Line scan camera Instruction Manual

Model: TL-7450UCL

TAKENAKA SENSOR GROUP
TAKENAKA SYSTEM CO.,LTD.

□ Head Office 86-66 Nomizo-cho Otsuka Yamashina-ku 607-8135 Kyoto JAPAN
TEL:+81-75-593-9300 FAX +81-75-593-9790

□ Camera Dept. 4F Matsumasa Bld.1-17-14 Ogaya Otsu Shiga 520-2144 JAPAN
TEL:+81-77-545-4331 FAX +81-77-545-4335

□ Image Inspection Dept. 86-66 Nomizo-cho Otsuka Yamashina-ku 607-8135 Kyoto JAPAN
TEL:+81-75-593-9300 FAX +81-75-593-9790

□ Tokyo Office 2F MK Bldg. 2-2-19 Sotokanda Chiyoda-ku 101-0021 Tokyo JAPAN
TEL :+81-3-3255-0361 FAX:+81-3-3255-0362

TAKENAKA SYSTEM CO.,LTD. URL http://www.takex-system.co.jp/
TAKENAKA SENSOR GROUP URL http://www.takex.co.jp/

Table of Contents

1. Outline

- TL-7450UCL is a High-resolution Digital Line Scan Camera adopting 7,450-pixel CCD Image Sensor.
- Video signal is output complying with Camera Link standard (Base Configuration).
- 50MHz data rate.

2. Features

- Capable of performing high-resolution inspection with 7450-pixels CCD image sensor.
- GAIN and OFFSET characteristic , 8/10 bits format etc. can be easily adjusted with communication command (RS232C) from the capture board.
- The equipment operates with a single DC12V power source.
- Reduction in size and weight has been realized by adopting original circuit and mechanism design.
- Since the output signal level hardly vary among the ODD and EVEN pixels, It can display crisp image.
- Simplified exposure control function is incorporated. (at below 3.2kHz in scan rate)

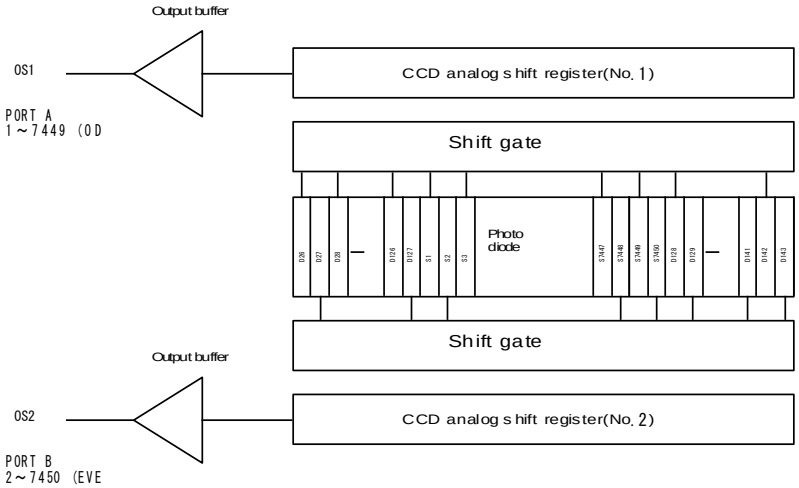
3. Applications

- Image processing device for Image inspection.
- Measuring device such as appearance inspection or dimensional measurement .
- Surface inspection apparatus of sheet-like object.
- High-resolution pattern inspection instrument.

