

Color line scan camera Instruction Manual



Model: TLC-7500CLD



TAKENAKA SENSOR GROUP

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1. Outline

TLC-7500CLD is the color line scan camera with 3-lines of 7500-pixels CCD image sensor and has the following features.

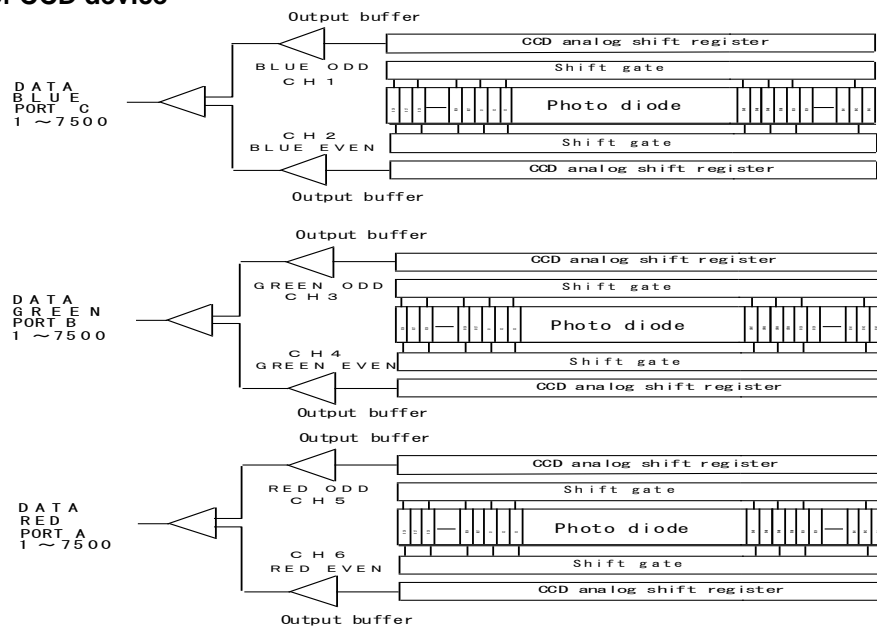
2. Features

- Capable of performing high-resolution inspection with 7500-pixels CCD image sensor.
- The pixel size is large enough ($9.325\mu\text{m}\times 9.325\mu\text{m}$) to capture high S/N images.
- The high speed operation at 50MHz data rate.
- 10 or 8 bit digital image signal output complying with Camera Link standard (Medium/Base Configuration).
- GAIN and OFFSET characteristic can be easily adjusted with RS232C communication (Camera Link spec.).
- 8/10 bits format can be easily changed by the communication command(RS232C).
- The equipment operates with a single DC12V power source.
- Possible to get stable video signal despite a change of ambient temperature, as the dark current correction circuit is incorporated.
- Internal Gain position (1,2,3...7,8 \times) is easily selected by the switch.
- Reduction in size and weight has been realized by adopting original circuit and mechanism design.
- The exposure control function is incorporated. (at below 3.1kHz in scan rate)

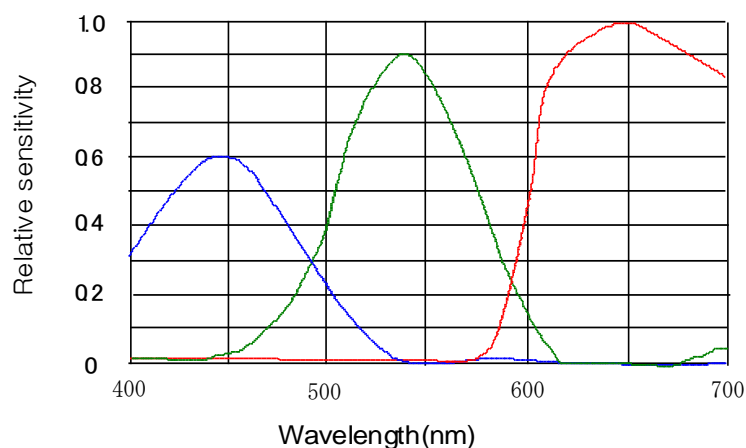
3. CCD image sensor

The CCD image sensor is characterized by $9.325\mu\text{m}$ square pixel, 7500 effective pixels and high speed performance. Charges accumulated in single-row photo diodes are output through two shift registers, respectively. (One for ODD numbered charges, and the another for EVEN numbered charges) It realizes high transfer efficiency and image uniformity by employing two shift registers.(It is not illustrated in the diagram below.) Each shift register operates at the rate of 25MHz.

