run   |
| Clock               | 85.0   |

### 5.3.9 Setting Exposure Mode

Sets the exposure mode.

- Register name ExposureMode
- VAL Free run / External edge / External level

(Example)

ExposureMode: Free run

|   |                |
|---|----------------|
| <input type="checkbox"/> <b>NED Camera features</b> |                |
| AnalogGain  | x 1.0 ( 0.0dB) |
| DigitalGain   | 255            |
| DigitalOffset                                       | 5              |
| ExposureMode  | Free run       |
| Clock   | Free run       |
| ExposureTimeDividing                                | External edge  |
| ExposureTimeCounter                                 | External level |

### 5.3.10 Setting Exposure Time

Sets the exposure time.

- Register name ExposureTimeCounter
- VAL 915~1048575 (Setting Counter)

(Example)

ExposureTimeCounter : 10000

The changes will be reflected in Integration Time and Scanrate.

|                      |          |
|----------------------|----------|
| ExposureMode         | Free run |
| Clock                | 85.0     |
| ExposureTimeDividing | 0        |
| ExposureTimeCounter  | 10000    |
| Padding              | 0        |
| IntegrationTime      | 117.647  |
| FixedBlanking        | 2.129    |
| Scanrate             | 119.776  |

### 5.3.11 Setting Exposure-Readout Time

Sets exposure-readout time.

- Register name Padding
- VAL 0~1048575

(Example)

Padding : 200

The changes will be reflected in Padding Time and Scanrate.

|                      |          |
|----------------------|----------|
| ExposureMode         | Free run |
| Clock                | 85.0     |
| ExposureTimeDividing | 1        |
| ExposureTimeCounter  | 10000    |
| Padding              | 200      |
| IntegrationTime      | 117.647  |
| PaddingTime          | 2.353    |
| FixedBlanking        | 2.129    |
| Scanrate             | 122.129  |

### 5.3.12 Generating Test Pattern

Generates test pattern.

- Register name Test Image Selector
- VAL Off / GreyHorizontalRamp

(Example)

TestImageSelector: GreyHorizontalRamp

|                      |                    |
|----------------------|--------------------|
| TestImageSelector    | Off                |
| PixelCorrectSetMode  | Off                |
| PixelCorrectSetLevel | GreyHorizontalRamp |



### 5.3.13 Setting Pixel Readout Direction

Sets the pixel readout direction.

- Register name ReverseX
- VAL clear the check box(Forward) / check box (Reverse)

(Example)

ReverseX : Check box

|                   |                                     |
|-------------------|-------------------------------------|
| TestImageSelector | Off                                 |
| ReverseX          | <input checked="" type="checkbox"/> |
| LineDelay         | 0                                   |

### 5.3.14 Setting Line Delay

Sets line delay when TDI mode is “Dual line”.

- Register name LineDelay
- VAL -1 / 0 / 1

(Example) Line Delay 1


LineDelay : 1

|                     |                          |
|---------------------|--------------------------|
| ReverseX            | <input type="checkbox"/> |
| LineDelay           | 1                        |
| PixelCorrectSetMode | Factory white            |

### 5.3.15 Setting Pixel Correction

Sets pixel correction.

- Register name Pixel Correct Set Mode
- VAL Disable / Factory white / User white / User Black +  
Factory white / User Black + User white
- Register name Pixel Correct Set Level
- VAL 0 ~ 255 (Setting correction level: 8bit)  
(Example) : for Factory white, correction level 127  
PixelCorrectSetMode : Factory white  
PixelCorrectSetLevel : 127

|                          |               |  |
|--------------------------|---------------|--|
| LineDelay                | 0             |  |
| PixelCorrectSetMode      | Factory white |  |
| PixelCorrectSetLevel     | 127           |  |
| PixelCorrectDataSave     | Execute()     |  |
| PixelCorrectDataSaveB... | Execute()     |  |

### 5.3.16 Getting User White

Gets arbitrary user white data, save the memory.

- Register name PixelCorrectDataSave
- VAL Execute()

|                          |           |  |
|--------------------------|-----------|--|
| PixelCorrectDataSave     | Execute() |  |
| PixelCorrectDataSaveB... | Execute() |  |

### 5.3.17 Getting User Black

Gets arbitrary user black data, save the memory.

- Register name PixelCorrectDataSaveBlack
- VAL Execute()

|                              |           |  |
|------------------------------|-----------|--|
| PixelCorrectDataSave         | Execute() |  |
| PixelCorrectDataSaveBlack    | Execute() |  |
| PixelCorrectData_ResetToF... | Execute() |  |

### 5.3.18 Reset User White-Black

After reset the user white-black correction data, return to the factory value.

To reset, it takes about 1 minute.

Please do not turn off the camera until the command is completed.

- Register name PixelCorrectData\_ResetToFactoryDefault
- VAL Execute()

|  |           |
|--|-----------|
| PixelCorrectDataSave                   | Execute() |
| PixelCorrectDataSaveBlack              | Execute() |
| PixelCorrectData_ResetToFactoryDefalut | Execute() |

### 5.3.19 Memory Initializing (Initializing Camera Settings)

Reset the flash memory to the factory default.

- Register name User Set\_Reset to Factory Default
- VAL Execute()

|                             |           |
|-----------------------------|-----------|
| UserSet_ResetToFactoryDe... | Execute() |
|-----------------------------|-----------|

### 5.3.20 Memory Load (Reads out the camera settings from the flash memory)

Reads out the camera settings from the flash memory

- Register name User Set\_Load
- VAL Execute()

|              |           |
|--------------|-----------|
| UserSet_Load | Execute() |
|--------------|-----------|

### 5.3.21 Memory Save

Stores current camera settings in the flash memory.

- Register name User Set\_Save
- VAL Execute()

|              |           |
|--------------|-----------|
| UserSet_Save | Execute() |
|--------------|-----------|

### 5.3.22 Setting Line Delay, TDI mode by the horizontal binning

To this camera, as a horizontal binning function, there are two types of Binning Off(4096pixels) and 2pixel Binning(2048pixels).

It summarizes how to set LineDelay and NED\_TDI Mode to be related Binning Horizontal in the following Table.

**Table 5-3-22-1 Setting Line Delay, TDI mode by the horizontal binning**

| Binning Horizontal  | LineDelay                                 | NED_TDI Mode  |               | Description   |  |
|---------------------|---|---------------|---------------|---|--|
| 1<br>Binning<br>Off | 0<br>No delay                             | 0             | Average       | Purpose : Improvement S/N ratio<br>Pixel size : 7x14um    |  |
|                     |   | 1             | A-line output | Output A-line only  |  |
|                     |   | 2             | Addition      | Purpose : Improvement Responsivity<br>Pixel size : 7x14um |  |
|                     |   | 3             | B-line output | Output B-line only  |  |
|                     | 1<br>Setting<br>1line delay<br>(Forward)  | 0             | Average       | Improvement S/N ratio                                     |  |
|                     |   | 1             | —             | —   |  |
|                     |   | 2             | Addition      | Improvement Responsivity                                  |  |
|                     |   | 3             | —             | —   |  |
|                     | -1<br>Setting<br>1line delay<br>(Reverse) | 0             | Average       | Improvement S/N ratio                                     |  |
|                     |   | 1             | —             | —   |  |
|                     |   | 2             | Addition      | Improvement Responsivity                                  |  |
|                     |   | 3             | —             | —   |  |
|                     | 2<br>2pixels<br>Binning                   | 0<br>No delay | 0             | Average   | Improvement S/N ratio<br>(Output signal is average of 4pixels)<br>Pixel size is 14x14um          |
|                     |   |               | 1             | —   | —  |
|                     |   |               | 2             | Addition  | Improvement Responsivity<br>(Output signal is digital added of 4pixels)<br>Pixel size is 14x14um |
|                     |   |               | 3             | —   | —  |
| 1<br>Not use        |   | 0             | —             | —   |  |
|                     |   | 1             | —             | —   |  |
|                     |   | 2             | —             | —   |  |
|                     |   | 3             | —             | —   |  |
| -1<br>Not use       |   | 0             | —             | —   |  |
|                     |   | 1             | —             | —   |  |
|                     |   | 2             | —             | —   |  |
|                     |   | 3             | —             | —   |  |



## 5.6 Saving and Loading Camera Settings

The camera setting data is saved in the internal memory (flash memory) and is loaded from the memory when turning on the power supply or loading.

