Line Scan Camera Model: XCM8040SA

Operation Manual

Introduction

Thank you for making a choice of our outstanding line scan camera “XCM8040SA”. As always, NED products can help you create a solution that is right for you.

For safety use

▲ Before use, carefully read through this manual for your safety operation.

▲ The warning symbols are indicated at parts where special precaution is required.

 Warning	Warning symbol indicates that improper use may result in fatal accident or serious injury.
 Caution	Caution symbol indicates that improper use may result in personal injury or damage to the equipment or property

Safety precaution

Warning

▲ Do not disassemble the camera as not outlined in this manual since malfunction or damage may occur.

▲ Do not touch the pins or metal parts of connecting cable with wet hands.

▲ Do not use the camera where it is subjected to a rain, a drop of water, a poisonous gas or liquid.

▲ When not using the camera for a long time, disconnect the camera cable for the safety sake.

▲ When handling the camera at a height, make sure to take measures not to drop any equipment or parts.

▲ When perceiving smoke, an offensive smell or unusual noise, break the power immediately and pull out the camera cable.

▲ Do not use this camera in the system when unusual camera performance can reasonably be expected to cause significant system trouble.

Instructions before use

Caution

▲ Always use the camera within ambient temperature specified.
▲ Always use the camera with specified power supply.
▲ Be careful not to drop the camera on the floor and avoid shock or vibration.
▲ To avoid internal rise in temperature, take enough space for the camera installation.
▲ Take measures to prevent dust proof when using the camera in dusty environment.
▲ To avoid product damages, be sure to cut off power when you pull out or plug in cable during power is on.
▲ Dirt or particles on the window glass may cause black flaw in the image. Blow off dirt and wipe particles on glass by swab with ethyl alcohol very carefully.
▲ With light source, we recommend daylight fluorescent lamp that has no infrared component. When using halogen lamps, use Infrared cut filters.
▲ To get more stable images, make aging for 10 to 20 minutes after power on.
▲ Do not use the same power supply together with motors or so that generates noise.
▲ SG(Signal Ground) and FG(Frame Ground) are connected in the camera.
Designers are requested not to make a loop caused by GND electric potential difference.
▲ Do not disconnect camera while rewriting an embedded memory.
▲ When you change exposure mode that is set at NED factory, input control signal (CC1) from capture board.

Exclusion Clause

▲ NED shall not be liable for damage that is due to fires, quake, third party's act, inevitable accident, intentional or improper use or usage under abnormal condition.
▲ NED shall not be liable for damage (lost profit or business interruption, etc.) caused by the use or malfunction of the product.
▲ NED shall not be liable for damage caused by improper usage not following the Instruction of the manual.
▲ NED shall not be liable for damage caused by malfunction coming from combination with other products.
▲ NED shall be no liable for damages caused by user's repair or adaptation.

Table of Content

1.Outline

◇ This product is a high speed line scan camera that has 160MHz data rate with high resolution of 8192 pixels.

2.Features

◇ The camera adopts CMOS sensor providing high responsivity and high-grade images.