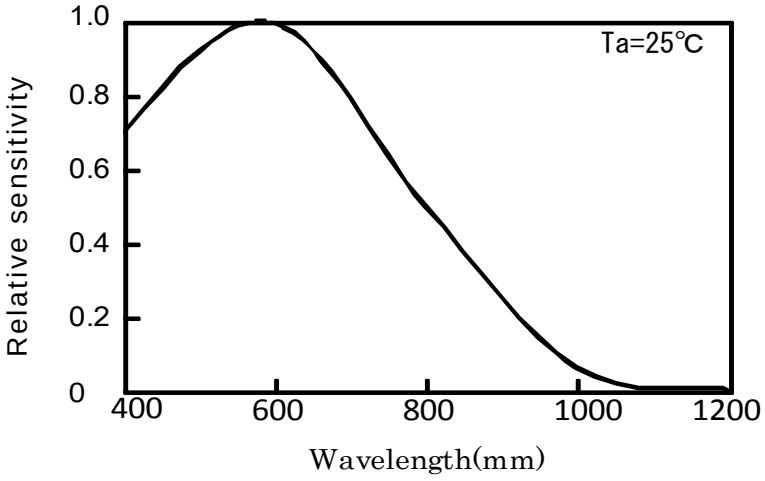
4. CCD image sensor

The CCD image sensor Is characterized by 4.7μm square pixel,7450 effective pixels and highly-sensitive characteristics.
Charges accumulated in single-row photo diodes are output thorough two shift registers, respectively. (One for ODD numbered charges and the another for EVEN numbered charges) Each shift register operates at the rate of 25MHz.

Block diagram of CCD device



Sensitivity-Wavelength Characteristics

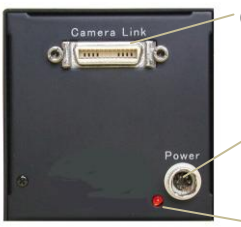


5. Specifications

Number of pixels	7450
Unit cell size	4.7μ m×4.7μ m
Photo array length	35 mm
Data rate	50 MHz
Scan rate (scan/sec)	6.4 kHz Max.
Line transfer pulse input	156 μ sec
Video output (Digital output)	Base Configuration 2×8/10 bit
Sensitivity	50 V/lx. sec
Saturated exposure amount	0.12 lx. sec
Output ununiformity	3% standard at 50% of saturation output(on the element)
Power supply	+12V ±0.5V (400mA)
Operational ambient temperature	0 ～ +40℃ (Shall be free from dew condensation and frost.)
Operational humidity range	85% MAX
Storage temperature range	−10℃ ～ +65℃
Weight	360g or less
External dimension (mm)	64(W)×64(H)×80.3(D)
lens mount	Nicon F mount(standard) Asahi K mount(option)

6. Camera I / O

Connector panel



Camera Link connector

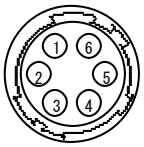
Power connector

Power indicator

6-1 Power connector

Power connector pin assignment

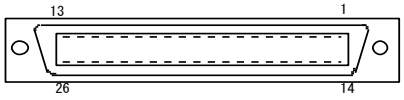
Pin No.	Signal name	Pin No.	Signal name
1	+ 1 2 V	4	G N D
2	+ 1 2 V	5	G N D
3	+ 1 2 V	6	G N D



Power connector (HR10A-7P-6S HIROSE)
(Pin arrangement viewed from the outside of the camera)

6-2 Camera Link connector

Camera Link connector pin-out



Conforming cable 3M made

Cf. 14B26-SZLB-＊00-0LC (＊m)
※14B26-SZ3B-＊00-04C (＊m)

※Flex resistance cable

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 Configration

Signal name	Connection
CC1	EXSYNC
CC2	Spare
CC3	Spare
CC4	Spare

Bit assignment of Base Configuration

8 Bit:

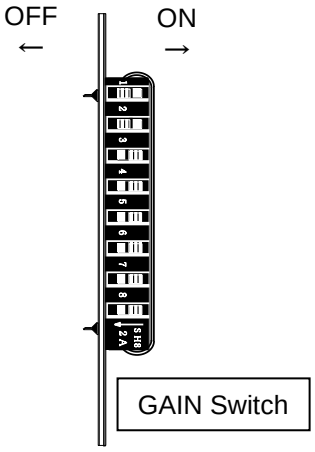
Base connector			
Port/bit	8-bit x 4	Port/bit	8-bit x 4
Port A0	A0	Port B4	B4
Port A1	A1	Port B5	B5
Port A2	A2	Port B6	B6
Port A3	A3	Port B7	B7
Port A4	A4	Port C0	
Port A5	A5	Port C1	
Port A6	A6	Port C2	
Port A7	A7	Port C3	
Port B0	B0	Port C4	
Port B1	B1	Port C5	
Port B2	B2	Port C6	
Port B3	B3	Port C7	

