User's Manual

Line Scan Camera

Type: SUi7450T2

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.

⚠ 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.

◆ If the CCD is continually exposed to bright light which would exceed the CCD saturation for a long time, the colour filter may become faded. As far as possible, the sensor should be protected from light except when in use.

◆ 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.

◆ The signal ground (SG) and the frame ground (FG) are connected inside the camera unit. Design the system configuration so that a loop will not be formed by the ground potential differential.

◆ 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 (CC1) from the capture board.

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

- Readout 50MHz
- High resolution 7400 pixels
- Easy connection with a variety of frame grabber boards via Camera Link interface
- Easy control of gain / offset / Sensitivity by sending the command through the frame grabber board.
- Pixel correction/shading correction, image data-level adjustment functions for all pixels become possible using the on-board FPGA .

1.2 Applications

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

An example of Visual Inspection of PCBs is shown below.
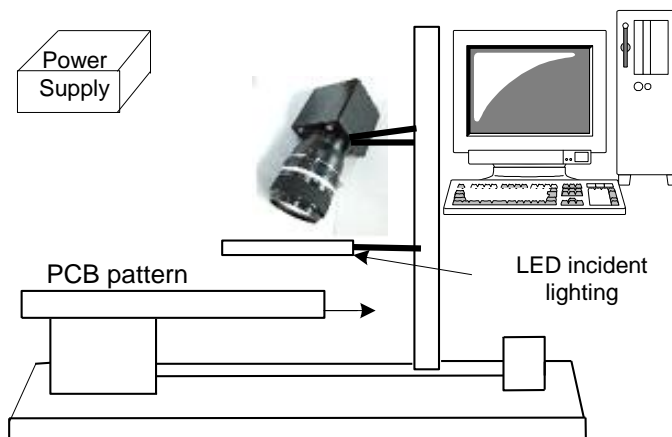
Figure 1-2-1   Visual Inspection of PCBs

Applicable Work

Printed circuit board

Performance

1. Printed circuit board size: 150mm×150mm

2. Resolution: 20μm

3. Inspection time: less than 30 seconds

Unit Configuration

1. Camera: line scan camera

2. Controller: Dedicated software for PC system

3. Size: L930 x D500 x H500 (mm)

Applicable Fields

Inspection of patterns on film PCBs

1.3 Image Sensor

The camera uses a CCD sensor with a maximum data rate of 50MHz to acquire high responsivity and superior quality images.

The pixel size is 4.7μm x 4.7μm. By outputting the front half and back half of the line (3700 pixels each) through 2 taps simultaneously, a fast data transmission rate (Video data rate 100MHz) becomes possible.

1.4 Performance Specifications

The Performance Specifications are shown below. Unless otherwise specified, the data shown is when the camera is operating at the maximum scan rate.

Table 1-4-1　Performance Specifications

Items	Specifications
Number of Pixels	7400
Pixel Size H x V (μm)	4.7 x 4.7
Sensor Length (mm)	34.78
Spectral Responsivity (nm)	400~800 *Peak 541
Data Rate (MHz)	50 (fixed)
Maximum Scan Rate (μs) / [kHz]	80 [12.5]
Saturation Exposure (V/ [lx/s]) (typically)	0.074 gain x 1, Daylight Fluorescent Light, Ta＝25℃
Responsivity (typically) (V/[lx/s]) Analog 5V Conversion Sensitivity	67 [gain x 1, Ta＝25℃,Daylight Fluorescent Light]

PGA Gain Adjustable Range (times)		1 to 6 [VAL＝0 ~ 350]
Offset Adjustable Range (LSB)		0 to 15
Video output		Camera Link Base Configuration
		8 bit :2 tap output
		10 bit :2 tap output
		12 bit :2 tap output
		Port A:1 ~ 3700 pixels
		Port B:7400 ~ 3701 pixels
Control Input		CC1: External Trigger Signal
		CC2,3,4: Not in use
Serial communication control		SerTC, SerTFG
Master clock (MHz)		50
Connectors	Data/Controller	3M: MDR26 [Camera Link]
	Power Supply	Hirose: HR10G-7R-6PB (6 Pin)
Maximum cable length		10　(*Using Camera Link standard)
Lens Mount		Nikon mount
Operating Temperature (˚C) *No Condensation		0 to 50
Power Supply Voltage (V)		DC 12 to 15 [+/-5%]
Consumption Current (mA) (typically)		440
Size W x H x D (mm)		64×70×90.3
Mass (g)　(Camera only)		Under 380
Additional Functions		1.　Pixel correction
		2.　Scan Rate Programmable time setting (at the time of Free run exposure mode)
		3.　Test Pattern Output
		4.　Data level transforming
		5.　Scan Direction Switching

The spectral Responsivity is shown below.

（Ta=25℃）
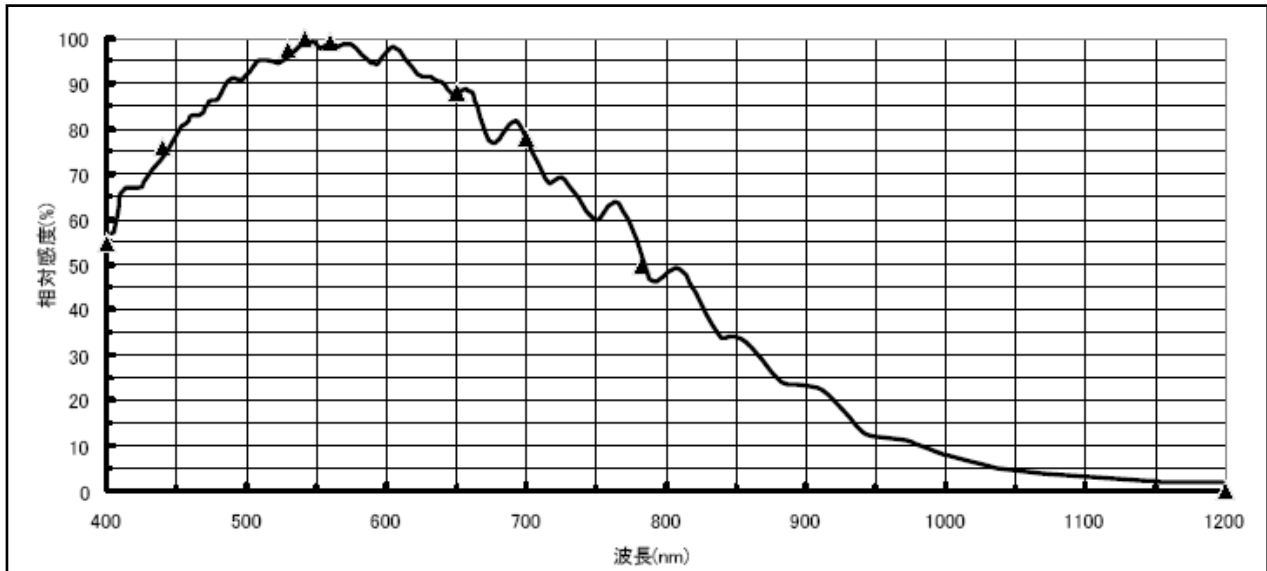
Figure 1-4-1 Spectral Responsivity

2 Camera Setting and Optical Interface

2.1 Setting Camera

The M4 screws on the front panel can be used to set the camera.

2.2 Fixing Camera

◆ No X-, Y-axis orientation and tilt adjustment mechanism is available. Please provide an adjustment mechanism yourself as necessary.

2.3 Camera dimension

The dimensions for the cameras are shown below.
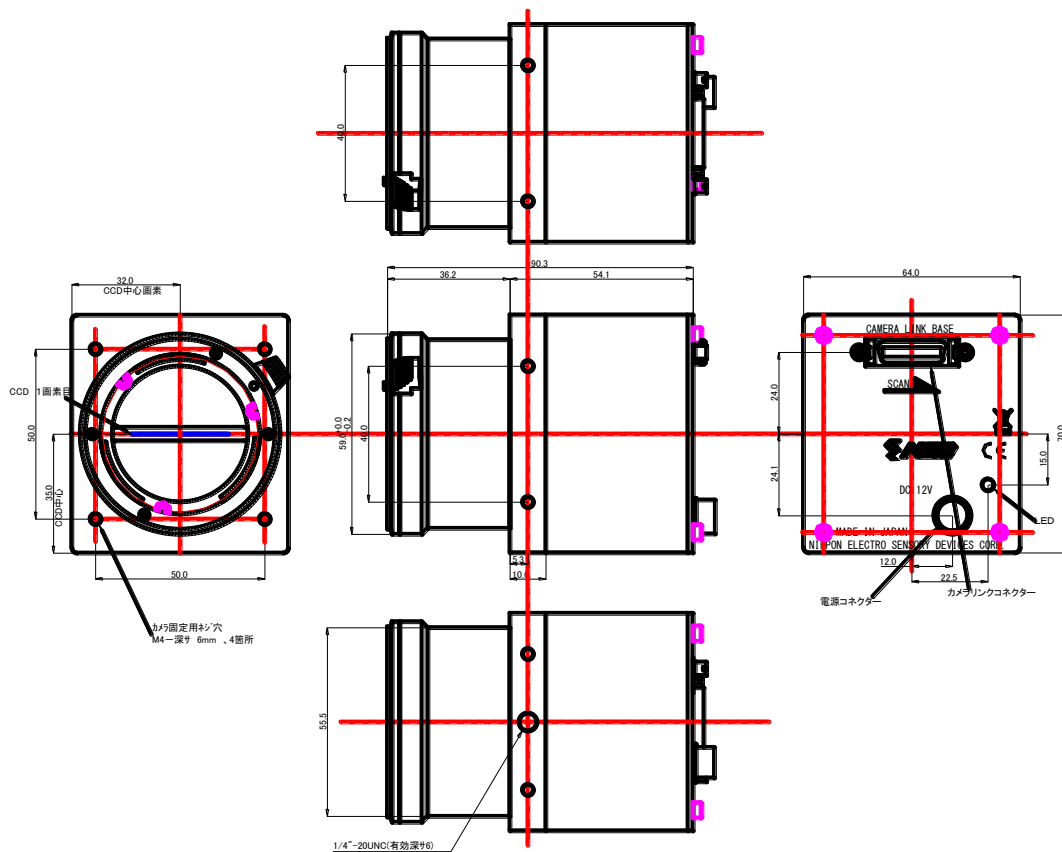
Figure 2-3-1 Dimensions(Nikon F Mount)

2.4 Optical Interface

The amount and wavelengths of light required to capture useful images depend on the intended use. Factors include the property, speed, the object's spectral characteristics, exposure time, the light source characteristics, the specifications of the acquisition system and so on.

The exposure amount (exposure time x light amount) is the most important factor in getting desirable images. Please determine the exposure amount after studying what is most important to your system.

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 relative to infrared light (IR).
● 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.

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

CCD 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 cutoff filter that does not transmit IR wavelengths.

3 Hardware

3.1 Camera Connection

(1) Camera Link cables shall be used to connect the camera unit with the frame grabber board.

◆ Use two cables of the same length and the same manufacturer. If you use asymmetric Camera Link cables, connect the camera with the connector labeled as "Camera side".

(2) Connect with a power supply.

Use a power cable to connect the camera with the power source for the camera. Insert the plug end of the cable into the camera. Attach the opposite end (loose wires) to the power unit.

◆ Other than the above, a personal computer, a frame grabber board, a photographic lens, a photographic lens mount, a light source and an encoder are necessary, depending on the situation.
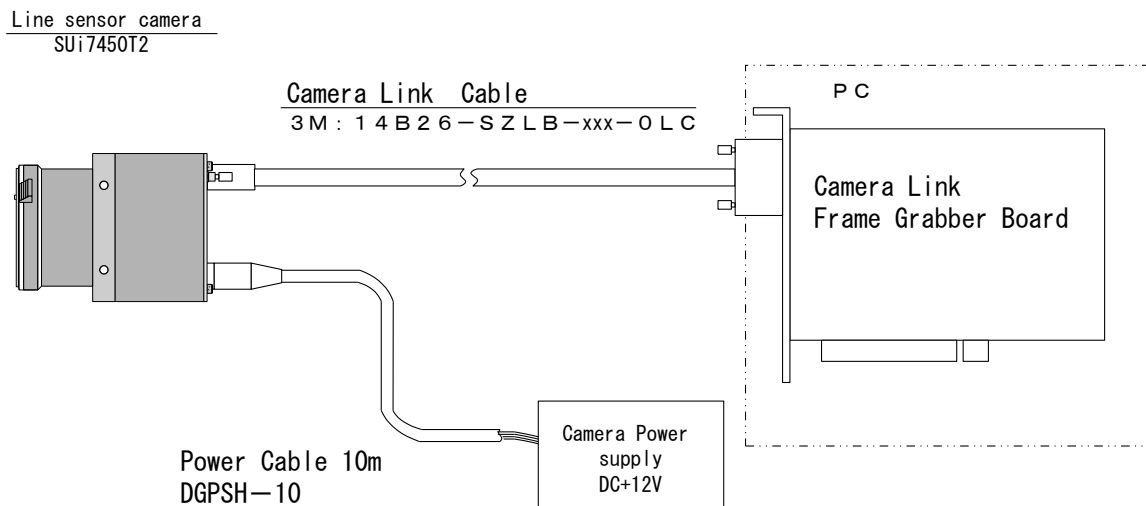
Figure 3-1-1 Connections between Camera and Frame Grabber Board and Power Supply

◆ There are two connectors available for the Camera Link Medium Configuration board. Always check the frame grabber board specifications before making connections.