3.Composition

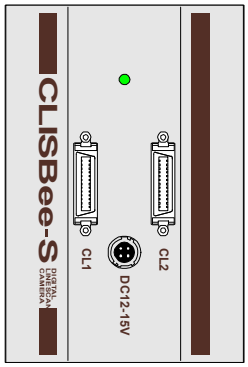
3.1 Camera specification

◇ Data rate: 160 MHz x CM8040SA

3.2 Content

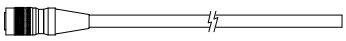
◇ Camera 1

◇ Operation manual (CD) … 1

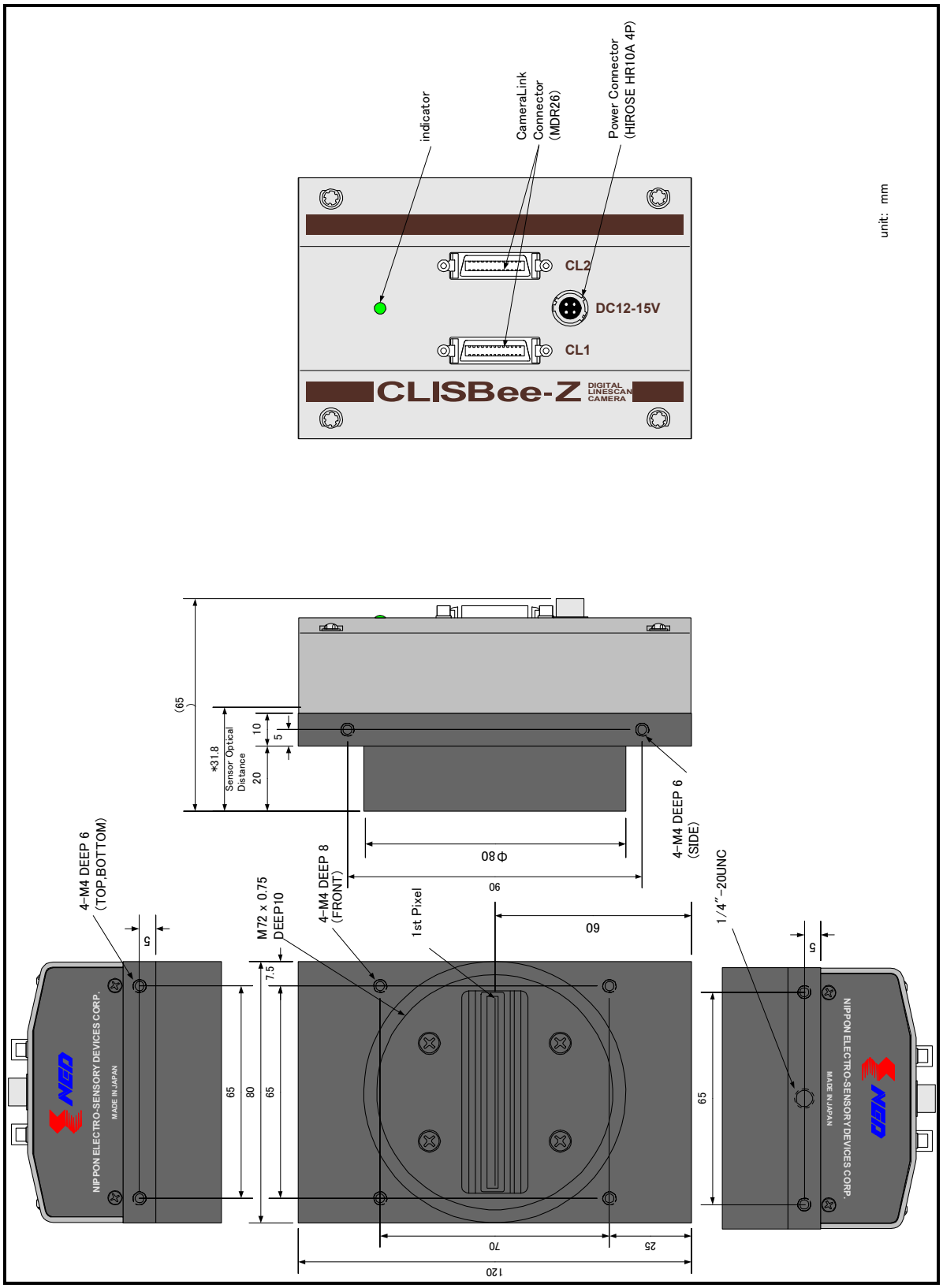


3.3 Option (charges are extra)

◇ Power cable with sealed DGSP-10



4.Dimension and Part Name



▲ Cable wiring space is excluded.

5.Camera Setting

5.1 Camera mounting

◇ You can mount the camera using M4 holes (front-4, side-8) of the front panel.

◇ You can mount the camera using one 1/4”-20UNC hole of the front panel.

▲ When using 12-M4 mounting holes (front-4, side-8), use the bolts of Max.8mm thread length for 4 front holes and Max.6mm thread length for 8 side holes.

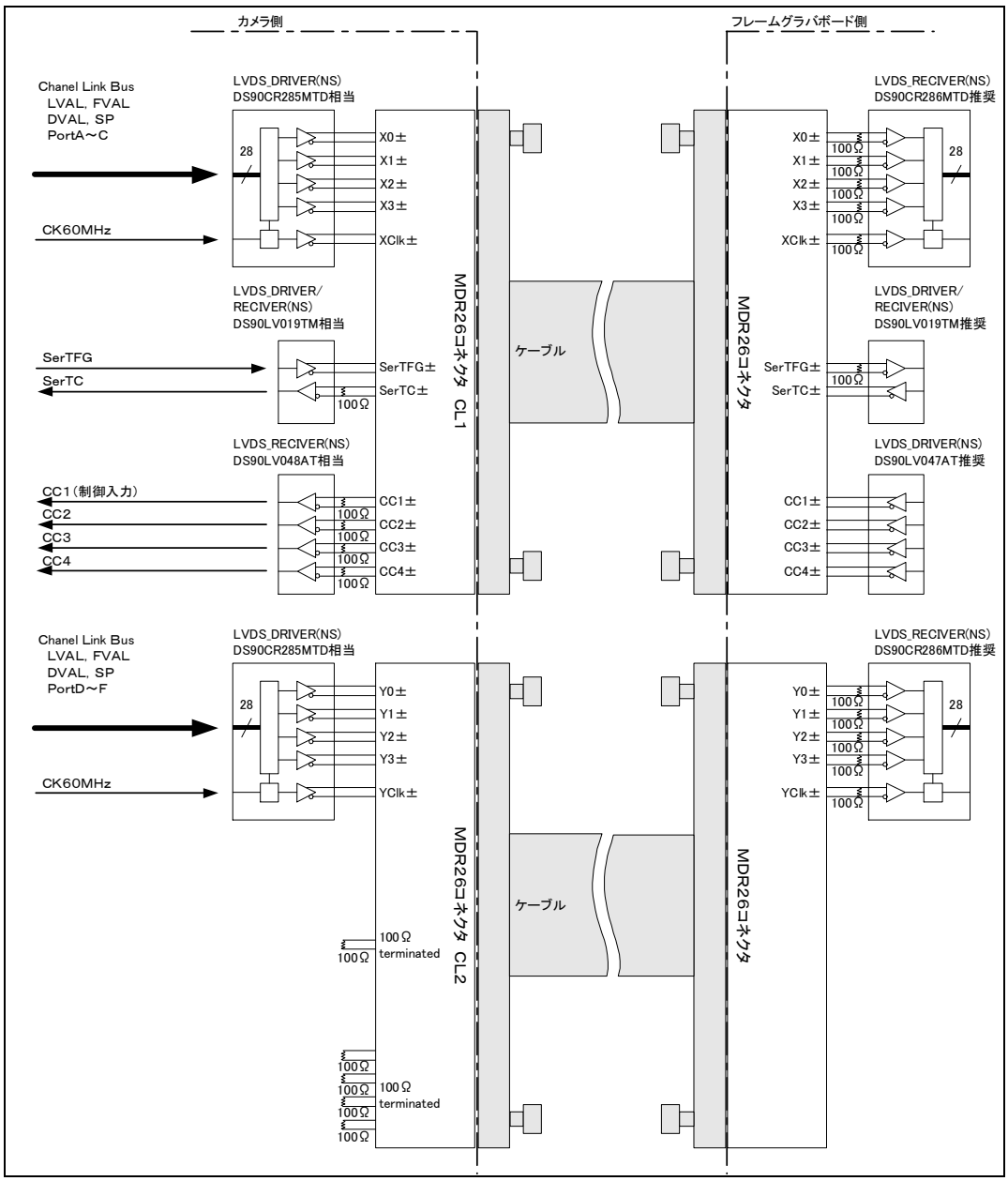
▲ The alignment of X-axis, Y-axis and angles of elevation can not be adjusted. Please prepare some adjusting mechanism if necessary.

6.EXTERNAL SIGNAL CONNECTION(INPUT/OUTPUT)

6.1 Camera Link Interface

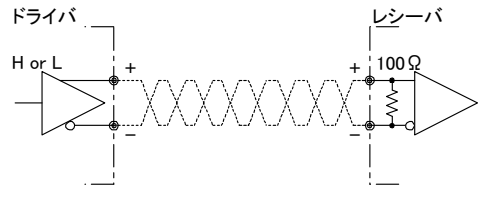
◇ This camera adopts Medium configuration of Camera Link I/F standard.

Camera side　　Frame grabber board side



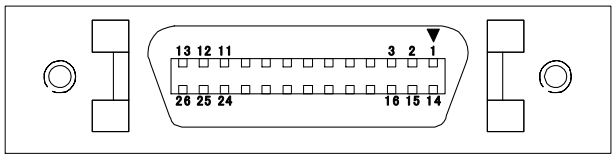
▲ Be sure to make 100Ω termination with receiver side of LVDS, Channel Link.

