User's Manual

Line Scan Camera

Type: XCM4040DLMT4

NIPPON ELECTRO-SENSORY DEVICES CORPORATION

For Customers in the 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.

 Warning	If the product is not handled properly, this may result in serious injury or possible death.
 Caution	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. Moreover, this irregular sensitivity can be completely lost by using 4.11 pixel correction function. Please refer to 4.11 pixel correction function for details.
- 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 an embedded memory.

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.

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.

Table of Contents

1 Product Outline

1.1 Features

- 7μ 4096 pixels x 2 dual line scan camera
- Low noise image with 2 lines TDI mode
- Choice of 2 taps or 4 taps with 4096 pixels on data format
- Two type readout formats with 4096 pixels 4 taps
- Binning function on data format (14μm-square 2048 pixels_2tap equivalent by 2x2 pixels binning)
- On-chip A/D converter (8/10bit) on readout of all format
- Easy control of gain / offset / gamma exchange with software outside the camera.
- Easy connection with a variety of frame grabber boards via Camera Link interface
- Single power source DC 12V to 15V for operation
- PRNU / Shading correcting function
- The camera comes with an F-Mount.

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

An example of Visual Inspection of PCBs is shown below.

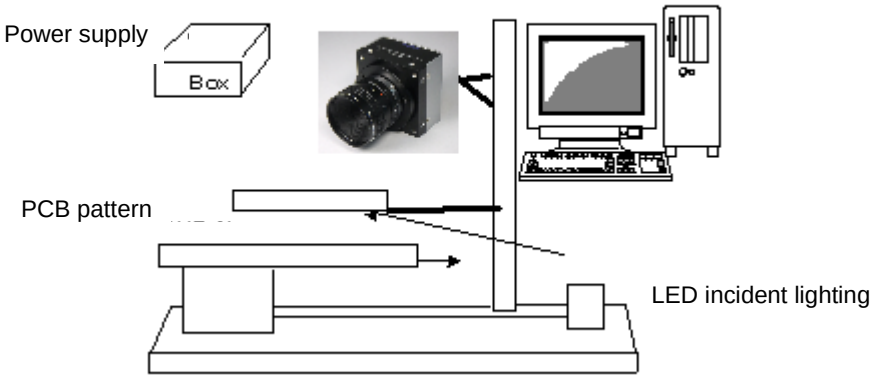


Figure 1-2-1 Visual Inspection of PCBs

Applicable Work

COB, BGA and MCM printed circuit boards

Unit Configuration

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

Applicable Fields

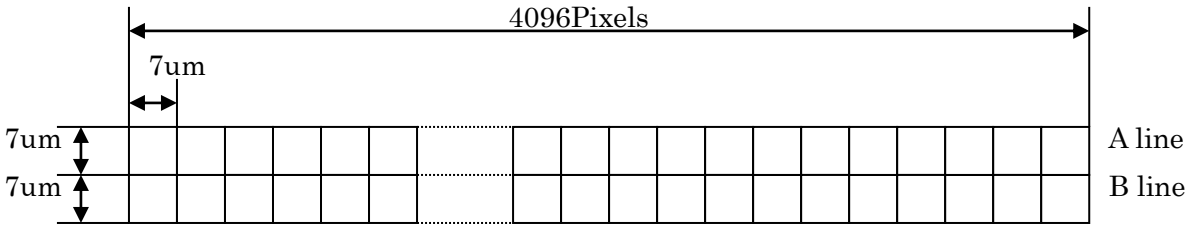
Inspection of patterns on film PCBs

1.3 Image Sensor

The camera uses a CMOS sensor with a maximum data rate of 160MHz to acquire high responsivity and superior quality images.

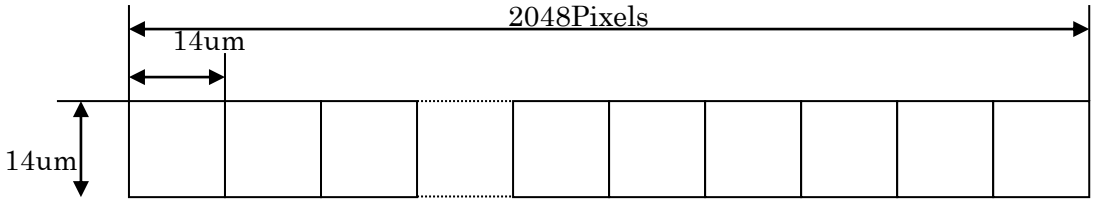
The sensor has pixels of 7μmx7μm in size and dual lines

The output data of 4096 pixels comes from 40MHz-4Tap or 40MHz-2Tap on TDI mode. Also, it comes as the output data of 2048 pixels with 14μm-square pixel equivalent from 40MHz_2tap by 2x2 pixels binning



（View from camera mount side when the camera screw hole for a tripod is at the bottom）

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
Number of Pixels		4096x2(Dual lines)
Pixel Size H x V (μm)		7 x 7
Sensor Length (mm)		28.672
Data Rate (MHz)		160 (40x4)/ 80 (40x2)
Min. Scan period (μs)/ Max. Scan rate [kHz]s	4k 4tap	27.825 /[35.938]
	4k 2tap	53.425 /[18.717]
	2k2tap(2x2mode)	27.825 /[35.938]
	4k 4tap(B)	27.825 /[35.938]
Responsivity (V/[lx･s]) (typically) [Minimum Gain, Pixel Correction Initial Value]		100 ＊Daylight Fluorescent Light ＊Analog 5V Conversion Sensitivity
Gain Adjustable Range *Analog Amplifier +Digital		Analog Amplifier： x 1 to x 17.8 (8 Steps) Digital ： x 1 to x 2 (512 Steps)
Offset Adjustable Range *Digital		-127 to 127 (0.5DN / Steps): 8bit
FPN (Fixed Pattern Noise)		Typically 5%(without correction, at minimum gain) 2%(with correction, at minimum gain)
PRNU (Photo Response Non Uniformity)		Typically 8% (without correction, at minimum gain) 4%(with correction, at minimum gain)
Random Noise		Typically 10DN (peak value at minimum gain)
Video output		Camera Link Medium Configuration (8or10bit/4tap) Camera Link Base Configuration (8or10bit/2tap)
Control Input		CC1: External Trigger Signal, CC2-4: Not in use
Connectors	Data/Controller	3M: MDR26 [Camera Link] x 2
	Power Supply	Hirose: HR10A (6Pin)
Lens Mount		Standard: F Mount
Operating Temperature (˚C) No Condensation		0 to 50

Power Supply Voltage (V)	DC 12 to 15 [+/-5%]
Consumption Current (mA) (typically)	300 (DC12V)
Size W x H x D (mm)	60x100x35
Mass (g) (Camera only)	Approx.300
Additional Function	1. Two-line TDI 2. Gain/Offset Adjustable 3. Test Pattern Output On / Off 4. Programmable Exposure Control 5. Scan Direction Switching

Note:

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

*2) Measurements were made at room temperature.

The spectral responsivity is shown below.

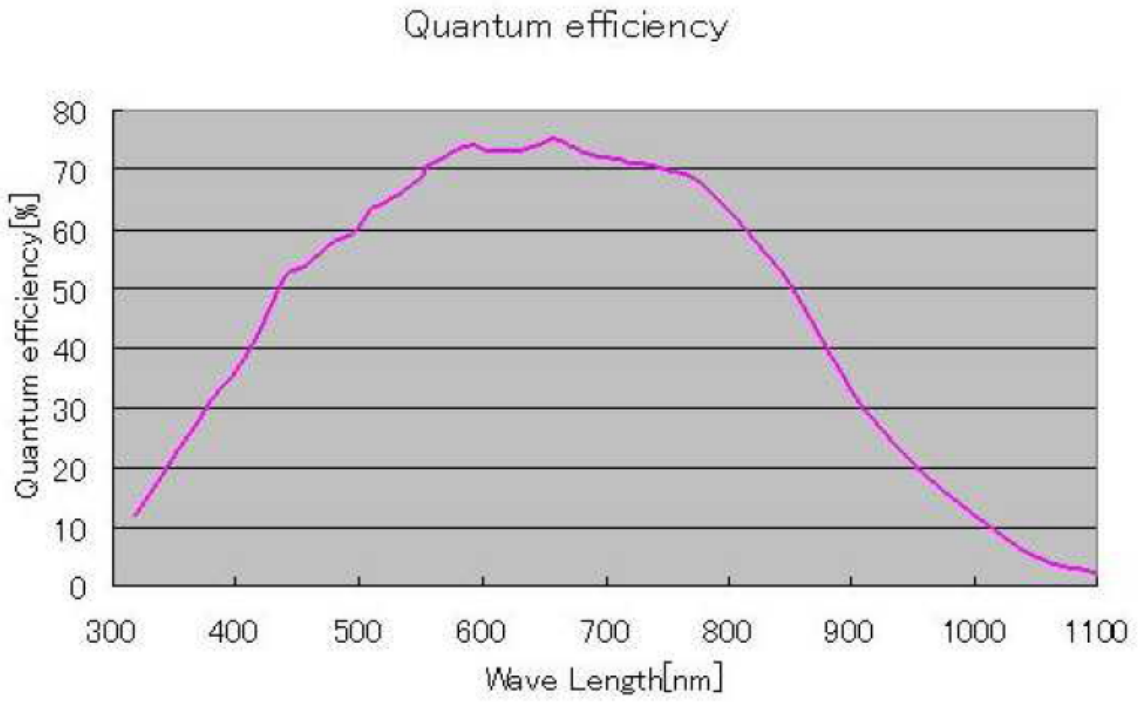


Figure 1-4-1 Spectral Responsivity

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.

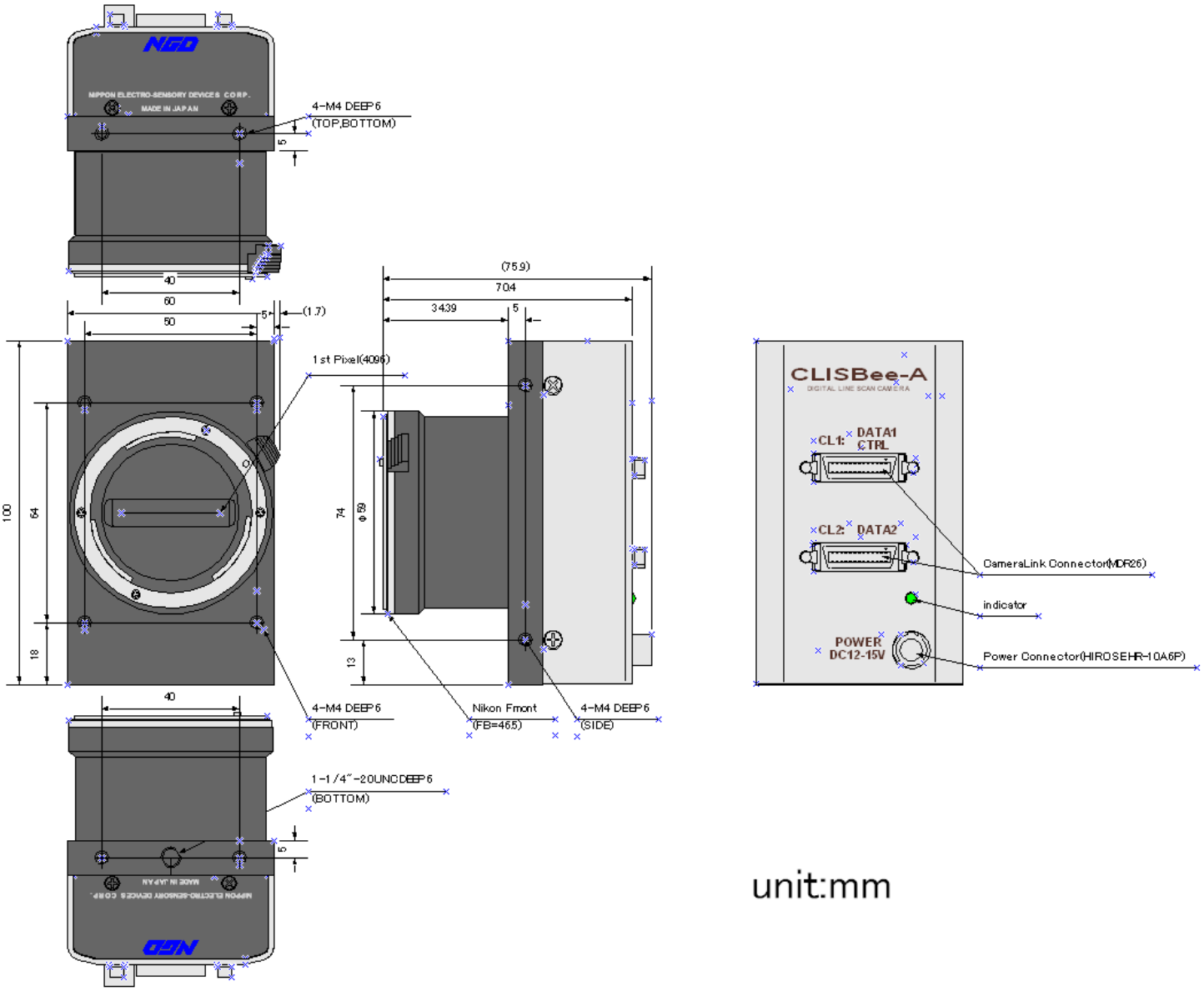


Figure 2-2-1 Dimensions of the Camera

2.3 Optical Interface

The XCM4040DLMT4 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

1. Connect the camera to the frame grabber board in the PC with two pieces of Camera Link cables.

Notes:

1) Use asymmetric Camera Link cables

2) Connect the camera with the connector labeled as “Camera side” if Camera Link cables have transmission direction.

2. Connect the power to the camera.

Notes:

Use a power cable to connect the camera with the power source. Connect the plug end of the cable to the camera, and the open end to the power supply.

In addition, a personal computer, the frame grabber board, a lens, lens mount, a light source and an encoder, etc. may be required. Please choose equipment suitable for your application.

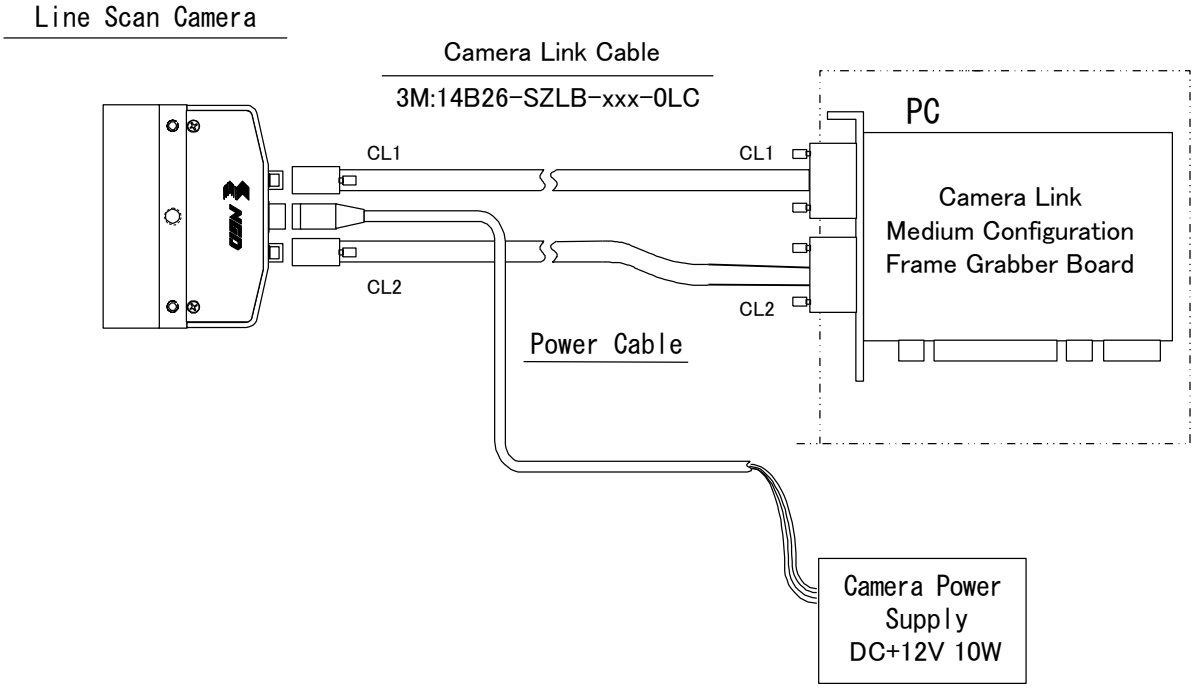


Figure 3-1-1 Connections between Camera and Frame Grabber Board and Power Supply

Camera Link cables maker may have two types of cable for the Camera Link Medium Configuration board. See the specification and choose the appropriate cable.

<Note: Choosing the appropriate Camera Link cable length >

According to the Camera Link Specification, the maximum cable length is 10m. But the maximum cable length to be able to transfer data depends on the type of cable performance and clock speed. The actual maximum transmission distance becomes less than 10m at faster clock speeds, though the transmission distance of 10m is feasible at slower clock speeds.

The following table shows values being calculated in accordance with the Camera Link Specification 2007.Version1.2, using a typical cable (14B26-SZLB-xxx-0LC from 3M) and frame grabber board (Solios from Matrox). Please choose the appropriate Camera Link cable type and length for your application. We recommend you perform a connection test in advance.

Table 3-1-1 calculated value of maximum cable length

Solios model	clock speed（MHz）	maximum cable length （m）
SOL 6M CL E* (20～66MHz)	40	9.8
	66	8.0
SOL 6M FC E* (20～85MHz)	75	7.6
	85	5.8

3.2 Input / Output Connectors and Indicator

The layout of input /output connecters and the LED indicator are as follows.