The number of times the flash memory can be rewritten will vary depending on actual operational conditions. After turning on the power supply, the camera always checks the memory status. If the data is not within the designated range due to a malfunction or other type of trouble, the memory will be automatically rewritten with the factory settings.

If disconnecting camera power while rewriting the memory, all data saved in the memory will be deleted.

As it takes several seconds to rewrite the memory, do not disconnect the power supply before receiving the response from the camera.

Registers for rewriting the memory are as follows.

- Get Pixel Correction User-white data (PixelCorrectDataSave)
- Get Pixel Correction User-black data (PixelCorrectDataSaveBlack)
- Reset to factory setting (PixelCorrectData\_ResetToFactoryDefault)
- Initialize memory (Userset\_ResetToFactoryDefault)
- Save memory (Userset\_Save)
- ◆ When changing the factory setting exposure mode, be sure to send the control input signal (Trigger packet) from the frame grabber board. If you do not send or sending control input signals are out of the designated range, you cannot get images and cannot change the setting. See 5.9.2 and 5.9.3.

**Table 5-6-1 Camera Operation Mode and Control Input**

| Camera operation mode<br>(Exposure mode)                       | Control input<br>(from frame grabber board)   |
|--|---|
| Free Run (Programmable time setting)<br>(Factory Setting)      | Not in use                                    |
| Ext Edge (External trigger edge+ Programmable<br>time setting) | External trigger (Trigger packet) is required |
| Ext Level (External trigger level time setting)                | External trigger (Trigger packet) is required |

## 5.7 Video Output Format

The camera outputs 8-bit or 10-bit black and white digital data (Pixel Format : Mono 8 or Mono 10) through CoaXPress IF.

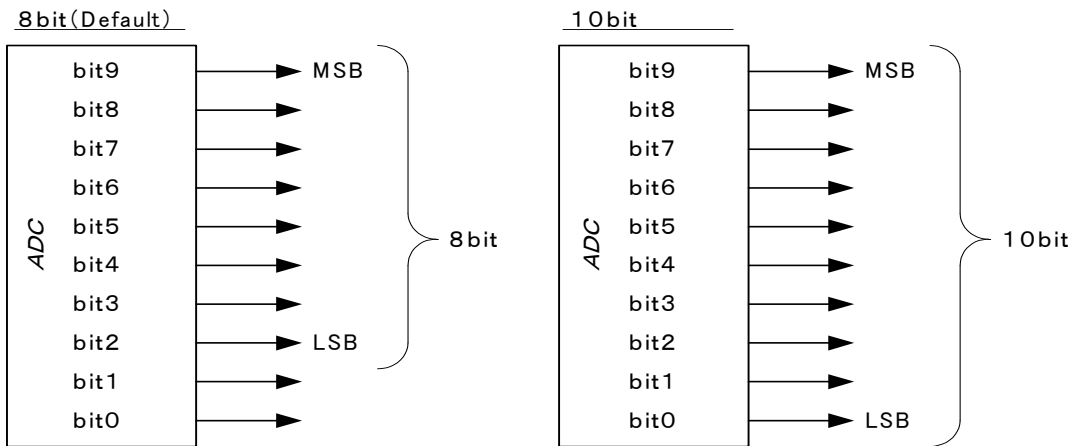


Figure 5-7-1 Assignments of Digital Data

- ◆ The A/D converter of the camera has a 10-bit resolution. For 8-bit output, the upper 8-bit signal can be output as a video data.

## 5.8 XML file

The XML file is a file saved in the camera which contains the register information described in chapter 5.

According to the CoaXPress specification, when “Device Discovery” is performed from the camera control software supplied with the frame grabber, this file is read out, and the camera control registers are displayed in the camera control software (in the case of some manufacturers, they may not be displayed)

- ◆ However, if the frame grabber does not support GenICam, this function is not available.

## 5.9 Exposure Mode and Timing Chart

The camera has three exposure modes. The overview of each mode and the timing are as follows.

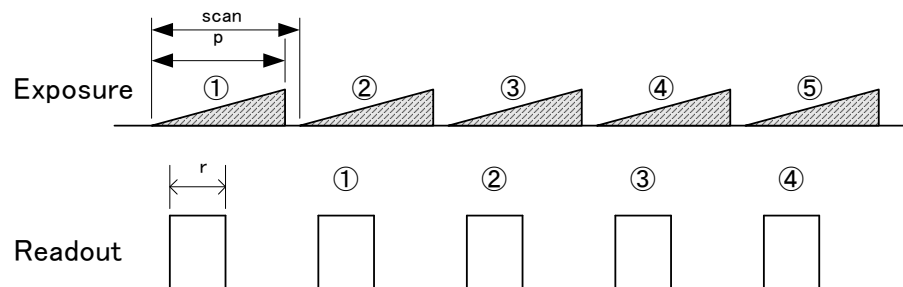
### 5.9.1 Free Run Exposure Mode

In free-run exposure mode, the camera generates its own internal control signal based on two programmable parameters, exposure time and readout time.

**Table 5-9-1-1 Free Run Programmable Exposure Time**

|   |                            |                   |                  |
|---|----------------------------|-------------------|------------------|
| p | Programmable exposure time | 4096pixels_Dual   | 10.765~12336.176 |
|   |                            | 4096pixels_Single | 23.000~12336.176 |
|   |                            | 2048pixels_Dual   | 10.941~12336.176 |
|   |                            | 2048pixels_Single | 10.941~12336.176 |
| r | Readout time               | 4096pixels_Dual   | 12.05            |
|   |                            | 4096pixels_Single | 24.09            |
|   |                            | 2048pixels_Dual   | 12.05            |
|   |                            | 2048pixels_Single | 12.05            |

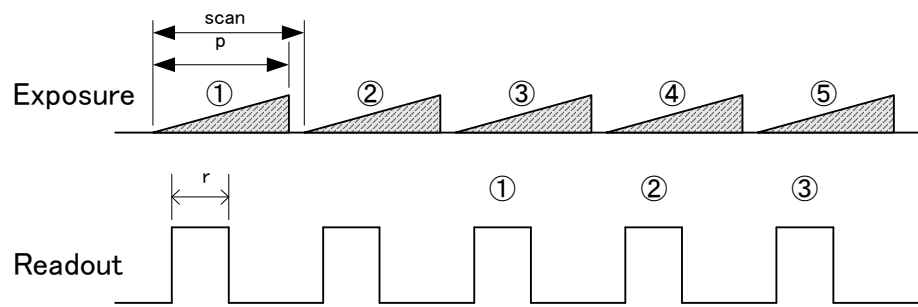
(Unit:μs)



**Figure 5-9-1-1 Free Run Exposure Mode(In case of 4096 pixels)**

- ◆ The data of Exposure (1) is read out at Readout (1)





**Figure 5-9-1-2 Free Run Exposure Mode(In case of 2048 pixels)**

- ◆ The data of Exposure (1) is read out at Readout (1)

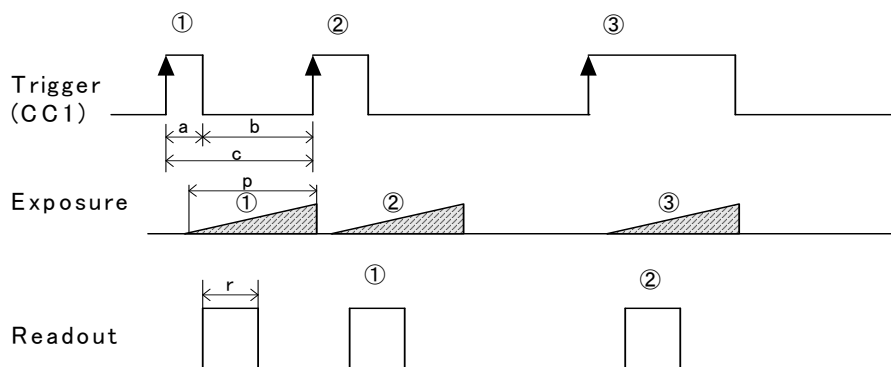
### 5.9.2 External Trigger Exposure Mode (Trigger Edge)

In external trigger exposure mode (Trigger Edge), the exposure time is determined by setting the control register, and the line period is determined by the external trigger period. Each exposure starts with the rising edge of the trigger pulse. The range of programmable exposure time and the timing chart of the exposure and the readout are shown below.