Block diagram of CCD device



Sensitivity-Wavelength Characteristics



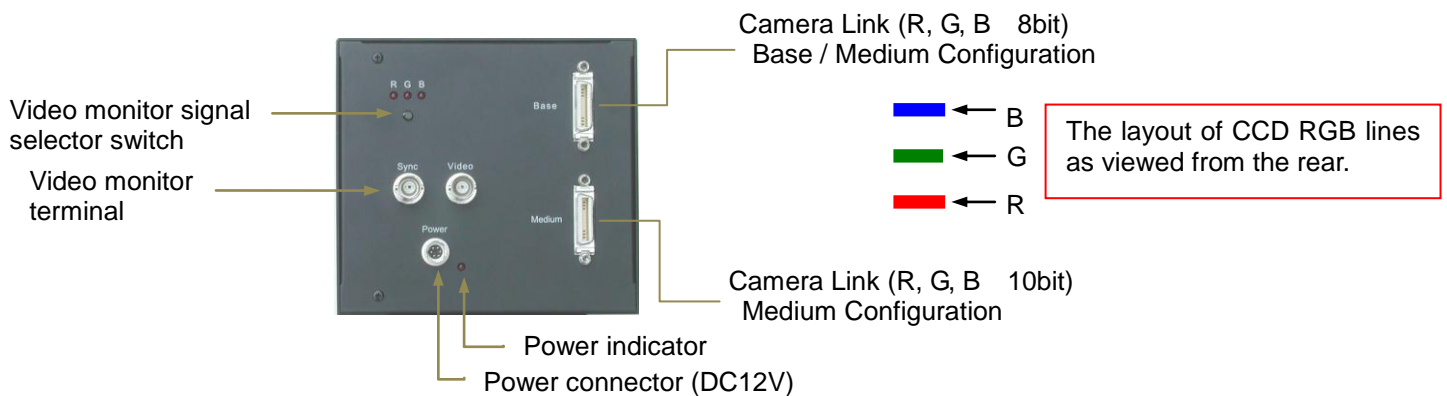
4. Specifications

Number of pixels	7500 × 3 lines
Unit cell size	9.325μ m × 9.325μ m
Distance between R,G,B lines light receiving element	37.3μ m (9.325μ m × 4 effectively)
Photo array length	69.9 mm
Data rate	50 MHz (R,G,B respectively)
Scan rate (scan/sec)	6.25 kHz
Line transfer pulse input	160 μ sec (Min.)
Video output (Digital output)	8 bit / Base Configuration 10 bit / Medium Configuration
Sensitivity	50 V/lx. sec
Saturated exposure amount	0.05 lx. sec (on the element)
Output ununiformity	3% standard at 50% of saturation output (on the element)
Dynamic range	500 (on the element)
Flange focus	28.8 mm
Power supply	+12V ±0.5V (800mA or less)
Operational ambient temperature	0 ~ +40°C
Operational humidity range	85% MAX
Storage temperature range	-10°C ~ +65°C
Weight	720g 以下
External dimension (mm)	120(W) × 120(H) × 56.3(D)
lens mount	M 72, P = 0.75 mm

5. Camera I/O

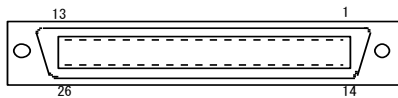
5-1 Signal I/O

The line scanner is connected to the Frame grabber board via two Camera Link cables.



5-2 Camera Link connector

Camera Link connector pin-out



Base Configuration Connector

Pin No.	Signal name	Pin No.	Signal name
1	Shield	14	Shield
2	X0-	15	X0+
3	X1-	16	X1+
4	X2-	17	X2+
5	Xclk-	18	Xclk+
6	X3-	19	X3+
7	SerTC+	20	SerTC-
8	SerTFG+	21	SerTFG+
9	CC1-	22	CC1+
10	CC2+	23	CC2-
11	CC3-	24	CC3+
12	CC4+	25	CC4-
13	Shield	26	Shield

Camera Control Configuration

Signal name	Connection
CC1	EXSYNC
CC2	Spare
CC3	Spare
CC4	Spare

5-3 Bit assignment

8 Bit:

Base connector			
Port/bit	8-bit	Port/bit	8-bit
Port A0	R0	Port B4	G4
Port A1	R1	Port B5	G5
Port A2	R2	Port B6	G6
Port A3	R3	Port B7	G7
Port A4	R4	Port C0	B0
Port A5	R5	Port C1	B1
Port A6	R6	Port C2	B2
Port A7	R7	Port C3	B3
Port B0	G0	Port C4	B4
Port B1	G1	Port C5	B5
Port B2	G2	Port C6	B6
Port B3	G3	Port C7	B7

10Bit:

Base connector			
Port/bit	10-bit	Port/bit	10-bit
Port A0	R0	Port B4	B8
Port A1	R1	Port B5	B9
Port A2	R2	Port B6	nc
Port A3	R3	Port B7	nc
Port A4	R4	Port C0	B0
Port A5	R5	Port C1	B1
Port A6	R6	Port C2	B2
Port A7	R7	Port C3	B3
Port B0	R8	Port C4	B4
Port B1	R9	Port C5	B5
Port B2	nc	Port C6	B6
Port B3	nc	Port C7	B7

Medium connector			
Port/bit	10-bit	Port/bit	10-bit
Port D0	nc	Port E4	G4
Port D1	nc	Port E5	G5
Port D2	nc	Port E6	G6
Port D3	nc	Port E7	G7
Port D4	nc	Port F0	G8
Port D5	nc	Port F1	G9
Port D6	nc	Port F2	nc
Port D7	nc	Port F3	nc
Port E0	G0	Port F4	nc
Port E1	G1	Port F5	nc
Port E2	G2	Port F6	nc
Port E3	G3	Port F7	nc