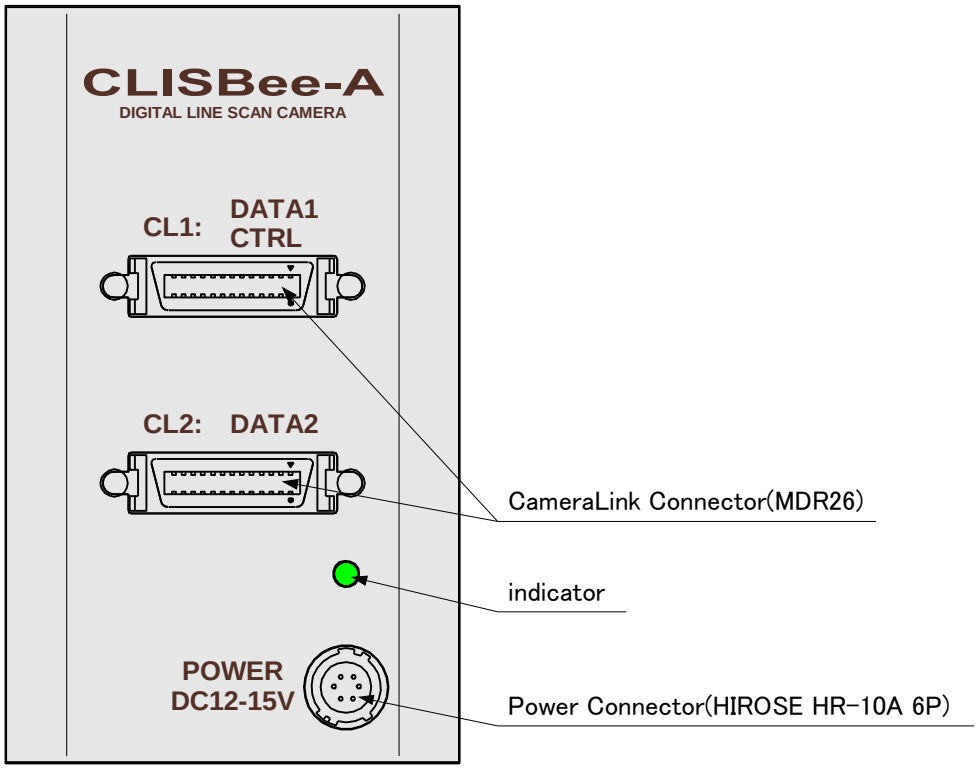


Figure 3-2-1 Input/Output Connectors and Indicator

3.3 Connectors・Pin Assignments・Cables

This camera adopts Medium Configuration of Camera Link interface standards. Figure 3-3-1 shows the interface for the camera and a typical implementation for the frame grabber interface.

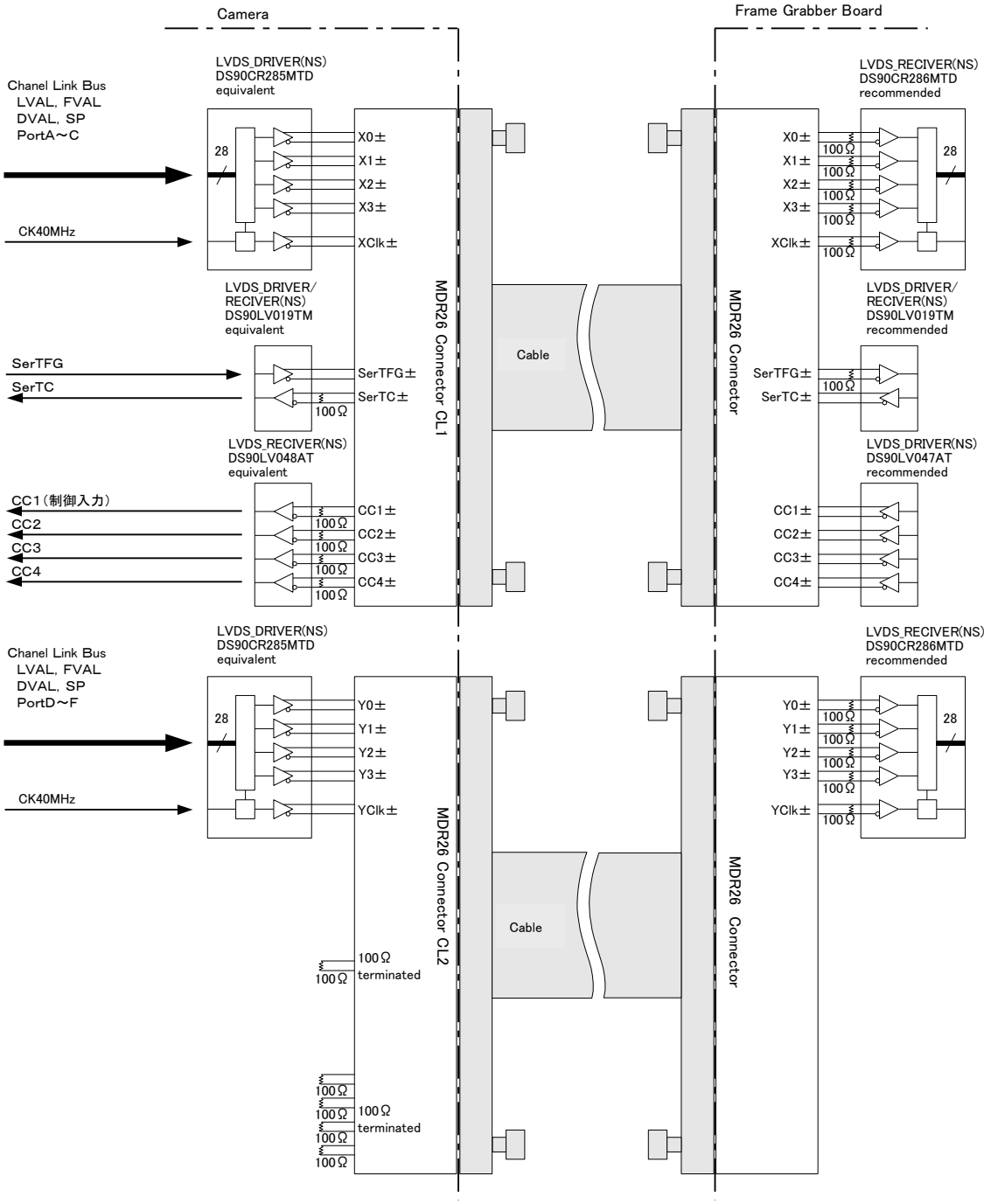


Figure 3-3-1 Camera / Frame Grabber Interface

Notes:

1) Do not make the driver side of LVDS open but set the logic to H or L, even if not used.
2) Set the LVDS, Channel Link receiver side to 100-ohm termination.

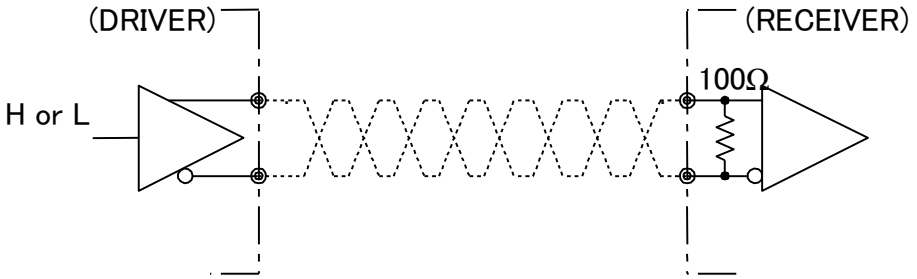


Figure 3-3-2 Circuit of LVDS

The camera has 26-pin MDR connectors for control signals of Camera Link, data signals and serial communications.

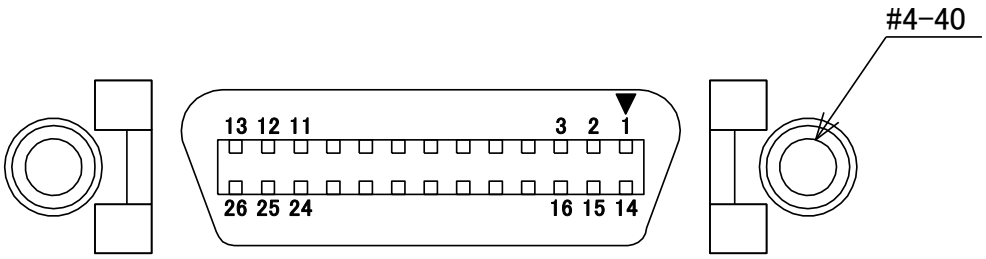


Figure 3-3-3 Camera Link エラー! ブックマークが定義されていません。

Connector

- Half pitch (miniature half ribbon) shape
- Locking screw (UNC #4-40) type

Table 3-3-1 Camera Link Connector (26-pin MDR Connector) pin assignments

CL1(Base Configuration)

No	Name	No	Name	I/O
1	Inner Shield	14	Inner Shield	
2	X0-	15	X0+	Out
3	X1-	16	X1+	Out
4	X2-	17	X2+	Out
5	Xclk-	18	Xclk+	Out
6	X3-	19	X3+	Out
7	SerTC+	20	SerTC-	In
8	SerTFG-	21	SerTFG+	Out
9	CC1-	22	CC1+	In
10	CC2+	23	CC2-	In
11	CC3-	24	CC3+	In
12	CC4+	25	CC4-	In
13	Inner Shield	26	Inner Shield	

CL2(Medium Configuration)

No	Name	No	Name	I/O
1	Inner Shield	14	Inner Shield	
2	Y0-	15	Y0+	Out
3	Y1-	16	Y1+	Out
4	Y2-	17	Y2+	Out
5	Yclk-	18	Yclk+	Out
6	Y3-	19	Y3+	Out
7	100Ωterminated	20	100Ωterminated	
8	Open	21	Open	
9	100Ωterminated	22	100Ωterminated	
10	100Ωterminated	23	100Ωterminated	
11	100Ωterminated	24	100Ωterminated	
12	100Ωterminated	25	100Ωterminated	
13	Inner Shield	26	Inner Shield	

- Explanation of Signals

  Inner Shield: Shield cable (GND)

  X0+, X0-…X3+, X3-: Data output (Channel Link)

  Xclk+, Xclk-: Clock output for above data output synchronization (Channel Link)

  Y0+,Y0-･･･Y3+,Y3- : Data output (Channel Link)

  Yclk+,Yclk- : Clock output for above data output synchronization (Channel Link)

  Z0+,Z0-･･･Z3+,Z3- : Data output (Channel Link)

  Zclk+,Zclk- : Clock output for above data output synchronization (Channel Link)

  SerTC+, SerTC- : Serial data input (LVDS)

  SerTFG+, SerTFG-: Serial data output (LVDS)

  CC1+, CC1- : External synchronous signal input (LVDS)

  CC2+, CC2-, CC3+, CC3-, CC4+, CC4-: Not in use (LVDS)

- Camera Link compatible cable

  3M: 14B26 –SZLB – xxx – 0LC by or equivalent

  Notes:

  1) To avoid uncoupling of the cable connectors during power on, make sure to clamp them with the locking screws.

2) Do not unplug the cables while power is being supplied to the camera.

This camera uses 6-pin round shape push-pull lock type connector for the Power Supply

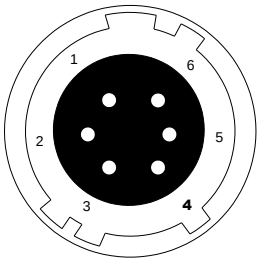


Figure 3-3-4 Power Supply Connector (HIROSE: HR10G-7R-6PB)

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

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

3.4 Power Supply

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

The indicator (LED green) blinks when supplying power, and it will change into lighting in about thirty seconds.

Notes:

1) When selecting a power source, choose one with the capacity to allow for inrush current. (10W or more recommended)
2) Insert the cable plug securely until it locks into position. This is to prevent the connector from coming loose during power transmission.
3) Turn off the power supply at once when the indicator (LED green) doesn't light even if supplied power. Make sure that the power supply is used on proper voltage and capacity and wiring arrangement is correct.
4) It is recommended that the shield processing of the power cable is connected with GND on the power supply side.

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

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

Consumption Current (rated): DC+12V: 300mA

4 Camera Control

The camera can be controlled through serial communication. Two methods can be used to change the camera's parameters. The first approach is to change parameters using CLISBeeCtrl (Camera control software). (See "8 CLISBeeCtrl".) Or you can also change the parameters directly from your application by using serial communication commands to set values in the camera register.

Once the camera has been set up according to your requirements, the camera can be used to read data without need of controlling it via the serial interface.

4.1 Flow of Camera Control

4.1.1 Command Overview

The serial interface uses a simple ASCII-based command.

- Communication begins when the computer sends control commands to the camera.
- The camera receives and interprets the computer commands and then executes control operations accordingly.
- Transmission ends when the camera returns the analyzed results of the control commands to the computer.
- ◆ Always allow the previous transmission to end before starting the next transmission. (Only one command can be sent per transmission.)

4.1.2 Camera Receiving Message (PC Sending Command)

- Format 1 CMD CR
- Format 2 CMD □ VAL 1 CR
- Format 3 CMD □ VAL 1 □ VAL2 CR
- Format 4 CMD □ VAL 1 □ VAL2 □ VAL3 CR

CMD**:** Control text Use lowercase letters only. The maximum numbers of letters depend on the model. No numerals allowed.

CR**:** Carriage Return (0x0D)

□**:** Space (0x20) or Comma (0x2C)

VAL**:** Setting value (decimal, 1 Byte x maximum 5 digits)

<Example>

gax□0 CR

4.1.3 Camera Sending Message (PC Receiving Message)

- Format R 1 >R CR >[SB] CR EOT
- Format R 2 (for “sta” command) >OK CR >[MEM] CR >sta CR EOT

>: Results start text (0 x 3E)
R: Camera receive command analyzed results
[SB]: Camera receive command send back
[MEM]: Memory data readout value
CR**:** Separated text (0 x 0D)
EOT: Send command all text end text (0 x 04)

<Example>

>OK CR >gax 0 CR E0T

Table 4-1-3-1 Error Messages

Camera Response	Meaning
OK	Camera executed command
CMD ERR!	Command is not valid
CMD OVR ERR!	Command text line is too long
VAL ERR!	Parameter accepted was outside of specified range
MEM ERR!	Camera memory error

4.1.4 Camera Control Commands

Table 4-1-4-1 shows the list of Camera Control Commands.

Table 4-1-4-1 Lists of Camera Control Commands

Control Item	CMD	VAL1	VAL2	VAL3	Control Description
Analog Gain	gax	0 to 7			x1.00....x17.8
Digital Gain	gdx	0 to 511			x1…x2(x0.003906/step)
Digital Offset	odx	-127 to 127			-63…63(0.5DN/step at 8bit) -254…254(2DN/step at10bit)
Exposure Mode	inm	0 /1/2			Free Run / Ext Edge / Ext Level
Programmable Exposure Time	int	0	984 to 1048575		voa * 0(4096pixels_4tap) 24.6～26214.375μs
			2008 to 1048575		voa * 1(4096pixels_2tap)： 50.2～26214.375μs
			984 to 1048575		voa * 2(2048pixels_2tap)： 24.6～26214.375μs
			984 to 1048575		voa * 3(4096pixels_4tap(TypeB)： 24.6～26214.375μs
Memory Initializing	rst				Reset to factory settings
Memory Load	rfd				Readout setup data in memory
Memory Save	sav				Store present setup data in memory
Test Pattern	tpn	0 /1			Off/On
Black Pixel Correction Data Save	blk				User arbitrary black pixel correction data is acquired and stores it in the memory.
White Pixel Correction Data Save	wht				User arbitrary white pixel correction data is acquired and stores it in the memory.
Pixel Correction Data Initializing	calibdef				Delete user arbitrary pixel correction data and reset to factory setting. Do not turn off the power supply until this control is completed. It takes about one minite 30 seconds to complete it.

Pixel Correction Setting	shc	0/1/2/ 3/4/5	0 to 255		Correction off/ Factory black correction+factory white correction/ Factory black correction+user arbitrary white correction / not used/ User arbitrary black correction+ factory white correction/ User arbitrary black correction+ user arbitrary white correction Target value of correction level (8 bit output conversion value)
Exposure-Read out Time	pad	0 to 1048575			3.225 to 26262.176μs
Operation Status Readout	sta				Returns the current camera settings.
Scanning Direction	rev	0 /1			0: Forward / 1: Reverse
Line Delay	d	-1/0/1			Output delay adjustment between line datas Amount of line data –1/0/1 Note: when using line delay mode setting at -1 or1, vod must be set at 0 or 2 **See more information on 4.2.21**
Output Signal Setting 1	voa	0 /1	0/1/2/3		8bit /10bit 4096pixels_4tap/4096pixels_2tap /2048pixels_2tap/4096pixels_4tap (TypeB) **See more information on 4.2.21**
Output Signal Setting 2	vod	0/1/2/3	0		Switch between Dual Line Mode (average)/ Single Line Mode (A line)/ Dual Line Mode (addition) Single Line Mode(B line). VAL 2 is fixed at 0. **See more information on 4.2.21**

Gamma Correction Setting	gamma	0/1/2/3/4	250 to 4000		Off(1.0)/0.45/0.56/Negative Positive inversion / Custom (by VAL2 setting). VAL2 is effective only at the gamma 4. VAL2 is omissible at other than gamma 4. The gamma value is VAL2/1000. For example: If gamma=2200, γ=2.2

Programmable Exposure Time＝VAL2÷40

Exposure-Readout Time＝3.225＋(VAL1÷40)

4.1.5 Memory Setup Values (Factory Settings)

The memory setup values (Factory settings) are shown in Table 4-1-5-1.

Table 4-1-5-1 Memory Setup Values (Factory Settings)

Control Item	CMD	VAL1	VAL2	VAL3	Control Description
Analog Gain	gax	0			x1.00
Digital Gain	gdx	0			x1.00
Digital Offset	odx	0			0
Exposure Mode	inm	0			Free Run
Programmable Exposure Time	int	0	10000		250.0μs (VAL1 fixed)
Test Pattern	tpn	0			Off
Pixel Correction Setting	shc	1	200		Factory correction data on, User correction target value
Exposure-Readout Time	pad	0			3.225μs
Scanning Direction	rev	0			Forward
Line Delay	d	0			Line Delay 0(Line Delay setting is not used)
Output Signal Setting 1	voa	0	0		8bit, 4096pixels_4tap
Output Signal Setting 2	vod	0	0		Dual Line Mode (Average)
Gamma Correction Setting	gamma	0	1000		Gamma correction setting is not used

4.2 Details on Commands

4.2.1 Setting Analog Gain

Sets analog gain in 8 steps between x 1 to x17.8

- Format 2 CMD ☐ VAL1 CR
- CMD gax
- VAL 0 (x1) to 7 (x17.8)

<Example>

gax ☐ 5 CR (Setting analog gain 5(x7.8))
>OK
>gax 5

4.2.2 Setting Digital Gain

Sets digital gain in 512 steps between x 1 and x 2.