▲ With driver side of LVDS, even if unused, do not make it open but fix with logic H or L



Driver　　Receiver

6.2 MDR26 Connector



◇ Half pitch (miniature delta ribbon)

◇ Locking screw (inch screw #4-40) Lock type

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	100Ω terminated	20	100Ω terminated	
8	Open	21	Open	
9	100Ω terminated	22	100Ω terminated	
10	100Ω terminated	23	100Ω terminated	
11	100Ω terminated	24	100Ω terminated	
12	100Ω terminated	25	100Ω terminated	
13	Inner Shield	26	Inner Shield	

◇ Explanation of each signal

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)

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

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

CC1+,CC1-：External synchronization trigger signal input (LVDS) ※When using external trigger

CC2+,CC2-：Unused (LVDS)

CC3+,CC3-：Unused (LVDS)

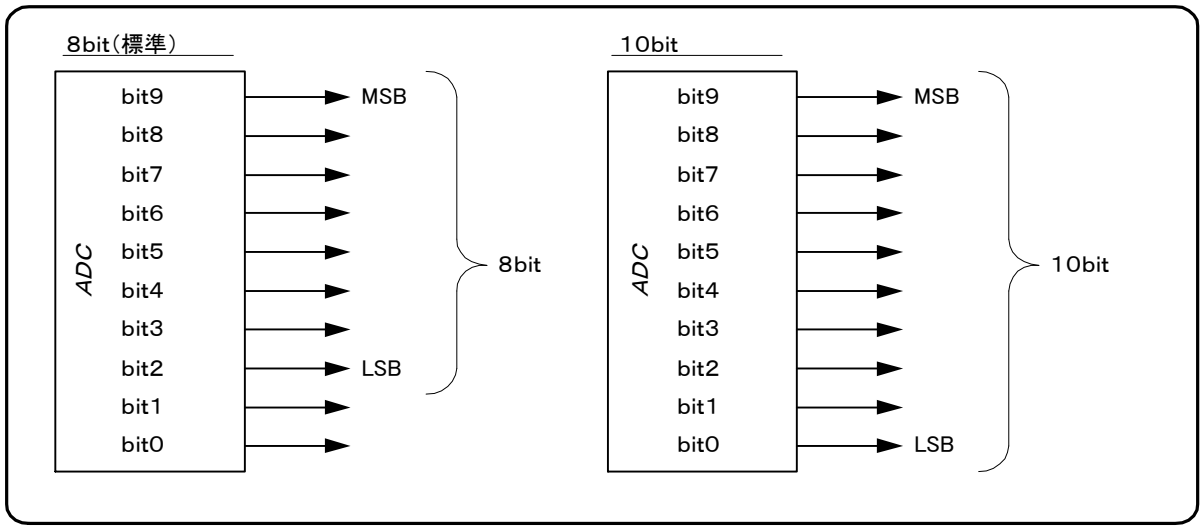
CC4+,CC4-：Unused (LVDS)

◇ Conform to Camera Link based cable

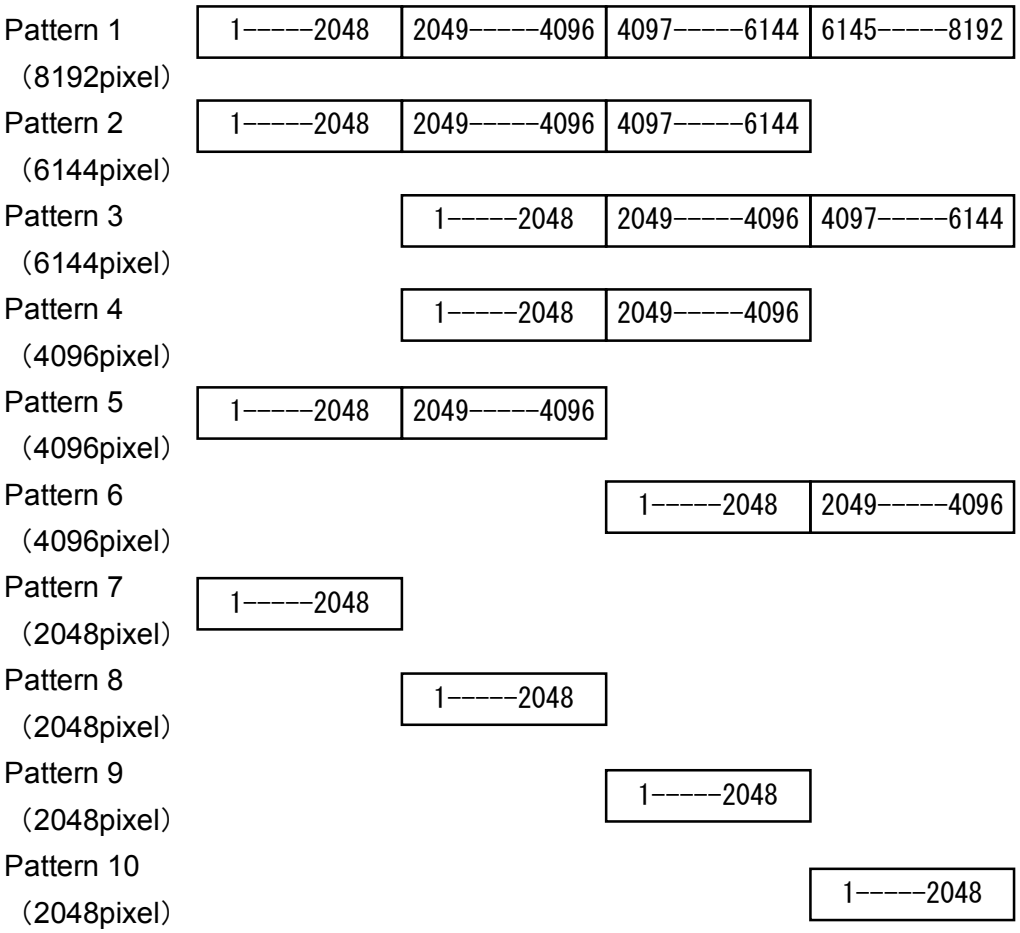
３Ｍ：１４Ｂ２６－ＳＺＬＢ—ｘｘｘ—０ＬＣ　equivalent

▲ To avoid tripping of cable connector during power on, make sure to clamp it by locking screws.

6.3 Video output format



▲ Although a resolution of A/D converter of this product is 10 bit, upper 8 bit is output as video output when 8 bit output is required.

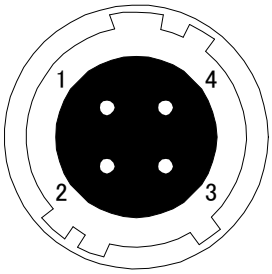


＊ When selecting 10 bit of pattern 1,2 and 3,:Camera Link medium configuration.