10Bit:

Base connector			
Port/bit	10-bit x 4	Port/bit	10-bit x 4
Port A0	A0	Port B4	B8
Port A1	A1	Port B5	B9
Port A2	A2	Port B6	nc
Port A3	A3	Port B7	nc
Port A4	A4	Port C0	B0
Port A5	A5	Port C1	B1
Port A6	A6	Port C2	B2
Port A7	A7	Port C3	B3
Port B0	A8	Port C4	B4
Port B1	A9	Port C5	B5
Port B2	nc	Port C6	B6
Port B3	nc	Port C7	B7

7. How to change camera GAIN

The camera gain has been set to “×4” as a factory default.
It is possible to double the gain using the built-in GAIN switch.
Select “×1” when high-quality image is needed, and select “×8” when high sensitivity is needed even if image quality degrades. Select “×2 to ×6” depending on the degree.

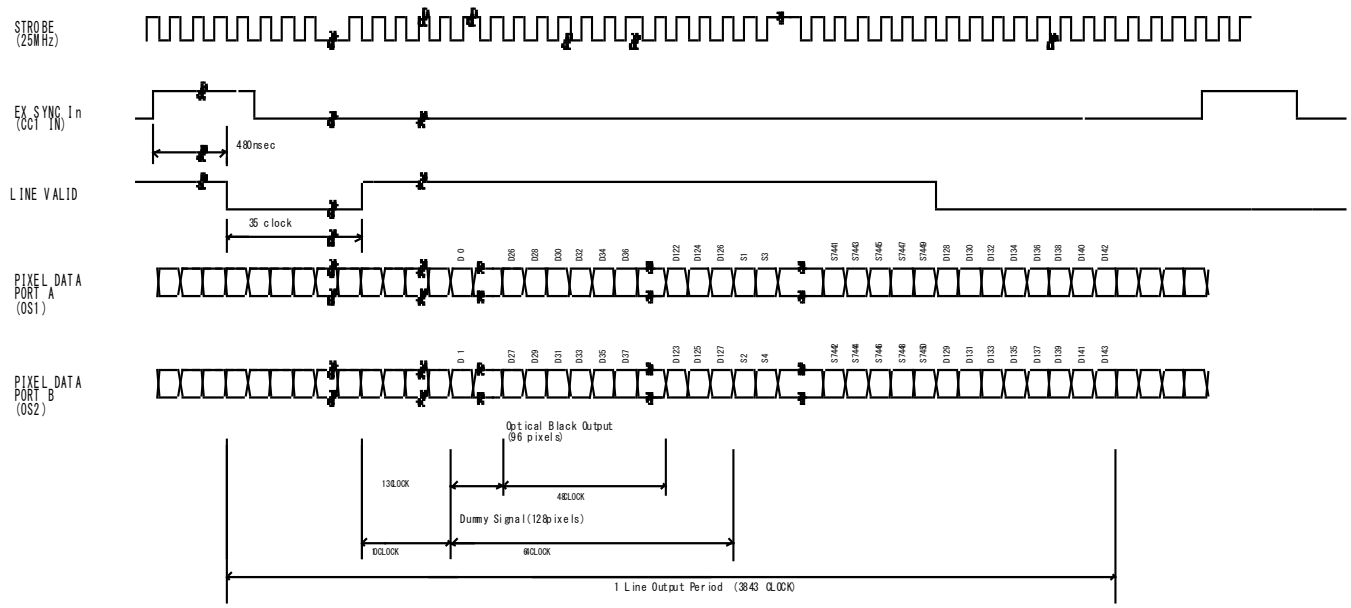


SW			
No.1	No.2	No.3	GAIN
OFF	OFF	OFF	×1
ON	OFF	OFF	×2
OFF	ON	OFF	×3
ON	ON	OFF	×4
OFF	OFF	ON	×5
ON	OFF	ON	×6
OFF	ON	ON	×7
ON	ON	ON	×8

SW No.8
: ON EXT SYNC
OFF AUTO EXT SYNC
(When the period of EXT SYNC is less than 1msec, it automatically switch to INT SYNC.)