- Format 2 CMD ☐ VAL 1 CR
- CMD gdx
- VAL 0(x 1) to 511(x 2)

<Example>

gdx ☐ 255 CR (Setting digital gain 255(1023/(1023-255)=x1.33))
>OK
>gdx 255

4.2.3 Setting Digital Offset

Sets digital offset -127 to 127(0.5DN/step at 8bit / 2DN/step at 10bit)

- Format 2 CMD ☐ VAL1 CR
- CMD odx
- VAL -127 to 127

<Example>

odx ☐10 CR (Setting digital offset 5/20DN at 8/10-bit])
>OK
>odx 10

4.2.4 Setting Exposure Mode

Sets the exposure mode.

- Format 2 CMD ☐ VAL1 CR
- CMD inm
- VAL 0,1,2

<Example>

inm ☐ 0 CR (Setting the exposure mode free run)
>OK
>inm 0

4.2.5 Setting Exposure Time

Sets the exposure time.

- Format 3 CMD ☐ VAL1 ☐ VAL2 CR
- CMD int
- VAL1 0 (fixed)
- VAL2 *984～1048575(Setting Counter value)
  Note:*The ranges of these counter values vary according to Output data formats as follows.

984～1048575(at 4096pixels_4tap)
2008～1048575(at 4096pixels_2tap)
984～1048575(at 2048pixels_2tap)
984～1048575(at 4096pixels_4tap(TypeB))

<Example>

int ☐ 0 ☐ 5760 CR (Setting exposure time 144μs)
>OK
>int 0, 5760

4.2.6 Memory Initializing (Initializing Camera Settings)

Reset the flash memory to the factory default.

- Format 1 CMD CR
- CMD rst

<Example>

rst CR
>OK
>Type=XCM4040DLMT4
>Ver. = 1.07_0x0156
>Serial=204
>gax 0
>gdx 0

>odx 0
>inm 0
>int 0, 10000
>pad 0
>shc 1,200
>tpn 0
>rev 0
>voa 0, 0
>vod 0
>d 0
>gamma 0, 1000
>rst

4.2.7 Memory Load

Reads out the camera settings from the flash memory.

- Format 1 CMD CR
- CMD rfd

<Example>

rfd CR
>OK
>Type=XCM4040DLMT4
>Ver. =1.07_0x0156
>Serial=204
>gax 0
>gdx 0
>odx 0
>inm 0
>int 0, 10000
>pad 0
>shc 1,200
>tpn 0
>rev 0
>voa 0, 0
>vod 0
>d 0
>gamma 0, 1000
>rfd

4.2.8 Memory Save

Stores the current camera settings in the flash memory.

- Format 1 CMD CR
- CMD sav

<Example>

sav CR
>OK
>sav

4.2.9 Generating Test Pattern

Generates test pattern.

- Format 2 CMD ☐ VAL1 CR
- CMD tpn
- VAL 0,1 (0:Image data, 1: Test pattern)

<Example>

tpn ☐ 1 CR (Generating test pattern)
>OK
>tpn 1

4.2.10 Black Pixel Correction Data Save

Save the user arbitray black pixel correction data of analog gain in flash memory. The data at each step of analog gain can be saved. This command can be used in at perfect dark of the camera.

Format 1 CMD CR
CMD blk

<Example>

blk CR
>OK
>blk

4.2.11 White Pixel Correction Data Save

Save the user arbitray white pixel correction data of analog gain in flash memory.
The data at each step of analog gain can be saved.

Format 1 CMD CR
CMD wht

<Example>

wht CR
>OK
>wht

In a simple average mode, set camera output at about 200DN and send commands of wht, shc2 200 for pixel correction.
The data of camera outputs is corrected at the 200DN and vicinity.

Note: When the output signal setting2 is set in simple addition mode (vod2), the second parameter (calibration level) of the pixel correction should be set as follows.

In case of voa x 0 and voa x 3, the second parameter (calibration level) of the pixel correction should be set at 100DN which is in half of digital number, because the data is increased approximately two times by the data in simple average mode.
In case of voa x 2, the second parameter (calibration level) of the pixel correction should be set at 50DN which is in quater of digital number, because the data is increased approximately four times by the data in simple average mode.
The data of camera outputs is corrected at the 200DN and vicinity.

The explanation is mentioned above in case of 8 bit output but the explanation in case of 10 bit output is the same because the second parameter (calibration level) of the pixel correction in 10 bit output is entered with 8bit output conversion value.

4.2.12 Initializing Pixel Correction Data

Deletes user arbitray pixel correction and resets to factory settings.

All of data of gain reset to factory settings except for the gain setting and offset setting of the camera setting.

When the camera is shipped out, the data of factory black pixel correction and factory white pixel correction is stored.It takes about 2 minutes to complete this command task since the command is sent.

Note: While the command task is excuted, the camera does not respose for about 1 minute and 30 seconds. After that, OK comes back from the camera. Do not turn off the power supply of the camera during this execution or the camera may be damaged.

Format 1 CMD CR

CMD calibdef

<Example>

calibdef CR

>OK

>calibdef

4.2.13 Setting Pixel Correction

Sets pixel correction.

- Format 3 CMD□VAL1□VAL2 CR
- CMD shc
- VAL1 0,1,2,3,4,5
  (0: Correction off
  1: Factory black correction+factory white correction
  2: Factory black correction+user arbitrary white correction
  3: not used
  4: User arbitrary black correction+ factory white correction
  5: User arbitrary black correction+ user arbitrary white correction)
- VAL2 0 to 255 (Setting correction level :8bit)

<Example>

shc□1□200 CR (for Factory white correction, Correction level 200)

>OK

>shc 1,200

4.2.14 Setting Exposure Time - Readout Time

Prolongs the line period without changing the exposure time.

- Format 2 CMD□VAL1 CR
- CMD pad
- VAL 0 to 1048575 (XCM4040DLMT4 : 0 to 26214.375μs)

<Example>

pad□10 CR
>OK
>pad 10

4.2.15 Returning the Camera Settings status

Returns the current camera settings.

- Format 1 CMD CR
- CMD sta

<Example>

sta CR
>OK
>Type=XCM4040DLMT4
>Ver. =1.07_0x0156
>Serial=204
>gax 0
>gdx 0
>odx 0
>inm 0
>int 0, 10000
>pad 0
>shc 1,200
>tpn 0
>rev 0
>voa 0,0
>vod 0
>d 0
>gamma 0, 1000
>sta

4.2.16 Setting the Pixel Readout Direction

Sets the pixel readout direction.

- Format 2 CMD □ VAL1 CR
- CMD rev
- VAL1 0,1 (0:Forward, 1:Reverse)

<Example>

rev □ 1 CR (Reverse)
>OK
>rev 1

4.2.17 Setting Line Delay

Adjusts Line Delay between dual lines datas.

- Format 2 CMD□VAL1 CR
- CMD d
- VAL -1,0,1 (-1:Forward, 0: No Line Delay, 1:Reverse)

<Example>

d □ 1 CR (Line Delay 1)
>OK
>rev 1

Notes: When Line Delay is set at -1 or 1 on VAL, the output signal 2(see 4.2.17) should be at 0 or 2 on vod because Line Delay is not effective at 1 and 3.

When Line Delay is set at “d □ 0” on CMD and VAL, the pixel size of the output data becomes 7x14μm equivalent on formats of 4096pixels4tap, 4096pixels2tap, 4096pixels4tap (typeB).

On format of 2048pixels2tap, set Line Delay only at “d □ 0” on CMD and VAL because the settings of “d □ -1” and “d □ 1” do not process correct binning.

4.2.18 Setting Output Signals 1

Sets the data format of output signals.

- Format 3 CMD□VAL1 □ VAL2 CR
- CMD voa
- VAL 1 0,1 (output data 8bit / 10bit switching)
- VAL 2 0,1,2,3 (Output data format switching)
  See “4.7 Video output format” on 4096pixels_4tap/4096pixels_2tap/2048pixels_2tap/ 4096pixels_4tap(TypeB) for more details.

<Example>

voa□0 □0 CR (8bit output)
>OK
>voa 0,0

4.2.19 Setting Output Signals 2

Set the camera output signal to Dual Line Mode (Average) / Single Line Mode (A line)/ Dual Line Mode (Addition)/ Single Line Mode (B line)

・Format 3 CMD□VAL1□VAL2 CR
・CMD vod
・VAL1 0,1,2,3（Output data switching,
Dual Line Mode(average)/Single Line Mode(A-line)
/Dual Line Mode(addition)/Single Line Mode(B-line)
・VAL2 0 (Fixed Value)

<Example>
vod□0□0 CR（Dual Line Mode (average)）
>OK
>vod 0, 0

4.2.20 Setting Gamma correction

Switch the gamma correction settings.

・Format 2 CMD□VAL1□VAL2 CR
・CMD gamma
・VAL1 0,1,2,3,4（0:Off(1,0), 1:0.45, 2:0.56,
3:positive negative inversion, 4: Custom)
・VAL2 250～4000(If γ=VAL2/1000 VAL1=4, it is effective)

<Example>
gamma□1 CR （0.45 at gamma correction setting）
>OK
>gamma 1

gamma□4□2200 CR (2.20 at gamma correction setting）
>OK
>gamma 4 2200

4.2.21 Relations of Output formats, Output Signals 1 and 2, and Line Delay

This camera has four kinds of output signal formats such as 4096pixels_4tap、4096pixels_2tap、2048pixels_2tap、4096pixels_4tap(TypeB).

The setting relations of Output formats, Output signals 1 and 2, and Line Delay are shown below.

Table 4-2-21-1 Setting Relations of Output Signals 1 and 2, and Line Delay

Output Signal Format Output Signal 1(voa)	Line Delay	Output Signal 2		Remarks
	d	vod		
4096pixels_4tap (voa : **0**) **4096pixels_2tap** (voa : **1**) **4096pixels_4tap (TypeB)** (voa : **3**)	**0** (No Line Delay)	**0**	Average	Close observation setting of S/N. 7x14um equivalent pixel size
		1	A-line output	Only one line output of dual lines
		2	Additional	Close Observation setting of large output signal. 7x14um equivalent pixel size
		3	B-line output	Only one line output of dual lines
	1 (One line delay, Forward)	**0**	Average	Close observation setting of S/N.
		1	–	–
		2	Additional	Close Observation setting of large output signal.
		3	–	–
	-1 (One line delay, Reverse)	**0**	Average	Close observation setting of S/N.
		1	–	–
		2	Additional	Close Observation setting of large output signal.
		3	–	–
2048pixels_2tap (voa :**2**)	**0** (No Line Delay)	**0**	Average	Close observation setting of S/N. 14x14 um equivalent effective pixel size. 7x7 um equivalent output signal.
		1	–	–
		2	Additional	Close observation setting of large output signal. 14x14 um equivalent sffective pixel size. 14x14 um equivalent output signal.
		3	–	–
	1 Do not set.	**0**	–	–
		1	–	–
		2	–	–
		3	–	–
	-1 Do not set.	**0**	–	–
		1	–	–
		2	–	–
		3	–	–

4.3 Digital Processing flow in FPGA

The digital processing flow in FPGA is shown below.

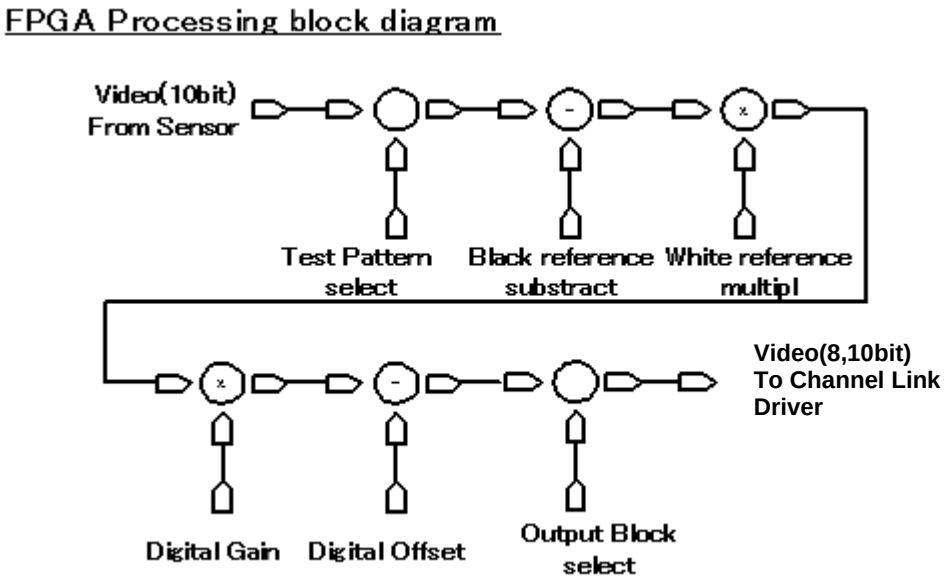


Figure 4-3-1 FPGA Processing Block Diagram

Note: When Test Pattern is selected, Black/White reference, Digital Gain & Offset are omitted.

4.4 Startup

After turning on, the camera run a startup procedure before it starts getting images and outputting data. It takes about 25 seconds.

The start-up is executed by the following sequence, and as for the camera, the preparation for the image acquisition and the output is complete when normally ending.

(1)The camera hardware initializes.

(2) Reads out the latest camera settings from the flash memory. (User settings if any or factory default settings)

(3) Set up the camera with the setting value from the flash memory.

After this sequence, the camera is ready to get images and output data.

4.5 Saving and Loading Camera Settings

The camera settings data is saved in the internal memory (flash memory) and is loaded from the memory when turning on the power supply or loading (sending the “rfd” command).

Commands for rewriting the memory are as follows.

- Reset to factory settings (rst)
- Store present setup data in memory (sav)
- Store pixel correction data in memory (wht)

Notes:

1) The number of times the flash memory can be rewritten will vary depending on actual operational conditions.
2) After turning on the power supply, the camera always checks the memory status. When it is content outside a set range due to the breakdown etc., it automatically rewrites it in the memory setting value when the factory is shipped.
3) If the camera power is disconnected while rewriting the memory, the whole data saved in the memory will be deleted.
4) As it takes several seconds to rewrite the memory, do not disconnect power supply before receiving the answer from the camera.
5) Please do when you change the exposure mode from factory setting with external trigger signal (CC1) supplied from the frame grabber board side. If you do not send CC1 or sending control input signals are out of the designated range, you cannot get images and cannot change the settings. See 4.8.2 and 4.8.3.

Table 4-5-1 Camera Operation Mode and Control Input

Camera operation mode (Exposure mode)	Control input (From frame grabber board)
Free Run(Programmable time setting) (Factory setting)	Not in use
Ext Edge (External trigger edge + Programmable time setting)	External trigger (CC1) is required
Ext Level (External trigger level time setting)	External trigger (CC1) is required

4.6 Serial Communication Settings

Serial communication is performed through the Camera Link Interface

Table 4-6-1 shows serial communication settings.

Table 4-6-1 Serial Communication Settings

Parameter Items	Setup Value
Communication Speed (Baud rate)	9600bps
Data Length	8bit
Parity Bit	None
Stop bit	1bit
Flow Control	None

4.7 Video Output Format

The camera outputs 8-bit or 10-bit digital data through 2 or 4 Taps.