<Note: Choosing the appropriate Camera Link cable length >

According to the Camera Link Specification, the maximum cable length is 10 m. 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 10 m at faster clock speeds, though the transmission distance of 10 m 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*	40	9.8
(20~66MHz)	66	8.0
SOL 6M FC E*	75	7.6
(20~85MHz)	85	5.8

3.2 Input / Output Connectors and Indicator

The layout of input /output connecters and the indicator lamp are as follows.
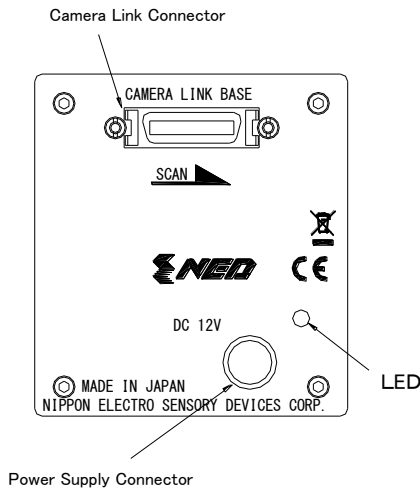
Figure 3-2-1 Input/Output Connectors and Indicator

3.3 Connectors / Pin Assignments / Cables

This camera uses the Base Configuration of the Camera Link interface standard. The figure shown below shows the interface for the camera and a typical implementation for the frame grabber interface in the case of Base Configuration.
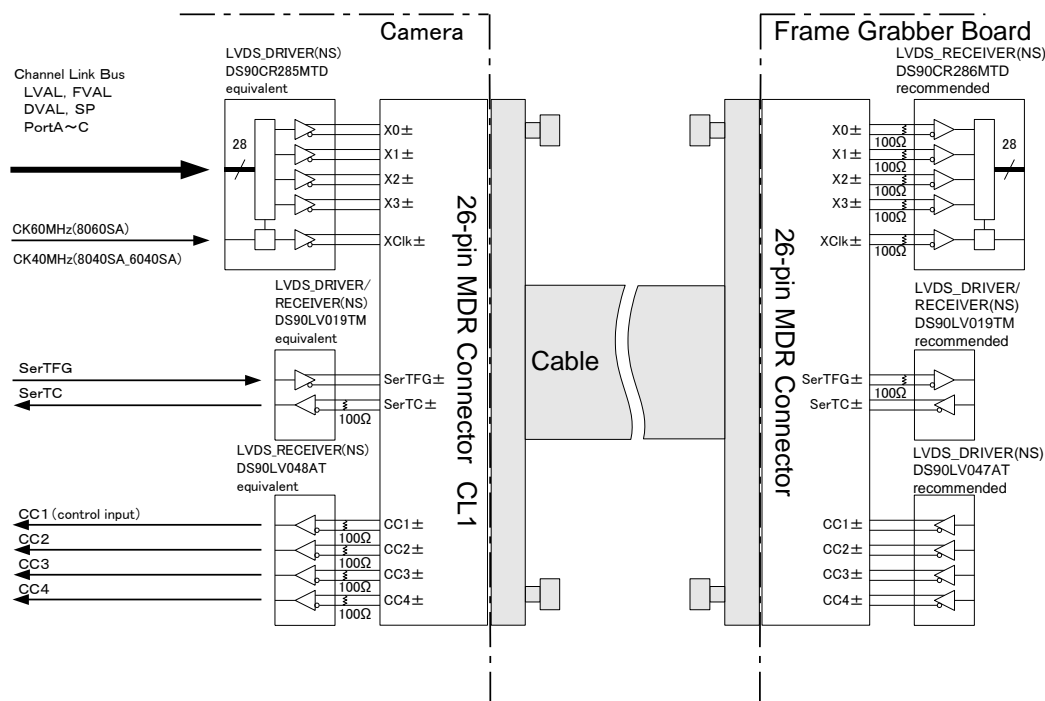
Figure 3-3-1 Camera / Frame Grabber Interface

The table below shows the Camera Link port assignments for 8bit/10bit output.

Table 3-3-1   Output data bit pin assignments

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	

- 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)
  SerTC+, SerTC- :   Serial data input (LVDS)
  SerTFG+, SerTFG- : Serial data output (LVDS)
  CC1+,CC1- :   External synchronous signal input (LVDS) *When using External Trigger
  CC2+,CC2- :   Not in use (LVDS)
  CC3+,CC3- :   Not in use (LVDS)
  CC4+,CC4- :   Not in use (LVDS)
- Camera Link compatible cable
  14B26 - SZLB - xxx - 0LC by 3M (or equivalent)

◆ Set the LVDS, Channel Link receiver side to 100-ohm termination.
◆ With the driver side of LVDS, even if not used, do not make it open but set the logic to H or L.
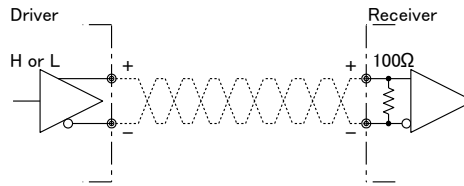
Figure 3-3-2 Circuit of LVDS

The camera has 26-pin MDR connectors for control signals of Camera Link, data signals and serial communications. The camera also has a 4-pin HIROSE connector for power supply.
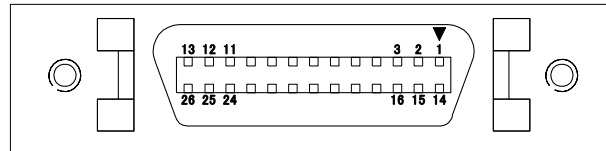
Figure 3-3-3 Camera Link Connector

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

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

◆ Do not unplug the cable while power is being supplied to the camera.

The pin assignment of the power supply connector is shown below.
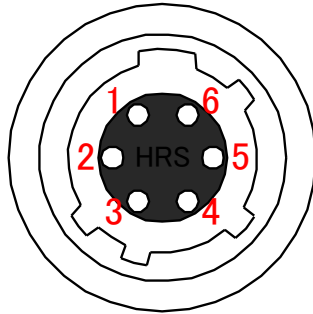
Figure 3-3-4 Power Supply Connector (HIROSE: HR10G -7R- 6PB)

● Round shape push-pull lock type

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

No	NAME
1	12 V
2	12 V
3	12 V
4	GND
5	GND
6	GND

3.4 Power Supply

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

◆ When selecting a power source, choose one with the capacity to allow for inrush current. (15W 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 to 15 V (+/-5%)
● Consumption Current (rated):　　　　DC+12V: 440mA

● The LED lamp illuminates when +12 V 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.

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 NCCtrl (Camera control software). Or you can also change the parameters directly from your application by using binary read/write commands to set values in the camera register.

The camera can be used without the serial interface after it has been set up correctly.

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 operation accordingly.
- Transmission ends when the camera returns the analyzed results of 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 Command Format (PC to Camera Transmission)

- Format 1   CMD CR
- Format 2   CMD VAL CR

CMD: Control text (1 Byte) Use 1 lowercase letters only. No numerals allowed.

CR: Carriage Return (0x0D)

VAL: Setting value (decimal, 1 Byte x maximum 7 digits)

<Example>

   l CR

   g70 CR

4.1.3 Reply Format (Camera to PC Transmission)

- Format 1   >R CR >[SB] CR EOT
- Format 2   (for "l" command) >OK CR >[MEM] CR > l CR EOT

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

<Example>

   >OK CR >g0 CR EOT

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
MEM ERR!	Memory error

4.1.4 Camera Control Commands

The table below shows the list of Camera Control Commands.

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

Control Item	CMD	VAL1	Control Description
Exposure Mode	t	0	Free Run (Fixed exposure time by Programmable setting)
		1	External Trigger (Exposure time determined by external trigger pulse H and L times)
		2	External Trigger (Exposure time determined by Command)
		3	External Trigger (Exposure time determined by external trigger pulse H time)
Free run Exposure Mode scan	i	4000 ~ 1048575	4000 ~ 1048575 CK (80µs ~ 20.9715 ms)
odd Gain (1 ~ 3700 pixel)	g	0 ~ 350	1 ~ 6 times
even Gain (1 ~ 3700 pixel)	G	0 ~ 350	1 ~ 6 times
odd Gain (3701 ~ 7400 pixel)	b	0 ~ 350	1 ~ 6 times
even Gain (3701 ~ 7400 pixel)	B	0 ~ 350	1 ~ 6 times
odd Offset (1 ~ 3700pixel)	o	0 ~ 15	8 bit : 0 ~ 15 LSB (1 LSB/STEP) 10 bit : 0 ~ 60 LSB (4 LSB/STEP) 12 bit : 0 ~ 240 LSB
even Offset (1 ~ 3700 pixel)	O	0 ~ 15	8 bit : 0 ~ 15 LSB (1 LSB/STEP) 10 bit : 0 ~ 60 LSB (4 LSB/STEP) 12 bit : 0 ~ 240 LSB

odd Offset (3701 ~ 7400pixel)	p	0 ~ 15	8 bit : 0 ~ 15 LSB (1 LSB/STEP) 10 bit : 0 ~ 60 LSB (4 LSB/STEP) 12 bit : 0 ~ 240 LSB
even Offset (3701 ~ 7400pixel)	P	0 ~ 15	8 bit : 0 ~ 15 LSB (1 LSB/STEP) 10 bit : 0 ~ 60 LSB (4 LSB/STEP) 12 bit : 0 ~ 240 LSB
Video Output Switching	v	0	8 bit 2 Tap
		1	10 bit 2 Tap
		6	12 bit 2 Tap
Select Pixel correction	C	0	Pixel Correction Off（CCD raw output）
		1	Activate Factory White Pixel Correction Data
		2	user pixel correction data valid
Pixel Correction target level	M	0 ~ 255	Set Pixel Correction Target Data Level (DN)
User Pixel Correction data acquisition 1	W		Acquire User White Pixel Correction Data
User Pixel Correction data acquisition 2	K		Acquire User Black Pixel Correction Data
User Pixel Correction data save	L		Save User Pixel Correction Data to internal memory
Select Data Level Adjustment	c	0	Deactivate Data Level Adjustment
		1	Activate Data Level Adjustment
Data Level Adjustment Minimum Value	s	0 ~ 128	Set Data Level Adjustment Minimum Value
Data Level Adjustment Maximum Value	S	129 ~ 255	Set Data Level Adjustment Maximum Value
Scanning direction reverse	R	0	invalid : Forward
		1	valid : Reverse
Test Pattern	T	0	Test Pattern output invalid (image data output)
		1	Test Pattern output valid
Memory Save	w		Store present setup data in memory
Memory Load	l		Load and apply saved settings from memory
Memory Initializing	z		Reset to factory settings

4.1.5 Memory Setup Values (Factory Settings)

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

Control Item	CMD	VAL	Control Description
Exposure Mode	t	0	Free Run (Programmable setting fixed time)
Free run Exposure Mode scan time	i	4000	4000CK (80µs) scan period time
odd Gain (1 ~ 3700 pixel)	g	0	1 times
even Gain (1 ~ 3700 pixel)	G	0	1 times
odd Gain (3701 ~ 7400 pixel)	b	0	1 times
even Gain (3701 ~ 7400 pixel)	B	0	1 times
odd Offset (1 ~ 3700 pixel)	o	1	1DN
even Offset (1 ~ 3700 pixel)	O	1	1DN
odd Offset (3701 ~ 7400 pixel)	p	1	1DN
even Offset (3701 ~ 7400 pixel)	P	1	1DN
Video Output Switching	v	0	8 bit 2 Tap
Pixel Correction selection	C	1	Activate Factory White Pixel Correction Data
Pixel Correction target level	M	128	Set Pixel Correction Target Data Level to 128DN
Select Data Level Adjustment	c	0	Data Level Adjustment Deactivated
Data Level Adjustment Minimum Value	s	0	Set Data Level Adjustment Minimum Value to 0DN
Data Level Adjustment Maximum Value	S	255	Set Data Level Adjustment Maximum Value to 4095DN
Scanning direction reverse	R	0	invalid : Forward
Test Pattern	T	0	OFF

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

4.2 Details on Commands

4.2.1 Exposure Mode
Sets Exposure Mode.
- Format 2   CMD VAL CR
- CMD   t
- VAL   0,1,2,3

<Example>

    t0CR (Free run selection)
    >OK
    >t0

4.2.2 Free run Exposure Mode Scanning
Sets the exposure time.
- Format 2   CMD VAL CR
- CMD   i
- VAL   4000 ~ 1048575

<Example>

    i 4000 CR (Setting Exposure time 80 µs)
    >OK
    >i4000

4.2.3 Setting Odd Gain (1~3700 pixel)
Sets Odd Gain in 0 to 350.
- Format 2   CMD VAL CR
- CMD   g
- VAL   0 ~ 350

<Example>

    g100CR
    >OK
    > g100

4.2.4 Setting Even Gain (1~3700 pixel)
Sets Even Gain in 0 to 350.
- Format 2   CMD VAL CR
- CMD   G
- VAL   0 ~ 350

<Example>

    G100CR
    >OK
    >G100

4.2.5 Setting Odd Gain (3701 ~ 7400 pixel)

Sets Odd Gain 0 to 350.

- Format 2   CMD VAL CR
- CMD   b
- VAL   0 ~ 350

<Example>

    b100CR
    >OK
    > b100

4.2.6 Setting Even Gain (3701~7400 pixel)

Sets Even Gain in 0 to 350.

- Format 2   CMD VAL CR
- CMD   B
- VAL   0 ~ 350

<Example>

    B100CR
    >OK
    >B100

4.2.7 Setting Odd Offset (1~3700 pixel)

Sets odd offset in 0 to 15.

- Format 2   CMD VAL CR
- CMD   o
- VAL   0 ~ 15

<Example>

    o5CR
    >OK
    >o5

4.2.8 Setting Even Offset (1~3700 pixel)

Sets Even offset in 0 to 15.

- Format 2   CMD VAL CR
- CMD   O
- VAL   0 ~ 15

<Example>

    O5CR
    >OK
    >O5

4.2.9 Setting Odd Offset (3701 ~ 7400 pixel)

Sets odd offset in 0 to 15.

- Format 2   CMD VAL CR
- CMD   p
- VAL   0 ~ 15

<Example>

p5CR

>OK

> p5

4.2.10 Setting Even Offset (3701~7400 pixel)

Sets Even offset in 0 to 15.

- Format 2   CMD VAL CR
- CMD   P
- VAL   0 ~ 15

<Example>

P5CR

>OK

>P5

4.2.11 Setting Video Output Switching

Sets data format of output signal.

- Format 2   CMD VAL CR
- CMD   v
- VAL   0,1,6

<Example>

v0CR (8 bit output)

>OK

>v0

4.2.12 Setting Pixel Correction

Sets pixel correction.

Format 2   CMD VAL CR

- CMD   C
- VAL   0,1,2

<Example>

C1CR (Activate Factory White Pixel Correction Data)

>OK

>C1

4.2.13 Pixel Correction target level

Set Pixel Correction Target Data Level (DN)

Format 2   CMD VAL CR

- CMD   M
- VAL   0 ~ 255

<Example>

     M192CR

     >OK

     >M192

4.2.14 User Pixel Correction data acquisition 1

Acquire User White Pixel Correction Data

- Format 1   CMD CR
- CMD   w

<Example>

     WCR

     >OK

     >W

4.2.15 User Pixel Correction data acquisition 2

Acquire User Black Pixel Correction Data

- Format 1   CMD CR
- CMD   K

<Example>

     KCR

     >OK

     >K

4.2.16 User Pixel Correction data Save

Acquires current pixel correction data and saves it in the flash memory.