5-4 Power connector

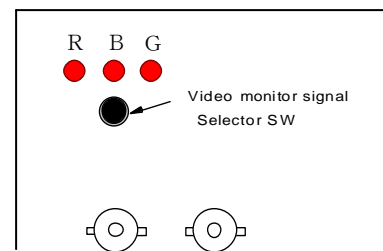
Power connector pin assignment

Pin No.	Signal name	Pin No.	Signal name
1	+ 1 2 V	4	GND
2	+ 1 2 V	5	GND
3	+ 1 2 V	6	GND

Conforming connector
HR 10A-7P-6S

5-5 Video monitor signal selector switch

It is able to monitor the video signal of each RGB line from the Video monitor terminal by pressing the "Video monitor signal selector switch". Every time the selector switch is pressed, LED indicator of RGB lights up by rotation.

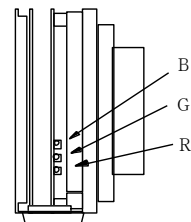


6. How to change settings

The GAIN value of video signal is able to change by RS232C communication. Also It is able to change in the following manner when not to use RS232C communication.

6-1 Fine adjustment of ODD/EVEN video signal on each RGB line

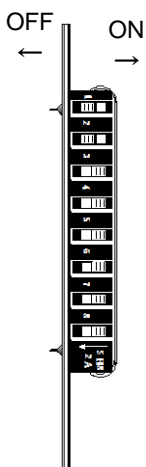
It is able to fine adjust the ODD/EVEN video signal on each RGB line by the fine control volume in the right figure.



6-2 How to change camera GAIN

The camera gain has been set to "x1" as a factory default. It is able to octuple the gain using the built-in GAIN switch.

Select "x1" when high-quality image is needed, and select "x8" when high sensitivity is needed even if image quality degrades.



GAIN Switch

SW			GAIN
No.1	No.2	No.3	
OFF	OFF	OFF	x1
ON	OFF	OFF	x2
OFF	ON	OFF	x3
ON	ON	OFF	x4
OFF	OFF	ON	x5
ON	OFF	ON	x6
OFF	ON	ON	x7
ON	ON	ON	x8

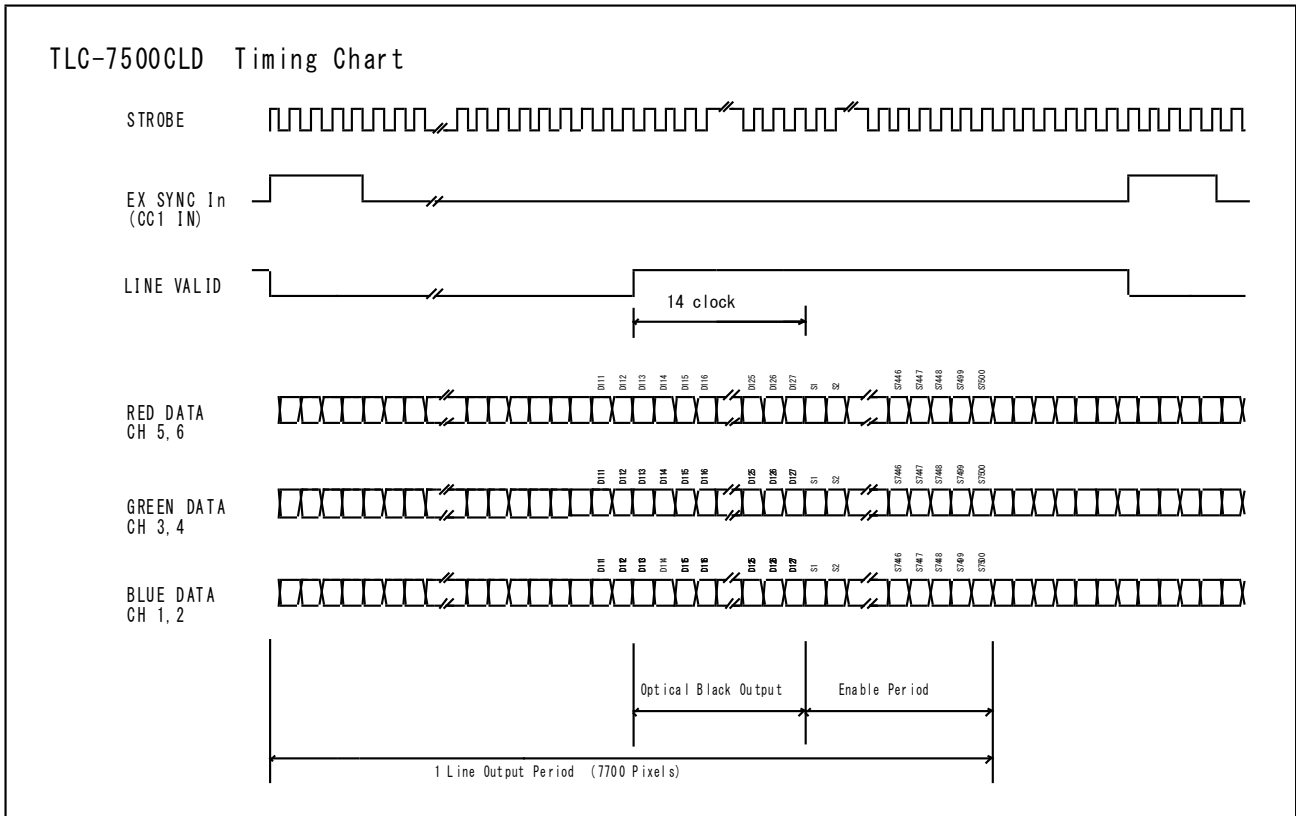
SW No.8:

ON EXT SYNC

OFF AUTO EXT SYNC

(When the period of EXT SYNC is less than 1msec, it automatically lead to INT SYNC.)

7. Timing chart



8. Serial communication protocol

[Network transmission setting]

Baud rate	:9600bps
Data Length	:8bit
Start Bit	:1bit
Stop Bit	:1bit
Parity	:Non
Xon / Xoff Control	:Non

[Communication overall]

1. Referring

To refer to the status of the camera.

e.g. `Id? <CR>` To refer to the camera ID.

2. Setting

To set the status of the camera.

e.g. `sync=1 <CR>` To set SYNC system to EXT.SYNC

[Glossary]

[]omissible
<CR>carriage return
Narbitrary numeral indicating some value
Aarbitrary numeral indicating GAIN position
Xarbitrary numeral indicating channel
Gain position.....	GAIN position of the camera
ChannelChannel to specify the GAIN control device for each CCD output line
EEPROMEEPROM incorporated in the camera

[Notes]

- Command name must be lower-case. Upper-case character is not valid.
- Input character must be one-byte character. Double-byte character is not valid.
- Blank is not valid.
- Line feed code is indicated by “CR(0x0D)”. And also “LF(0x0A)” and “CR+LF” are usable. However returning line feed code must be CR only.

<When in use of Hyper terminal>

- Retyping is required In case of inputting error.(Correction by cursor movement is not valid.)

[Description of exceptional case]

* NG is returned in case of command input error or inputting nonexistent command.

e.g. : Command input error (Gain position No. is not designated.)

Input: ch1gain=96

Output: NG

e.g. : Input of nonexistent command

Input: chake

Output: NG

* NE is returned in case of numeric entry error.

e.g. : Input error (Input value is beyond the setting range.)

Input: gainpos=96

Output: NE

e.g. : Input error (Input value is beyond the setting range.)

Input: ch1gain1=2000

Output: NE

* NC is returned in case of inputting invalid value under the condition that the ctrl setting (DIP-SW setting) is 0.

e.g. :

Input: ch1gain=96 (at ctrl=0)

Output: NC

* TO is returned when a command input period overruns the time-out period (15 sec.).

e.g. :

Input: gainpo (No CR entry)

Output: TO

* " ? " at the bottom of Command is omissible

e.g. :

Input: id

Output: 0

【Command Protocol】(PC→Camera)

	Command Name	Format	Argument	Return value	Explanation
Method	Get Ctrl	ctrl[?]<CR>	Non	0: Dip Switch 1: Com	Get DIP switch status / communication value selection
	Set Ctrl	ctrl=N<CR>	N=0: Dip Sw N=1: Com	OK	Set DIP switch status / communication value selection
	Get Dip Sw	dipsw<CR>	Non	0-255	Get DIP switch status with the decimal number
User	ID gets *1	id[?]<CR>	Non	ID(default: 0)	Get the camera ID This is for the multiple camera management
	ID sets *1	id=N<CR>	N: 0~255	OK	Set the camera ID This is for the multiple camera management
Bit	Get Bit number	bit[?]<CR>	Non	8: 8bit(default) 10: 10bit	Get the bit number of the output
	Set Bit number	bit=N<CR>	N=8: 8bit N=10: 10bit	OK	Set the bit number of the output * This parameter can set when ctrl is 1 only
Sync selection	Get Sync.	sync[?]<CR>	Non	0: Auto 1: Ext Sync	Get the Sync system of the camera
	Set Sync.	sync=N<CR>	N=0: Auto N=1: Ext Sync	OK	Set the Sync system of the camera
Exposure control	Get exposure control	expc[?]<CR>	Non	0: line cycle 1: Fixed exposure time 2: exposure with the pulse	Get the exposure control status * This parameter actives when ctrl is 1 only
	Set exposure control	expc=N<CR>	N=0: line cycle N=1: Fixed exposure time N=2: exposure with the pulse	OK	Set the exposure control status * This parameter can set when ctrl is 1 only
Exposure time	Get exposure time	expt[?]<CR>	Non	0-255: Exposure time	Set the exposure time * This parameter actives when ctrl is 1 only
	Set exposure time	expt=N<CR>	N=0-255: Exposure time	OK	Get the exposure time * This parameter can set when ctrl is 1 only
Gain	Get gain position	gainpos[?]<CR>	Non	1-8: gain position	Get the gain position * This parameter actives when ctrl is 1 only
	Set gain position	gainpos=A<CR>	A=1-8: gain position	OK	Set the gain position * This parameter can set when ctrl is 1 only
	Get chXgainA	chXgainA[?]<CR>	X=1: BLUE ODD X=2: BLUE EVEN X=3: GREEN ODD X=4: GREEN EVEN X=5: RED ODD X=6: RED EVEN A=1-8: gain position	0-255: gain level	Get the gain level of each gain postion of each channel
	Set chXgainA	chXgainA=N<CR>	X=1: BLUE ODD X=2: BLUE EVEN X=3: GREEN ODD X=4: GREEN EVEN X=5: RED ODD X=6: RED EVEN A=1-8: gain position N=0-255: gain level	OK	Set the gain level of each gain postion of each channel * This parameter can set when ctrl is 1 only