＊ When selecting 8 bit of pattern 2 and 3 and pattern 4~10:Camera Link base configuration.

7.Power supply connection

7.1 HR 10A Connector



◇ Circular / Push-Pull lock type

◇ Pin out

No	Name	※ Cable color
1	１２～１５Ｖ	White
2	１２～１５Ｖ	Red
3	ＧＮＤ	Green
4	ＧＮＤ	Black

※ When using the following conformed cables

◇ Conformed cable (Conformed plug)

DGPS-10（HIROSE:HR10A-7P-4S）

◇ Power voltage details

ＤＣ＋１２～１５Ｖ（±５％）

◇ Power dissipation (Rating)

ＤＣ＋１２Ｖ：５００ｍＡ

▲ 15W or over power supply is recommended to have some margin against rush current.

▲ To avoid tripping of cable connector during power is on, insert plug tightly into lock position.

7.2 Indicator

When supplying power of DC+12~15V, LED lights on.

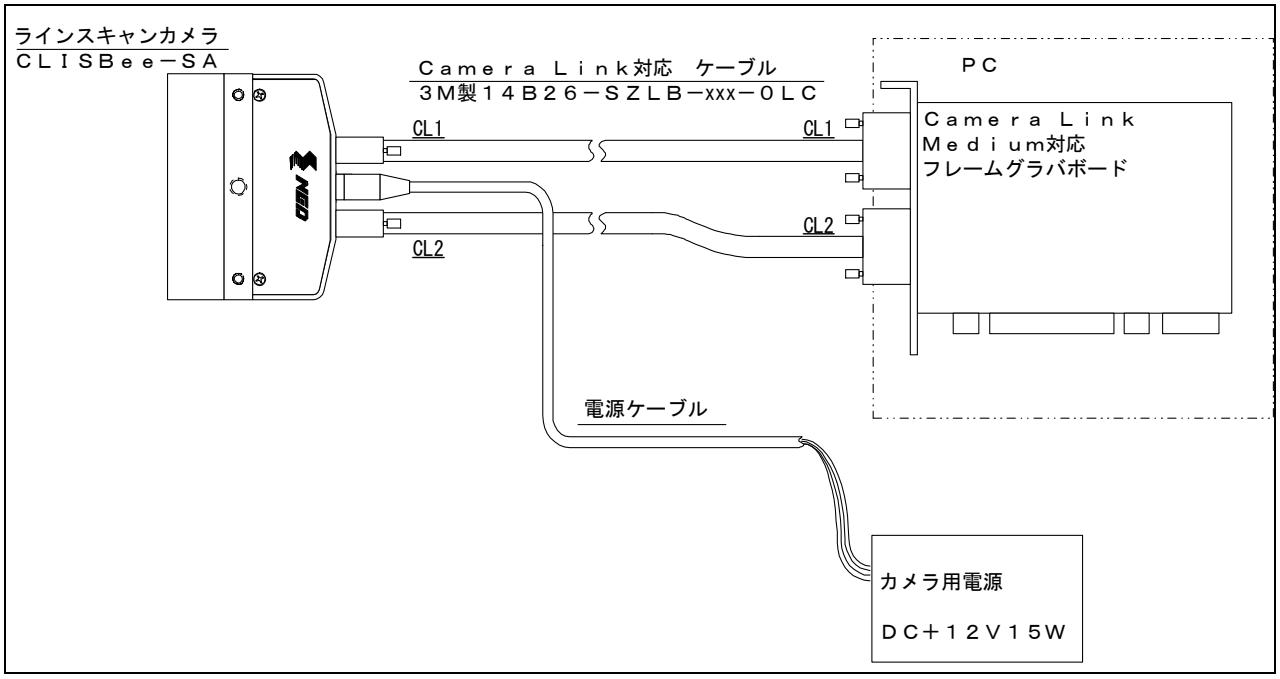
▲When LED does not light, disconnect power immediately then check wiring, power voltage and capacity.

8.Camera connection

◇ To connect camera and image capture board, use Camera Link cable. When 2 cables are used, they should be the same length of the same maker.

◇ To connect camera and camera power supply, use power cable. Connect plug side of power cable to camera and connect open side to camera power supply.

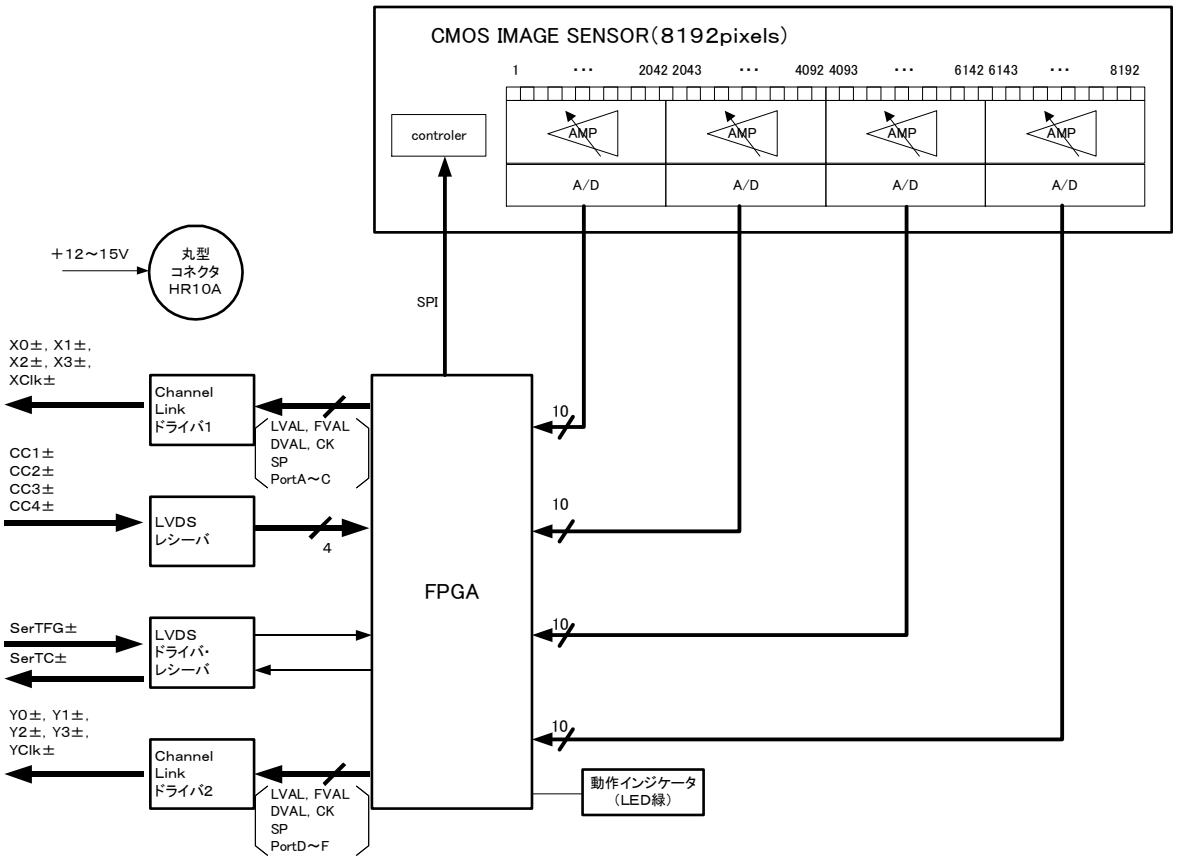
Line scan camera　　camera Link Medium based frame grabber board