- Format 1   CMD CR
- CMD   L

<Example>

     LCR

     >OK

     >L

4.2.17 Data level conversion selection

Selects the data level conversion.

- Format 2　　　CMD VAL CR
- CMD　　　　　c
- VAL　　　　　0, 1

  \<Example\>

    c1CR　　（the data level conversion valid）

    \>OK

    \>c1

4.2.18 Data Level Adjustment Minimum Value

Set Data Level Adjustment Minimum Value

- Format 2　　　CMD VAL CR
- CMD　　　　　s
- VAL　　　　　0 ～ 128

  \<Example\>

      s64CR

      \>OK

      \>s64

4.2.19 Data Level Adjustment Maximum Value

Set Data Level Adjustment Maximum Value

- Format 2　　　CMD VAL CR
- CMD　　　　　S
- VAL　　　　　129 ～ 255

  \<Example\>

      S192CR

      \>OK

      \>S192

4.2.20 Setting Pixel Readout Direction

Sets the pixel readout direction.

- Format 2　　　CMD VAL CR
- CMD　　　　　R
- VAL　　　　　0,1 (0:Forward, 1:Reverse)

  \<Example\>

    R1CR (Reverse)

    \>OK

    \>R1

4.2.21 Generating Test Pattern

Generates test pattern.

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

<Example>

     T1CR (Generating test pattern)

     >OK

     >T1

4.2.22 Memory Save

Stores current camera settings in the flash memory.

- Format 1   CMD CR
- CMD   w

<Example>

     wCR

     >OK

     >w

4.2.23 Memory Load

Reads out the camera settings from the flash memory.

- Format 1   CMD CR
- CMD   l

<Example>

     lCR

     >OK

     >l

4.2.24 Memory Initializing (Initializing Camera Settings)

Reset the flash memory to the factory default.

- Format 1   CMD CR
- CMD   z

<Example>

     zCR

     >OK

     >z

4.3 Digital Processing flow in FPGA

The figure below shows the digital processing flow in the FPGA.

After the CCD output passes through A/D conversion, data is processed in the digital domain and converted to Camera Link Medium Configuration (for 8 bit output) for output.
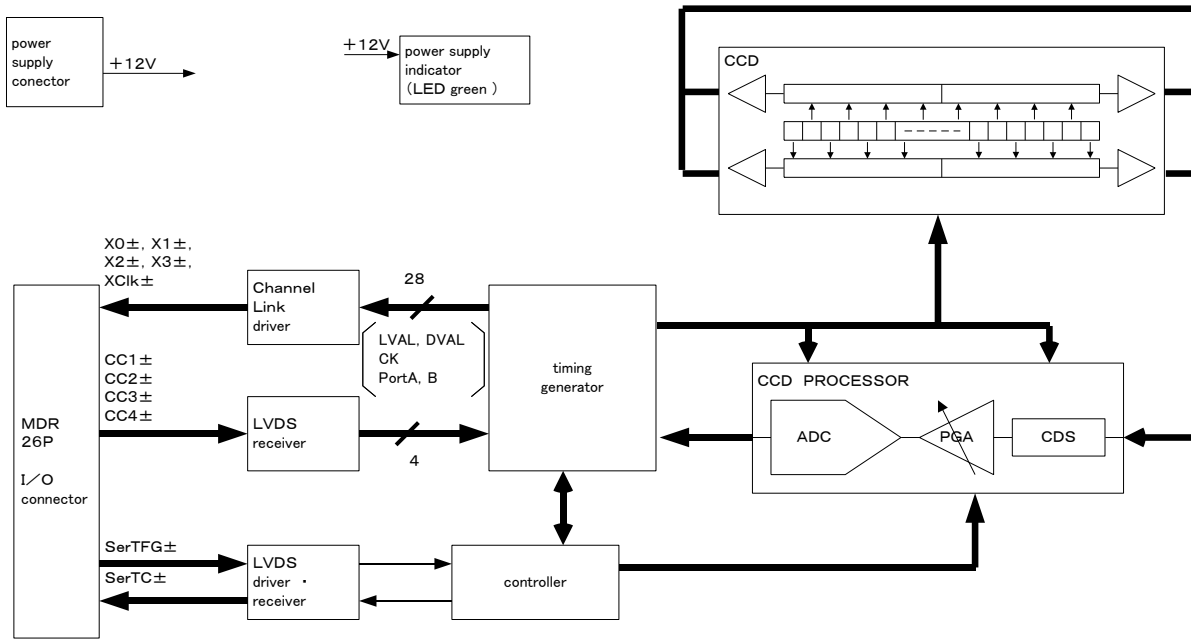
Figure 4-3-1 FPGA Processing block diagram

4.4 Startup

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

The startup procedure is as follows.

(1) The camera initializes the hardware.

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

(3) Sets up the camera with the setting values 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 setting 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 "l" command).

- 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.

Commands for rewriting the memory are as follows.

- Reset to factory settings (z)
- Store present setup data in memory (w)
- Store pixel correction data in memory (L)

◆ When changing the camera setting, be sure to send the control input signal CC1 from the frame grabber board. If you do not send CC1 or send control input signals are out of the designated range, you cannot get images and cannot change the settings. See 4.8.2.

4.6 Serial Communication Settings

Serial communication is performed through the Camera Link Interface.

The table below shows the 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.
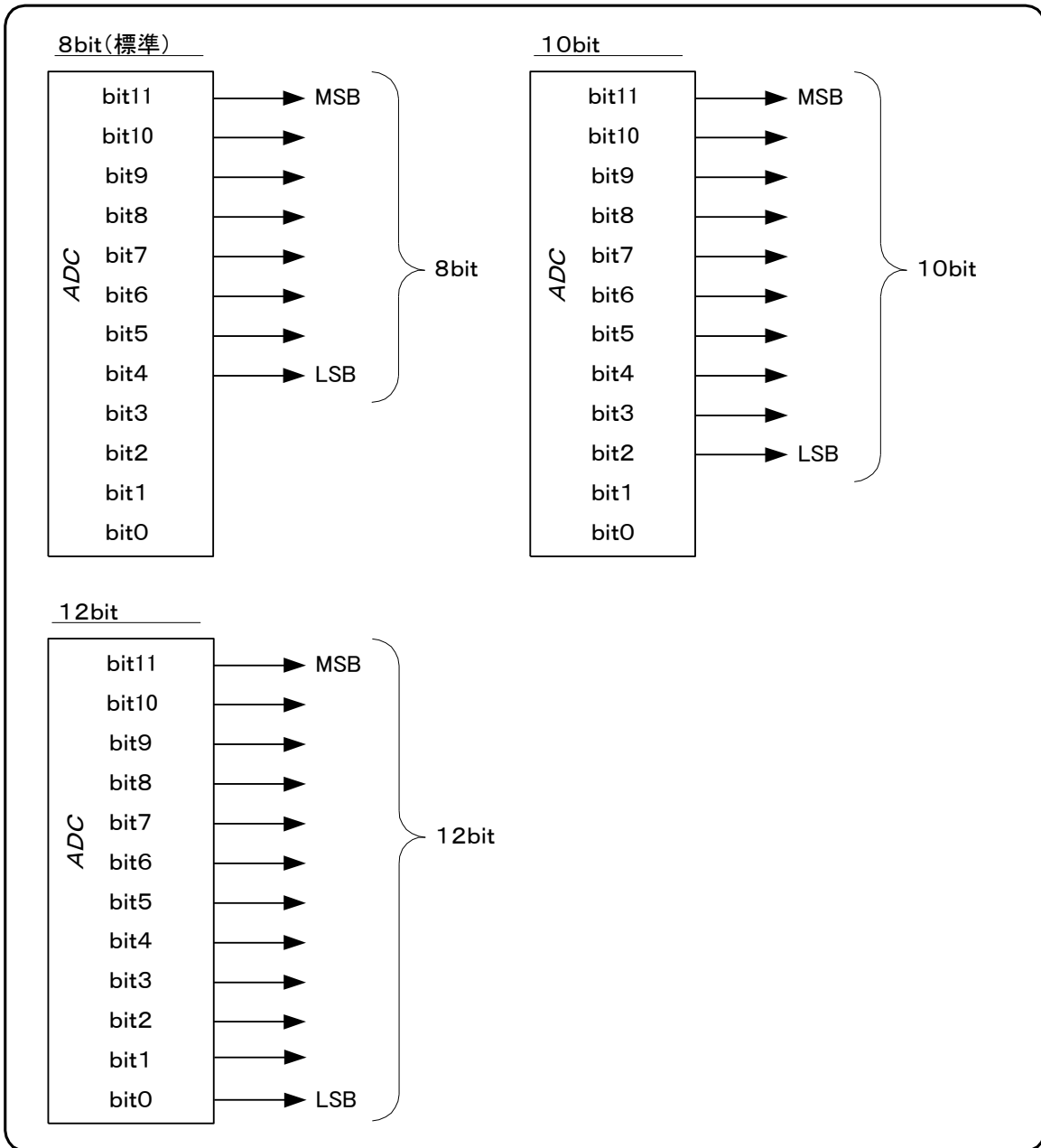
Figure 4-7-1 Pin Assignments of Digital Data

◆ The A/D converter of the camera has a 12-bit resolution. For 10-bit output, the upper 10-bit signal, for 8-bit output, the upper 8-bit signal is output as a video data.

The video output phase is shown below.
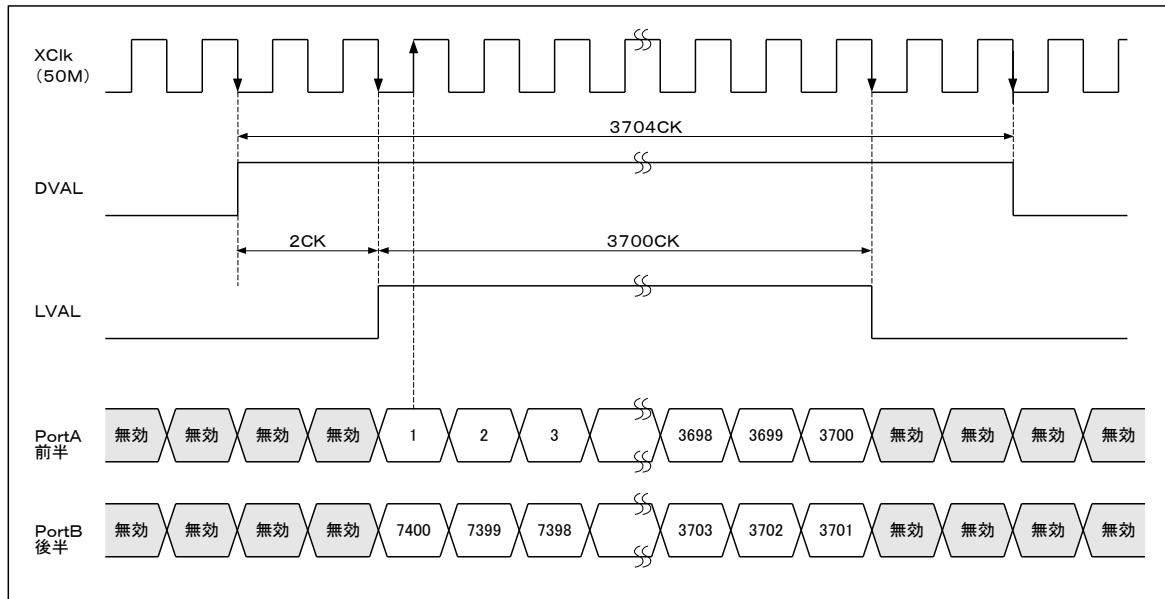
Figure 4-7-2 Video Output Phase

◆ FVAL = 0 (low level) fixed

◆ The first half of the pixels (Port A) outputs in order 3700 from 1. On the other hand,
   the second half of the pixels (Port B) outputs in order 3701 from 7400.

   The pixel output order may be changed by the frame grabber board for the combined image.

4.8 Exposure Mode and Timing Chart

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

4.8.1 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.

The range of programmable exposure time and the timing chart of the exposure and the readout are shown below.

Table 4-8-1-1 Programmable Times

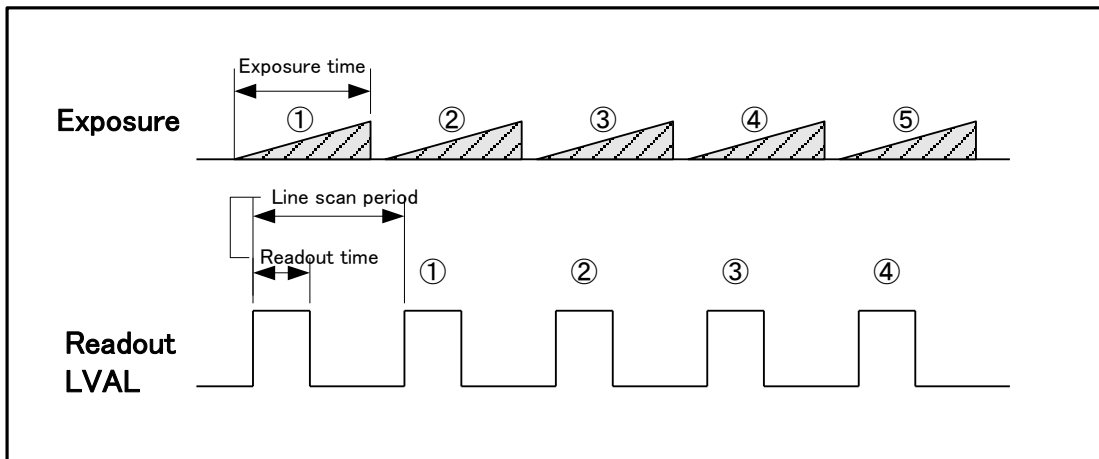| Exposure	Programmable Exposure time ＝Line scan period	80μs～20.9715ms
Readout	Readout time	80μs

Figure 4-8-1-1 Free Run Exposure Mode

◆ The line scan period (Programmable setting) can be set in the range 80μs～20.9715ms (4000～1048575CK)

◆ Line scan period calculating formula: Line scan period（μs）＝ Clocks x 0.02

4.8.2 External Trigger Exposure Mode

(Exposure time determined by external trigger pulse H & L times)

In this external trigger exposure mode, the line scan period and the exposure time is set through the external trigger pulse (CC1) cycle.