8. Timing chart

TL-7450UCL Timing Chart



9. Serial communication protocol

Operation under the RS232C communication

(1) Selection of output bit format 8/10 bit

(2) SYNC system switching

AUTO	When EXT SYNC is not designated, it automatically switch to INT SYNC.
EXT.SYNC	EXT. SYNC operation only
INT. SYNC	INT. SYNC operation only

※SYNC period is determined from the following equation.

SYNC period = Minimum period + n × a

Where

Internal sync(sync=2) expt (exposure time) = n

a= 12.8μsec ….. TL-5150UCL

10.24μsec ….. TL-1024UCL
TL-2048UCL
TL-4096UCL
TL-7400UCL
TL-7400RCL
TL-7450UCL

(3) Exposure control system switching (Refer to the time chart on P.11)

Line period exposure	Exposure during periodic time
Fixed time exposure	Exposure during pre-set time
Pulse width exposure	Exposure during the pulse width of EXT.SYNC

(4) GAIN switching

Selection of GAIN position 1,2,3,……8 ×

Selection of GAIN position for each channel ODD/EVEN adjustment

(5) Adjustment of OFFSET

OFFSET adjustment for each channel (ODD/EVEN)

[Network transmission setting]

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

[Communication overall]

1. Viewing

   To view the status of the camera.

   e.g. Id? <CR> To view 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
N	……arbitrary numeral indicating some value
A	……arbitrary numeral indicating GAIN position
X	……arbitrary numeral indicating channel
Gain position	……GAIN position of the camera
Channel	…….Channel to specify the GAIN control device for each CCD output line
EEPROM	…….EEPROM 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(0×0A)” 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 when in command input error or in 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 when in 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 when in inputting invalid value under the condition that the ctrl setting (DIP-SW setting) is 0.

e.g. :

Input: ch1gain=9 (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

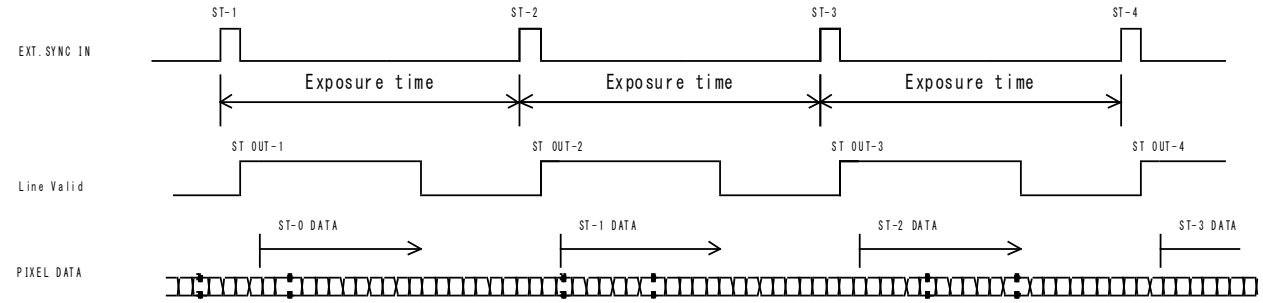
【Command Protocol】(PC->Camera)