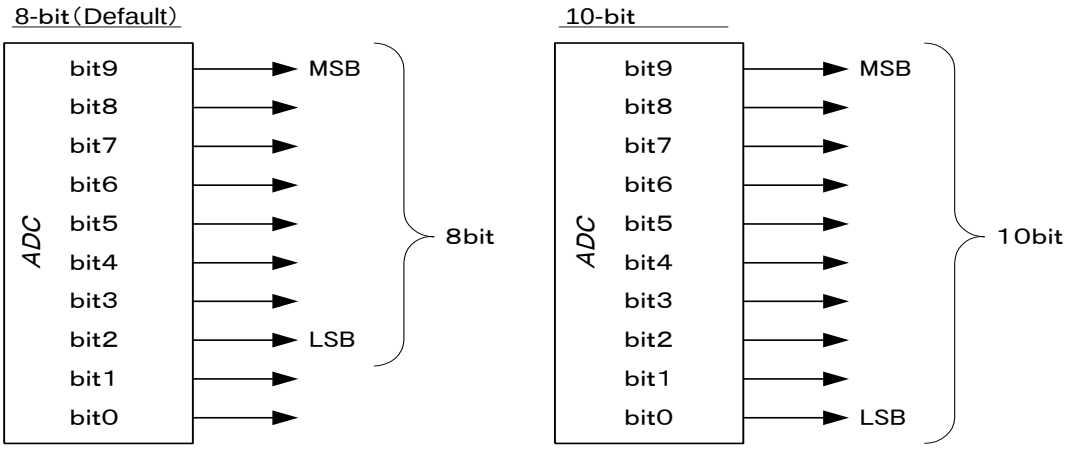
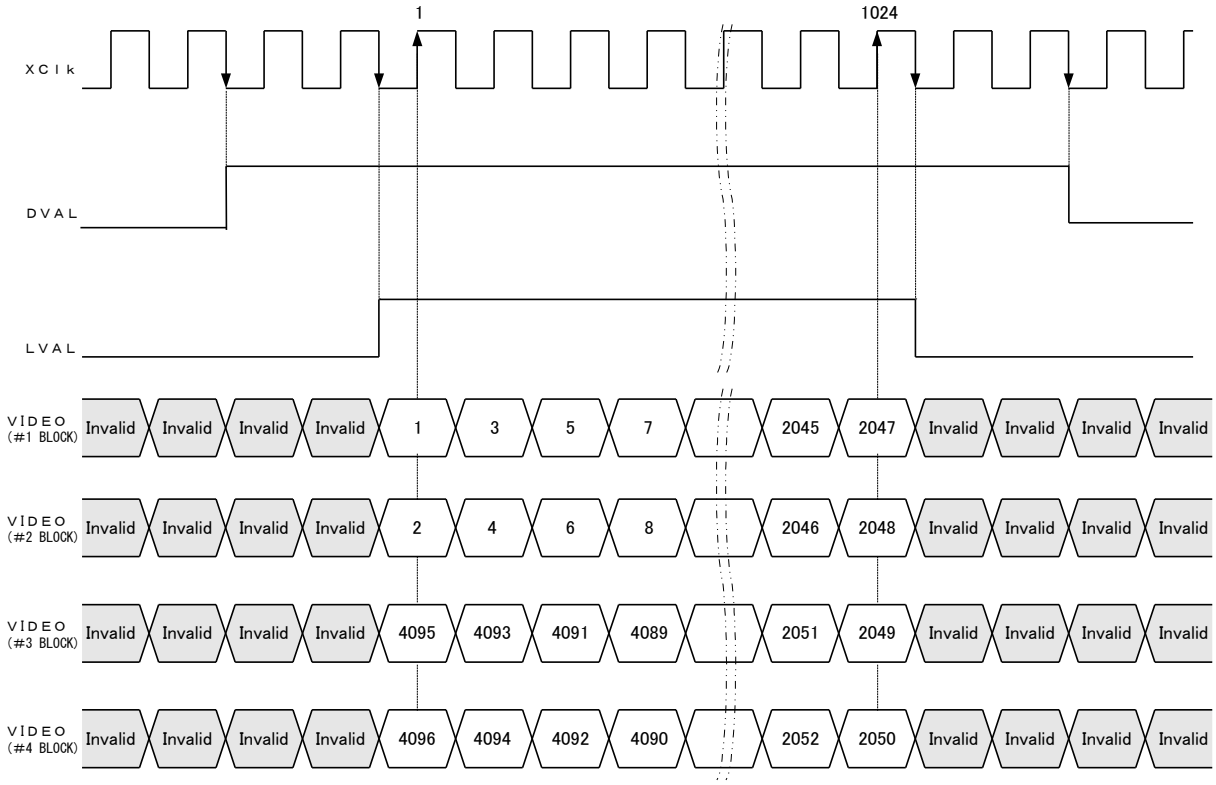


Figure 4-7-1 Pin Assignments of Digital Data

Video output phases of the camera are shown at the following four formats below.

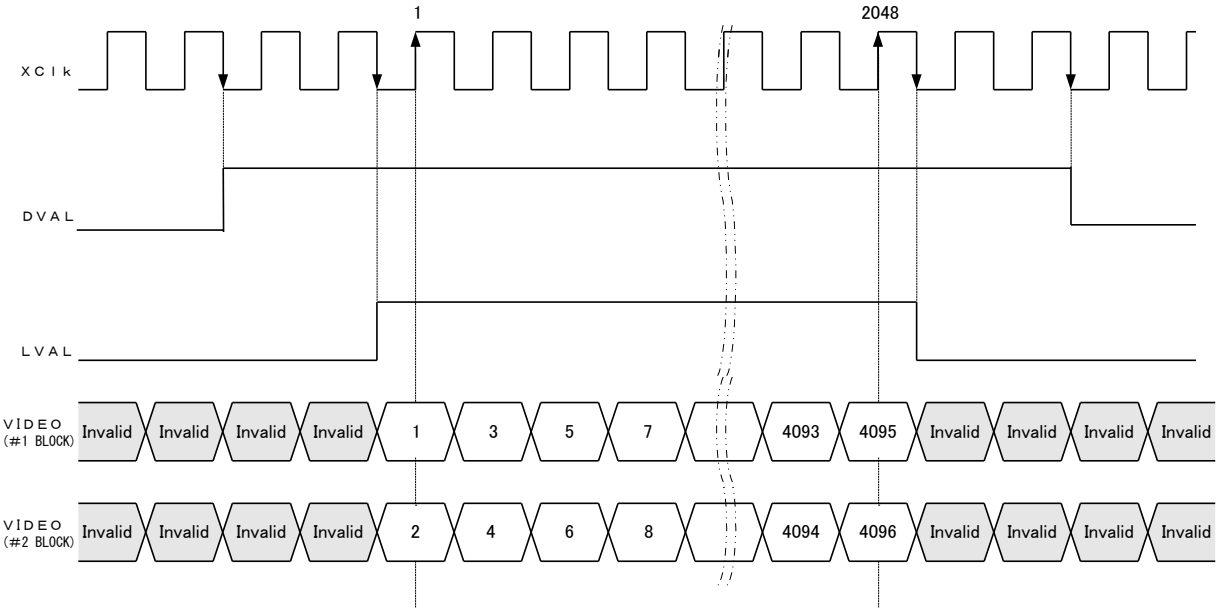
①This camera outputs 8/10 bit digital data through 4096pixels_4tap formats.（voa * 0）



◆ Note: FVAL = 0 (low level) fixed

Figure 4-7-2 Video Output Phase of the Camera at XCM4040DLMT4(4096pixels_4tap)

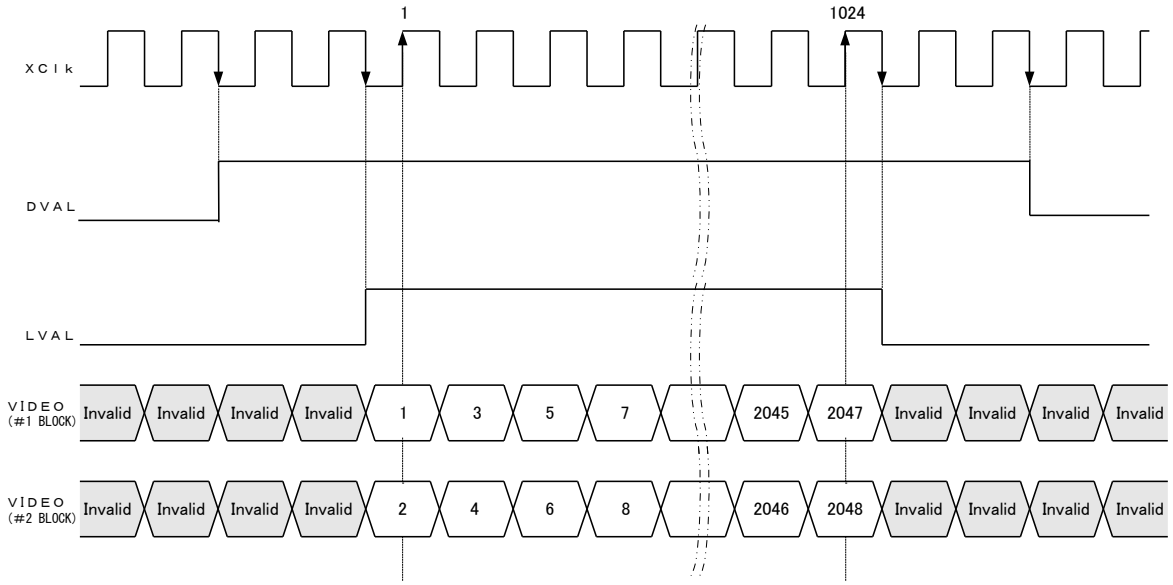
②This camera outputs 8/10 bit digital data through 4096pixels_2tap formats.（voa * 1）



◆ Note: FVAL = 0 (low level) fixed

Figure 4-7-3 Video Output Phase of the Camera at XCM4040DLMT4(4096pixels_2tap)

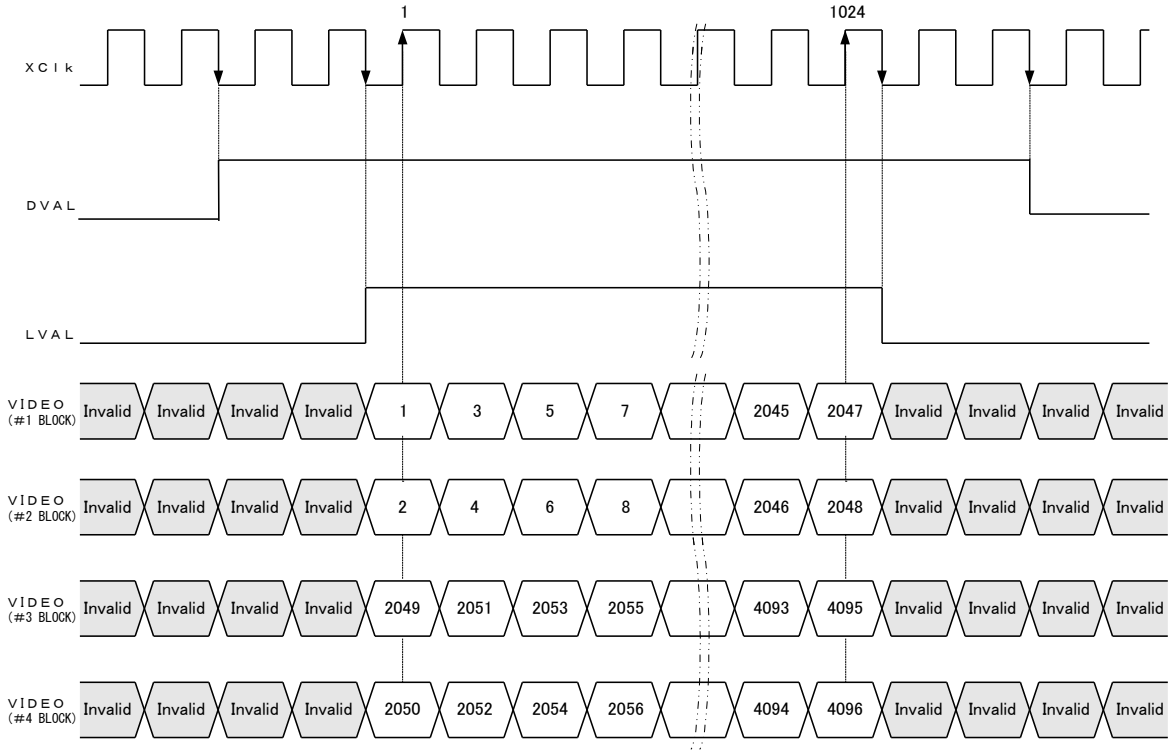
③This camera outputs 8/10 bit digital data through 2048pixels_2tap formats.（voa * 2）



◆ Note: FVAL = 0 (low level) fixed

Figure 4-7-4 Video Output Phase of the Camera at XCM4040DLMT4(2048pixels_2tap)

④This camera outputs 8/10 bit digital data through 4096pixels_4tap (Type B) formats.（voa * 3）



◆ Note: FVAL = 0 (low level) fixed

Figure 4-7-5 Video Output Phase of the Camera at XCM4040DLMT4(4096pixels_4tap)(TypeB)

4.8 Exposure Mode and Timing Chart

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

4.8.1 Free Run Exposure Mode (Programming time setting)

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

Table 4-8-1-1 Programmable Exposure Time

p	Programmable exposure time	4096pixels_4tap	24.6～26214.375
		4096pixels_2tap	50.2～26214.375
		2048pixels_2tap	24.6～26214.375
		4096pixels_4tap（TypeB）	24.6～26214.375
r	Readout time	4096pixels_4tap	25.6
		4096pixels_2tap	51.2
		2048pixels_2tap	25.6
		4096pixels_4tap（TypeB）	25.6

(unit：μs)

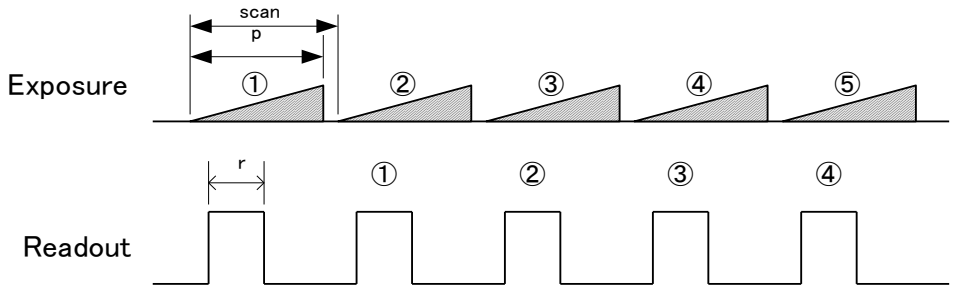


Figure 4-8-1-1 Free Run Exposure Mode at 4096pixels_4tap

Note:

The timing of reading out does one scanning delay from the exposure.

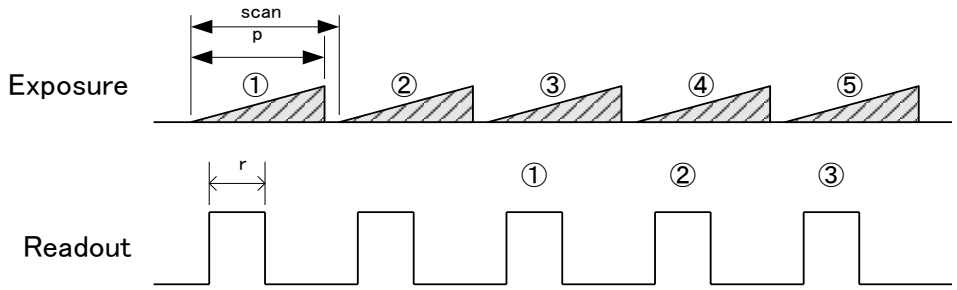


Figure 4-8-1-2 Free Run Exposure Mode at other than 4096pixels_4tap

Note:

The timing of reading out does two scannings delay from the exposure.

4.8.2 External Trigger Exposure Mode (External trigger edge)

In external trigger exposure mode (Trigger Edge), the exposure time is determined by the setting through serial communication, each exposure starts with the rising edge and the line period is determined by the time from rising edge to 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 4-8-2-1 Programmable Exposure Time(Trigger Edge)

p	Programmable exposure time	4096pixels_4tap	24.6～26214.375
		4096pixels_2tap	50.2～26214.375
		2048pixels_2tap	24.6～26214.375
		4096pixels_4tap（TypeB）	24.6～26214.375
r	Readout time	4096pixels_4tap	25.6
		4096pixels_2tap	51.2
		2048pixels_2tap	25.6
		4096pixels_4tap（TypeB）	25.6
a	Trigger pulse H time	≧0.05	
b	Trigger pulse L time	≧0.05	
c	Trigger pulse cycle	4096pixels_4tap	≧27.825
		4096pixels_2tap	≧53.425
		2048pixels_2tap	≧27.825
		4096pixels_4tap（TypeB）	≧27.825

(unit：μs)

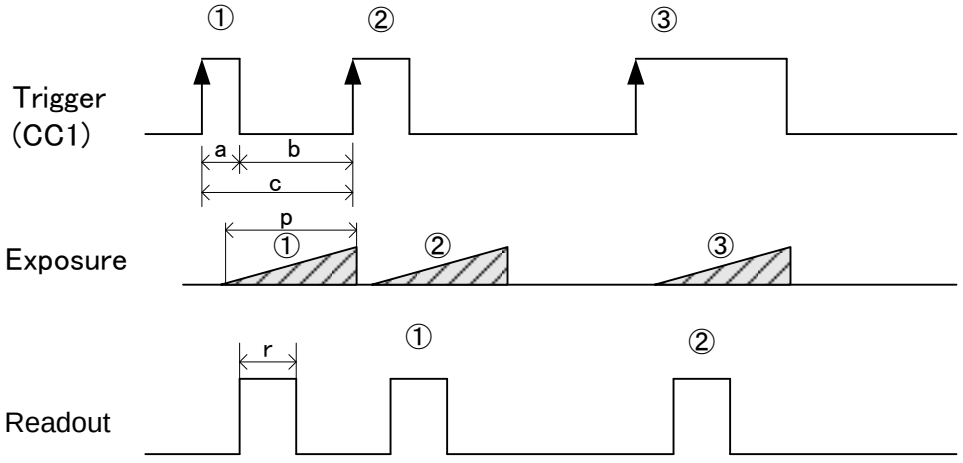


Figure 4-8-2-1 External Trigger (Trigger Edge) Exposure Mode at 4096pixels_4tap

Note:

The timing of reading out does one scanning delay from the exposure.

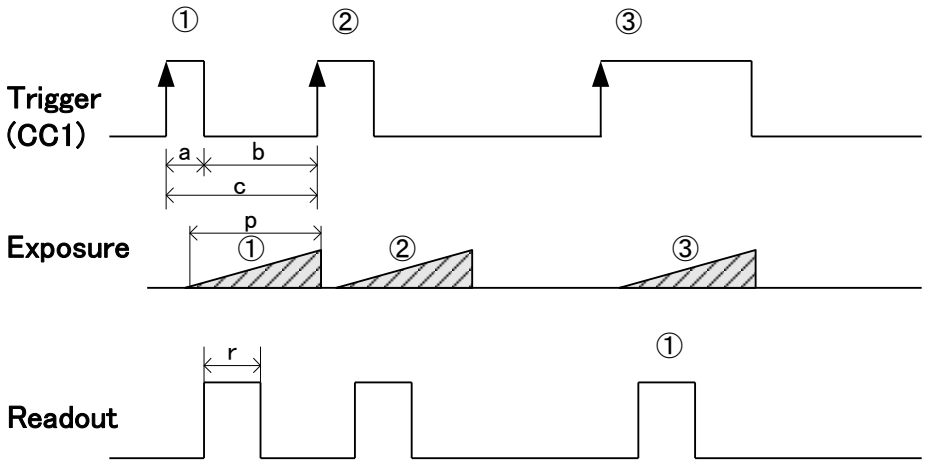


Figure 4-8-2-2 External Trigger (Trigger Edge) Exposure Mode at other than 4096pixels_4tap

Note:

The timing of reading out does two scannings delay from the exposure.