**Table 5-9-2-1 External Trigger (Trigger Edge) Programmable Exposure Time**

|   |                            |                   |                  |
|---|----------------------------|-------------------|------------------|
| p | Programmable exposure time | 4096pixels_Dual   | 10.765~12336.176 |
|   |                            | 4096pixels_Single | 23.000~12336.176 |
|   |                            | 2048pixels_Dual   | 10.941~12336.176 |
|   |                            | 2048pixels_Single | 10.941~12336.176 |
| r | Readout time               | 4096pixels_Dual   | 12.05            |
|   |                            | 4096pixels_Single | 24.09            |
|   |                            | 2048pixels_Dual   | 12.05            |
|   |                            | 4096pixels_Single | 12.05            |
| a | Trigger pulse H time       | $\geq 2.9$        |                  |
| b | Trigger pulse L time       | $\geq 2.9$        |                  |
| c | Trigger pulse cycle        | 4096pixels_Dual   | $\geq 13.12$     |
|   |                            | 4096pixels_Single | $\geq 25.93$     |
|   |                            | 2048pixels_Dual   | $\geq 13.43$     |
|   |                            | 2048pixels_Single | $\geq 13.43$     |

(Unit:  $\mu$ s)



**Figure 5-9-2-1 External Trigger (Trigger Edge) Exposure Mode (In case of 4096 pixels)**

- ◆ The data of Exposure (1) is read out at Readout (1)

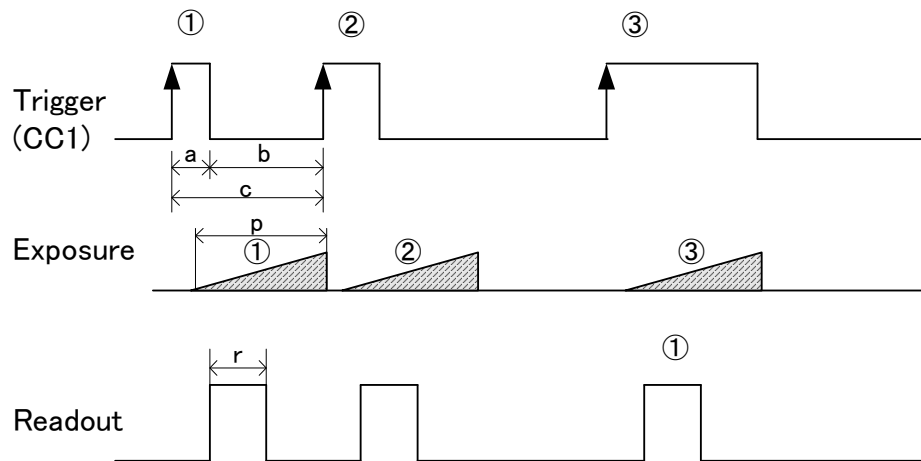


Figure 5-9-2-2 External Trigger (Trigger Edge) Exposure Mode (In case of 2048 pixels)

- ◆ The data of Exposure (1) is read out at Readout (1)

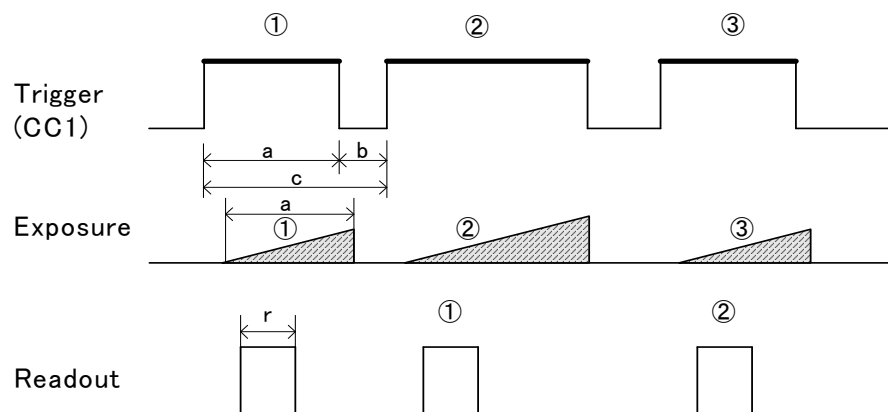
### 5.9.3 External Trigger Exposure Mode (Trigger Level)

In external trigger exposure mode (Trigger Level), the exposure time is determined by the high trigger pulse time, and the line period is determined by the external trigger period. Each exposure starts with the rising edge of the trigger pulse. The range of programmable exposure time, the timing chart of the exposure and the readout are shown below.

**Table 5-9-3-1 ExternalTrigger(Trigger Level) Programmable Exposure Time**

|   |                      |                   |              |
|---|----------------------|-------------------|--------------|
| r | Readout time         | 4096pixels_Dual   | 12.05        |
|   |                      | 4096pixels_Single | 24.09        |
|   |                      | 2048pixels_Dual   | 12.05        |
|   |                      | 2048pixels_Single | 12.05        |
| a | Trigger pulse H time | 4096pixels_Dual   | $\geq 10.22$ |
|   |                      | 4096pixels_Single | $\geq 23.03$ |
|   |                      | 2048pixels_Dual   | $\geq 10.53$ |
|   |                      | 2048pixels_Single | $\geq 10.53$ |
| b | Trigger pulse L time | $\geq 2.9$        |              |
| c | Trigger pulse cycle  | 4096pixels_Dual   | $\geq 13.12$ |
|   |                      | 4096pixels_Single | $\geq 25.93$ |
|   |                      | 2048pixels_Dual   | $\geq 13.43$ |
|   |                      | 2048pixels_Single | $\geq 13.43$ |

(Unit:  $\mu\text{s}$ )



**Figure 5-9-3-1 External Trigger (Trigger Level) Exposure Mode (In case of 4096 pixels)**

- ◆ The data of Exposure (1) is read out at Readout (1)

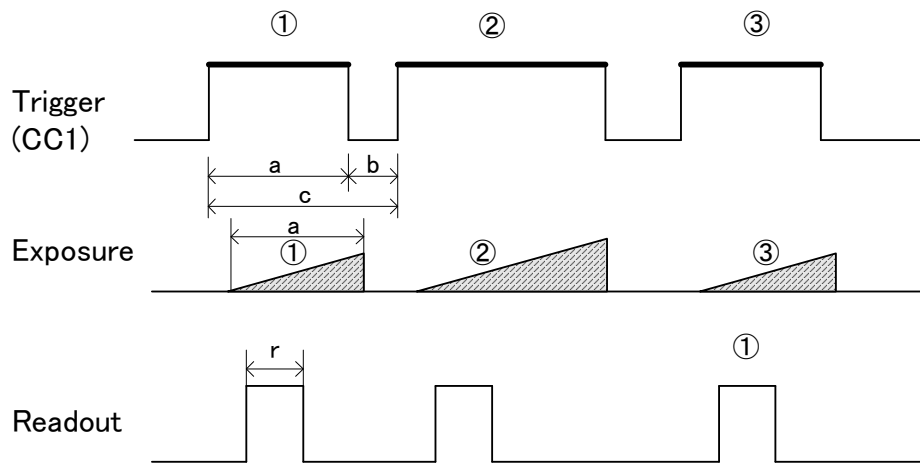


Figure 5-9-3-2 External Trigger (Trigger Level) Exposure Mode (In case of 2048 pixels)

- ◆ The data of Exposure (1) is read out at Readout (1)

### 5.10 Setting Offset

In the figure below, the horizontal axis indicates the amount of incident light and the vertical axis indicates the output.