No	Command Name	Format	Argument	Return value	Explanantion
Communication					
1	Check	check<CR>	Non	OK	Command for communication test
Camera setting					
2	Ctrl (view)	ctrl[?]<CR>	Non	0:Dip Switch 1:Com	View the effective state of Communication setting value/DIP SW.
3	Ctrl (set)	ctrl=N<CR>	N=0:Dip Sw N=1:Com	OK	Set the effective state of Communication setting value/DIP SW.
4	Dip Sw (view)	dipsw<CR>	Non	0～255	View the state of DIP SW Return the state of DIP SW in decimal number
User ID					
5	ID (view)	id[?]<CR>	Non	ID(default:0)	View the camera ID. Administrative use for plural cameras. For user's operation.
6	ID (set)	id=N<CR>	N:0～255	OK	Set the camera ID. Administrative use for plural cameras. For user's operation.
Output bit					
7	Output bit (view)	bit[?]<CR>	Non	8: 8bit(default) 10: 10bit	View the output bit format of the camera.
8	Output bit (set)	bit=N<CR>	N= 8 : 8bit N=10 : 10bit	OK	Set the output bit format of the camera. *Settable only at ctrl=1.
SYNC switching					
9	Sync (view).	sync[?]<CR>	Non	0:Auto 1:Ext Sync 2:Internal sync	View the state of SYNC mode. *Effective value only at ctrl=1.
10	Sync (set)	sync=N<CR>	0:Auto 1:Ext Sync 2:Internal sync	OK	Set the SYNC mode. *Settable only at ctrl=1.
Exposure control					
11	Exposure control (view)	expc[?]<CR>	Non	0:Line period exposure 1:Fixed time exposure 2:Pulse width exposure	View the exposure control state of the camera. *Effective value only at ctrl=1.
12	Exposure control (set)	expc=N<CR>	0:Line period exposure 1:Fixed time exposure 2:Pulse width exposure	OK	Set the exposure control state of the camera. *Settable only at ctrl=1.
Exposure time					
13	Exposure time	expt[?]<CR>	Non	0～127:Exposure time	View the period at Fixed time exposure mode. *Effective value only at ctrl=1
14	Exposure time	expt=N<CR>	N=0～127:Exposure time	OK	Set the period at Fixed time exposure mode. *Settable only at ctrl=1
Gain					
15	Gain Position (view)	gainpos[?]<CR>	Non	1～8:gain position	View the Gain position of the camera. *Effective value only at ctrl=1
16	Gain Position (set)	gainpos=A<CR>	A=1～8:gain position	OK	Set the Gain position of the camera. *Settable only at ctrl=1
17	chXgainA (view)	chXgainA[?]<CR>	X=1～2:ch A=1～8:gain position	0～255:gain level	View the Gain value fow each Gain position of each channel.
18	chXgainA (set)	chXgainA=N<CR>	X=1～2:ch A=1～8:gain position N=0～255:gain level	OK	Set the Gain value fow each Gain position of each channel. *Settable only at ctrl=1
Offset					
19	chXoffset (view)	chXoffset[?]<CR>	X=1～2:ch	0～31:offset level	View the offset value of each channel.
20	chXoffset (set)	chXoffset=N<CR>	X=1～2:ch N=0～31:offset level	OK	Set the offset value of each channel. *Settable only at ctrl=1
EEPROM					
21	Save	save<CR>	Non	OK	Save the setting to EEPROM.
22	Load	load<CR>	Non	OK	Load the setting from EEPROM.
System					
23	Version	ver<CR>	Non	Version	View the version of microcomputer control program of the camera.
24	Revision	rev<CR>	Non	Revision	View the version of EPGA.
25	Initialize	init<CR>	Non	OK	Load the factory default.
26	config	cfg<CR>	Non	(data output)	View the all current setting data of the camera.

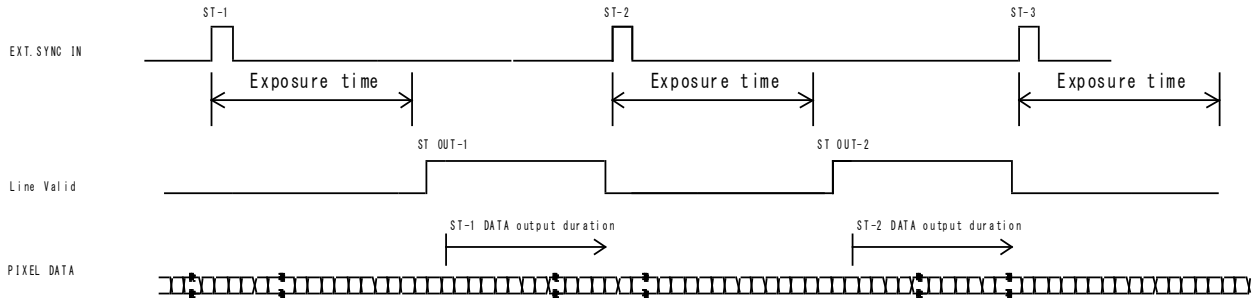
10. Exposure control

UCL-Exposure control
(TL-7450UCL, TL-7450UCL-C0)