The exposure time is determined by H (high level) time and L (low level) time of Trigger pulse. Each exposure starts with the rising edge. The line scan period is determined by the time from rising edge to 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 4-8-2-1 Programmable Times

a	Trigger pulse H time	$\geqq$40ns
Exposure time （a＋b）	Trigger pulse cycle (Line scan period)	$\geqq$80µs
Readout	Readout time	80µs

Figure 4-8-2-1 External Trigger Exposure Mode

Timing restrictions are as below:

    a: External Trigger Pulse H Time 40nS(2CK) or more

    b: External Trigger Pulse L Time 20nS(1CK) or more

    a+b: Line Scan Period is between 80µS～20.9715mS (4000～1048575CK)

4.8.3 External Trigger Exposure Mode
(Exposure time set by command)

In this external trigger exposure mode, the line scan period is set through the external trigger pulse (CC1) cycle. The exposure time is set by the command. Each exposure starts with the rising edge. The line scan period is determined by the time from rising edge to 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 4-8-3-1 Programmable Times

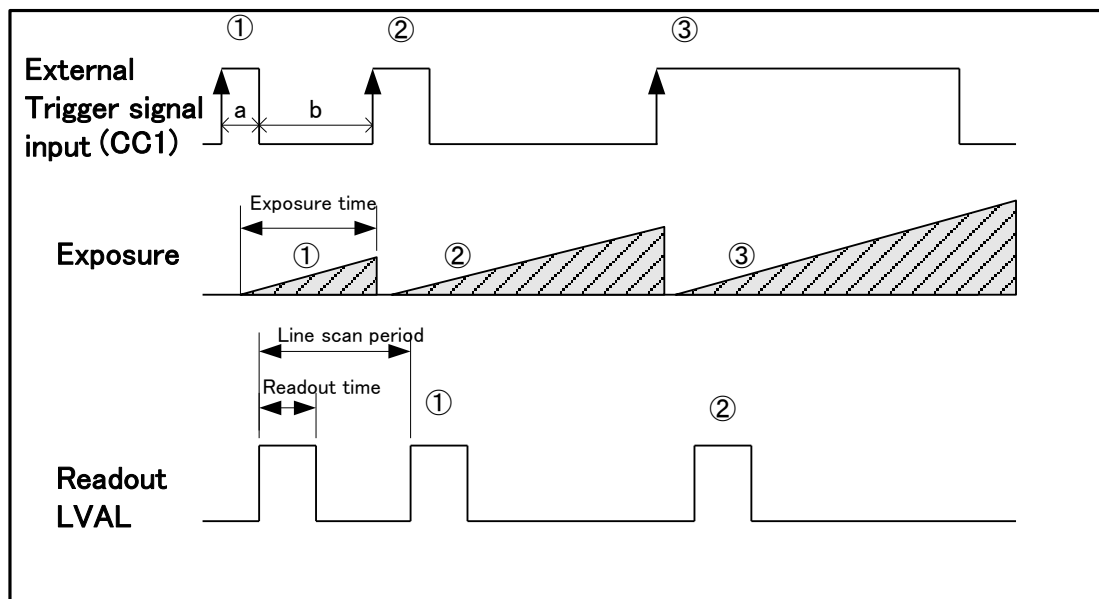| a	Trigger pulse H time	≧40 ns
a ＋ b	Trigger pulse cycle (Line scan period)	≧Programmed exposure time＋80µs
Exposure	Programmable exposure time set by command	80µ s ～20.9715ms
Readout	Readout time	80µs

Figure 4-8-3-1 External Trigger Exposure Mode

Timing restrictions are as below:

　　a: External Trigger Pulse H Time 40nS(2CK) or more

　　b: External Trigger Pulse L Time 20nS(1CK) or more

　　a+b: Line Scan Period is between 80µS～20.9715mS (4000～1048575CK)

4.8.4 External Trigger Exposure Mode
(Exposure time set by external trigger pulse H time)

In this external trigger exposure mode, the line scan period and the exposure time is set through the external trigger pulse (CC1) cycle.

The exposure time is determined by H (high level) time of Trigger pulse. Each exposure starts with the rising edge. The line scan period is determined by the time from rising edge to 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 4-8-4-1 Programmable Times

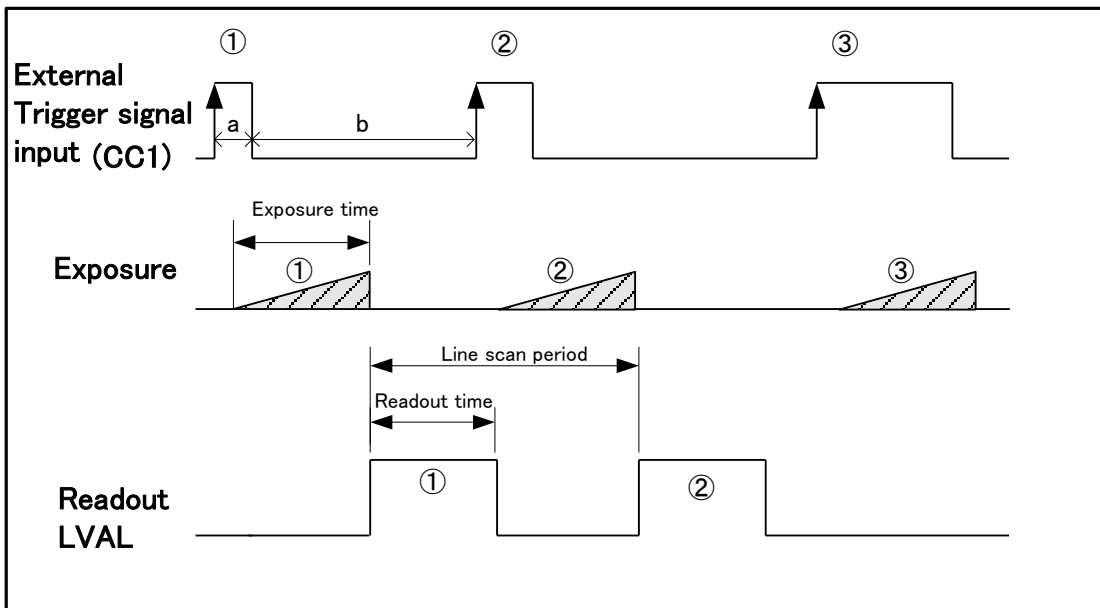| a	Trigger pulse H time	$\geqq 80\mu s$
b	Trigger pulse L time	$\geqq 80\mu s$
Readout	Readout time	$160\mu s$
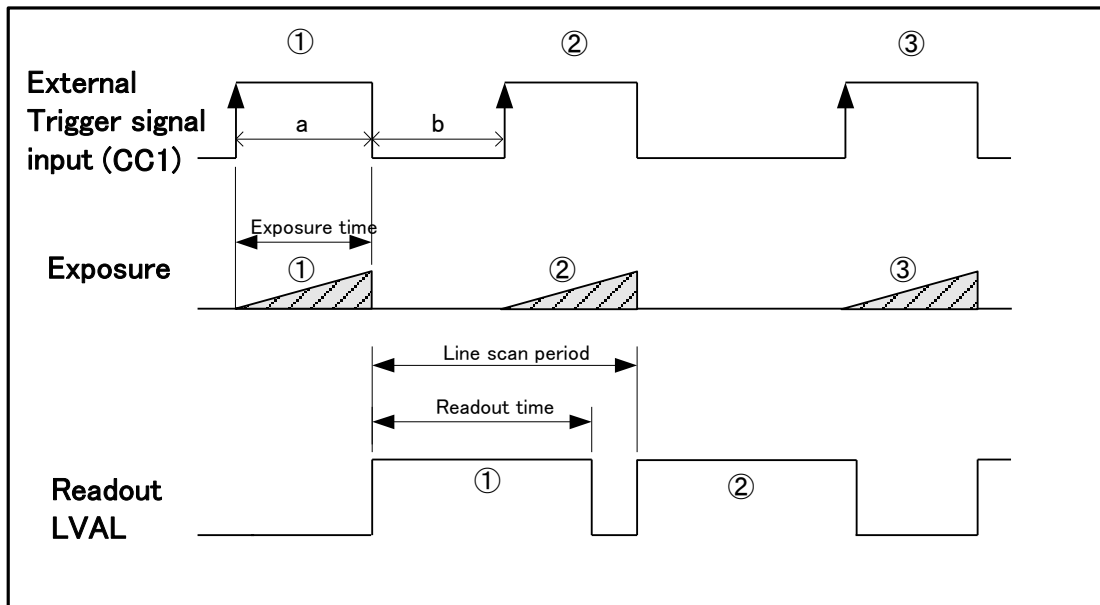
Figure 4-8-4-1 External Trigger Exposure Mode

Timing restrictions are as below:

a: External Trigger Pulse H Time 40nS(2CK) or more

b: External Trigger Pulse L Time 20nS(1CK) or more

a+b: Line Scan Period is between 160μS～20.9715mS

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.

Se : Saturation Exposure
Fs : Saturation Output
Dd : Dark Current
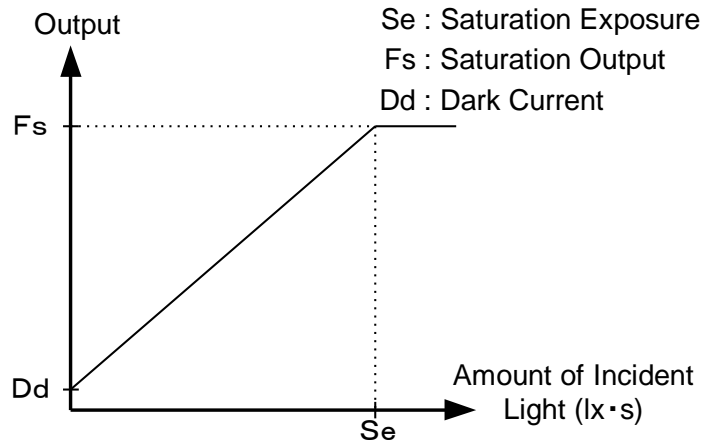
Figure 4-9-1 Saturation Exposure and Dark Current Output

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.

DF : Offset Value
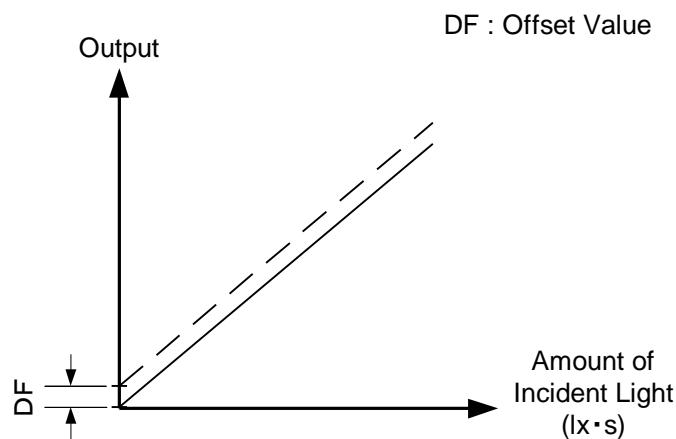
Figure 4-9-2 Offset Adjustment

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

4.10 Setting Gain

It is possible to adjust the gain setting of this camera (x1 ~ 6). This is done by adjusting the slope of the line in the figure below. The slope becomes steeper when you raise the gain, and saturation occurs at a lower light exposure level. On the other hand, at a lower light level, the output increases, so the sensitivity is said to have increased.

The gain can be adjusted with the command listed in the commands table. However, if you are using the User Pixel Correction function, gain can be automatically adjusted by setting the output target level.
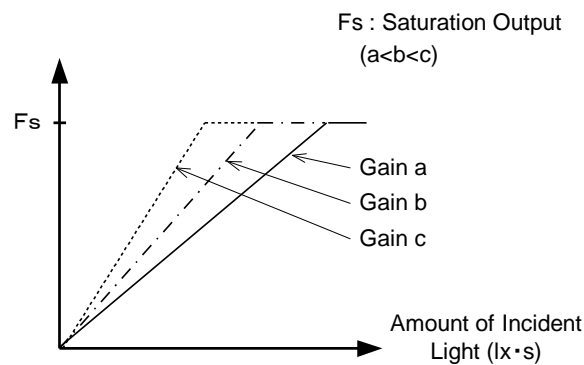
Figure 4-10-1 PGA Gain Adjustment

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

Gain should be calculated according to the following formula:

$$G(\text{multiple}) \fallingdotseq (\text{Gain code}/70) + 1$$

＜**Example**＞

Gain code	G(multiple)	Sensitivity (V/(lx・s))
0	1	67
70	2	134
210	4	268
350	6	402

NED

4.11 Data Level Adjustment

Contrast can be enhanced through digital processing.