4.8.3 External Trigger Exposure Mode (Trigger Level)

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

Table 4-8-3-1 Programmable Exposure Time (Trigger Level)

r	Readout time	4096pixels_4tap	25.6
		4096pixels_2tap	51.2
		2048pixels_2tap	25.6
		4096pixels_4tap（TypeB）	25.6
a	Trigger pulse High time	4096pixels_4tap	≧24.6
		4096pixels_2tap	≧50.2
		2048pixels_2tap	≧24.6
		4096pixels_4tap（TypeB）	≧24.6
b	Trigger pulse Low time	≧3.225	
c	Trigger pulse cycle	4096pixels_4tap	≧27.825
		4096pixels_2tap	≧53.425
		2048pixels_2tap	≧27.825
		4096pixels_4tap（TypeB）	≧27.825

(unit：μs)

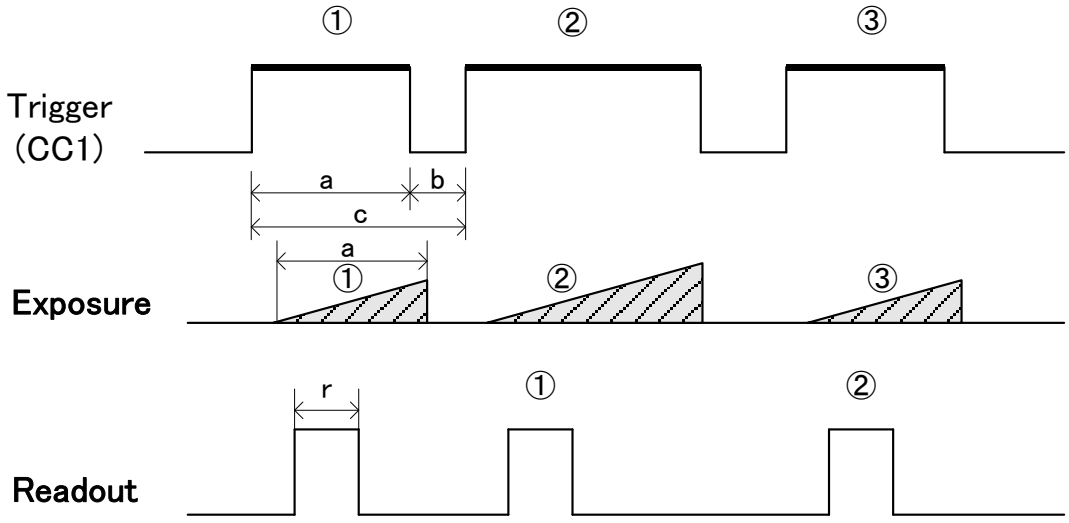


Figure 4-8-3-1 External Trigger (Trigger Level) Exposure Mode at 4096pixels_4tap

Note:

The timing of reading out does one scanning delay from the exposure.

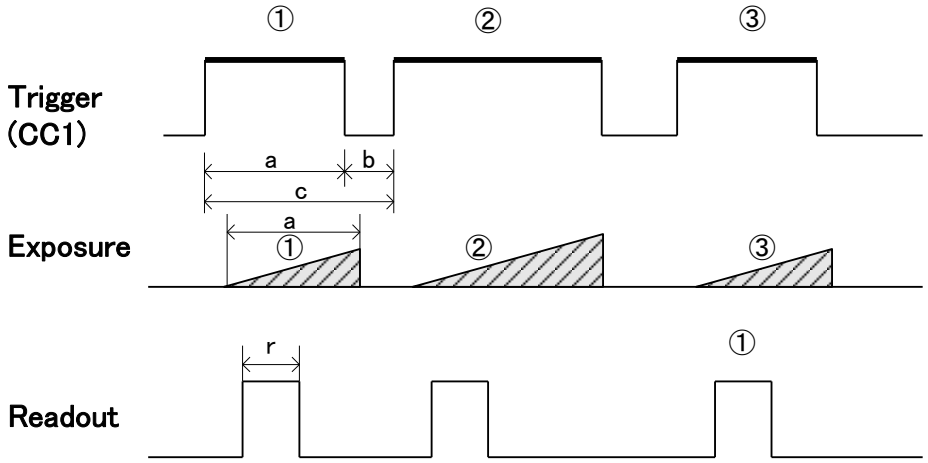


Figure 4-8-3-2 External Trigger (Trigger Level) Exposure Mode at other than 4096pixels_4tap

Note:

The timing of reading out does two scannings delay from the exposure.

4.9 Setting Offset

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

Fs shows the output at saturation. Dd shows the output at darkness. (Both Fs and Dd are digital.) Se shows the saturation current, or the amount of exposure when the output saturates.

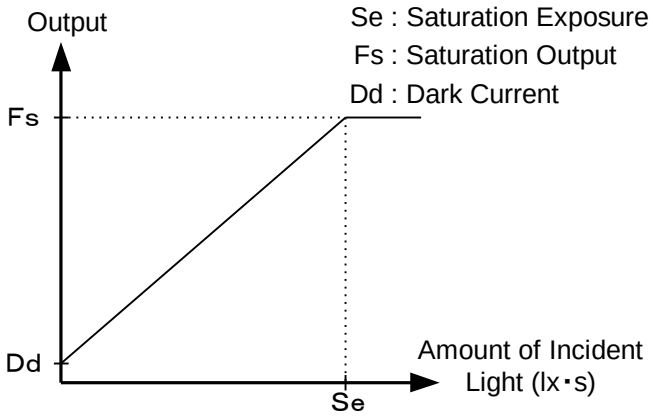


Figure 4-9-1 Saturation Exposure and Dark Current Output

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

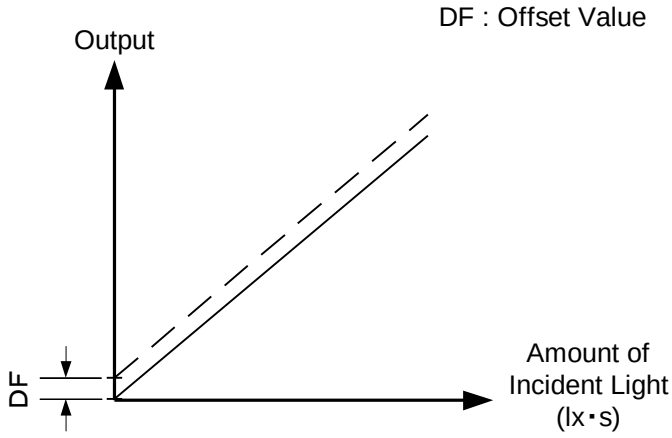


Figure 4-9-2 Offset Adjustment

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

4.10 Setting Gain

The camera can adjust the analog gain (x1 to x17.8 in 8 steps) 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 sending the "gax" command. Digital gain can be changed by sending the "gdx" command.

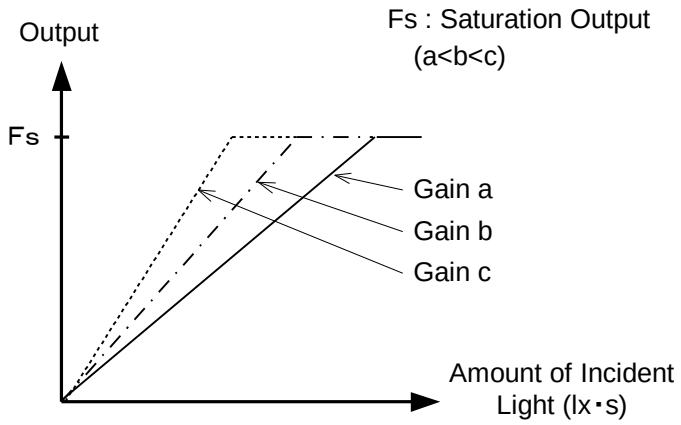


Figure 4-10-1 Gain Adjustment

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

Table 4-10-1 Gain-Sensitivity

gax	Analog Amplifier		Sensitivity 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

Note:
Digital gain x1, Pixel correction default (Factory white correction data, Correction level 200 DN / 8 bit)

When the gain is high and the period is short, S/N worsens. The gain should be low and the period should be long to get a good signal of S/N.
We recommend that the value of analog gain should be as low as possible such as gax 0-4 when the period is less than 30μs.

4.11 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. Vout= (Vin-Cal_bl) x Target_Val / (Cal_wh-Cal_bl)

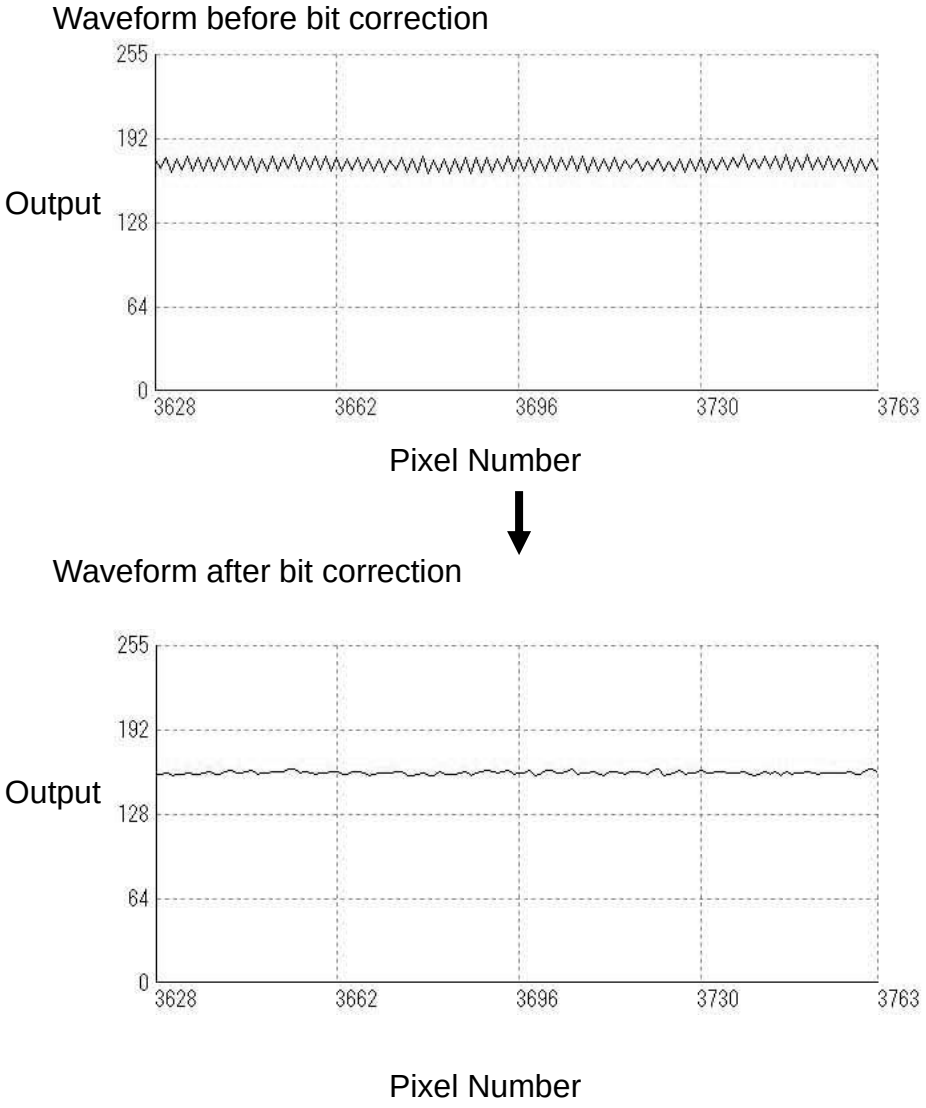


Figure 4-11-1 Waveform before and after bit correction

4.11.1 Command Settings

Set the correction on or off, acquire user white correction data by sending commands through serial communication.

Examples of command settings

shc 0,200:	No correction
shc 1,200:	Factory white correction
shc 2,200:	User white correction
wht:	Acquisition of user white correction data

4.11.2 How to correct

(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) Send the “wht CR” command through serial communication.

(3) Confirm that the camera returns “>OK” and “>wht”. Thus user white correction data is saved and loaded to the camera.

(4) Send the “shc 2 VAL CR” command through serial communication. Then the user white correction will be on and set the correction level as “VAL”.

4.12 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.

The test pattern of XCM4040DLMT4 , (10 bit 4096 Pixels) is as follows.

Figure 4-12-1 Test Pattern of XCM4040DLMT4(4096pixels_4tap, 4096pixels_2tap, 4096pixels_4tap(TypeB))

Figure 4-12-2 Test Image of XCM4040DLMT4(4096pixels_4tap, 4096pixels_2tap, 4096pixels_4tap(TypeB))

In 10-bit mode, from pixel 0, 10-bit data is output in order (0,1,2,3... 1023), repeating four times.

From pixel 0, 8-bit data is output in order (0,0,0,0,1,1,1,1,2,2,2,2,3,3,3... 255,255,255,255), repeating four times..

The test pattern of XCM4040DLMT4 , (10 bit 2048 Pixels) is as follows.

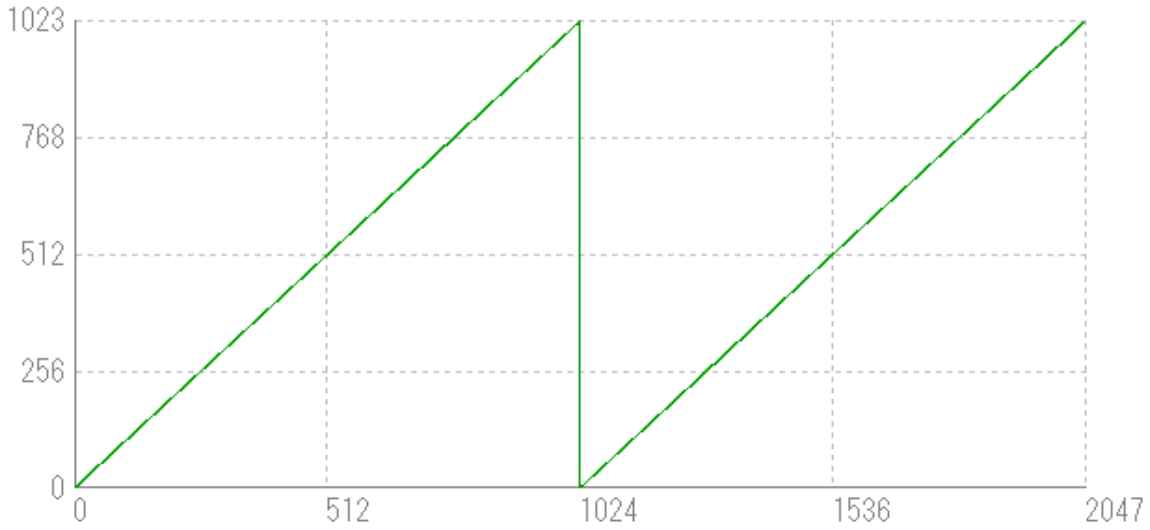


Figure 4-12-3 Test Pattern of XCM4040DLMT4(2048 pixels_2tap)

Figure 4-12-4 Test Image of XCM4040DLMT4(2048 pixels_2tap)

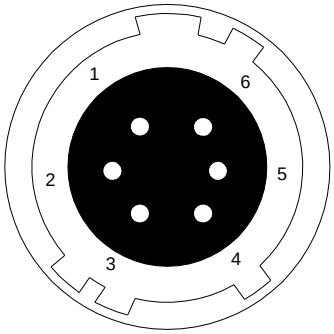
In 10-bit mode, from pixel 0, 10-bit data is output in order (0,1,2,3... 1023), repeating two times.

From pixel 0, 8-bit data is output in order (0,0,0,0,1,1,1,1,2,2,2,2,3,3,3... 255,255,255,255), repeating two times..

5 Confirming Camera Settings

5.1 Before Power-on

(1) Confirm the pin assignment of the power cable.



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

Figure 5-1-1 Pin Assignment of Power Cable

(2) Confirm the direction and the channel of the cables. Some Camera Link cables are directional.

If one of the connectors says “Camera side”, connect this to the camera.

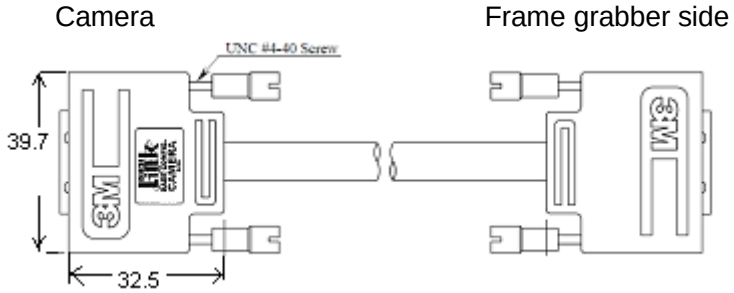


Figure 5-1-2 Connection Direction of Camera Cable

Confirm the connection with the Camera Link cable and frame grabber.

The connection channel in case of “Solios”,

Camera side connector CL1 and frame grabber side connector CHANNEL#0

Camera side connector CL2 and frame grabber side connector CHANNEL#1

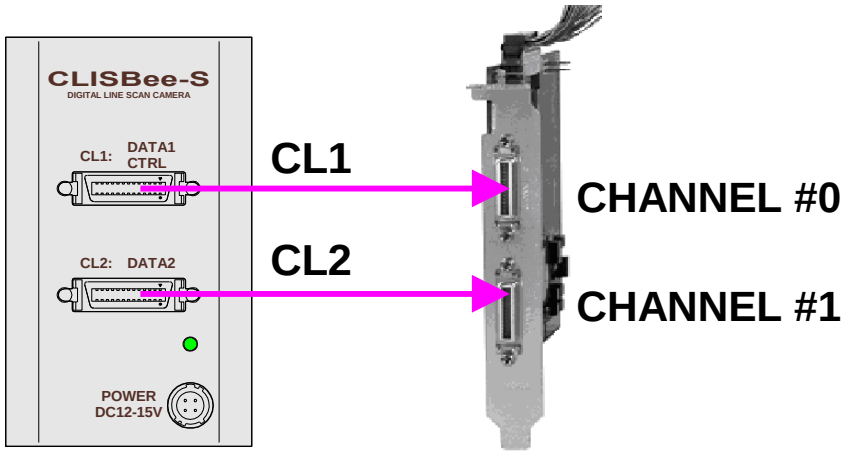


Figure 5-1-3 Channels of Camera Link Cables

5.2 After Power-on

(1)Confirm sent and received commands using the camera control utility. Launch CLISBeeCtrl, set COM port and connect. Click “Memory Dump” and wait for the response.