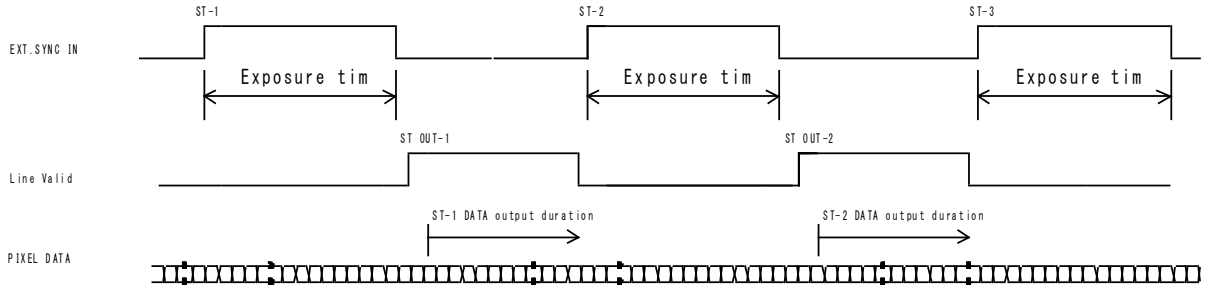
Line period exposure (expc=0)
Exposure during each period of EXT.SYNC(CC1)



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)
Exposure time=156+10.24×N (μsec)
Minimum Exposure time=156μsec
★Note that the minimum period of EXT.SYNC is 312μsec at the Fixed time exposure mode
Minimum period =156μsec+DATA output duration (156μsec)



Pulse width exposure (expc=2)
Exposure during the period of the pulse width of EXT.SYNC(CC1
Minimum exposure time =156μsec
★Note that the minimum period of EXT.SYNC is 312μsec at the Pulse width exposure mode
Minimum period =156μsec+DATA output duration(156μsec)



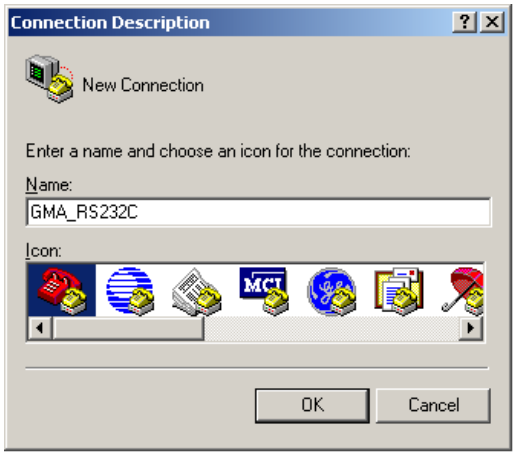
11. Setup steps of Hyper terminal.

[Setup of Hyper terminal]

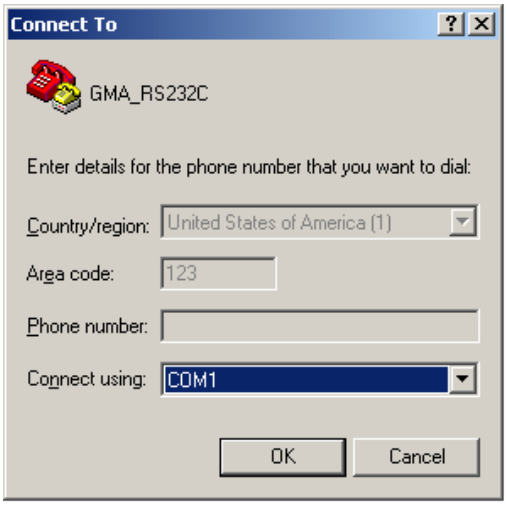
1) Select “Start”→ “Programs”→”Accessories”→”Communications”→”Hyper Terminal”

2) The windows will appear with the picture below.