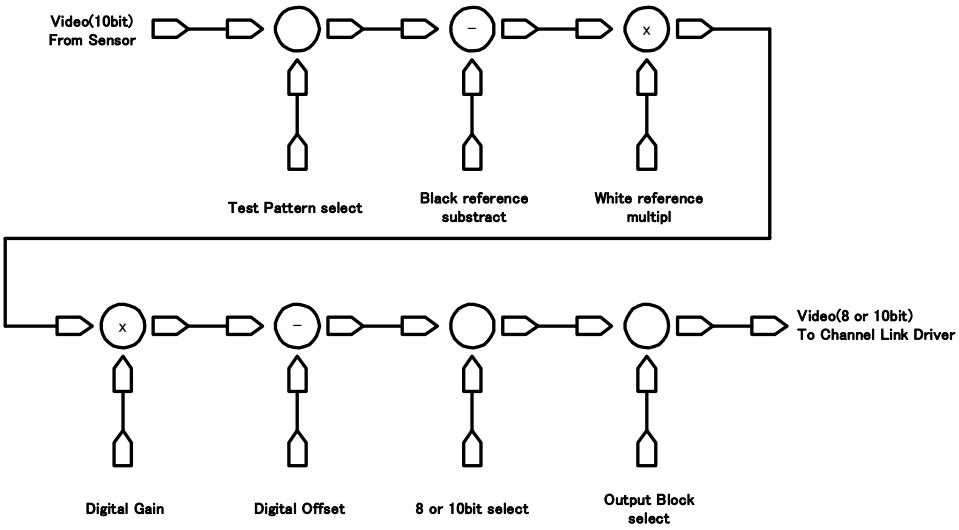
Camera power supply

▲ Camera Link medium configuration board has 2 connectors so confirm the specification of your capture board before connection.

9.Internal circuit block diagram



FPGA Processing block diagram



Note：Test Pattern select時はBlack 、White reference及びDigital Gain、Offsetはスキップします。

Selection of Test Pattern makes Black, White reference, Digital Gain and Offset skip.

10. Camera setting change (Control)

10.1 Serial communication setting

Item	Setting value
Communication speed (Baud rate)	9600 bps
Data length	8 bit
Parity bit	Non
Stop bit	1 bit
Flow control	Non

10.2 Protocol

◇ Communication gets start by sending control command from PC to camera.

◇ Camera makes an analysis of recipient control command then executes control according to that command.

◇ Communication is completed after answer the analysis result of recipient control command from camera to PC.

▲ Start another communication after completion of one communication.(One command accepts one communication)

10.3 Camera control (Recipient) command (PC Sending command)

◇ Style 1　CMD CR

◇ Style 2　CMD□VAL CR

◇ Style 3　CMD□VAL□VAL CR

◇ Style 4　CMD□VAL□VAL□VAL CR

CMD：Control letter(3 Byte) Half size English small letter 3 letters　Numerical can not be used.

CR　：Carriage Return（0x0D）

□　：Space（0x20） or　Comma（0x2C）

VAL　：Setting value (10 decimal system, 1bytex 5 figures max.)

＜Example＞

gax□0 CR

10.4 Camera Sending (Answer) message (PC recipient message)

◇ Style 1. >R CR >[SB] CR EOT

◇ Style 2. (when CMD is sta)>OK CR >[MEM] CR >sta CR EOT

> ：Result start letter（0x3E）

R ：Analysis result of camera recipient command Refer to item 10.5

[SB] ：Send back camera recipient command

[MEM]：Memory data read out value

CR ：Carriage Return（0x0D）

EOT ：End of full text of sending command（0x04）

＜Example＞

>OK CR >gax 0 CR EOT

10.5 Analysis result table of camera recipient command

Analysis result answer command	Analysis result
OK	Command reception is normal
CMD ERR！	Command error
CMD OVR ERR！	Command character string overflow error
VAL ERR！	Set value error for out of range
MEM ERR！	Camera memory set value error for out of range

10.6 Camera control (Recipient) command table

Item	CMD	VAL1	VAL2	Control description
Analog gain	gax	0to20		X1.00...x11.22(1.06dB/step)
Digital gain	gdx	0to511		x1...x2(x0.003906/step)
Digital offset	odx	-15to15		-15...15(1DN/step at8bit)-60...60(4DN/step at10bit)
rigger mode	inm	0to2		FreeRun/ExtEdge/ExtLevel
Programmable exposure time (Dividing, Counter)	int	0to11	61to1023	48.8～1.6760832 μ sec (Dividing=1/16, 1/32...to1/32768,ｶｳﾝﾀｰ 61to1023)
Output signal setting 1	voa	0to1	0to9	8bit/10bit、Output block selection
Output signal setting2	voc	0to1		linear/log
Memory initialize	rst			Initialize memory to the status of factory shipping
Memory load	rfd			Read out memory setting value
Memory save	sav			Save present camera setting value into memory
Test pattern indicate	tpn	0to1		ON/OFF
Acquire pixel correction data	wht			Acquire arbitrary correction data and save it into memory
Pixel correction setting	shc	0to2	0to1023	Correction OFF/Factory White correction/Arbitrary White correction, Correction level (10bit)
Exposure- Read out time	pad	0to50		0～81920 μ sec
Read out state	sta			Read out present setting value of camera
Scan direction	rev	0to1		Right Direction: 0 Reverse:1