$F_s$  shows the output at saturation.  $D_d$  shows the output at darkness. (Both  $F_s$  and  $D_d$  are digital.)  $S_e$  shows the saturation current, or the amount of exposure when the output saturates.

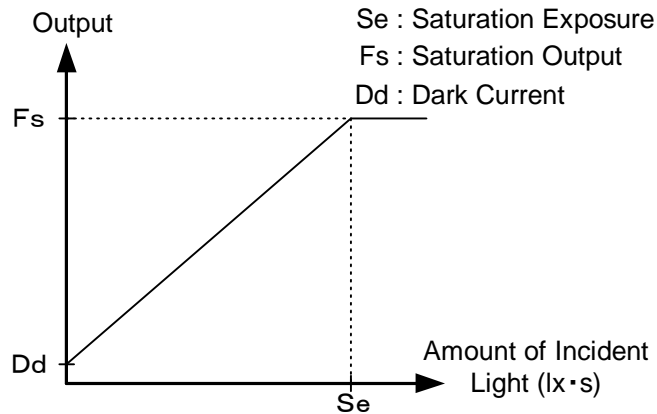


Figure 5-10-1 Saturation Exposure and Dark Current Output

By setting the offset, you can set the Y-intercept arbitrarily.  $D_f$  shows the digital offset value. The gradient of the line does not change.

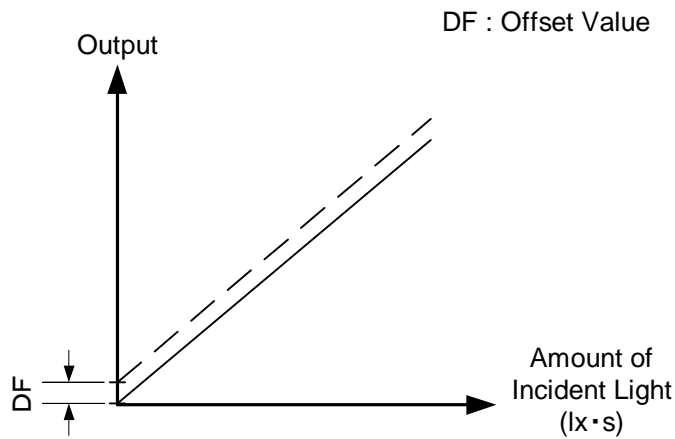


Figure 5-10-2 Offset Adjustment

- ◆ Adjust amount of offset in accordance with the requirements of your camera system.

### 5.11 Setting Gain

The camera can adjust the analog gain (x1 to x17.8) and the digital gain. As shown in the figure below, increasing the gain setting increases the gradient of the camera's response curve and results in a higher camera output for a given amount of light. Analog gain can be changed by setting the "AnalogGain" control register. Digital gain can be changed by setting the "DigitalGain" control register.

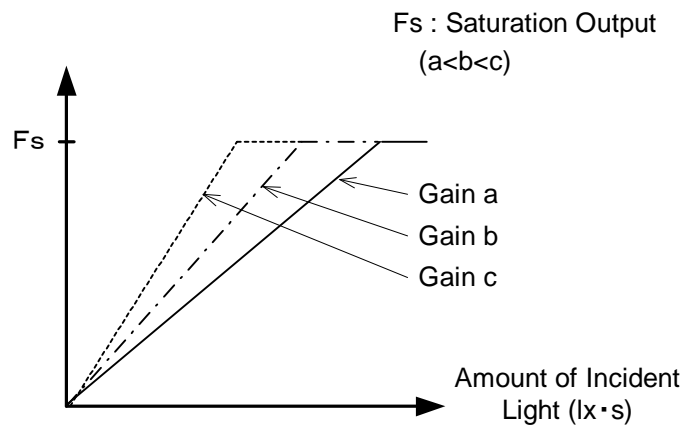


Figure 5-11-1 PGA Gain Adjustment

- ◆ Gain and noise values are proportionally related.
- ◆ Adjust the amount of gain in accordance with the requirements of your camera system.

Gain-Sensitivity is shown below.

**Table 5-11-1 Gain-Sensitivity**

| AnalogGain | Analog Amplifier |        | Sensitivity<br>(V/lx · s) |
|------------|------------------|--------|---------------------------|
| 0          | x1.0             | 0.0dB  | 125                       |
| 1          | x1.8             | 5.0dB  | 225                       |
| 2          | x3.4             | 10.7dB | 425                       |
| 3          | x5.2             | 14.3dB | 650                       |
| 4          | x6.4             | 16.1dB | 800                       |
| 5          | x7.8             | 17.9dB | 975                       |
| 6          | x9.7             | 19.7dB | 1213                      |
| 7          | x17.8            | 25.0dB | 2225                      |

Digital gain x1, Pixel correction:default(Factory white correction data, Correctionlevel 200DN /8-bit)



### 5.12 Pixel Correction

As a rule, image sensors (CCD, CMOS and so on) have fixed pattern noise and photo response non-uniformity. Lens shading and light sources can also cause non-uniformity. The camera is set to the optimal correction before shipping in order to provide images of the highest grade.

The camera also has a user white correction function to cope with lens shading and non-uniform illumination, or to be able to completely clear the uneven brightness generated by changing the spectral response level of the light source.

Cal\_bl: Output data of each pixel at perfectly dark (digital) Cal\_wh: Output data of each pixel in uniform illumination (digital) Target\_Val : Target value for correction (10bit digital) Vin : Input data (digital) Vout : Output data (digital) The corrected data is expressed in the following equation.  $V_{out} = (V_{in} - Cal_{bl}) \times Target\_val / (Cal_{wh} - Cal_{bl})$