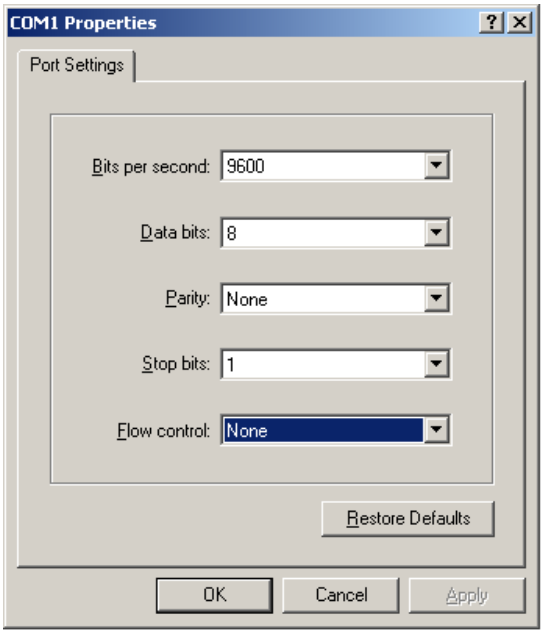
3) When the next picture appears, enter any name.(e.g. GMA_RS232C)
Then click the “OK” button.



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

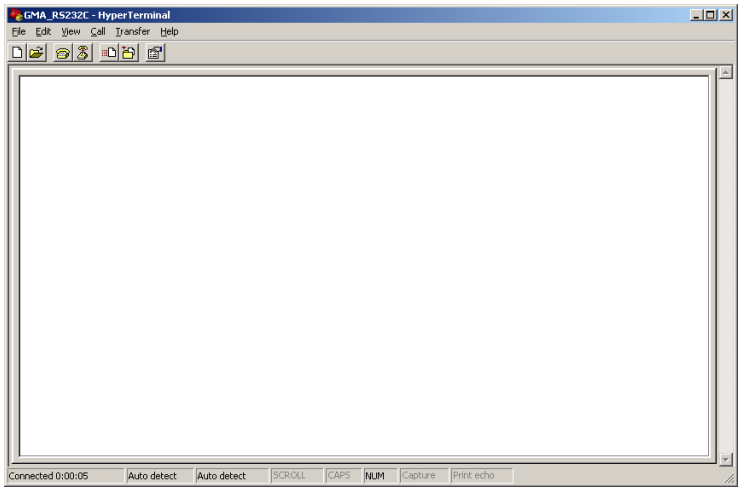


5) When the next picture appears, select each items as follows.(9600,8,None,1,Non)
Then click the “OK” button.

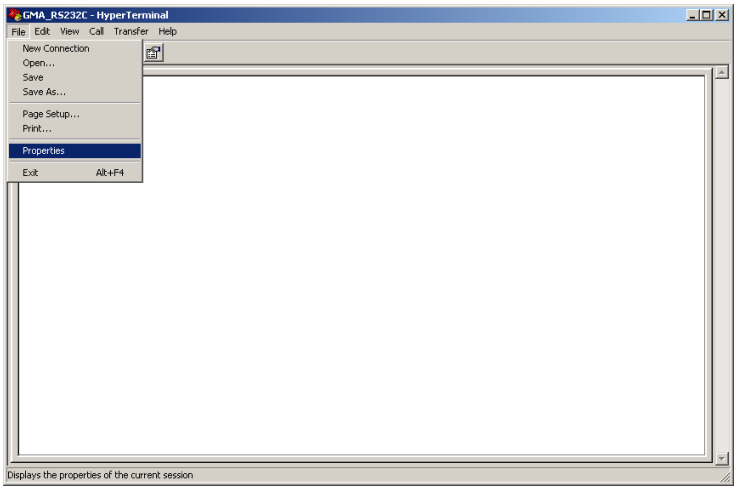


[Communication settings]
Baud Rate : 9600bps
Data Length : 8bit
Start Bit : 1bit
Stop Bit : 1bit
Parity : Non
Xon/Xoff Control : Non