The data level adjustment calculation is:

$$Vout = (Vin - Min) \times 256 \div (Max - Min)$$

Vout：Data Level Adjusted Output Data

Vin：Output Data before Adjustment

Min：Data Level Adjustment Minimum Value

Max：Data Level Adjustment Maximum Value

<Example>　Data Level Adjustment Settings: Minimum 23DN, Maximum 129DN
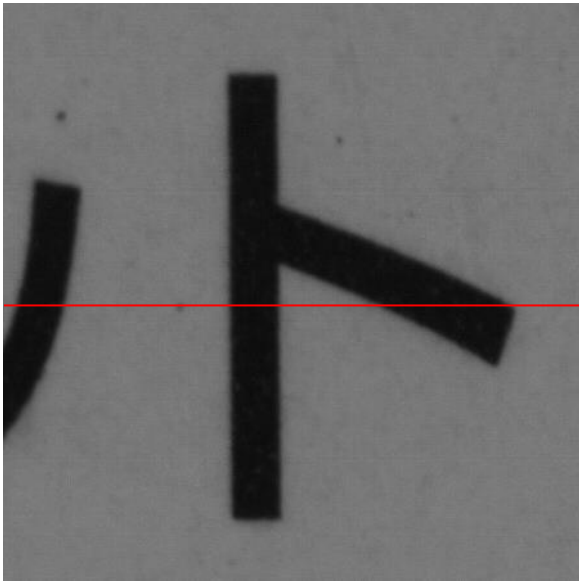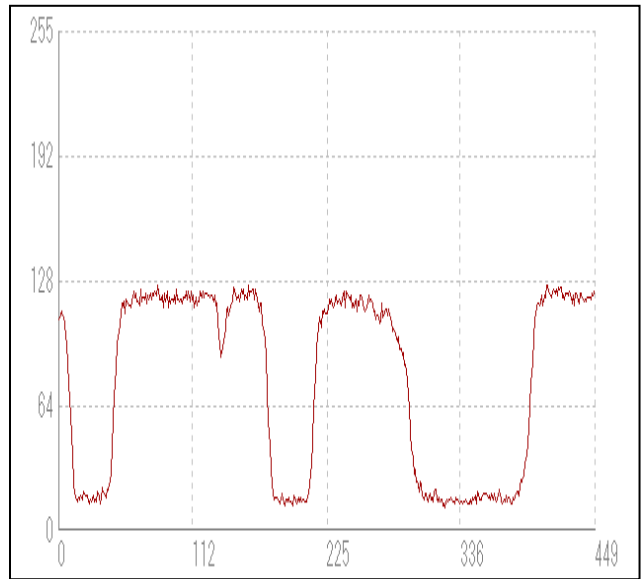
Image Before Adjustment　　　　　　　　Profile of the left image at the red line
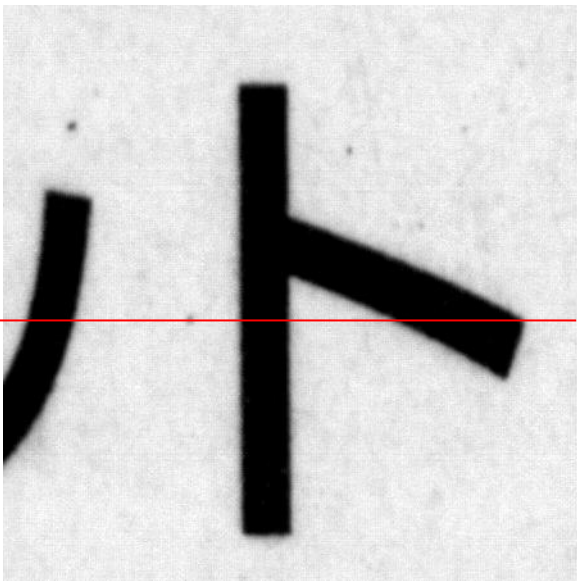
Image Before Adjustment　　　　　　　　Profile of the left image at the red line

◆ Noise may increase due to data level adjustment

4.12 Pixel Correction

Generally speaking, image sensors (CCD, CMOS and so on) have fixed pattern noise and photo response non-uniformity. When you use a lens, lens shadings and light sources also can cause non-uniformity. The camera is factory set to the optimal correction before shipping in order to provide images of high grade. The camera also has a user white correction function in order to cope with lens shading and non-uniform illumination.

Cal_bl : Output data of each pixel in perfect dark (digial)
Cal_wh : Output data of each pixel in uniform illumination (digial))
When Vin: Input data (digital), Vout: Output data (digital),
Vout＝(Vin-Cal_bl）×Cal_wh to correct output data.

<Example> Pixel correction target level:192DN
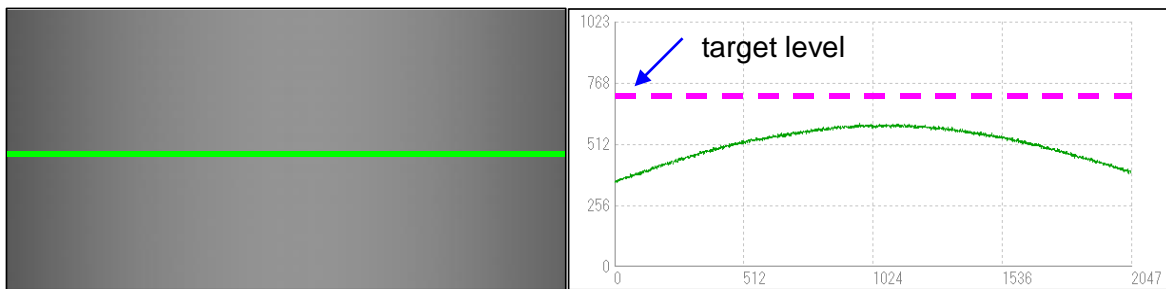
Image"before"user arbitrary pixel
is corrected.

Green line is Luminance Profile
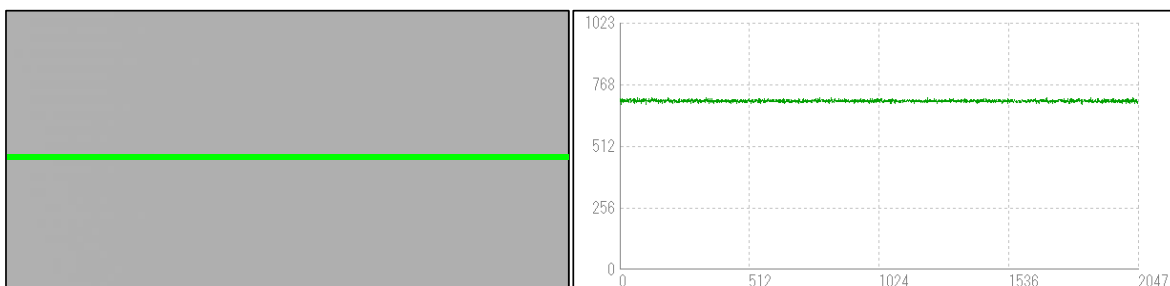
Image"after"user arbitrary pixel
is corrected.

Green line is Luminance Profile

Figure 4-12-1 Waveform and image before and after bit correction

4.12.1 Command Settings

Pixel correction is switched on and off, and correction data is obtained by sending serial commands from a PC.

Command Setting List

C0: No correction

C1: Factory white correction

C2: User pixel correction (white data active)

K: User pixel correction (acquire black data)

W: User pixel correction (acquire white data)

L: Save user pixel correction data to internal memory

M[Val]：Set target data level for pixel correction

4.12.2 Operation Method

① Put on the lens cap to create a dark environment

② Send 「K CR」 via the COM port of the PC. This acquires User Black Data (256 lines average)

③ Confirm that the reply 「>K OK CR」 comes back from the camera.

④ Remove the lens cap and prepare the object to be photographed

※If a lens is attached, lens and illumination shading will be corrected at the same time.

※It is recommended to defocus the lens when obtaining correction data

⑤ Send 「W CR」 via the COM port. This acquires User White Data (256 lines average)

⑥ Confirm that the reply 「＞W OK CR」 comes back from the camera.

⑦ Send 「L CR」 via the COM port. This saves User Correction Data to the internal memory/

⑧ Send 「M [Val] CR」 via the COM port. This sets the Pixel Correction Target Level.

※If the target data level is not set higher than the acquired User White data, the full range of 8 bit data may not be used even at saturation.

⑨ Send 「C2 CR」 via the COM port. This activates the User Pixel Correction.

※Send 「C1 CR」 to activate Factory White Correction Data.

4.13 Test Pattern

From pixel 1 to 3700, the pattern 0-255DN repeats, and pixel 3700 is 115DN. From pixel 3701 to 7400, the output is 115-0DN, then repeating 255-0DN, so that pixel 7400 is 0DN.
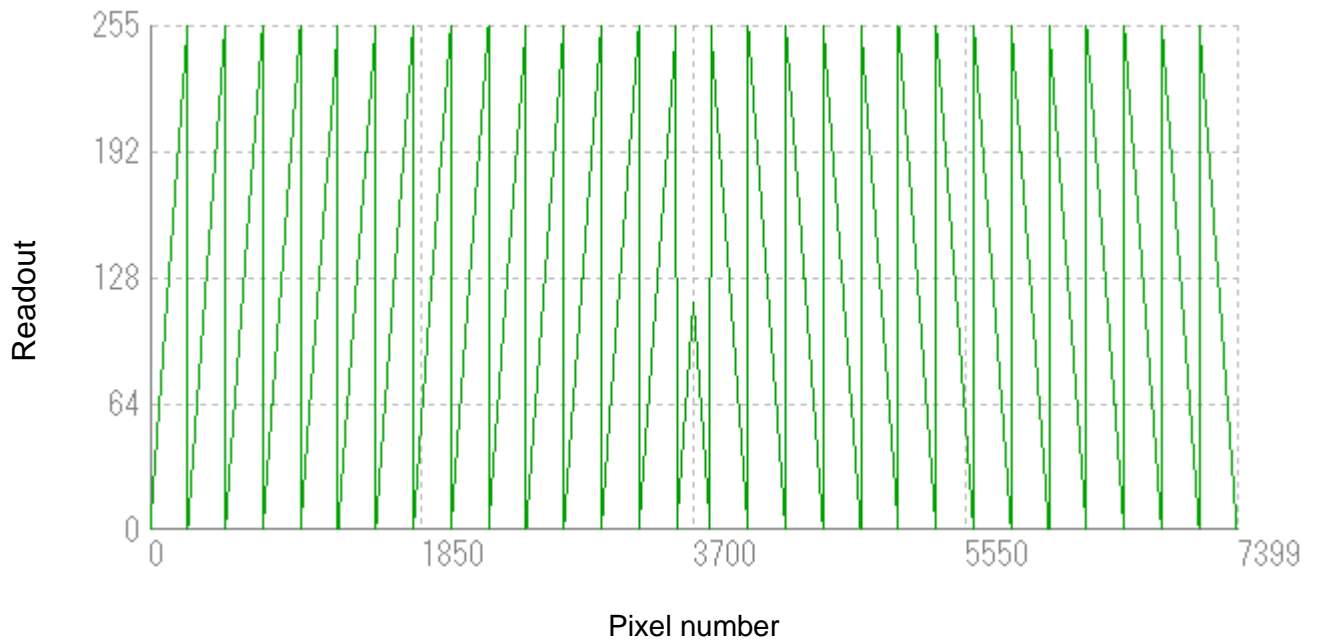
Figure 4-12-1 Test Pattern

5 Confirming Camera Settings

5.1 Before Power-on

Check that there are no dents or scratches on the casing. Dropping or bumping during transport and handling may have caused damage to connectors or internal components.

(1) Confirm the pin assignment of the power cable.
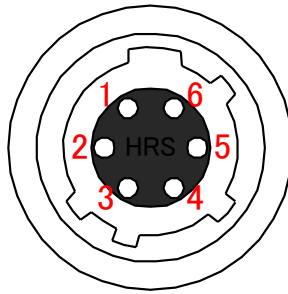
Figure 5-1-1 Pin Assignment of Power Cable

(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.
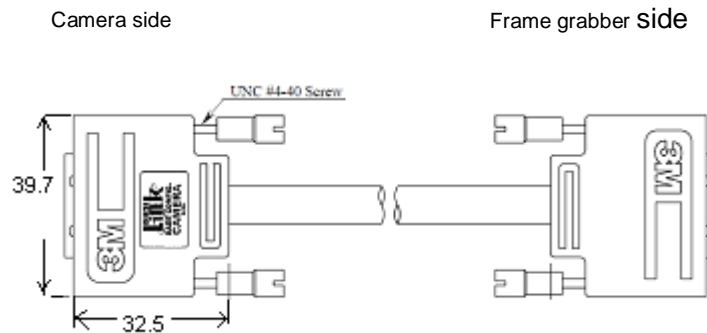
Figure 5-1-2 Connection Direction of Camera Cable

The connection channel of in the case of using a "Solios" board:

CL1 = CHANNEL #0

CL2 = CHANNEL #1
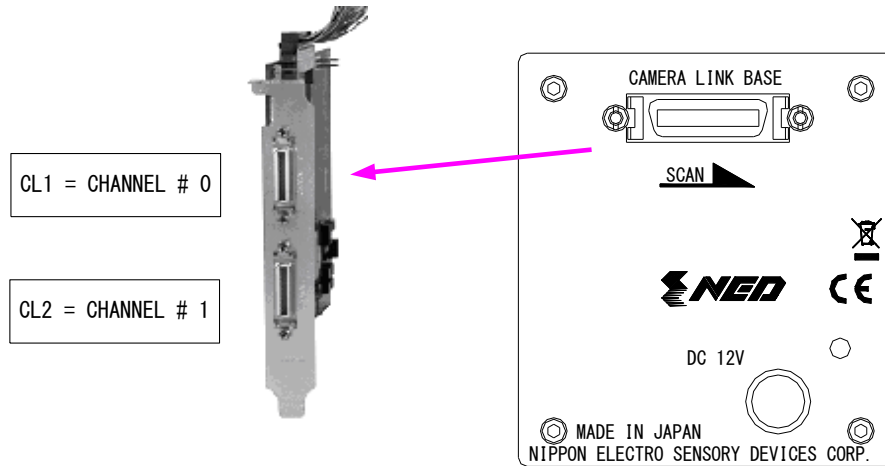
Figure 5-1-3 Channel of Camera Link Cables

5.2 After Power-on

(1) Confirm sent and received commands using the camera control utility. Launch NCCtrl, set COM port and connect. Click "Load" and"O.K", then wait for the response.

Figure 5-2-1 Confirmation of Connection

(2) Set an Exposure mode and a video output mode with the camera control utility.
Video output mode =8 bit 2 tap, 10 bit 2 tap or 12 bit 2 tap.
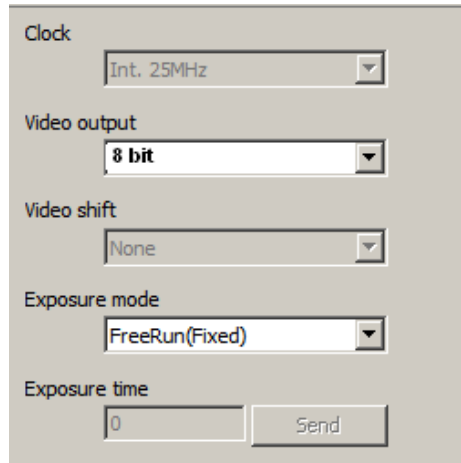
Figure 5-2-2 Video Output Mode Settting

If you have your own application to check the images, select suitable settings.
(3) Capture images using a camera interface board utility. In the case of Matrox's Solios,
it is convenient to use Intellicam.

Figure 5-2-3 Solios Window

5.3 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 Camera Link 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 be 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

CCD sensors are susceptible to damage from electrostatic discharge and can deteriorate as a result. Take care when handing the sensor.