Programmable exposure time＝VAL2÷{20000000÷(16 x 2^ VAL1)}
★
Exposure-Read out time＝VAL1÷{20000000÷(16 x 2 ^ VAL1)} ★Dividing of programmable exposure time

Unit: μ sec

10.7 Memory setting value at factory shipping (Initial value)

Item	CMD	VAL1	VAL2	Control description
Analog gain	gax	0		X1(0dB)
Digital gain	gdi	0		X1
Digital offset	odx	0		0DN(8bit)
Trigger mode	inm	0		FreeRun
Programmable exposure time	int	0	61	48.8 μ sec(Dividing=1/16、Counter=61)
Output signal setting 1	voa	0	0	8bit、8192pixel
Output signal setting 2	voc	0		Linear
Test pattern indication	tpn	0		OFF
Pixel correction setting	shc	1	600	Factory White-correction, Correction level 600DN(10bit)
Exposure-Read out time	pad	0		0 μ sec
Scan direction	rev	0		Right direction:0

10.8 Embedded memory

◇ Erasable flash memory is adopted as embedded memory.

◇ How many times to rewrite embedded memory shall depend on your usage condition.

▲ When turn on power supply, even if you find the built-in memory is out of setting range somehow, the memory rewriting to factory set value could be executed automatically.

▲ When disconnecting camera power while erasing embedded memory, whole data saved in the memory is deleted.

As it takes several seconds for erasing the memory, do not disconnect power supply before receiving answer from camera.

Commands for erasing memory content are as follows.

- Memory initialize (rst)
- Memory save (sav)
- Pixel correction data acquisition (wht)

▲ When changing factory set exposure mode, be sure to send control input signal (CC1) from capture board .

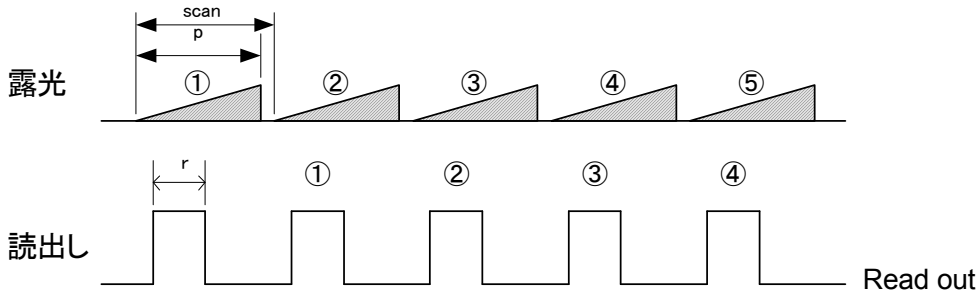
※ If you do not send (CC1) or sending control input signals are out of range, you can not only acquire images but also change camera setting. Refer to item 11.2 and 11.3

Set at shipping →

Camera operation mode (Exposure mode)	Control Input (From image capture board)
FreeRun (Programmable time setting)	Unused
ExtEdge (External trigger edge + Programmable time setting)	External trigger (CC1) is required
ExtLevel (External trigger level time setting)	External trigger (CC1) is required

11.Timing chart

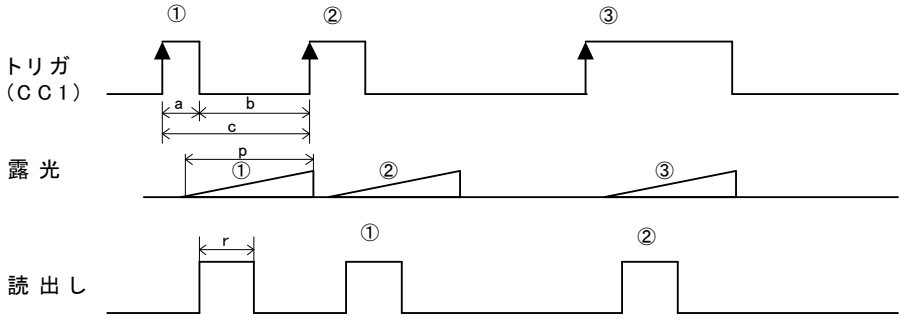
11.1 Free Run exposure mode (Programmable time setting)