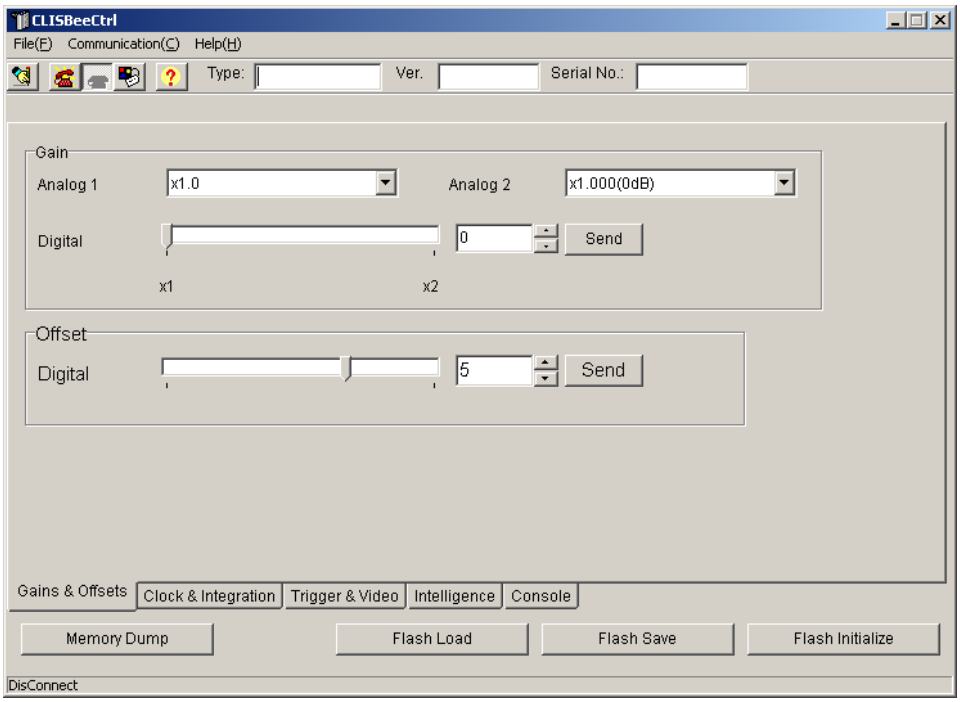


Figure 5-2-1 Confirmation of Connection

(2) Set a trigger mode and a video output mode with the camera control utility

Trigger mode: Free Run Video output: 8bit, 4096pixels_4TAP

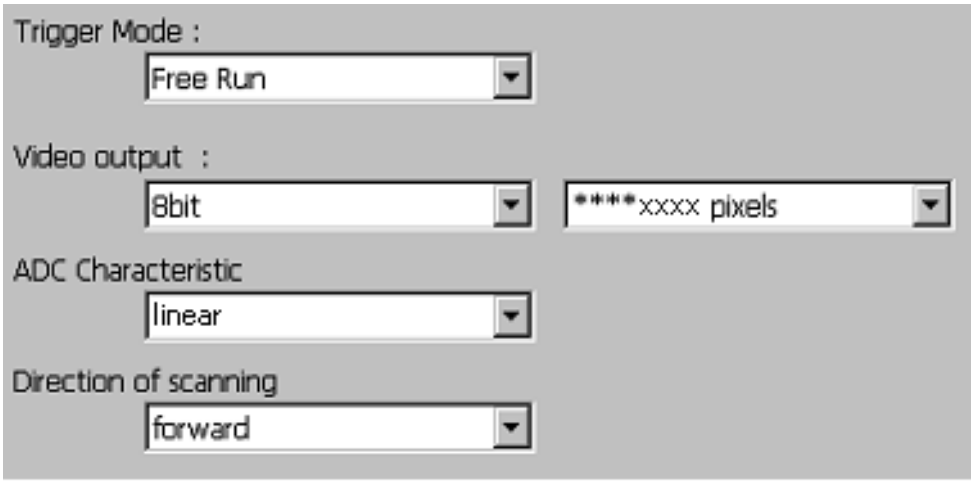


Figure 5-2-2 Setting of Exposure Mode and Video Output Mode

(3) Capture images using a camera interface board utility. In case of Matrox's Solios, it is convenient to use Intellicam.

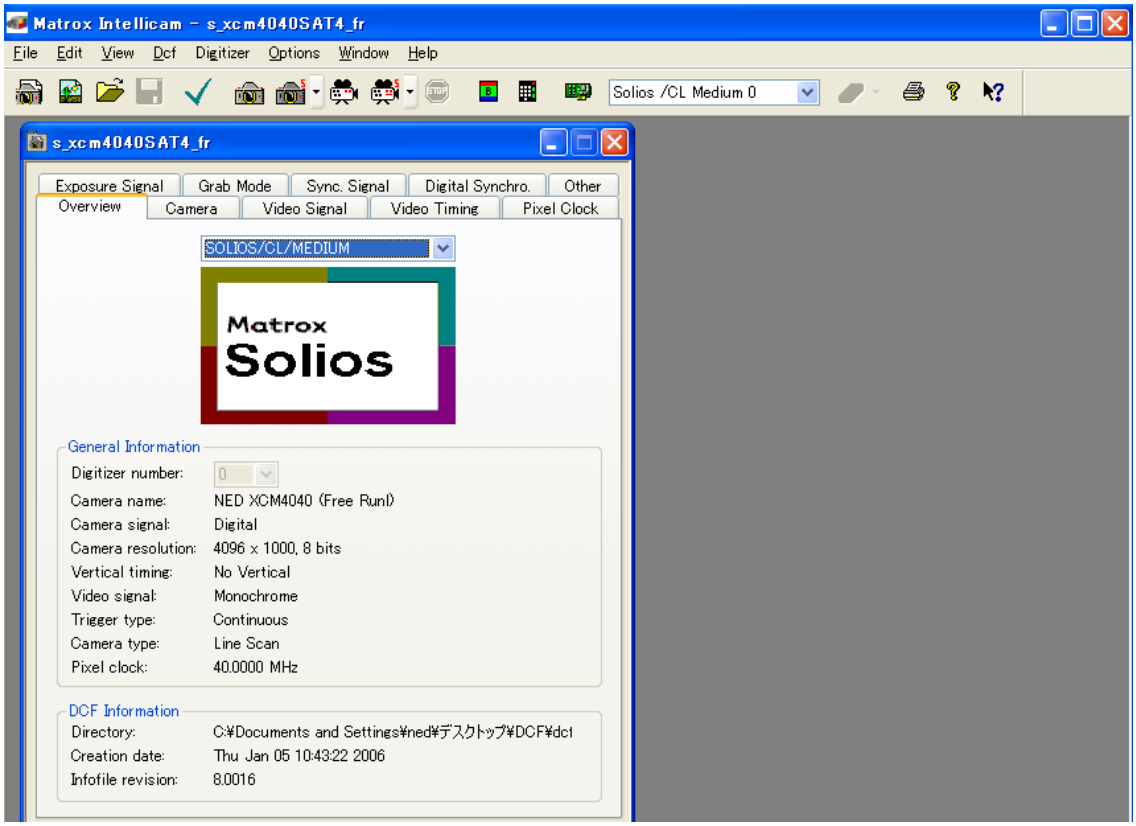


Figure 5-2-3 Solios Intellicam dcf Window

5.3 In 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> Camera Link 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.

6 Sensor Handling Instructions

6.1 Electrostatic Discharge and the Sensor

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

6.2 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.

6.3 Cleaning the Sensor Window

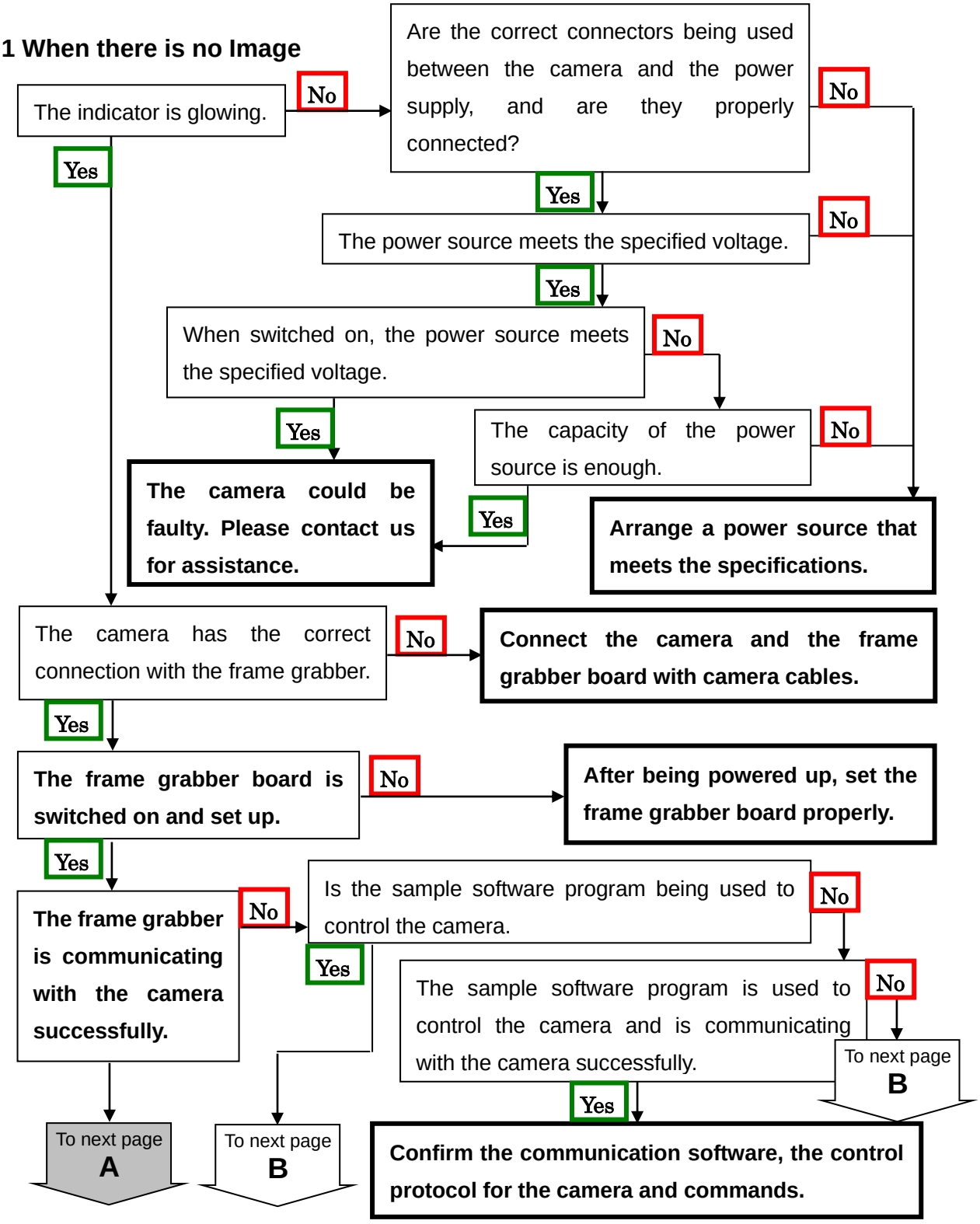
Dust: Can usually be removed by blowing the window surface using a compressed air blower.

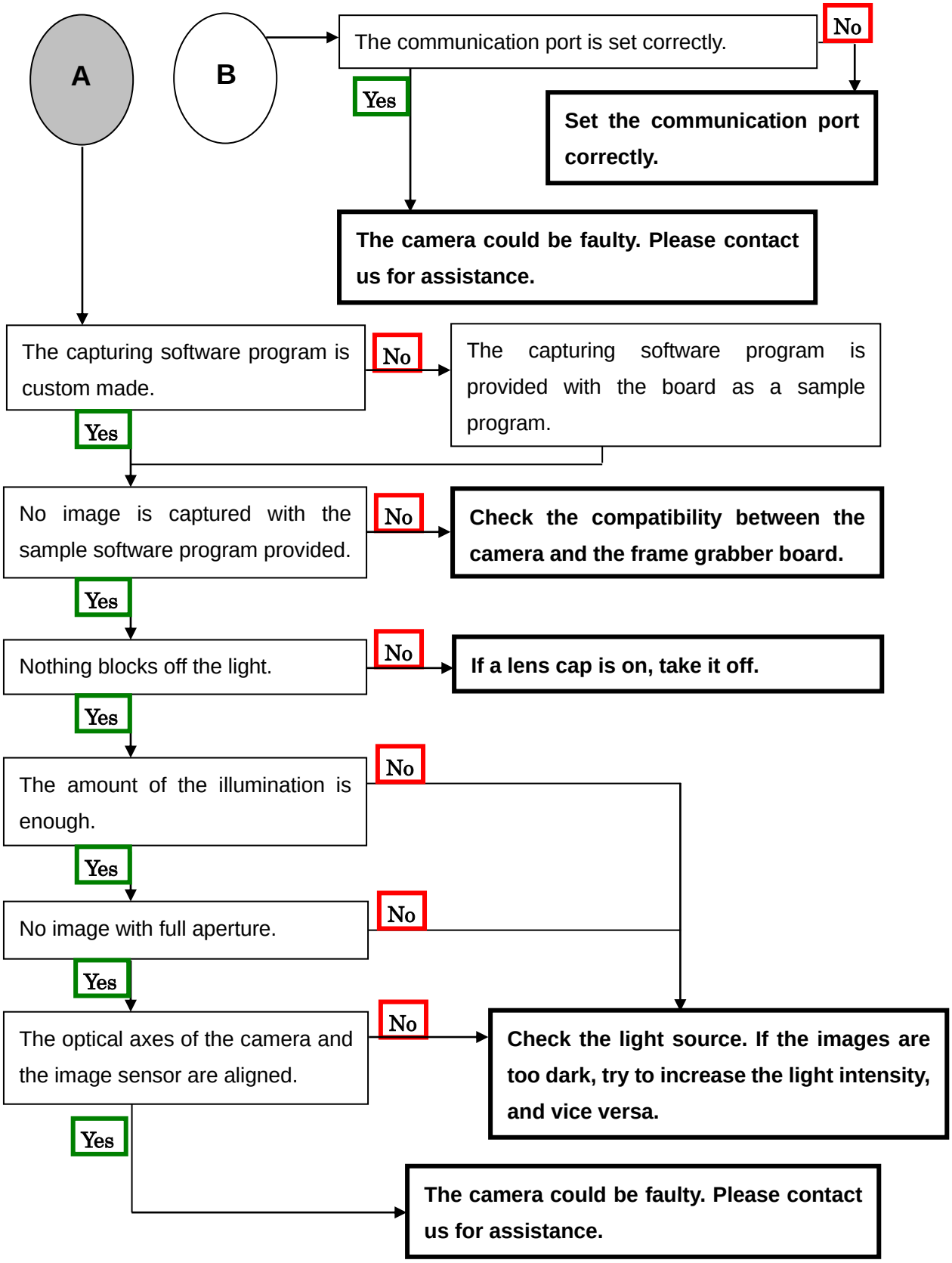
Oil: Wipe the window with a lint-free cloth wiper moistened with ethyl alcohol carefully and slowly.

7 Troubleshooting

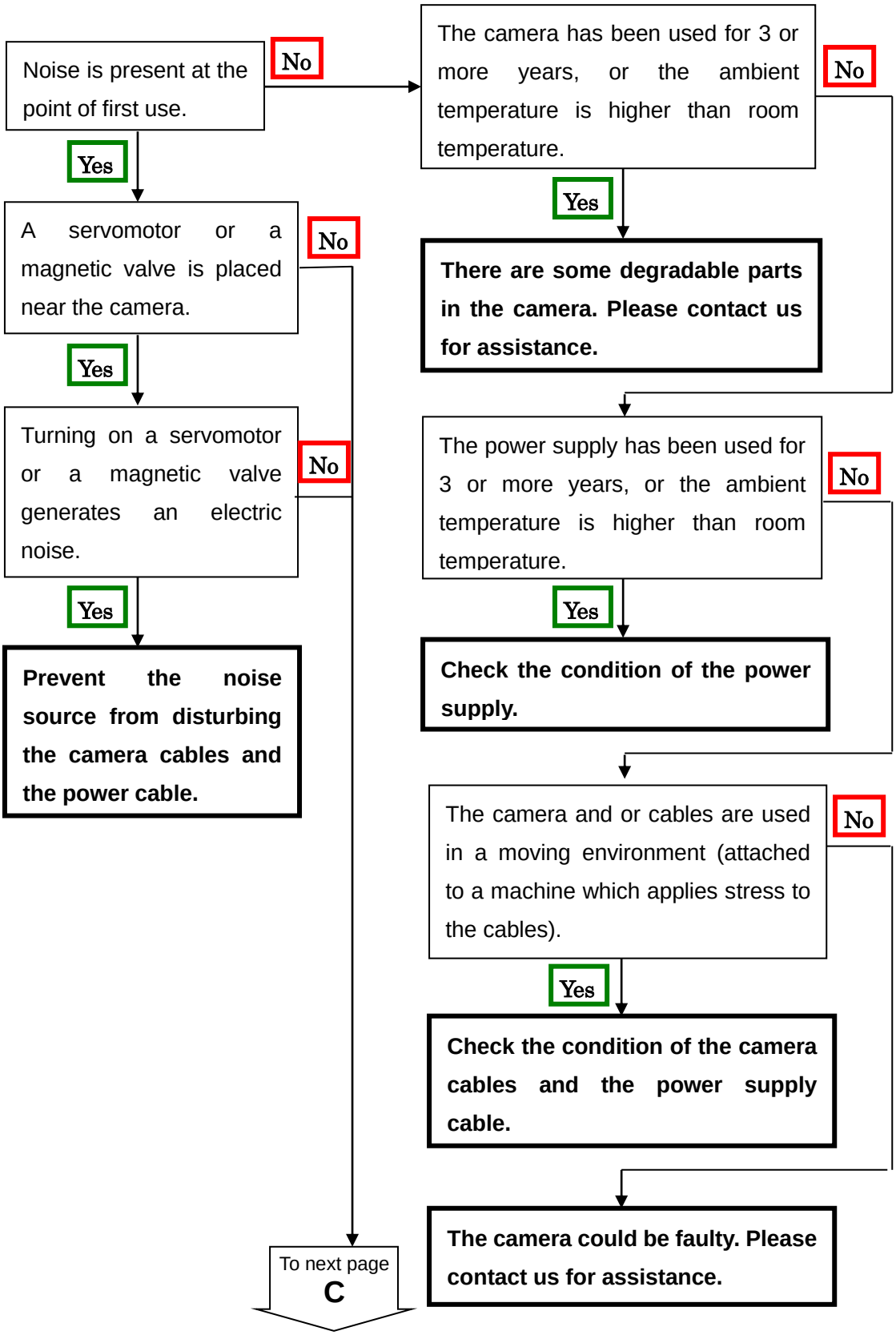
The following pages contain several troubleshooting charts that can help you find the cause of problems user sometimes encounters.