6.2 Protecting Against Dust, Oil and Scratches

The CCD 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.

When there is dust or smudges on the sensor window, it appears in the same way as noise on the image. Please remove it appropriately.

7 Troubleshooting

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

7.1 No Image

```
The indicator is glowing.  ──No──▶  The camera has the correct connections
                                     with the power source and the frame      ──No──▶
       │Yes                          grabber.
       │                                    │Yes
       │                                    ▼
       │                             The power source meets the specified voltage.  ──No──▶
       │                                    │Yes
       │                                    ▼
       │                    After power on, the power source meets the   ──No──▶
       │                    specified voltage.
       │                            │Yes                      ▼
       │                            ▼              The capacity of the power    ──No──▶
       │                                           source is sufficient
       │            ┌──────────────────────────┐
       │            │ The camera may be out of │◀──Yes──  ┌──────────────────────────┐
       │            │ order. Please contact us │          │ Use a power source that  │
       │            │ for service.             │          │ meets the specifications.│
       │            └──────────────────────────┘          └──────────────────────────┘
       ▼
The camera has the correct   ──No──▶  ┌──────────────────────────────────┐
connection with the frame grabber.    │ Connect the camera and the frame │
       │Yes                           │ grabber board with camera cables.│
       ▼                              └──────────────────────────────────┘
The frame grabber board is   ──No──▶  ┌──────────────────────────────────┐
powered on and set up.                │ After being powered on, set up the│
       │Yes                           │ frame grabber board suitably.     │
       ▼                              └──────────────────────────────────┘
The frame grabber  ──No──▶  The sample software program is used to control  ──No──▶
is communicating           the camera.
with the camera            │Yes
successfully.              │          The sample software program is used to  ──No──▶
       │                   │          control the camera and is communicating
       │                   │          with the camera successfully.              To next page
       │                   │                  │Yes                                    B
       ▼                   ▼                  ▼
   To next page       To next page    ┌──────────────────────────────────────────────┐
       A                  B           │ Confirm the communication software, the       │
                                      │ control protocol for the camera and commands. │
                                      └──────────────────────────────────────────────┘
```
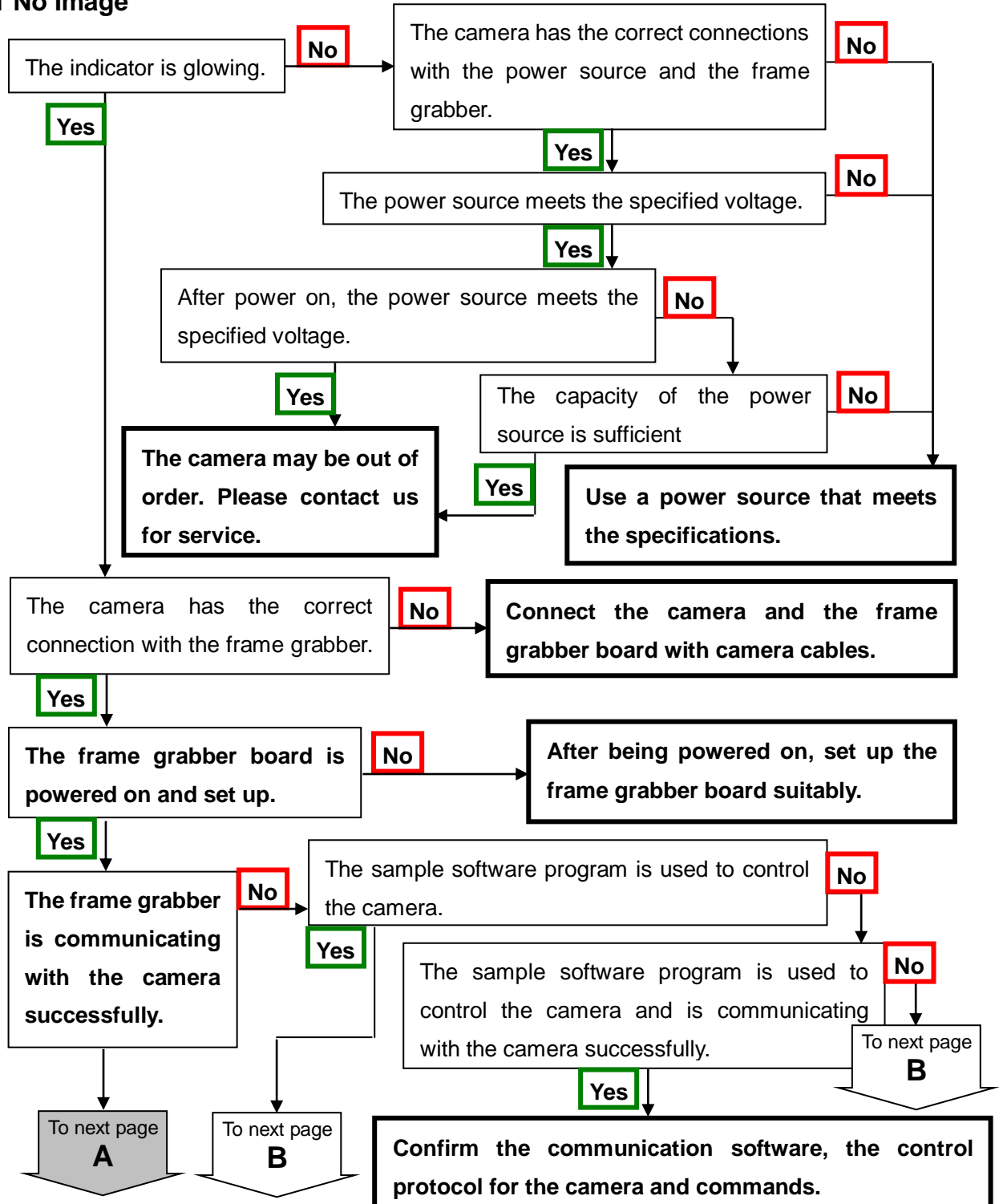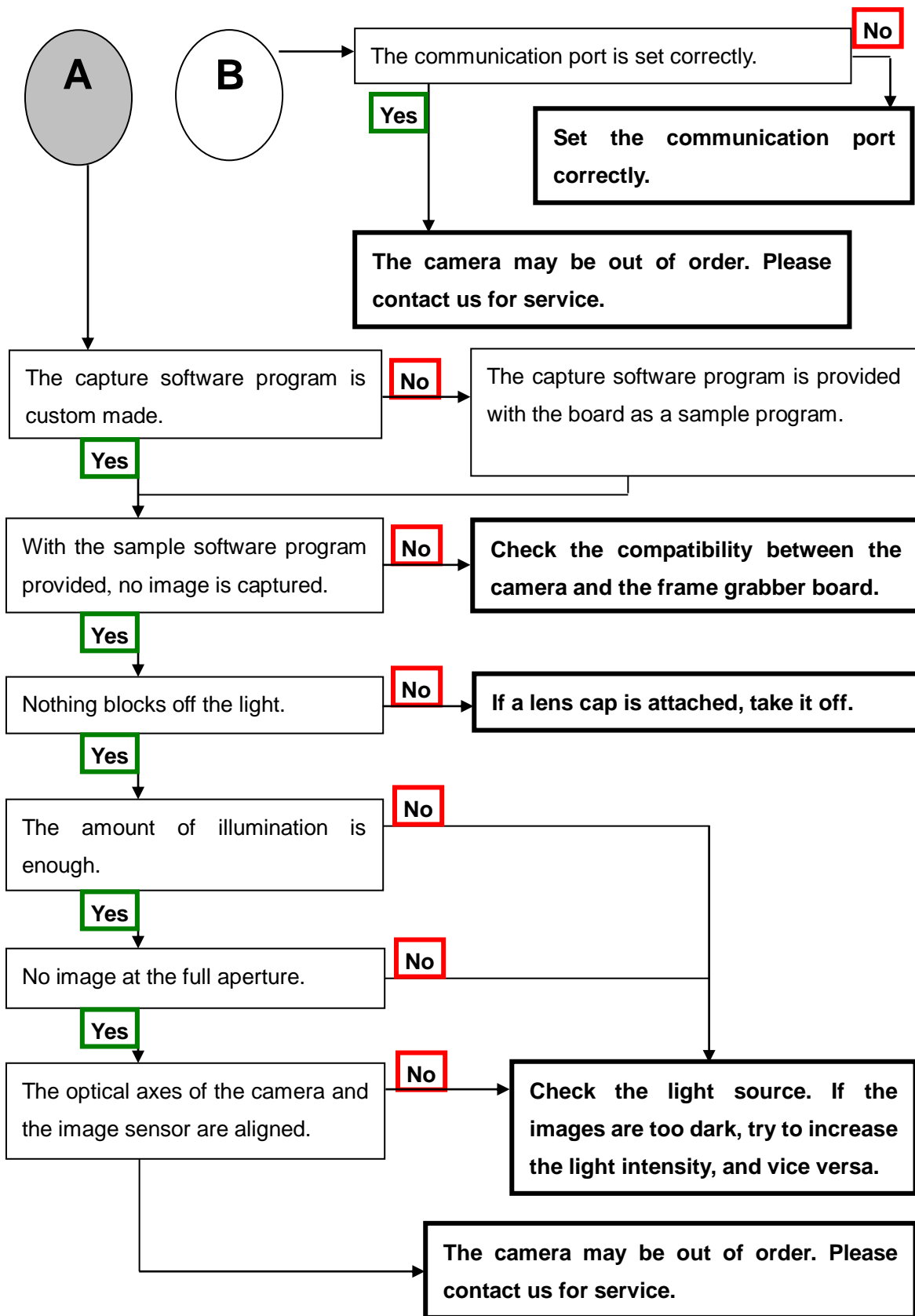
A   **B** → The communication port is set correctly.   **No**

Yes ↓   → **Set the communication port correctly.**

The camera may be out of order. Please contact us for service.

The capture software program is custom made.   **No** → The capture software program is provided with the board as a sample program.

Yes ↓

With the sample software program provided, no image is captured.   **No** → **Check the compatibility between the camera and the frame grabber board.**

Yes ↓

Nothing blocks off the light.   **No** → **If a lens cap is attached, take it off.**

Yes ↓

The amount of illumination is enough.   **No**

Yes ↓

No image at the 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.**

The camera may be out of order. Please contact us for service.

7.2 Noise on Image

Noise is present from the beginning. — **No** → The camera has been used for 3 or more years, or the ambient temperature is higher than room temperature. — **No**

↓ **Yes**

A servomotor or a magnetic valve is placed near the camera. — **No**

↓ **Yes**

Turning on a servomotor or a magnetic valve generates noise. — **No**

↓ **Yes**

Prevent the noise source from disturbing the camera cables and the power cable.

The camera has been used for 3 or more years, or the ambient temperature is higher than room temperature. — **No**

↓ **Yes**

There are some consumable parts in the camera. Please contact us for service.

↓

The power supply has been used for 3 or more years, or the ambient temperature is higher than room temperature. — **No**

↓ **Yes**

Check the deterioration of the power supply.

↓

The camera, the camera cables and the power source cable are in swinging motion. — **No**

↓ **Yes**

Check the deterioration of the camera cables and the power supply cable.

↓

The camera may be out of order. Please contact us for service.

To next page
C

C

Cables are asymmetric e.g. thin cables. — **No**

Yes

Only one of the connectors of an asymmetric camera cable can be connected with the 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 in order to avoid noise disturbance.

The power source has no fluctuation in voltage and is not deteriorated. — **No**

Yes

When the camera gain is on a high level, bright spots occur without incident light. — **No**

Yes

Use a stable power supply.

Secondary radiation (rays) could cause bright spots, but this is not a malfunction.

The camera may be out of order. Please contact us for service.

7.3 Camera becomes hot

The consumption current of the power supply is larger than the rating.

No

Yes

The camera is too hot to touch.

No

Yes

The camera will become hotter than the ambient temperature while in operation because of self-heating. Allow sufficient air circulation around the camera to give it a longer life.

Keep the ambient temperature within the range the specifications specify.

The camera may be out of order. Please contact us for service.

8 NCCtrl

8.1 Overview

NCCtrl02 is software designed for line scan cameras that support the NED camera control protocol (NCCP). This software enables you to remotely control line scan cameras from a PC.

The following interface connections are available:
1) COM port (RS232C)
2) Camera Link

8.2 System Requirements

PC: PC/AT compatible

OS: Microsoft Windows series (9x / NT / 2000 / XP)

Free disk space: 1 MB – 2 MB

(The required size may vary depending on the number of camera setting files)

The following system environment is required for the respective interfaces.

For COM port (RS232C) connection:
1) COM port that is compatible with the hardware and OS
2) RS232C cross cable (Dsub9s – Dsub9s)

Dsub9p		Dsub9s		Dsub9s		Dsub9p	
	1		1	1		1	
RxD (receive)	2	RxD (receive)	2	2	RxD (receive)	2	RxD (receive)
TxD (send)	3	TxD (send)	3	3	TxD (send)	3	TxD (send)
	4		4	4		4	
GND	5	GND	5	5	GND	5	GND
	6		6	6		6	
	7		7	7		7	
	8		8	8		8	
	9		9	9		9	
PC side		**RS232C cross cable**				**Camera side**	
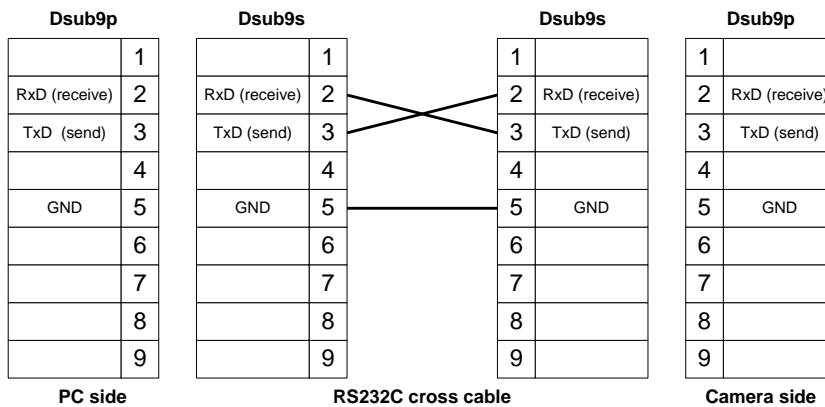
For Camera Link connection:
1) Camera Link compatible frame grabber board and device driver must be installed. The DLL file for Camera Link API provided by the frame grabber manufacturer must be included. For details, ask the frame grabber manufacturer.
2) Camera Link compatible cable

8.3 Installaton

Insert the FD or CD-ROM (or other media) provided by NED into your PC.