	Command Name	Format	Argument	Return value	Explanation
Offset	Get chXoffset	chXoffset[?]<CR>	X=1-6:ch	0-31 : offset level	Get the offset level of each channel
	Set chXoffset	chXoffset=N<CR>	X=1-6:ch N=0-31 : offset level	OK	Set the offset level of each channel * This parameter can set when ctrl is 1 only
System	Check	check<CR>	Non	OK	Communication test
	Save	save<CR>	Non	OK	Save settings to the EEPROM
	Load	load<CR>	Non	OK	Load settings from the EEPROM
	Version	ver<CR>	Non	Version	Get the version number of the program for the microcomputer control
	Revision	rev<CR>	Non	Revision	Get the version number of FPGA
	Initialize	init<CR>	Non	OK	Load the factory settings
	config	cfg<CR>	Non	(Data output)	Get the all current settings

*1...This can save to the user area of the EEPROM by the save command. Cannot clear by the clear command.

【Command Protocol】(PC→Camera: Only when set ctrl=1, following command is effective.

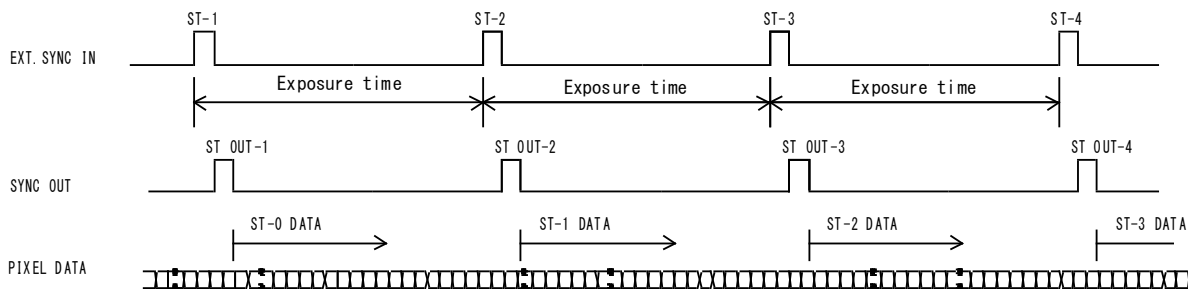
	Command Name	Format	Set value	Return value	Explanation
Color Gap	Color gap control on/off	rgb_on=N<CR>	0:OFF 1:ON	OK	Color gap control on/off value setting
		rgb_on[?]<CR>	Non	0:OFF 1:ON	Color gap control on/off value reference
	Color gap dir	rgb_dir=N<CR>	0:RGB 1:BGR	OK	Color gap scan direction value setting
		rgb_dir[?]<CR>	Non	0:RGB 1:BGR	Color gap scan direction value reference
	Color gap line	rgb_ldelay=N<CR>	0-31	OK	Color gap delay lines value setting
		rgb_ldelay[?]<CR>	Non	0-31	Color gap line設定 value reference
	Color gap setting channel	rgb_ch=N<CR>	0-2:R/G/B	OK	Color gap channel value setting (rgb_ldelay Setting target CH)
		rgb_ch[?]<CR>	Non	0-2:R/G/B	Color gap channel value reference (rgb_ldelay Setting target CH)

9. Exposure control

UCL-Exposure control (TLC-7500CL)

Line period exposure (expc=0)

Exposure during each period of EXT.SYNC (CC1)



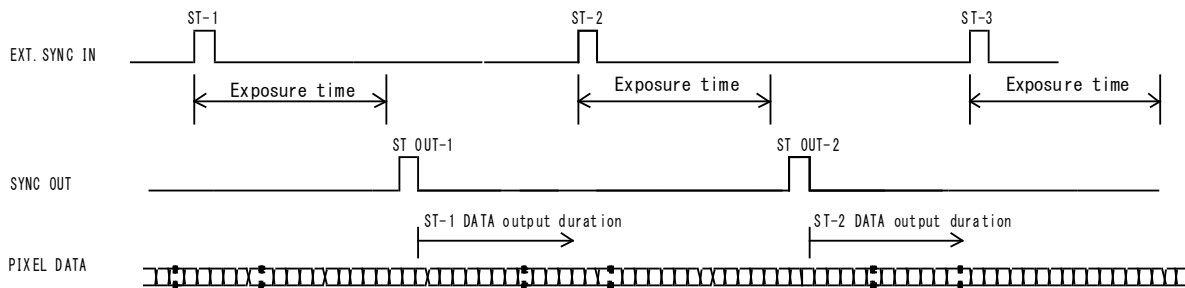
Fixed time exposure (expc=1, expt=N)

Exposure during the period of the equation below from the timing of leading edge of EXT.SYNC(CC1)

$$\text{Exposure time} = 156 + 10.24 \times N \text{ (}\mu\text{ sec)}$$

$$\text{Minimum Exposure time} = 156 \mu\text{ sec}$$

* Note that the minimum period of EXT.SYNC is 312 μ sec at the Fixed time exposure mode.