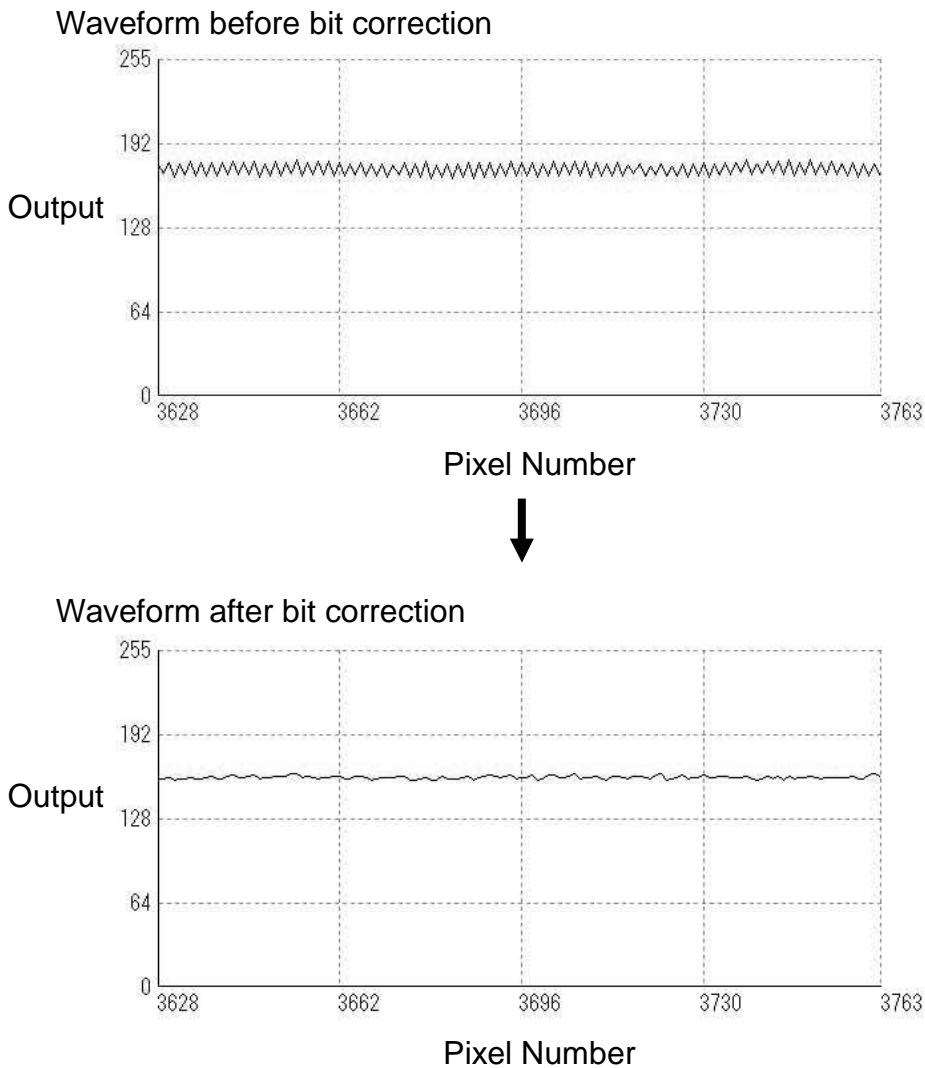


Figure5-12-1 Waveform before and after bit correction

### 5.12.1 How to Perform Pixel Correction

- ① Remove the lens cap and place a white object. Then you can acquire user white correction data. With a lens, the shading by both the lens and the light source will be simultaneously corrected. At this time, please defocus a little to avoid being affected by the non-uniformity of the object.


- ② Run PixelCorrectDataSave

|                          |           |
|--------------------------|-----------|
| PixelCorrectDataSave     | Execute() |
| PixelCorrectDataSaveB... | Execute() |

- ③ Complete PixelCorrectDataSave : Background color is change into white

|                           |           |
|---------------------------|-----------|
| PixelCorrectDataSave      | Execute() |
| PixelCorrectDataSaveBlack | Execute() |

- ④ Setting PixelCorrectSetLevel (Correction level : 8bit)

|                          |  |
|--------------------------|--|
| LineDelay                | 0  |
| PixelCorrectSetMode      | Factory white  |
| PixelCorrectSetLevel     | 127  |
| PixelCorrectDataSave     | Execute()  |
| PixelCorrectDataSaveB... | Execute()  |

### 5.13 Test Pattern

This camera can generate a test pattern. Use the test pattern to verify the proper timing and connections between the camera and the frame grabber board.



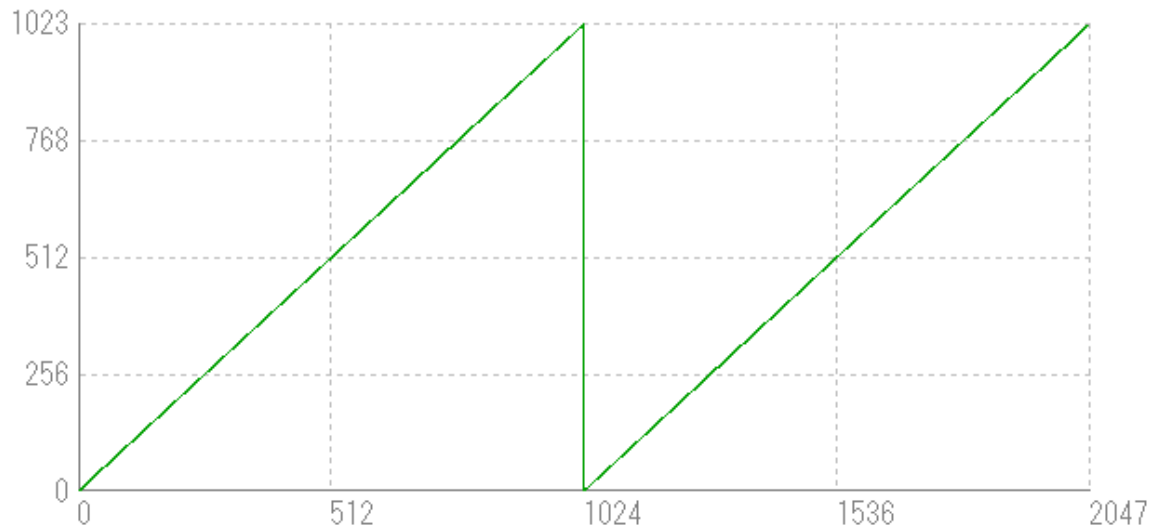
Figure 5-13-1 Test Pattern of XCM40170DLMT2CXP(4096pixels)



Figure 5-13-2 Test Image of XCM40170DLMT2CXP(4096pixels)

From pixel 0, 10bit data is output in order (0,1, 2, 3 ... 1023, 0, 1, 2), repeating 4 times.

In case of 8bit, data is output in order (0,0,0, 0, 1, 1, 1, 1, 2, 2, 2, 2, 3, 3, 3, 3 ... 255, 255, 255, 255), repeating 4 times.



**Figure 5-13-3 Test Pattern of XCM40170DLMT2CXP(2048pixels)**



**Figure 5-13-4 Test Image of XCM40170DLMT2CXP(2048pixels)**

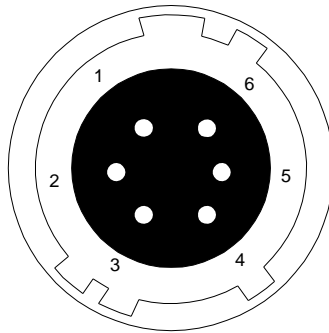
From pixel 0, 10bit data is output in order (0,1, 2, 3 ... 1023, 0, 1, 2), repeating 2 times.

In case of 8bit, data is output in order (0,0,0, 0, 1, 1, 1, 1, 2, 2, 2, 2, 3, 3, 3, 3 ... 255, 255, 255, 255), repeating 2 times.

## 6 Confirming Camera Settings

### 6.1 Before Power-on

- ① Make sure that the pin assignment of the power cable is correct.



| No | Name   |
|----|--------|
| 1  | 12~15V |
| 2  | 12~15V |
| 3  | 12~15V |
| 4  | GND    |
| 5  | GND    |
| 6  | GND    |

**Figure 6-1-1 Pin Assignment of Power Cable**

- ② Make sure that the coaxial cables are connected to the frame grabber board correctly as follows.

A 75Ω-type coaxial cable and connector must be used. The number of links and usable positions on the frame grabber board varies by board manufacturer.

(In the case of the Matrox Radiant eV-CXP there are 4 connectors, and 2 cameras can be connected)

Camera CXP1 → Frame Grabber CXP0

Camera CXP2 → Frame Grabber CXP1

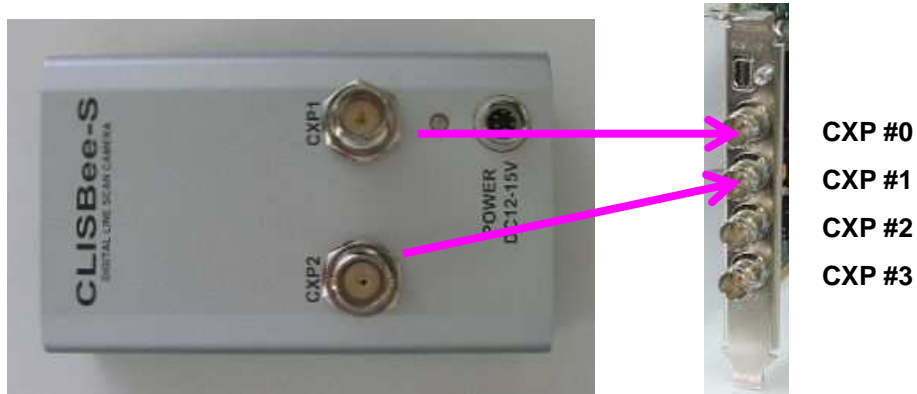


Figure 6-1-2 Channel of Camera Cables

## 6.2 After Power-on

Check the camera operation using the camera control software supplied with your frame grabber. For details please refer to your frame grabber's manual.

Capture images using a camera interface board utility. In the case of Matrox's Radiant eV-CXP, it is convenient to use Intellicam.