Programmable exposure period：p ＝ 48.8 ～ 1.6760832μs

Read out period：r ＝ 51.2μs

11.2 External trigger (Trigger edge + Programmable time setting) exposure mode



Programmable exposure period：p ＝ ４８．８～１．６７６０８３２μs

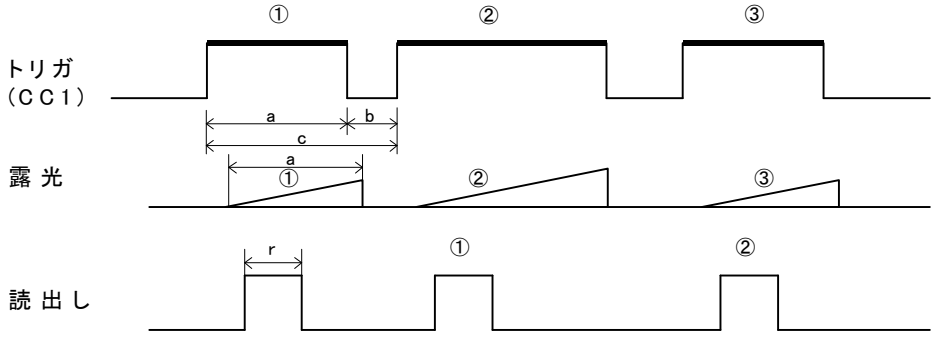
Read out period：r ＝ ５１．２μs

Trigger pulse H period：a ≧ １．６μs

Trigger pulse L period ：b ≧ １．６μs

Trigger pulse cycle ：c ≧ ５３．６μs

11.3 External trigger (Trigger level) exposure mode



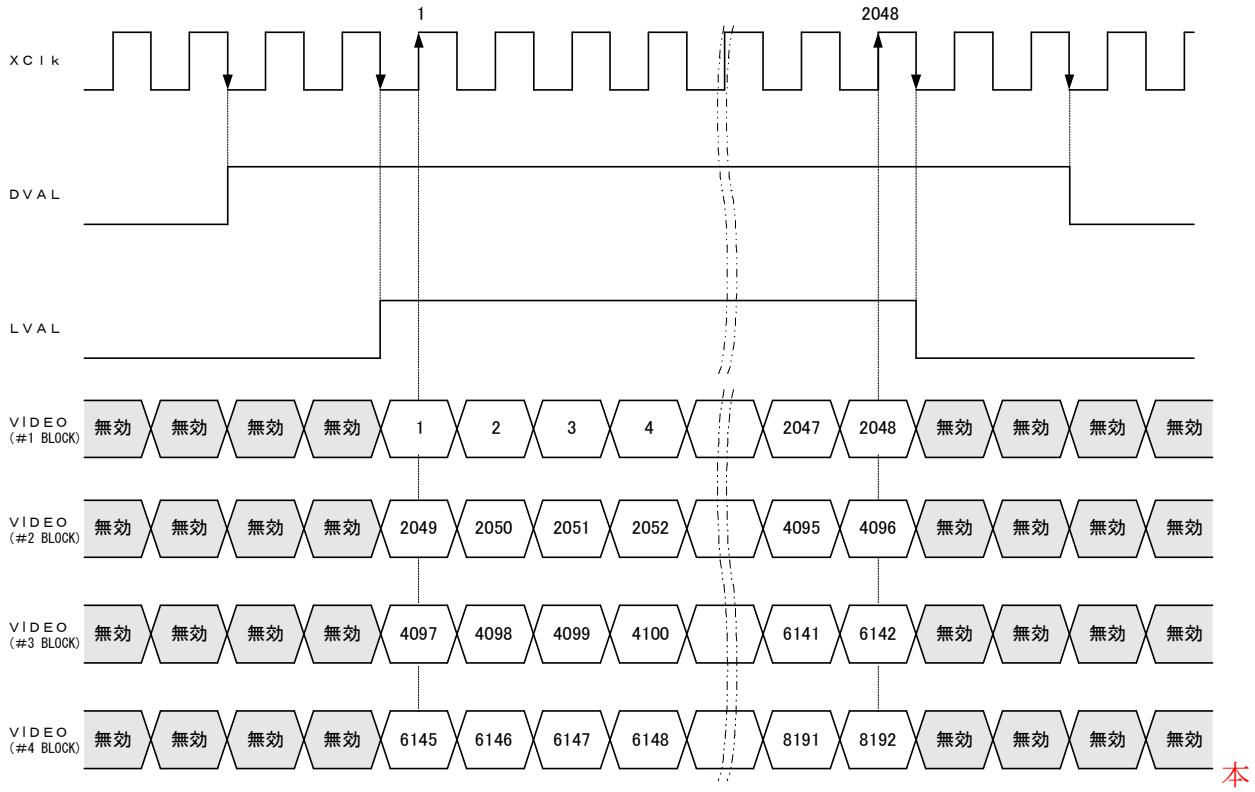
Read out period：r ＝ ５１．２μs

Trigger pulse H period ：a ≧ ４８．８μs

Trigger pulse L period ：b ≧ １．６μs

Trigger pulse cycle ：c ≧ ５３．６μs

11.4 Phase



▲ FVAL=「0」 (Low level) Fixed

12. Specification

12.1 Specification table

Item		Specification
Number of pixels		８１９２
Pixel size Ｈｘ Ｖ （μm）		７ｘ７
Sensor length（mm）		５７．３４４
Spectral responsivity （nm）		４００～１０００ ※Peak ６２５
Data rate（MHz）		１６０（４０ｘ４）
Shortest scan rate（μs）／[KHz]		５３．６[１８．６５]
Saturation exposure quantity(lx・s) typ		０．０７１ [Min. Gain・Pixel correction initial value・Daylight fluorescent lamp]
Responsivity (V/〔ｌｘ・s〕) typ ※ Conversion value in analog 5V output		７０ [Min. Gain・Pixel correction initial value・Daylight fluorescent lamp]
Gain adjust range ※Analog amplifier + Digital		Analog amplifier：ｘ１～ｘ１１．２（２１STEP） Digital：ｘ１～ｘ２（５１２STEP）
Offset adjust range ※Digital		Digital：－１５～１５ＤＮ(１６STEP) 8bit －６０～６０ＤＮ(１６STEP) 10bit
Video output		CameraLink Medium Configuration (8or10bit/4tap)
Control input		CC1：External trigger signal、CC2-4：Unused
Master clock (MHｚ)		４０
Connector	Data、 Control	３Ｍ：ＭＤＲ２６[Camera Link] x 2
	Power	HIROSE：ＨＲ１０Ａ（4 Pin）
Maximum cable length（m） ※Camera Link based cable		１０
Lens mount		Ｍ７２ｘ０．７５
Operating temperature（℃） ※Without dew condensation		０～４０
Power supply（V）		ＤＣ１２～１５[±５%]
Power dissipation（mA） ｔｙｐ		５００
Size Ｗｘ Ｈｘ Ｄ（mm） ※Projections of connector and screws are excluded		８０ｘ１２０ｘ６５
Camera mass (g) ※Camera only		Approx.６００
Additional function		2. Programmable exposure control 3. Output block selection 4. Test pattern output 5. Scan direction switching