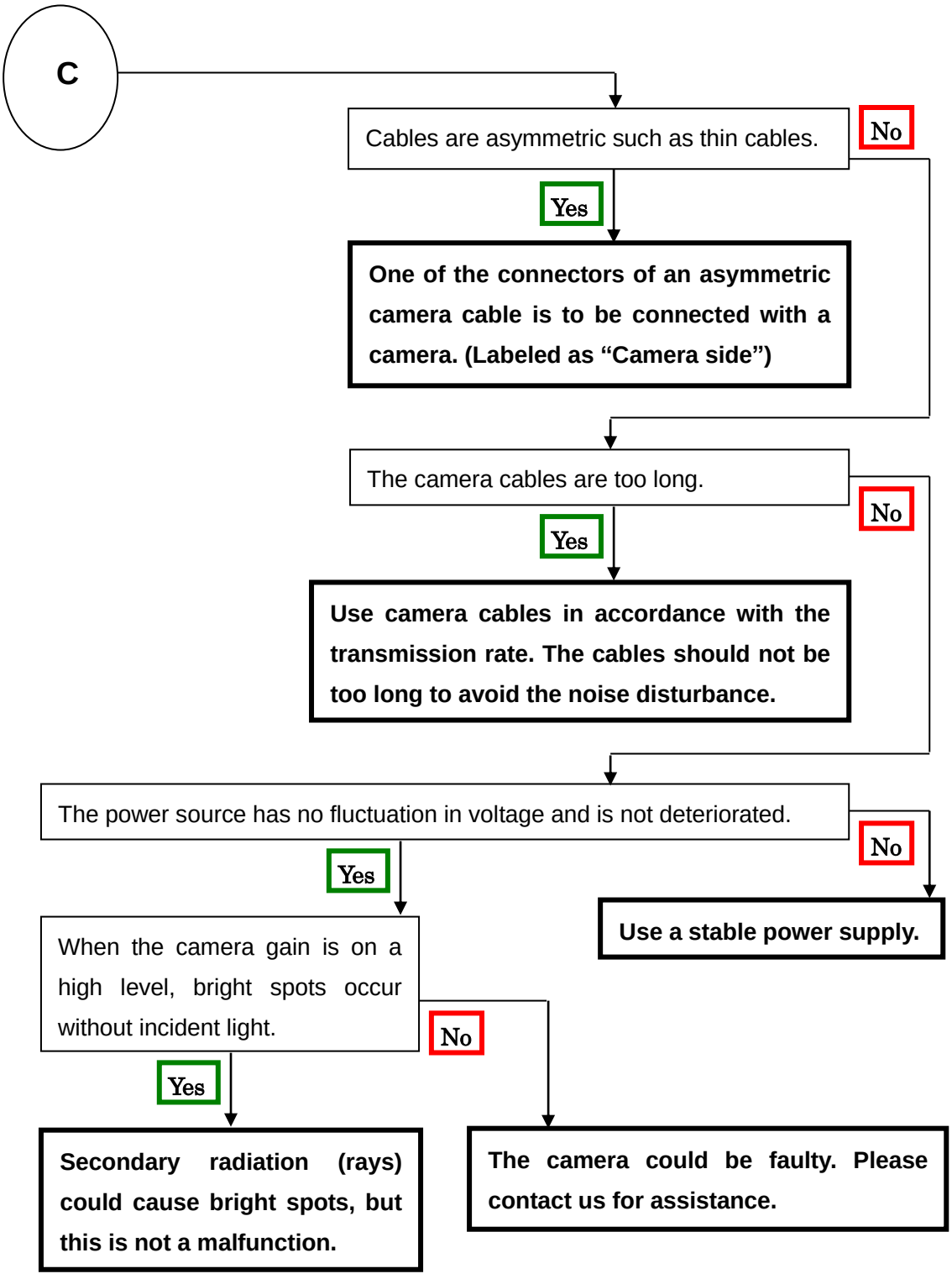
7.1 When there is no Image



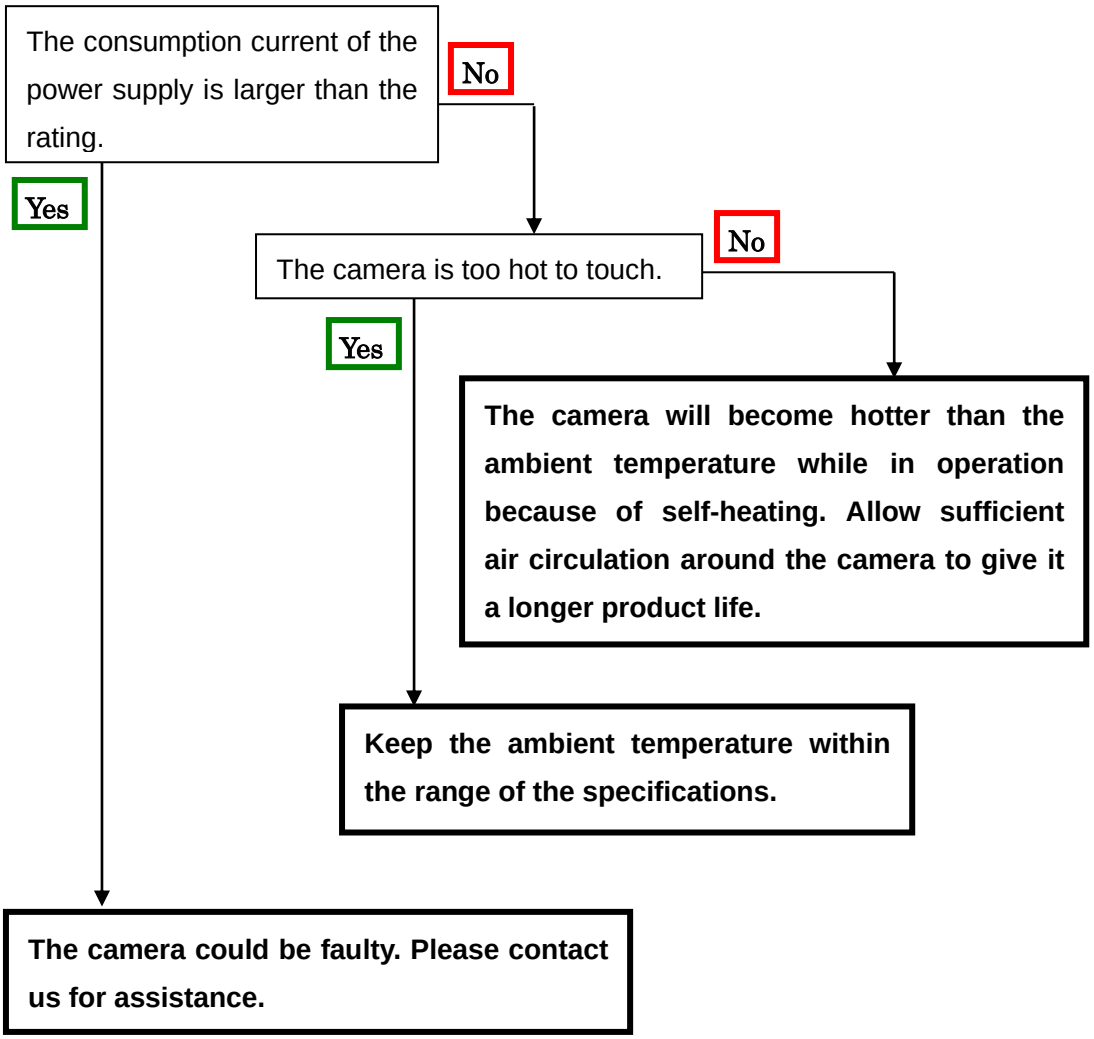

A
B
The communication port is set correctly.
No
Yes
Set the communication port correctly.
The camera could be faulty. Please contact us for assistance.
The capturing software program is custom made.
No
The capturing software program is provided with the board as a sample program.
Yes
No image is captured with the sample software program provided.
No
Check the compatibility between the camera and the frame grabber board.
Yes
Nothing blocks off the light.
No
If a lens cap is on, take it off.
Yes
The amount of the illumination is enough.
No
Yes
No image with full aperture.
No
Yes
The optical axes of the camera and the image sensor are aligned.
No
Check the light source. If the images are too dark, try to increase the light intensity, and vice versa.
Yes
The camera could be faulty. Please contact us for assistance.

7.2 When Noise is present in the Image




C
Cables are asymmetric such as thin cables.
No
Yes
One of the connectors of an asymmetric camera cable is to be connected with a camera. (Labeled as “Camera side”)
The camera cables are too long.
No
Yes
Use camera cables in accordance with the transmission rate. The cables should not be too long to avoid the noise disturbance.
The power source has no fluctuation in voltage and is not deteriorated.
No
Yes
Use a stable power supply.
When the camera gain is on a high level, bright spots occur without incident light.
No
Yes
Secondary radiation (rays) could cause bright spots, but this is not a malfunction.
The camera could be faulty. Please contact us for assistance.

7.3 When the Camera becomes hot



8 CLISBeeCtrl

8.1 Overview

The CLISBeeCtrl is the remote control software for “CLISBee*” camera using “**N**ED **C**amera **C**ontrol **P**rotocol” (NCCP) from a PC.

Connectable interfaces are following.

1） Camera Link API

2） Communication Port (COM port, RS232C)

*CLISBee is the nickname for XCM series camera.

8.2 System Requirements

PC: PC/AT compatible

Operating System: Microsoft Windows (XP/7).

Free disk space: 1-2MB (It may fluctuate with the number of camera parameter files.)

Connection: Camera Link frame grabber board, Camera Link cables

8.3 Install

Copy the CLISBeeCtrl folder in the media (CD-ROM, etc) which our company provides, to your hard disk.

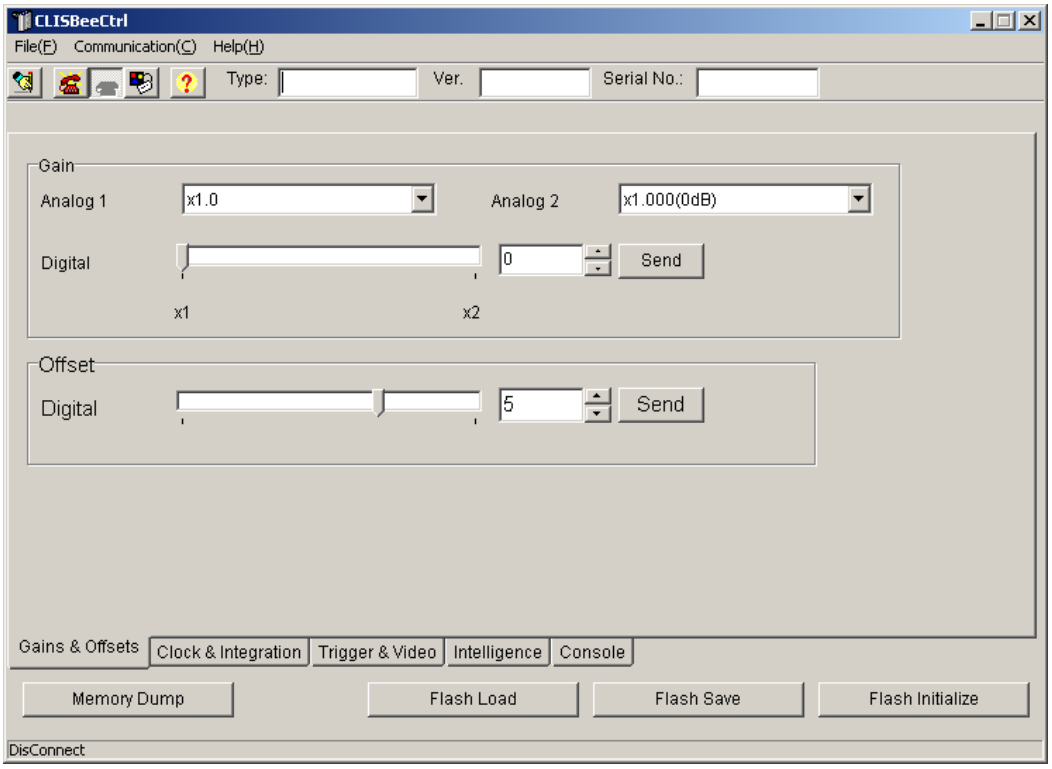
8.4 Uninstall

Remove the CLISBeeCtrl folder and all files in CLISBeeCtrl folder.

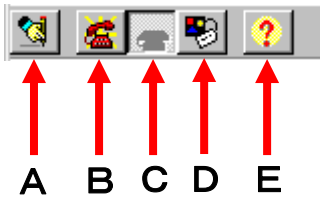
8.5 Operation

8.5.1 Start Program

Open Windows Explorer and Double-click the “CLISBeeCtrl.exe”.



It is possible to switch page by clicking each tab under the window.



Buttons in the tool-bar have the following functions.

A: Exporting parameters in the text file format.

B: Connection with the camera.

C: Disconnection.

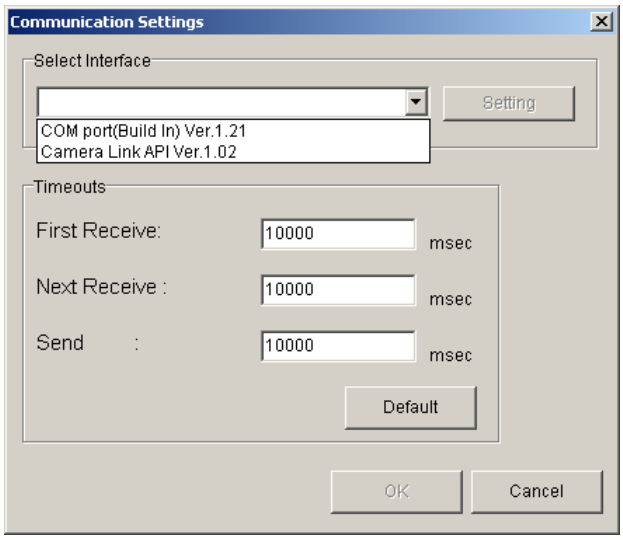
D: Setting Communication.

E: Version Information.

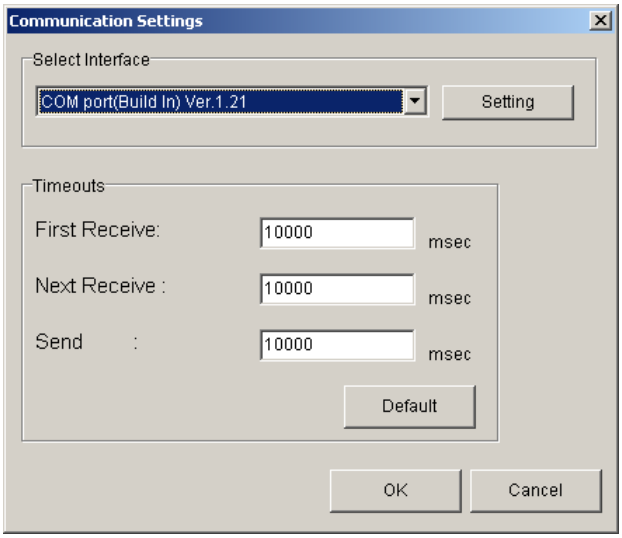
8.5.2 Selecting interface and Timeout setting

8.5.2.1. Selecting interface

1) Click button D.



2) Select the interface in Drop-down-list-box.

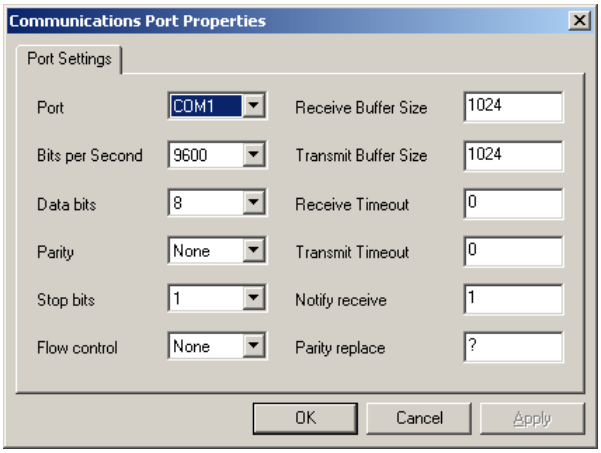


3) Click “Setting” button to set the interface. (See 8.5.2.2. and 8.5.2.3.)

4) Click “OK” button.
Click “Cancel” button when stopping setup.

Note: The camera can be used without this operation after it has been set up correctly.

8.5.2.2 Setting Communication port



1) Set up each item as follows. (NED standard)
However, when the setup which differs to the camera to connect is shown, follow there.

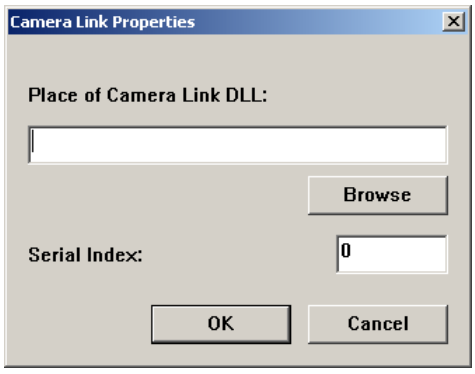
(1)Port: Select connecting port.
(2) Bits per Second: 9600
(3) Data bits: 8
(4) Parity: None
(5) Stop bits: 1
(6) Flow control: None

Note: Other parameters are not used.