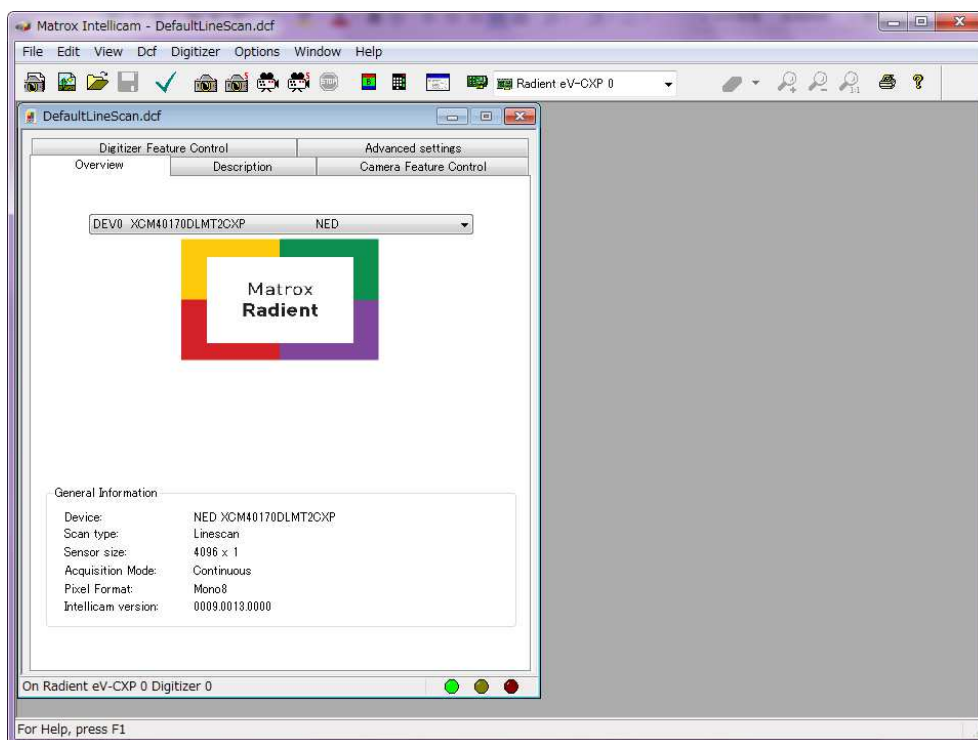


Figure 6-2-1 Radiant eV-CXP Window

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### 6.3 During Operation

(1) Does an acquisition time out error occur?

<Cause>

<1> Captured images are too large.

If there are many filtering processes, the assignments to the driver may be insufficient.

<2> The cable is detached from the connector

Ensure that the power cable and coaxial cables are connected to the camera firmly.

<3> Coaxial cables are susceptible to noise when the cables are laid near a light source inverter line or a power line. The personal computer in use may freeze and need to be reset.

(2) Are there dark lines in the direction of vertical scanning on the image?

<Cause>

<1> Dust on the sensor window

Dust may get onto the sensor window from the inside or the outside of the camera.

Remove the dust with air or a lens cleaner.

## 7 Sensor Handling Instructions

### 7.1 Electrostatic Discharge and the Sensor

CMOS sensors are susceptible to damage from electrostatic discharge and can become defective.

### 7.2 Protecting Against Dust, Oil and Scratches

The CMOS sensor window is part of the optical path and should be handled like other optical components with care. If you use the camera in a dusty area, prepare a dust-proof enclosure. Dust can obscure pixels, producing dark lines on the image.

### 7.3 Cleaning the Sensor Window

Dust: Can usually be removed by blowing the window surface using a compressed air blower.

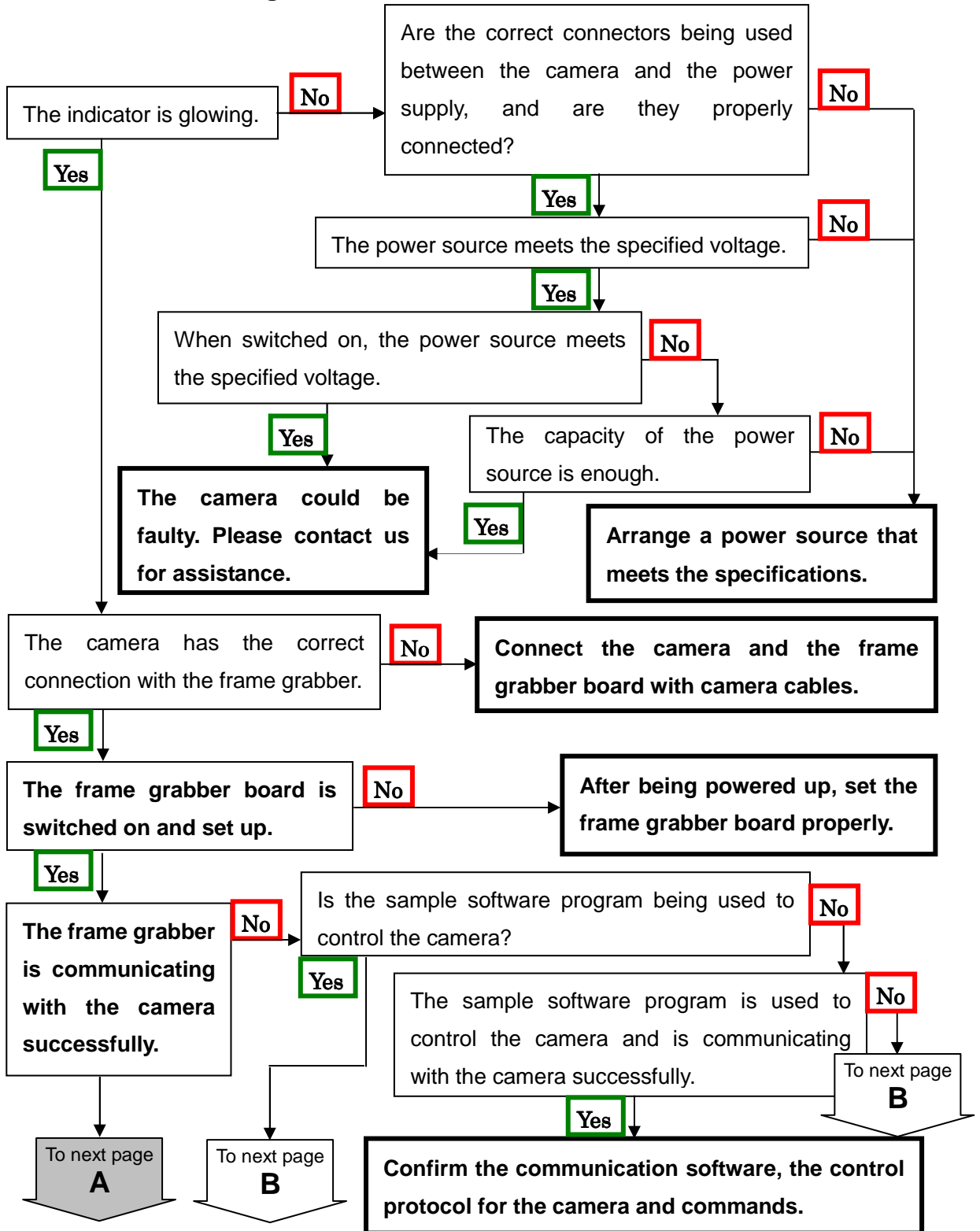
Oil: Wipe the window with a lint-free cloth wiper moistened with ethyl alcohol carefully and slowly.