12.2 Spectral responsivity characteristic

（Ta=25℃）

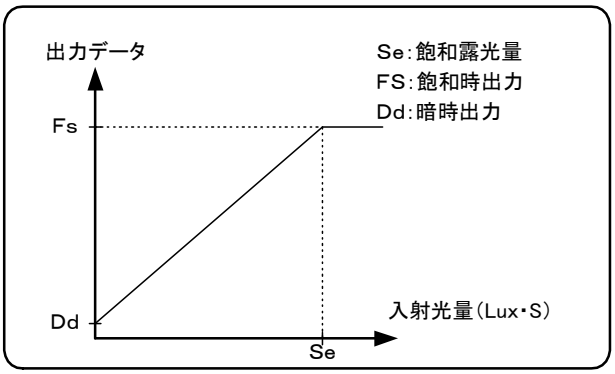
本図を削除しました。

図中の「相対感度（%）」の英訳は Relative responsivity(%)です。

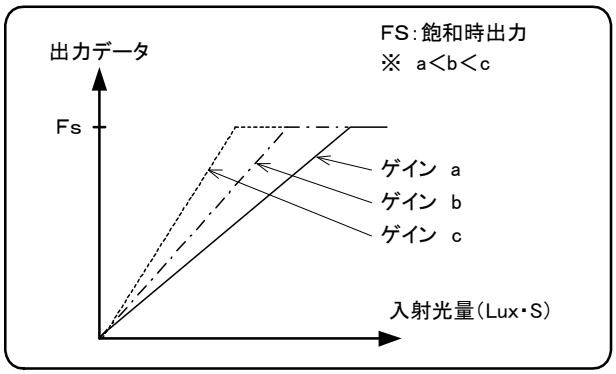
「波長」の英訳は Wave length です。

12.3 Photo-Electric conversion characteristic

—Saturation exposure quantity and dark output—

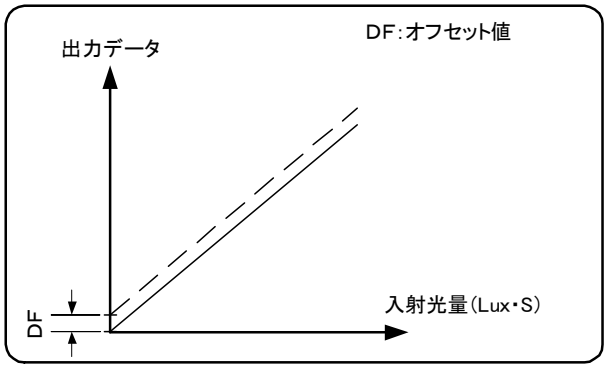


—PGA Gain adjustment—



—Offset adjustment—

Output data　　Offset value



Incidence light quantity

▲ Gain is directly proportional to noise.

▲ Adjust Gain and Offset properly to meet your system.

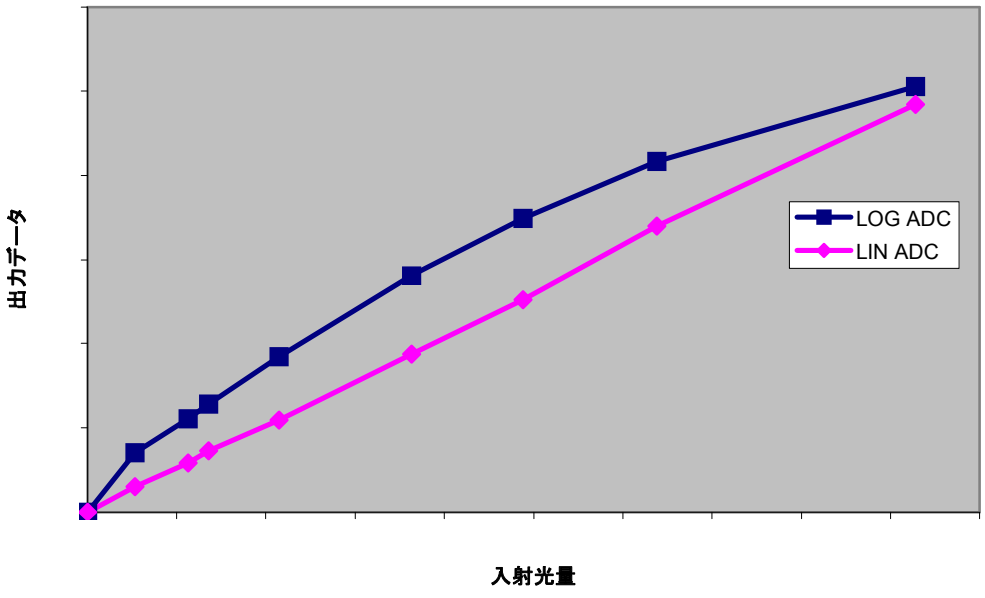
12.4 Gain – Responsivity table

Analog amplifier	Responsivity (V/lx・s)
x1.00(0.00dB)	70
x1.13(1.06dB)	79

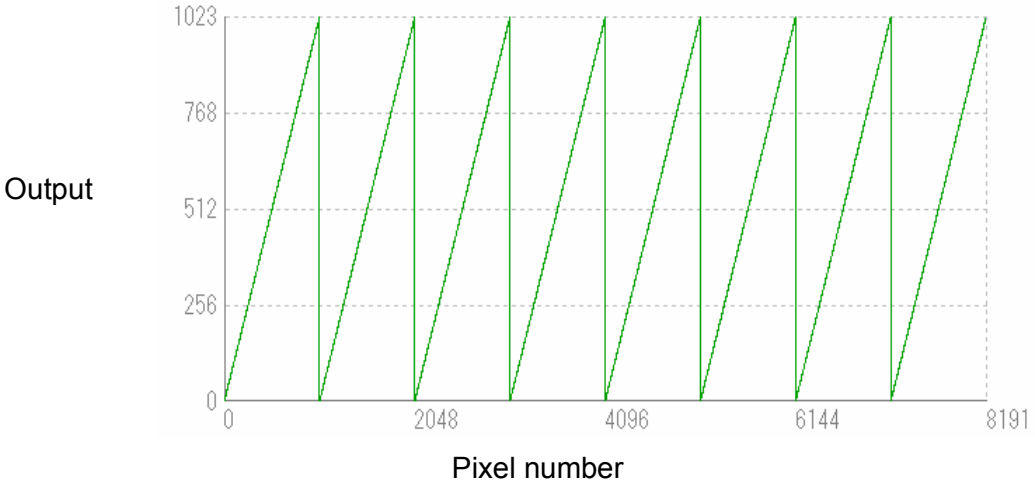
x1.28(2.12dB)	89
x1.44(3.18dB)	101
x1.63(4.24dB)	114
X1.84(5.3dB)	129
X2.08(6.36dB)	146
X2.29(7.20dB)	160
X2.59(8.26dB)	181
X2.92(9.32dB)	205
X3.31(10.40dB)	232
X3.74(11.46dB)	262
X4.23(12.52dB)	296
X4.78(13.58dB)	334
X5.40(14.64dB)	378
X6.10(15.70dB)	427
X6.89(16.76dB)	482
X7.78(17.82dB)	545
8.79(18.88dB)	615
X9.93(19.94dB)	695
X11.22(20.64dB)	785

Note) Digital Gain x 1, Pixel correction initial value
(Factory White-correction data, Correction level 600 DN)

12.5 A/D Characteristic



12.6 Test pattern



13. Miscellaneous

13.1 Note

◇ Reproduction of this manual in whole or in part is prohibited.

◇ NED reserves the right to make changes to this manual without notice.

◇ We have compiled this manual properly. However, in the case that any obscure explanations are found, please advise us with concerned matters.

13.2 Contact to NED:

◇Head office

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

Nippon Electro-Sensory Devices Corp.

TEL +81-6-6534-5300　FAX+81-6-6534-6080

Tokyo office

1-45-2 Oi, Shinagawa-ku, Gibraltar-Seimei BLDG. Room402, Tokyo Japan 140-0014

TEL +81-3-5718-3181　FAX +81-3-5718-0331

◇Nishi-Nippon Office

4-3-34 Yoshizuka, Hakata-ku, Fukuoka, Japan 812-0041

TEL *81-92-612-5577　FAX +81-92-612-5578

◇URL

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