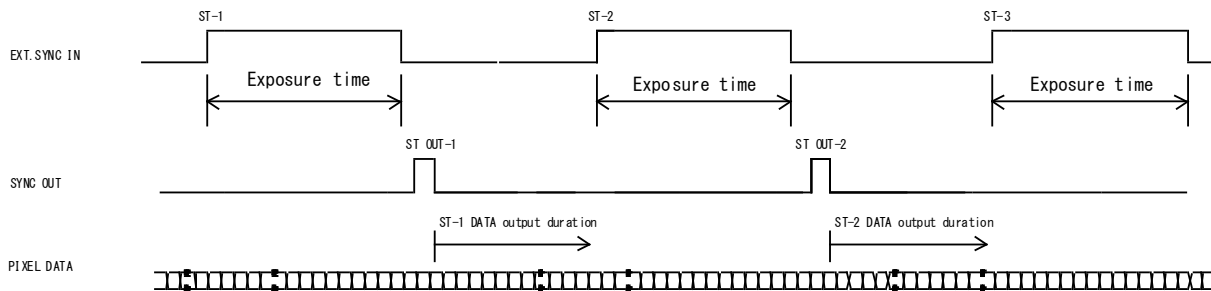
Pulse width exposure (expc=2)

Exposure during the period of the pulse width of EXT.SYNC(CC1).

Minimum exposure time=156 μ sec

* Note that the minimum period of EXT.SYNC is 312 μ sec at the Fixed time exposure mode.

Minimum period=156 μ sec+DATA output duration(156 μ sec)



10. Setup steps of Hyper terminal.

[Applicable camera] TL-□□□□CL, TL-□□□□UCL

[Network transmission setting]

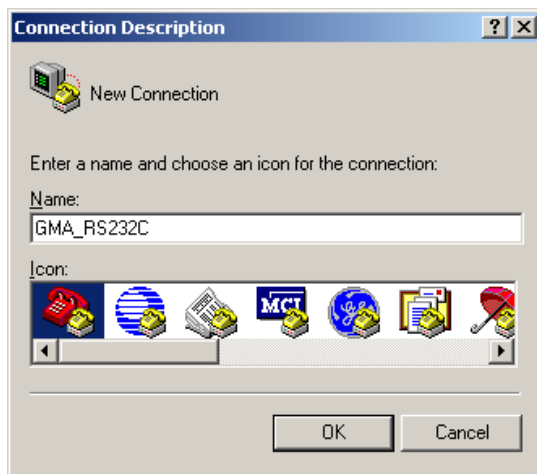
Baud rate	:	9600 bps
Data length	:	8 bit
Start bit	:	1 bit
Stop bit	:	1 bit
Parity	:	Non
Xon / Xoff control	:	Non

[Setup of Hyper terminal]

- 1) Select "Start"→ "Programs"→"Accessories"→"Communications"→"Hyper Terminal"
- 2) The windows will appear with the picture below.



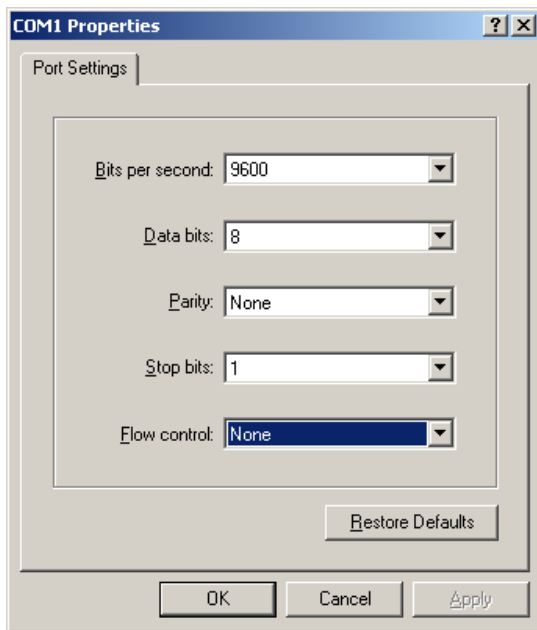
- 3) When the next picture appears, enter any name.(e.g. GMA_RS232C)
Then click the "OK" button.