Copy the NCCtrl02 folder into the desired location in your hard disk drive.

Note: In case you copy from CD-ROM you should cancel the read only attribute.

8.4 Uninstall

1) Delete NCCtrl02 folder and all data files that included in that folder.

8.5 Operation

8.5.1 General description
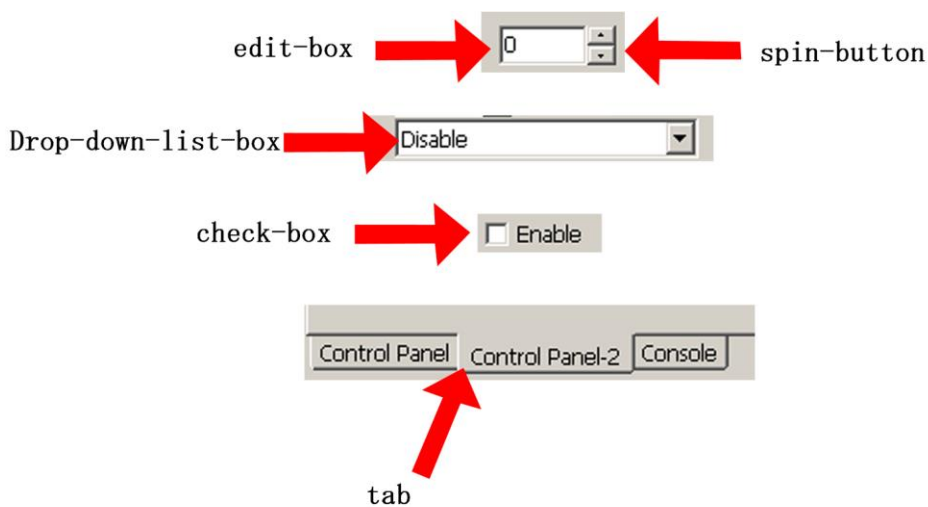
8.5.2 Starting NCCtrl02

Start Windows Explorer and double-click the NCCtrl02.exe icon.
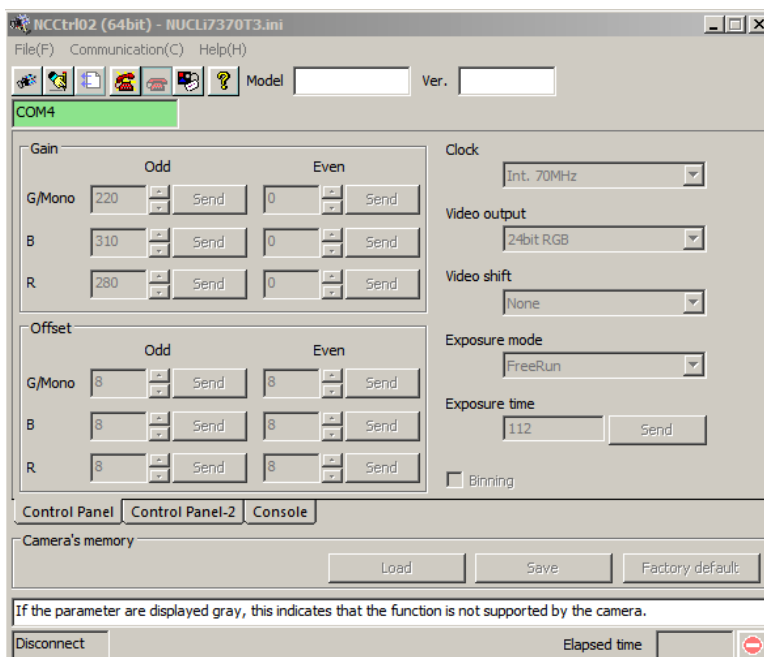
There are some buttons in the tool-bar. The function of each button is follows.

A B C D E F G
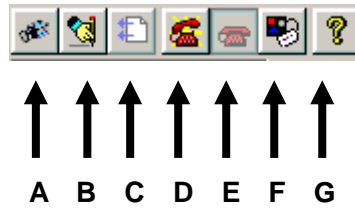
A: Open a camera setting file (*.ini file)

B: Export the parameters to text file (*.txt file)

C: Load the parameters from a text file (*.txt file)

D: Connect to the camera.

E: Disconnect from the camera

F: Communication settings

G: Version information.

8.5.3 Open the control setting file

1) Click on tool-bar button "A".

2) Select the appropriate setting file (*.ini file) and click on the "Open" button.

3) The setting is loaded, and each control parameter is initialized.
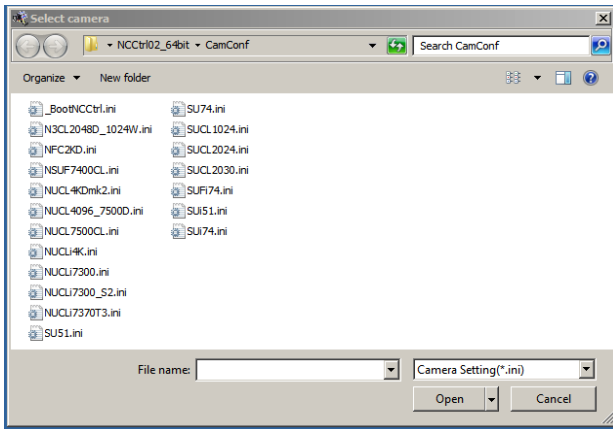
Note: **If the parameters displayed are gray, this indicates that the camera does not support the function.**

NCCtrl02 memorizes automatically the setting file name that was last opened.

This file is automatically opened when NCCtrl02 is booted up.

8.5.4 Selecting interface and Timeout setting

8.5.4.1 Selecting interface

1) Click tool-bar button F.

2) Select the desired interface in the Drop-down-list-box.
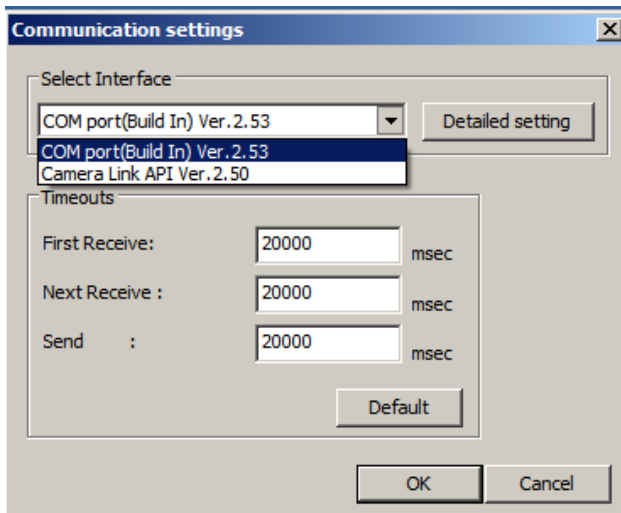
3) Using the "Detailed setting" button, you can change the interface setting.

4) Click on the "OK" button to complete this operation. Click on the "Cancel" button to cancel this operation.

Note: NCCtrl02 memorizes settings automatically. So you do not have to repeat this operation every time.

8.5.4.2 Setting the COM port

1) Set each item as follows. (NED standard)
   Unless in cases where different settings have been specified.
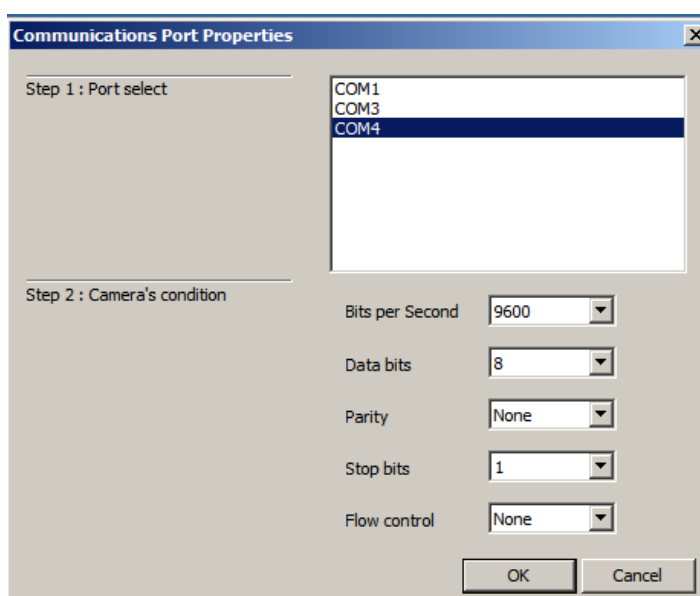
(1) Port: Select connecting port.

(2) Bits per Second: 9600

(3) Data bits: 8

(4) Parity: None

(5) Stop bits: 1

(6) Flow control: None

Note: Other parameter should not be used.

2) Click on the "OK" button to complete this operation.

Click on the "Cancel" button to cancel this operation.

Note: NCCtrl02 memorize settings automatically. So you do not have to repeat this operation every time.

8.5.4.3 Setting Camera Link
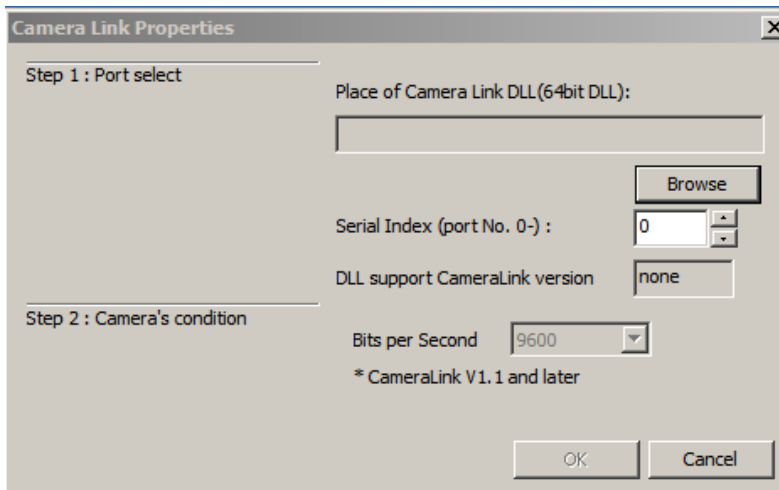
1) Enter the DLL file name of Camera Link API in the edit-box, or click "Browse" button and select DLL file.
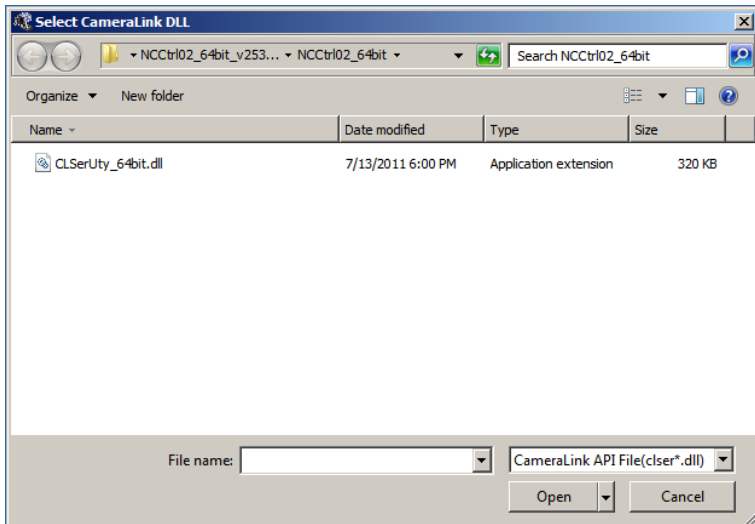
2) Enter value corresponding to the position of Camera Link cable to connect into the "Serial Index" column.

3) Click on the "OK" button to complete this operation.
   Click on the "Cancel" button to cancel this operation.

Note: NCCtrl02 memorize settings automatically. So you do not have to repeat this operation every time.

Frame grabber manufacturers provide the DLL file for Camera Link API.
Some frame grabber boards are connected directly to the PC's COM port.
In this case, set the interface to COM port (RS232C).
For details, please inquire with the frame grabber manufacturer.

8.5.4.4 Setting Timeout
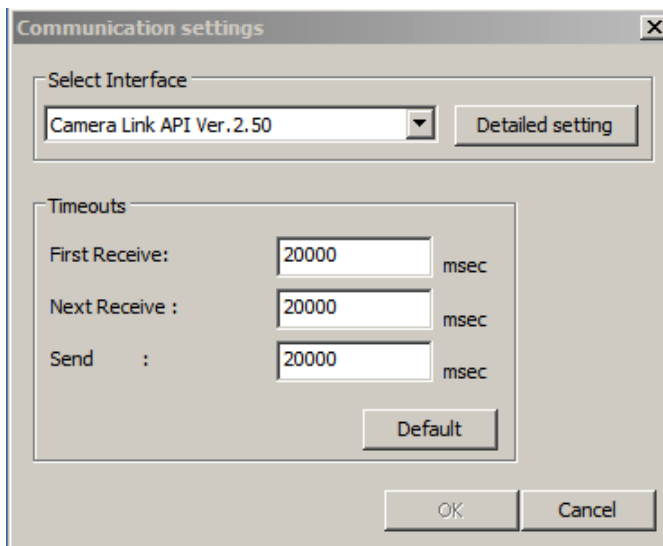
1) Enter timeout values to each edit-box in milliseconds.
   Click "Default" button to restore all timeout values to default settings.
   The meanings of each timeout are as follows.
   First Receive: Maximum time, allowed to arrival of first characters after command transmission.
   Next Receive : Maximum time, allowed to elapse between the arrival of two characters.
   Send   : Maximum time, allowed to completing of command transmission.

2) Click on the "OK" button to save the setting.
   Click on the "Cancel" button to cancel the setting.

Note: NCCtrl02 memorizes settings automatically. So you do not have to repeat this operation every time.