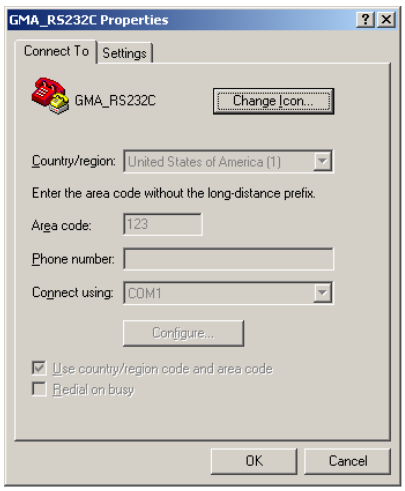
6) The next picture will appear.



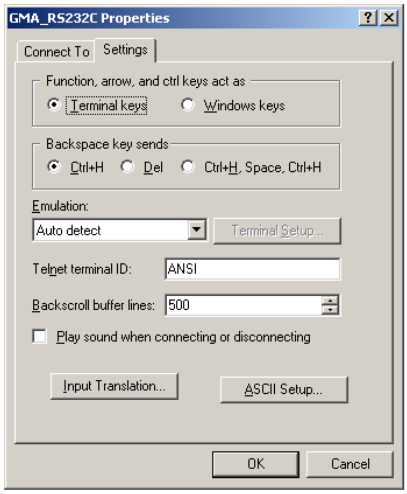
7) Select [File]→ [Properties]



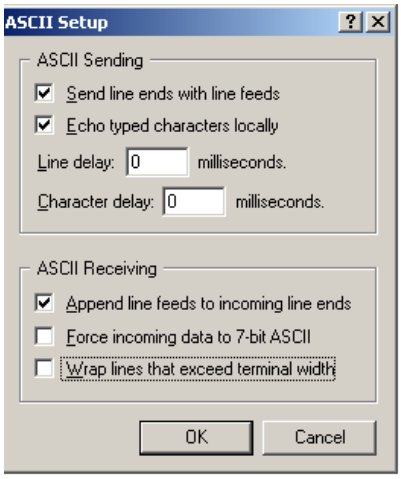
8) When the next picture appears, select “Settings” tag.



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.

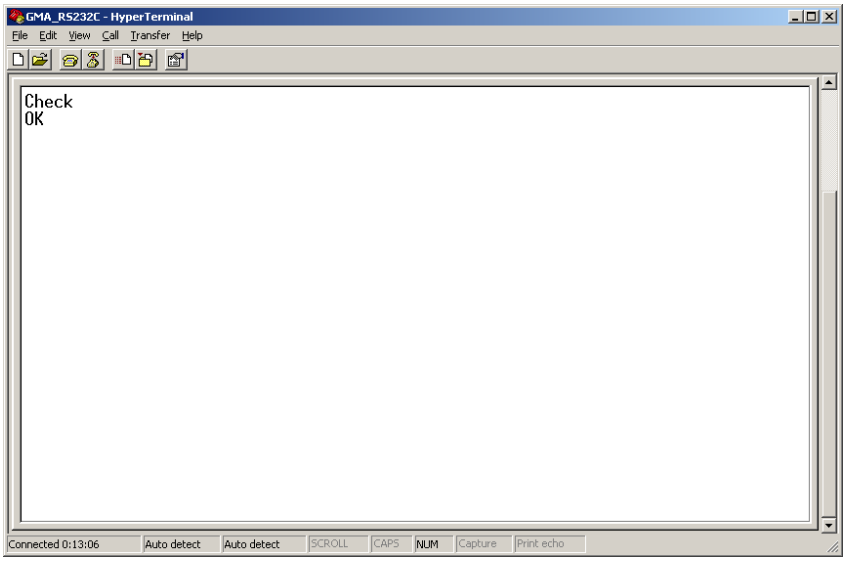
12) End of setup.

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)

12. 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 contains 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.
- In case 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.
- In case of the linear object, jagged picture may be displayed. Also in case 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.

Attention

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

12. External dimensions