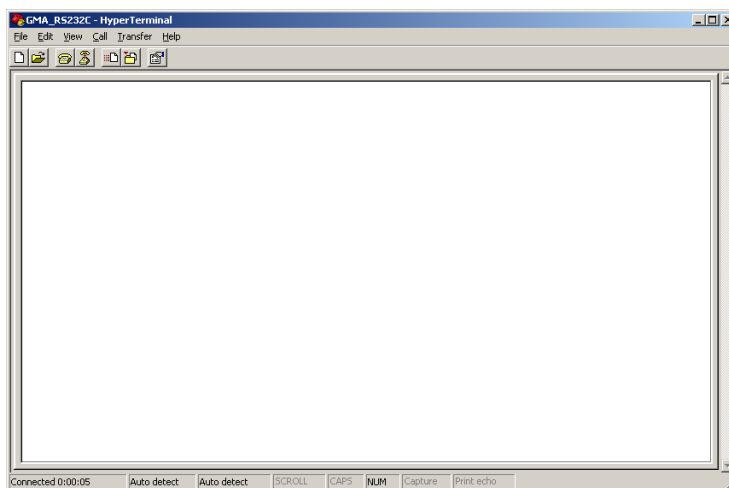
- 4) When the next picture appears, select " COM? " on Connect using.
(? changes depending on the setting of the computer.)
Then click the "OK" button.



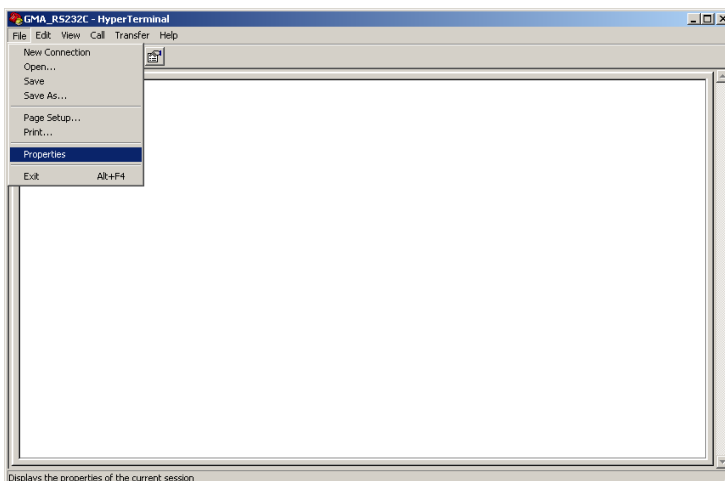
- 5) When the next picture appears, select each items as follows.(9600,8,None,1,Non)
Then click the “OK” button.



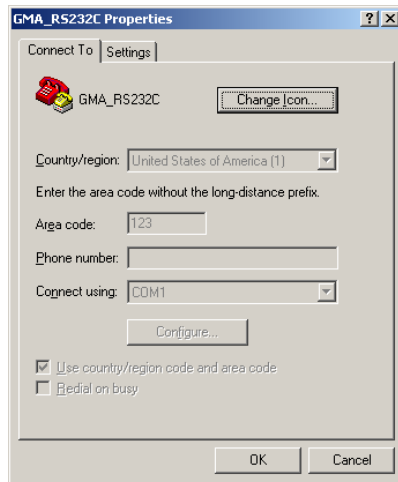
- 6) The next picture will appear.



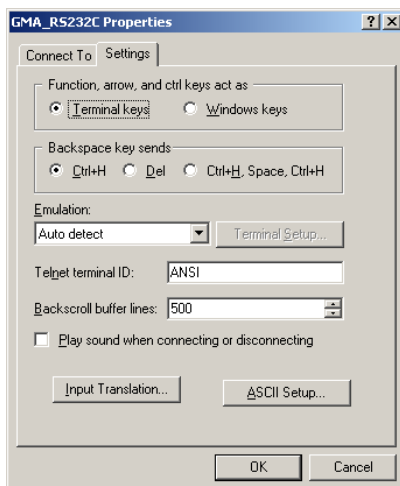
- 7) Select [File]→ [Properties]



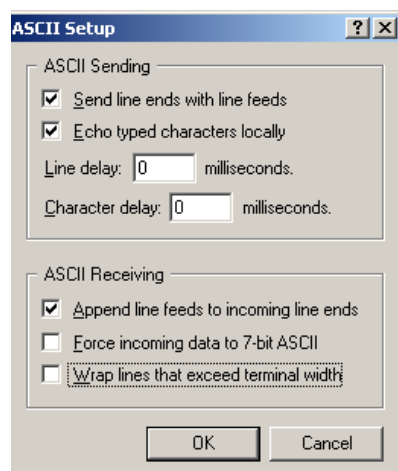
8) When the next picture appears, select “Settings” tag.



9) When the next picture appears, click the “ASCII Setup” button.



10) When the next picture appears, select each items as follows. (, , 0, 0, , blank, blank)
Then click the “OK” button.