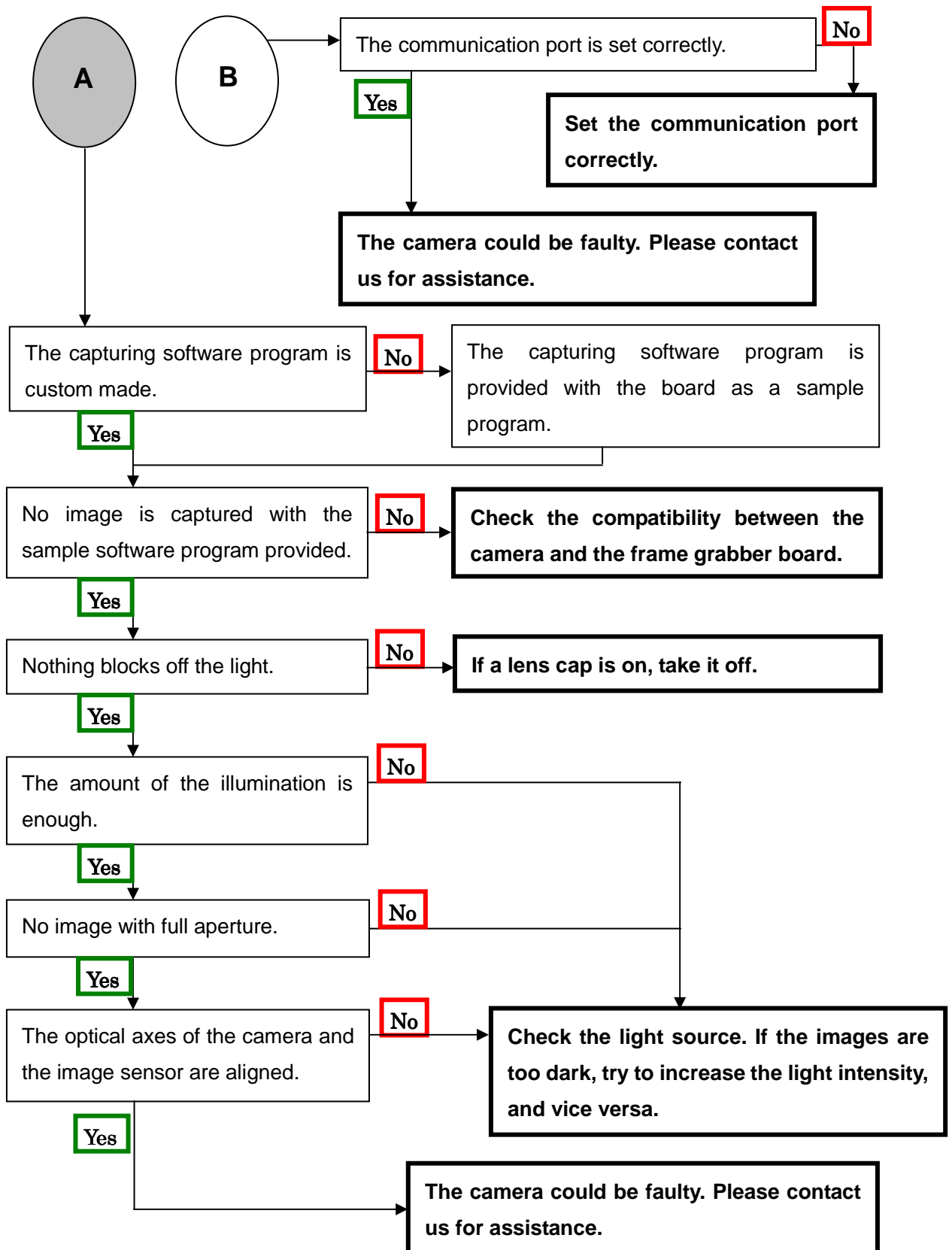


## 8 Troubleshooting

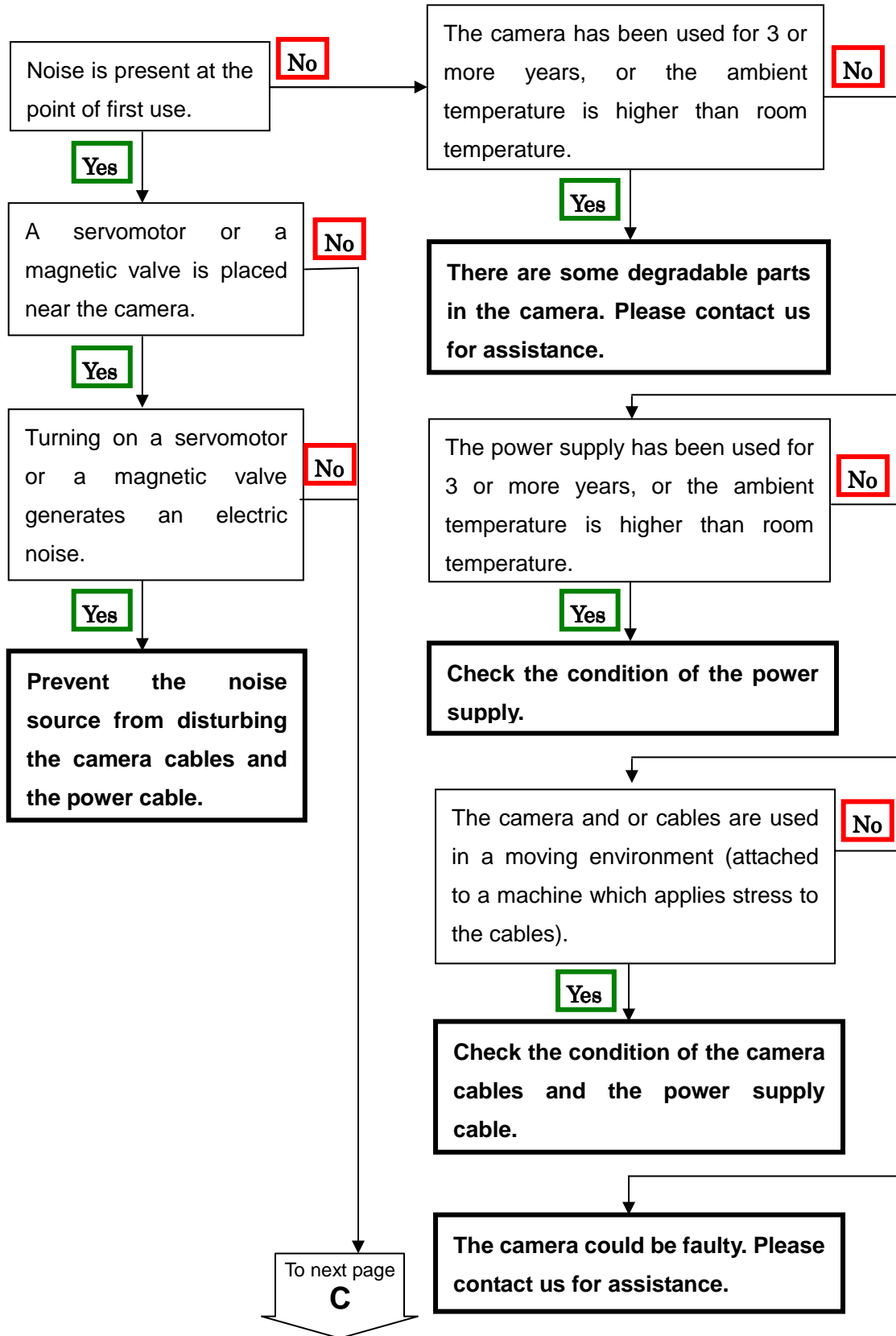
The following pages contain several troubleshooting charts that can help you find the cause of problems user sometimes encounters.