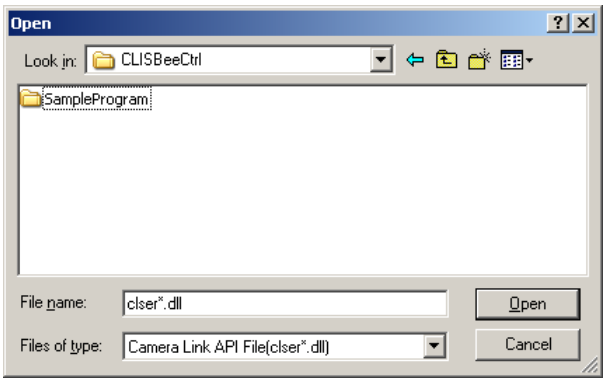
Click “OK” button.
Click “Cancel” button when stopping setup.

Note:
The camera can be used without this operation after it has been set up correctly.

8.5.2.3 Setting Camera Link API



Input the DLL file name for Camera Link API by edit-box,
or click “Browse” button and select this file.



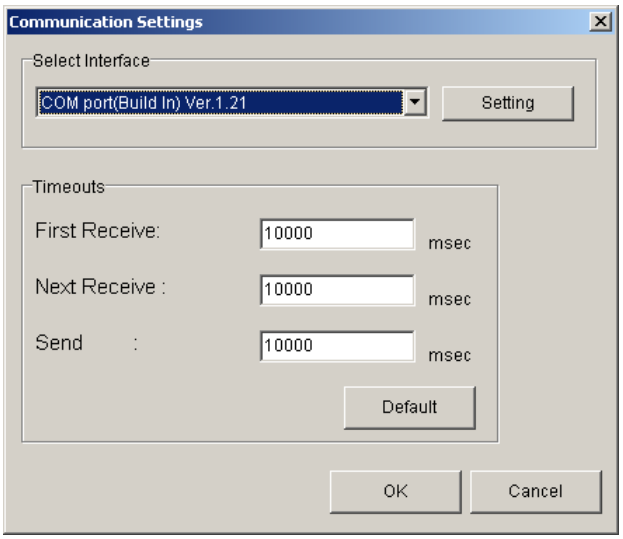
Input value corresponding to the position of Camera Link cable to connect, into “Serial Index” column.

Click “OK” button.
Click “Cancel” button when stopping setup.

Note: The camera can be used without this operation after it has been set up correctly.

Note: DLL for Camera Link API is provided by the manufacturer of the grabber board. Please contact the manufacturer of the grabber board for detail.

8.5.2.4 Setting Timeout



Input each timeout value in the edit-box (unit: msec)

When clicking the “Default” button, the value will be reset to the camera’s default values.

The meanings of each timeout are as follows.

First Receive:	The maximum time from sending a command to receiving the first data.
Next Receive:	The maximum time between a letter and the next one.
Send:	The maximum time until finishing sending a command.

Click “OK” button.

Click “Cancel” button when stopping setup.

Note: The camera can be used without this operation after it has been set up correctly.

8.5.3 Connect

Click button B. Then you can control the camera. (See “8.6.Control”)

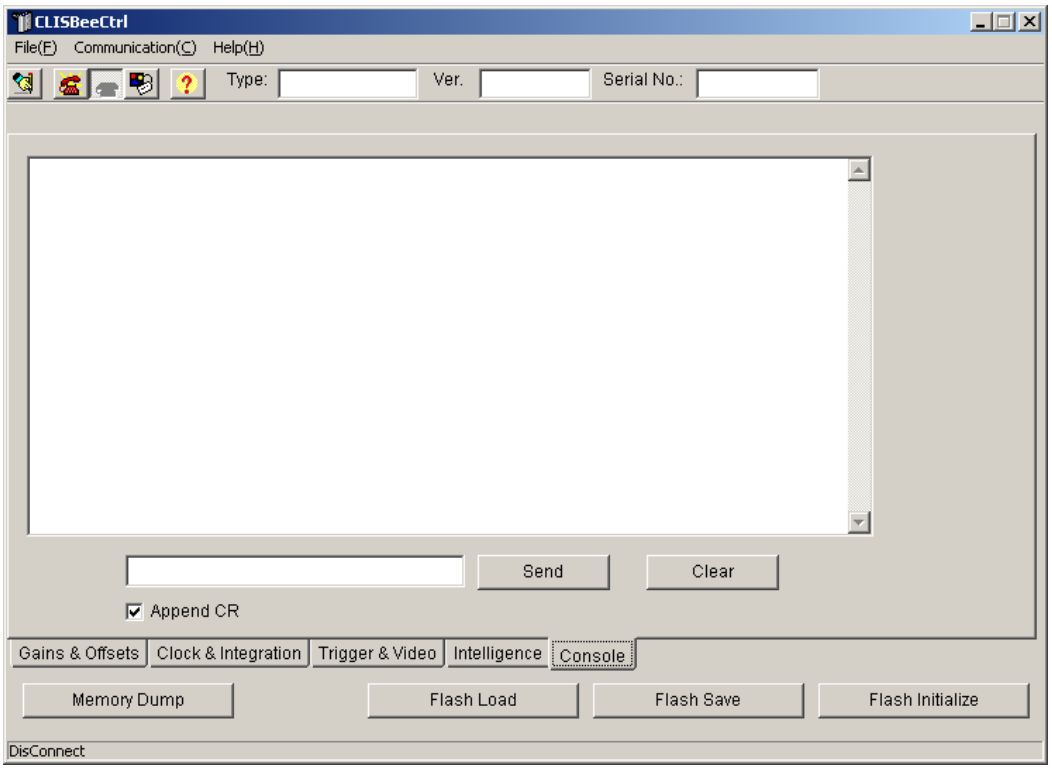
Click the “Memory Dump” button to acquire the current data of the camera.

8.5.4 Disconnect and end program

Click button C. Then click “X” button in the upper right of the window.

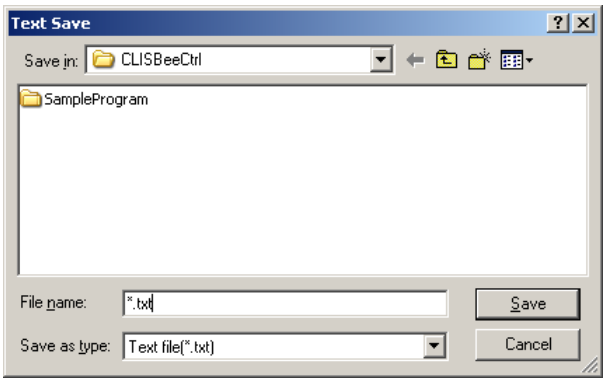
8.5.5 Check of the contents of communication

Click “Console” tag near the bottom window.



8.5.6 Export Parameters to text file

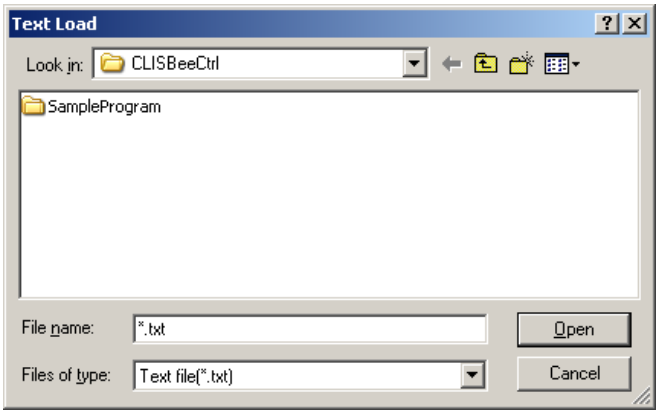
Click button A.



Input file name and click “Save” button. Present setting value of each control is saved by text format.

8.5.7 Import Parameters from text file

Select menu “File” – “Text Load”



Input file name and click “Open” button.

8.6 Control

8.6.1 Gains and Offsets

『Gains & Offsets』tab.

< Gain >

Analog 1 :

The signal will be sent to the camera every time you make a selection from the menu in the drop-down-list-box.

Note:

This camera does not use ‘Analog 2’

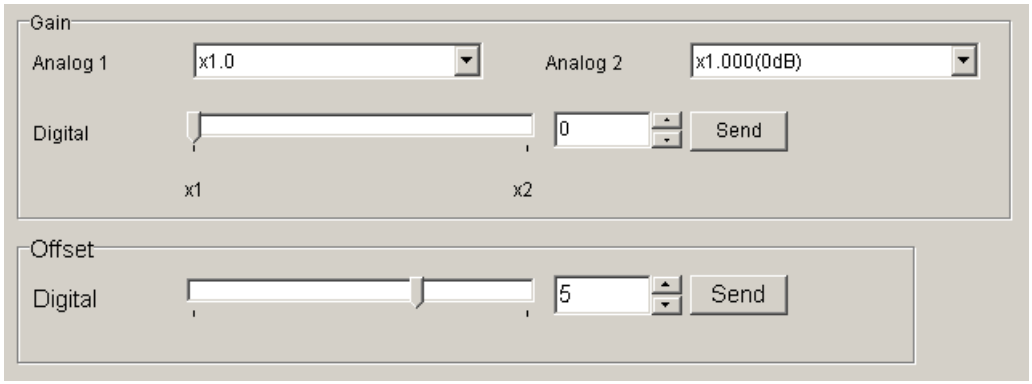
Digital :

Set a value with the slider, the edit-box or the spin-button. Then, click “Send” button.

< Offset >

Digital :

Set a value with the slider, the edit-box or the spin-button. Then, click “Send” button.



8.6.2 Clock & Integration

『Clock & Integration』tab.

Clock: Shows the camera internal clock frequency.

Note: Read Only

Integration Time: Setting integration time. (unit: μs)

Dividing: 1 (fixed)

Counter: Set a counter value with the slider, edit-box or the spin-button. Then, click "Send" button.

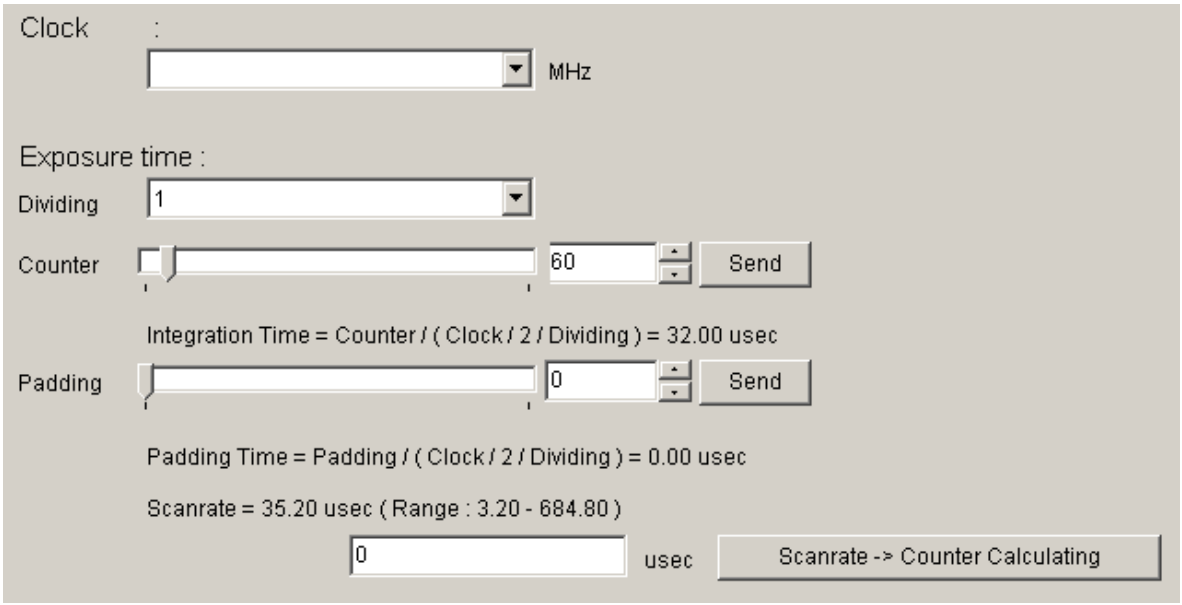
Padding: Set a counter value with the slider, edit-box or the spin-button. Then, click "Send" button.

Padding time: Shows the calculated value of the Padding. (unit: μs)

Scanrate: Shows the calculated value of the scan rate. (unit: μs)

Scanrate -> Counter automatic setting:

The Counter value of Clock, Dividing, and Padding is calculated and set from the present value when the scanning cycle is set and then clicking on the "Scanrate->Counter Calculating" button.



8.6.3 Exposure mode (Trigger Mode) & Video output mode

『Trigger & Video』tab.

Exposure mode （Trigger Mode）

Select Free Run Exposure mode, External Trigger Exposure mode and External Trigger level. The signal will be sent to the camera every time you make a selection from the menu in the drop-down-list-box.

Video output:

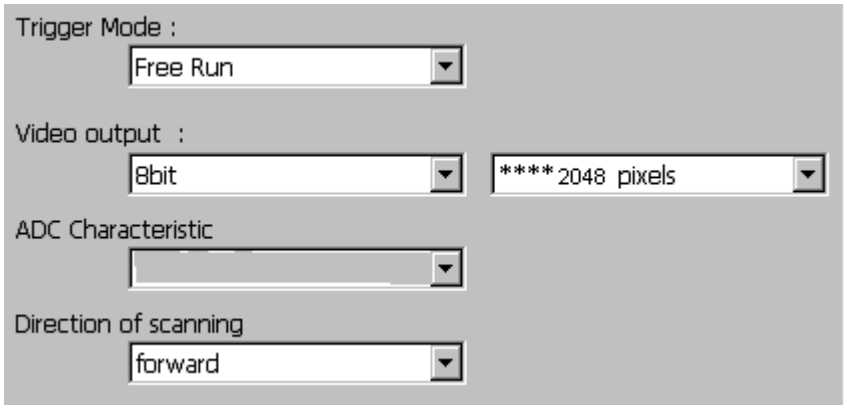
Select the number of the output bit and the output block. The signal will be sent to the camera every time you make a selection from the menu in the drop-down-list-box.

ADC Characteristic

Read Only

Direction of scanning:

The order of outputting data from the camera is switched in positive direction (forward) or opposite direction (reverse).



8.6.4 Intelligence

『Intelligence』tab.

< Calibration >

Calib White:

Acquisition of white data and saving the calibration data to camera's flash memory.

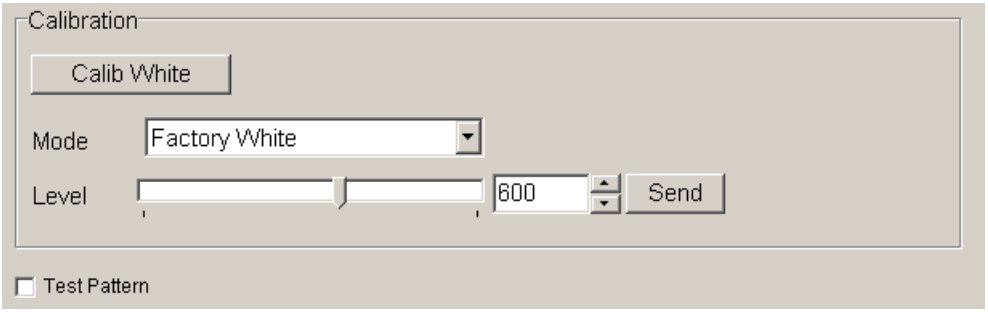
Mode / **Level**:

First, choose the mode from the drop-down-list-box.

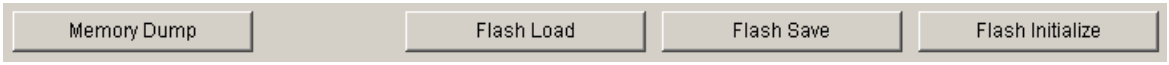
Next, set a value with the slider, the edit-box or the spin-button. Then, click "Send" button.

Test Pattern:

On/Off of the test pattern output is switched clicking the check box.



8.6.5 Memory in camera



Memory Dump:

Read the data from the camera's work memory.

Flash Load:

Loading the data from the camera's flash memory.

Flash Save:

Saving the data in the camera's flash memory.

Flash Initialize:

Initializing the camera's flash memory with the factory standard data.

Note:

It takes a while to save and initialize.

8.7 Upgrade

When installing a newer / updated software version from our company,
Please perform in the following procedure.

Check the CLISBeeCtrl has not started.
Uninstall the old version software. (See “8.4.Uninstall”)
Install new version software. (See “8.3.Install”)

8.8 How to Program

Please refer sample programs in CLISBeeCtrl¥SampleProgram folder.

8.9 Attention on use

Reproducing and distributing without notice the part or all of this software and this document is prohibited.
Reverse engineering, decompiling, disassembling and modifying parts or all of this software without notice is prohibited.
The specification of this software and the contents of this document may be changed without announcement.

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

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Fax +81-92-451-9335

URL
http://ned-sensor.co.jp/

E-Mail
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.

In such case, please inform us of the status of the camera. You can get the status by
(1) executing the “sta” command, or
(2) clicking “Memory Dump” button when using CLISBeeCtrl.

The example of the camera status.

```
sta
>OK
>Type=XCM4040DLMT4
>Ver. =1.01_0x0161
>Serial=2563
>gax 0
>gdx 0
>odx 0
>inm 0
>int 0, 10000
>pad 0
>shc 1,200
>tpn 0
>rev 0
>voa 0,2
>vod 2
>d 0
>gamma 0,1000
>sta
```

Revision History

Revision Number	Date	Changes
03	29 October 2015	Initial release
04	23 February 2018	Modified the model number of the power cable
05	14 May 2020	Fixed 4.1.2
06	30 March 2021	Modified Table 1-4-1 Video output