8.5.5 Connect

Click on tool-bar button D. Then you can control the camera.
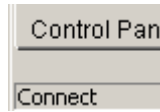
8.5.6 Disconnect and exit program

Click on tool-bar button E. Then click the "X" button in the top right of the window.
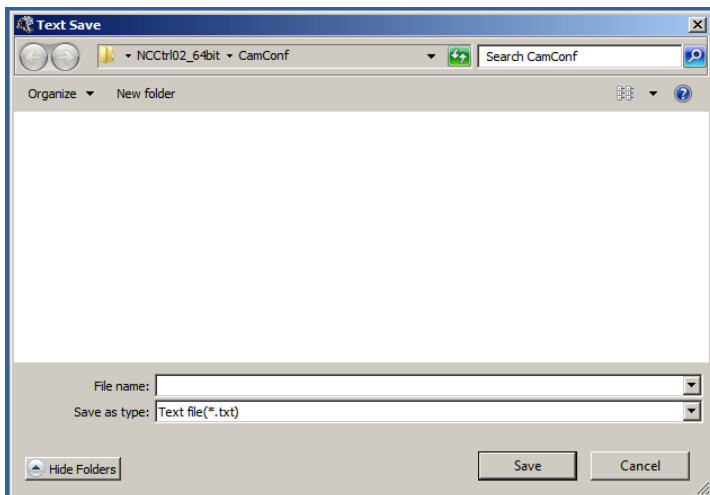
8.5.7 Check the contents of communication

Click on the "Console" tab at the bottom of the window to confirm the settings.
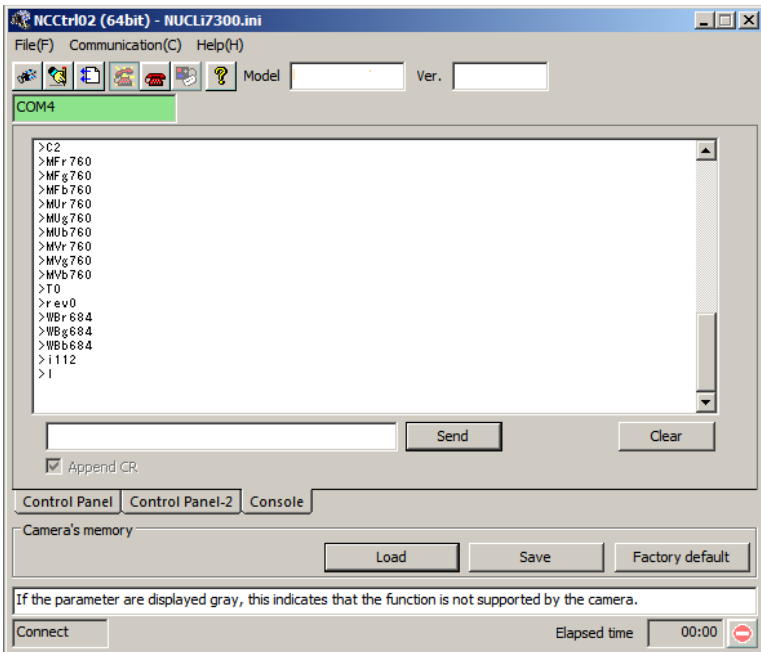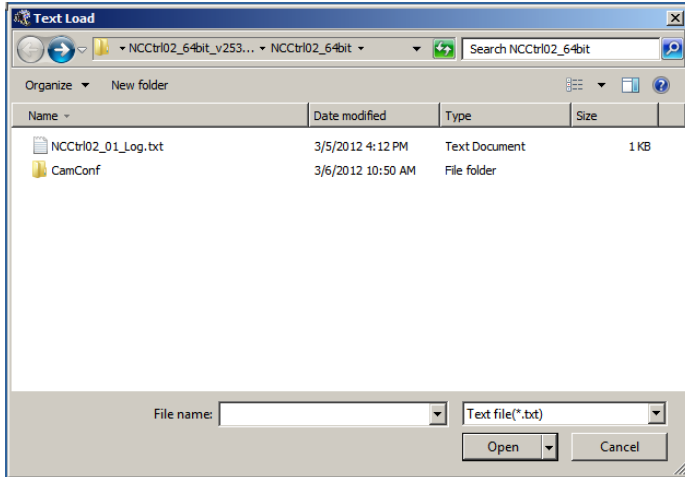
8.5.8 Export Parameters to text file

1) Click on tool-bar button B.

2) Input the desired file name and click on the "Save" button. The current settings value of each item is saved in text format.

8.5.9 Import Parameters from text file

1) Select menu "File" – "Text Load"

2) Select the file name and click on the "Open" button.
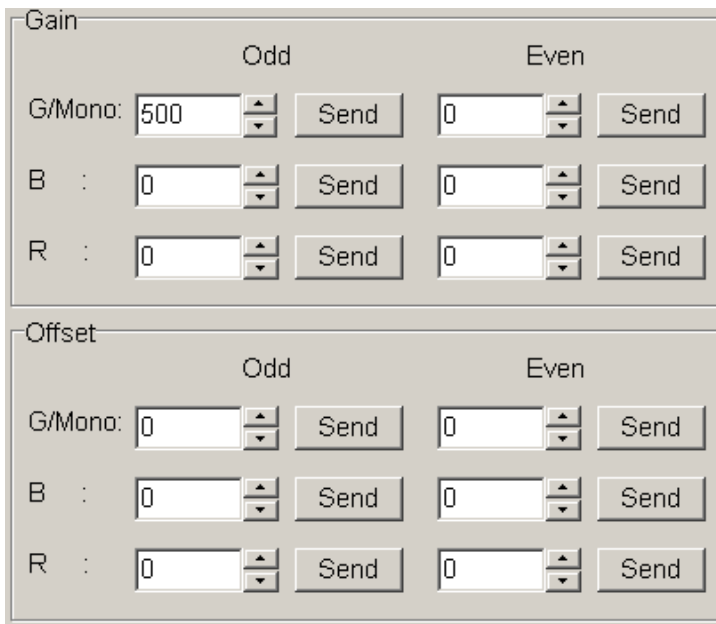   Each command written in the text file is executed sequentially.

8.6 Control

The controllable functions and range of values differ for every camera.
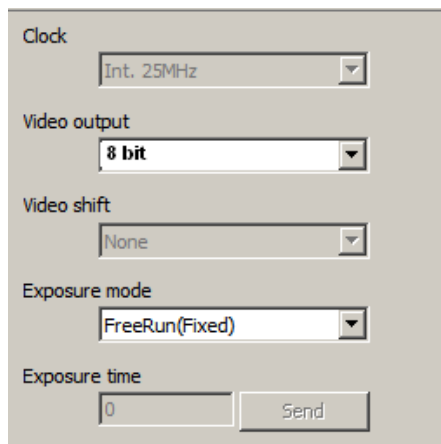
For details, refer to the camera specifications.
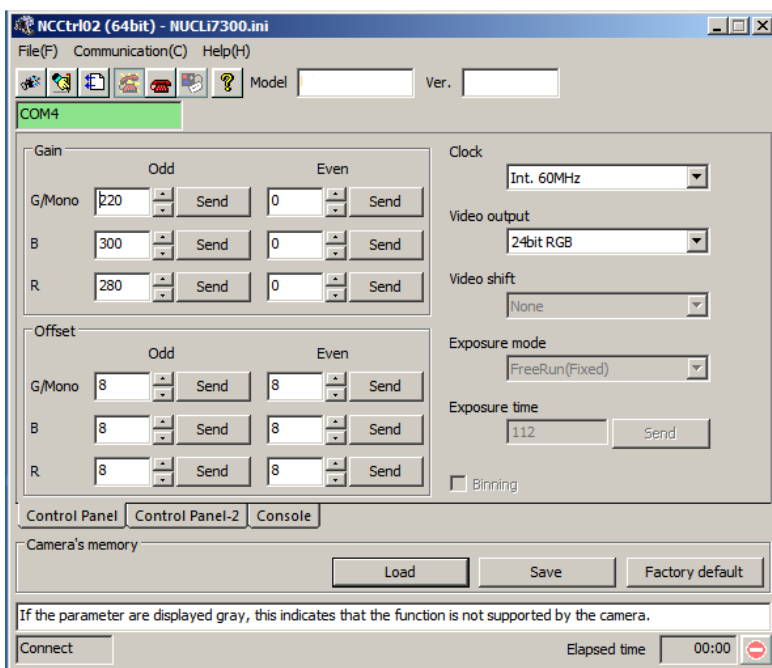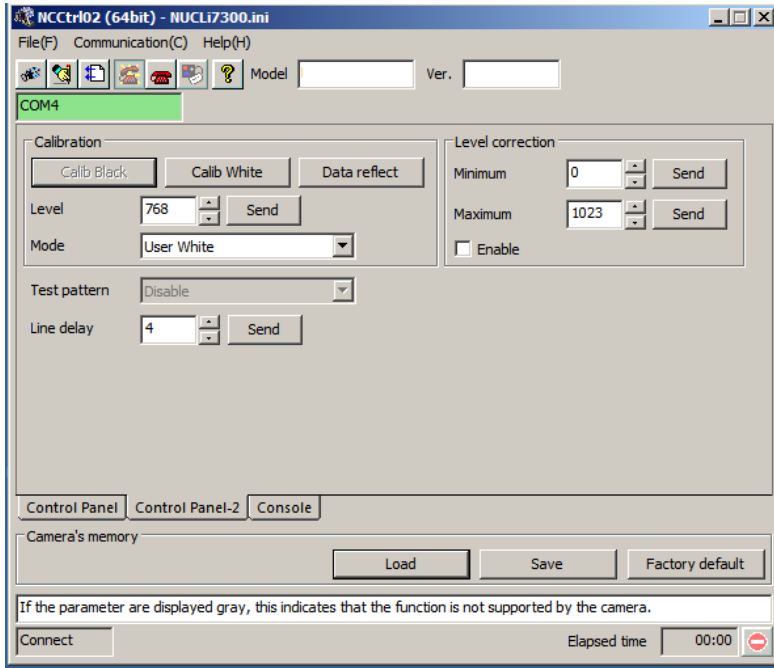
8.6.1 Gain and Offset

Enter the value directly into the edit-box or click on the spin-button to set the value.

Then, click on the "Send" button to send the command to the camera.

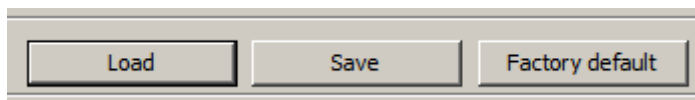### 8.6.2 Clock, Video output, Video shift, Exposure mode

Every time you choose from the Drop-down-list-box, the command is sent to the camera.

8.6.3 Camera Memory

a) "Load": Load data from camera memory
b) "Save": Save data into camera memory
c) "Factory default": Restore camera memory data to factory settings.

8.6.4 Pixel Correction

①Input the pixel correction target level 「M xxx」 in the input box on the console screen, and set it by pressing the Send button.

②Input 「W」 and click Send to apply the correction.

③Input 「L」 and click Send when correction is complete to save the data in the camera memory.
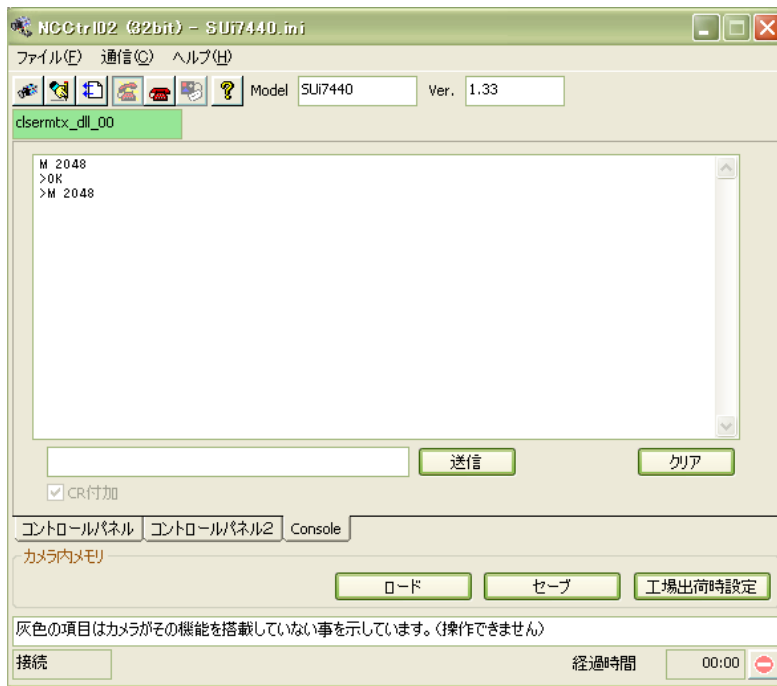
8.7 Software Upgrades

   When you received the newest software from NED,
   Please execute the following procedure.

8.7.1 NCCtrl02 upgrades
   1) Check the old version of NCCtrl is not in operation.
   2) Uninstall old version. (See "8.4.Uninstall")
   3) Install new version. (See "8.3.Software installation")

8.7.2 Adding/Replacing control setting file
   1) Check the old version of NCCtrl02 is not in operation.
   2) Copy the control setting file(*.ini) to NCCtrl02¥Camconf folder.

8.7.3 Adding/Replacing the interface Plug-in
   1) Check the old version of NCCtrl02 is not in operation.
   2) Copy the Plug-in file (*.dll) to the NCCtrl02 folder.

8.8 Data Transmission Programming

To make your own communication program, please refer to the sample programs in NCCtrl02¥SampleProgram folder.

8.9 Attention on use

1) Reproducing and distributing without notice part or all of this software and this manual is prohibited.
2) Reverse engineering, decompiling, disassembling and modifying without notice part or all of this software is prohibited.
3) The specification of this software and the contents of this manual may be changed by NED at any time without notice.

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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    2-5-12, Itachibori, Nishi-ku, Osaka 550-0012, Japan
    Phone +81-6-6534-5300
    Fax +81-6-6534-6080

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    Phone +81-3-5718-3181
    Fax +81-3-5718-0331

West Japan Office
    Twin Square 1-8-28 Enokida, Hakata-Ku, Fukuoka, 812-0004, Japan
    Phone +81-92-451-9333
    Fax +81-92-451-9335

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

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 executing the "I" command.

The example of the camera status.

```
I
>OK
>Type=SUi7450T2
>Ver. =1.50(2013.04.01)
>FPGA_VER1 = 00000100
>FPGA_VER2 = 20130527
>g0
>o1
>G0
>O1
>b0
>p1
>B0
>P1
>v0
>t0
>i4000
>C1
>M128
>c0
>s0
>S255
>T0
>R0
>I
```

Revision History

Revision Number	Date	Changes
01	10 Apr. 2014	Initial release
02	09 May 2019	Added Sections 4.8.3 and 4.8.4