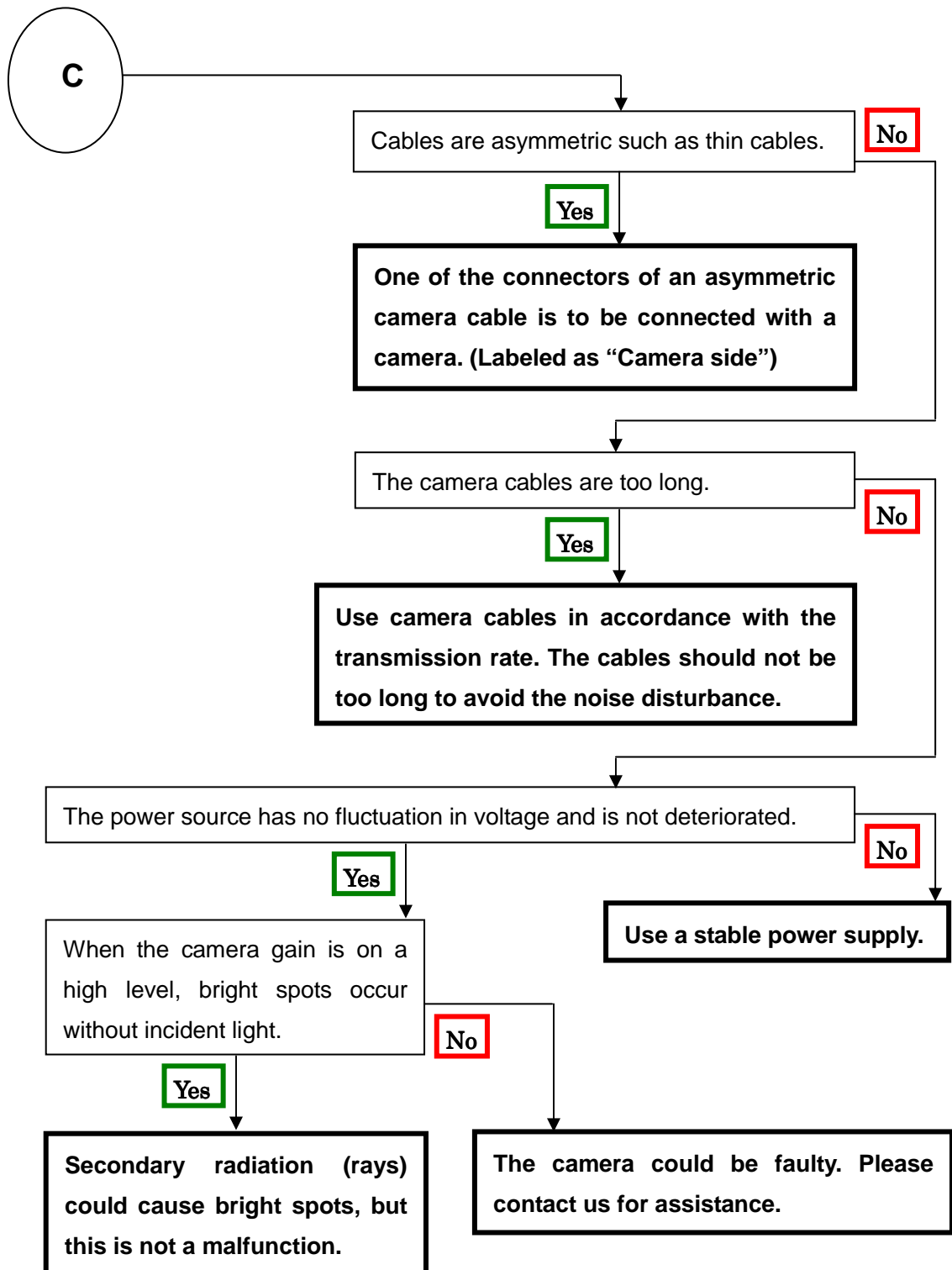
### 8.1 When there is no Image



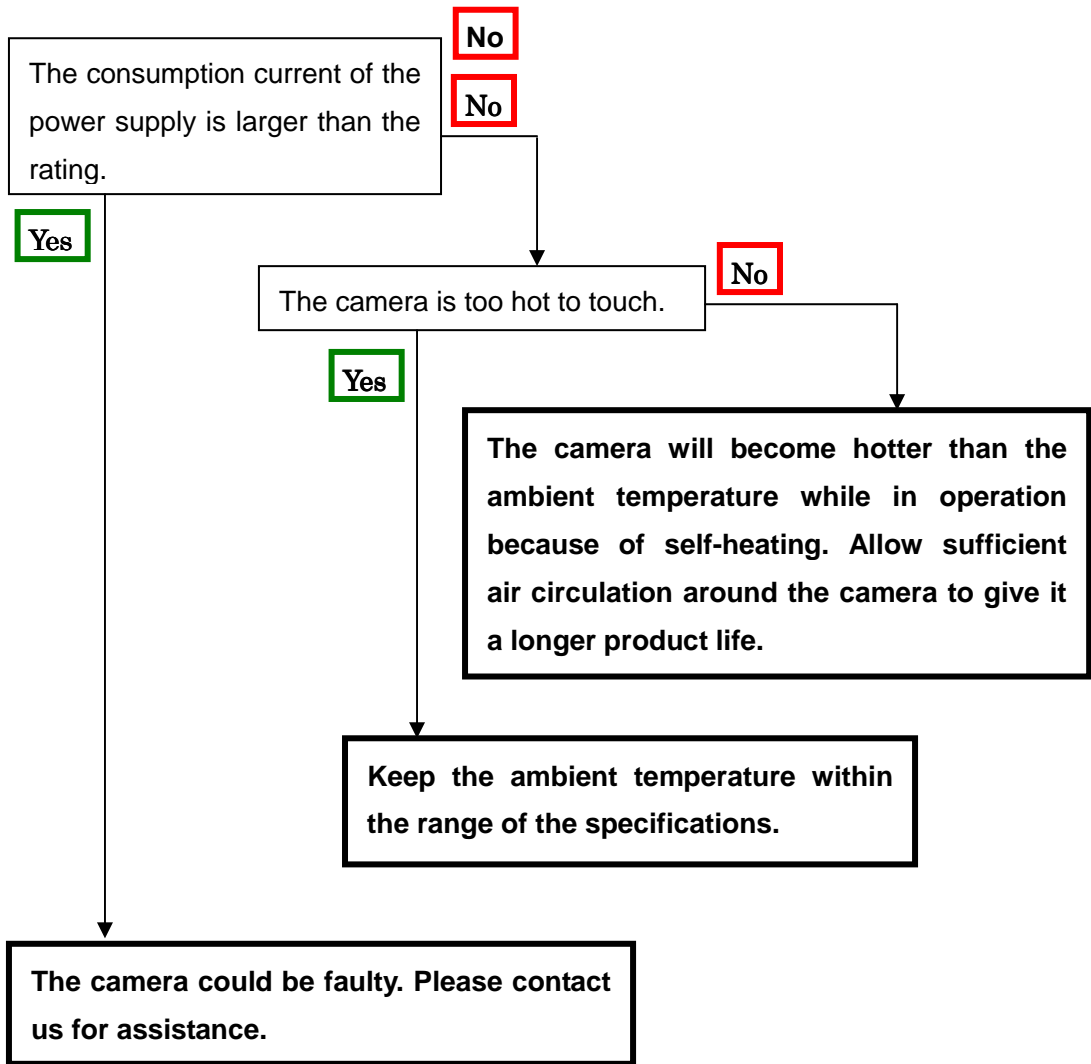


### 8.2 When Noise is present in the Image





### 8.3 When the Camera becomes hot



## 9 Others

### 9.1 Notice

- No part of this document may be reproduced in any form, in whole or in part, without the expressed written consent of NED.
- Contents of this document are subject to change without prior notice.
- Every care has been taken in the preparation of this User's Manual. If you should discover any errors or omissions, please notify your nearest NED representative.

### 9.2 Contact for support

Nippon Electro-Sensory Devices Corporation

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2-5-12, Itachibori, Nishi-ku, Osaka 550-0012, Japan

Phone +81-6-6534-5300

Fax +81-6-6534-6080

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Gibraltar Oi BLDG., Room No.402

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Phone +81-92-451-9333

Fax +81-92-451-9335

URL

<http://ned-sensor.co.jp/en>

E-Mail

[sales@ned-sensor.com](mailto:sales@ned-sensor.com)

### 9.3 Product Support

If there is still a problem with your camera after checking it in accordance with the troubleshooting guide, turn off the power and call your NED representative.

## Revision History

| Revision | Date          | Changes         |
|----------|---------------|-----------------|
| 01       | 24 March 2016 | Initial release |
|          |               |                 |