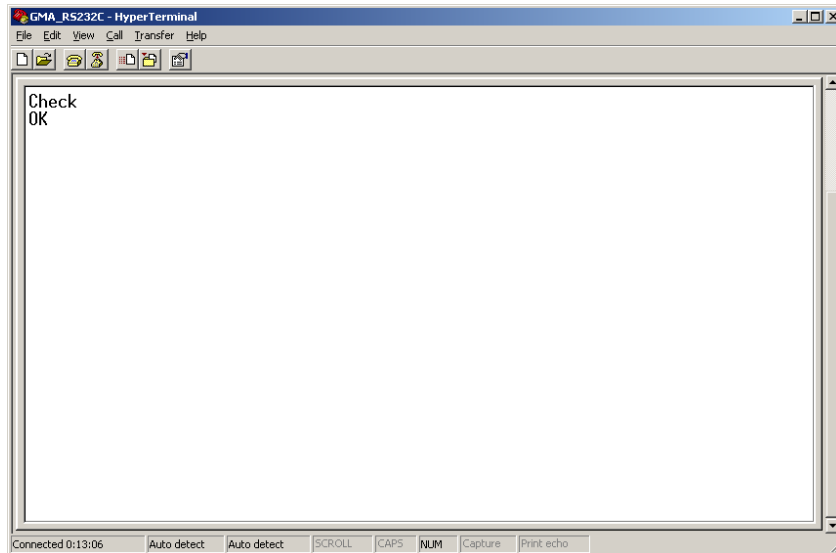


11) The screen display will return to the screen of 9).
Then click the OK button.

12) End of setup.

Confirm the connection of the camera ,
enter “check” on the screen below
and then send it out.

If “OK” is displayed on the screen, communication processing has been completed.



13) Select “Start”→ “Programs”→”Accessories”→”Communications”→”Hyper Terminal” →”(* 1) ”, when to launch the Hyper terminal again with the same settings after having exited the above screen.

* 1.....The name which was entered at section 3)

11. Color gap correction

ctrl=1 ↶
 rgb_on = 1 ↶
 rgb_dir = 0 ↶ color gap scan direction
 rgb_ldelay = 4 ↶ value setting

Current setting is in the status as above.

If the object flow is in the reverse direction, set the color gap scan direction as below,

rgb_dir = 1 ↶

When it is needed to change the correction value of the color gap, set up the value of n

rgb_ldelay = n ↶

And,

save ↶

It is able to replicate the last setting status even after an abnormal end of task.

cfg ↶

The following file is available.

```

cfg
ver=1.8.5 rev=3 id=0
ctrl=1 sync=0 dipsw=3
bit=8 expc=0 expt=0 explt=37 [37]
offset=0,0,0,0,0,0
testp=0 lval=1 lv_st=57 _end=255
rgb_on=1 _dir=0 _ldelay=4
wlc0=64 wlc1=2 c2b_on=0 _r=0 _g=0 _b=0
gainpos=4
gain1=1,0,0,2,2,0
gain2=45,45,45,46,46,45
gain3=72,73,72,73,72,72
gain4=95,95,90,90,91,91
gain5=106,107,106,106,106,106
gain6=118,119,119,118,118,118
gain7=128,129,129,128,128,128
gain8=137,138,138,137,137,137

```

11. Notes

Precautions for use

- Do not make an impact on the equipment.
- Do not lag the equipment with heat insulating agent. If the equipment is covered with heat insulating agent, it produces an increase in temperature and it causes the equipment to malfunction. (except for low-temperature environment use)
- Take appropriate measures such as heat removal or cold removal to prevent dew condensation, when to move it to the place where temperature difference is extremely severe.
Usage with dew condensation causes the equipment to malfunction.
- When the equipment is not used for a long time, protect the imaging device from dust or scratch by attaching a lens cap. Do not store the equipment at the following places.
 - The place where is subjected to a lot of dust and moisture.
 - The place where is subjected to direct sunlight.
 - The place where is extremely hot or cold.
 - The place in the vicinity of an object which generates intensive electromagnetic field.
 - The place where is subjected to intensive vibration.
- Please wipe off the dirt on the lens surface with a cotton swab preventing scratch to the lens surface.
Use a soft cloth to clean up the camera body.
- Use the equipment with a voltage within the range of specifications and do not connect the equipment to a power source that contains intense noise components. In such case, the image output from the camera may contain noise components.
- Do not use the equipment in an environment subject to intense electromagnetic field.
In such an environment, malfunction of the camera, disturbance of image and noise are caused by the field.
- When to take images of the high-intensity object, it may happen that even the low intensity part is displayed whitely like a vertical streak above and below the high-intensity object. This phenomenon is called "smear".
However it is the problem specific to CCD and it is not the camera-related failure.
- When to take images of the linear object, jagged picture may be displayed. Also when to take images of the pinstripe or checkered pattern, annual rings- like picture may be displayed. However these are also the problem specific to CCD and it is not the camera-related failure.
- The lighting using a commercial power source may cause a perceptible flicker at higher shutter speed.
In cases like this, consider to adjust shutter speed setting of the camera or to use the DC lighting or high-frequency lighting.
- Use a ceramic driver to adjust ODD/EVEN video signal.
- Do not remove a cover and do not insert/remove a Camera Link connector when applying current to the equipment. It causes the equipment to malfunction.

Attention

- All rights on this manual reserved.
- The specifications and operational details described in the manual are subject to change for performance improvement or other reasons without notice.

12. External dimensions

