See the possibilities

User Manual

AT-140CL

Digital 3CCD Progressive Scan RGB Color Camera

Document Version: Ver.1.1
AT-140CL_Ver.1.1_May2012

1010E-0908

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Warranty

For information about the warranty, please contact your factory representative.

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that AT-140CL complies with the following provisions applying to its standards.
EN 61000-6-3 (Generic emission standard part 1)
EN 61000-6-2 (immunity)

FCC

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to 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 I a residential area may cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Warning

Changes or modifications to this unit not expressly approved by the party responsible for FCC compliance could void the user's authority to operate the equipment.

Supplement

The following statement is related to the regulation on " Measures for the Administration of the control of Pollution by Electronic Information Products " , known as " China RoHS ". The table shows contained Hazardous Substances in this camera.

mark shows that the environment-friendly use period of contained Hazardous Substances is 15 years.

重要注意事项

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根据中华人民共和国信息产业部『电子信息产品污染控制管理办法』，本产品《 有毒，有害物质或元素名称及含量表 》如下.

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(Ⅵ))	多溴联苯 (PPB)	多溴二苯醚 (PBDE)
棱镜	×	○	○	○	○	○
光学滤色镜	×	○	×	○	○	○
.....	.....	.....	.....	.....	.....	.....

○: 表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006规定的限量要求以下。
×: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006规定的限量要求。
（企业可在此处、根据实际情况对上表中打 " × " 的技术原因进行进一步说明。）

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数字「15」为期限15年。

Table of Contents

1. General

The AT-140CL is a digital 3CCD progressive scan RGB color camera. It employs three 1/2-inch 1392 (h) x 1040 (v), 1.45 Megapixel CCDs and it runs 25 frames per second in full resolution mode. The AT-140CL has a Camera Link® interface and its output can be either 8-bit through a Camera Link Base configuration, or 10-bit or 12-bit through a Camera Link Medium configuration. JAI developed a new 1/2-inch compact F4.0 prism optical system and in combination with a linear color matrix, the AT-140CL provides a higher fidelity of color reproduction. The AT-140CL also incorporates a dynamic shading circuit, gamma correction circuit and knee correction circuit to provide high picture quality. Functions like partial scanning and vertical binning allow higher frame rates.

The latest version of this manual can be downloaded from: www.jai.com
The latest version of Camera Control Tool for AT-140CL can be downloaded from: www.jai.com

For camera revision history, please contact your local JAI distributor.

2. Camera nomenclature

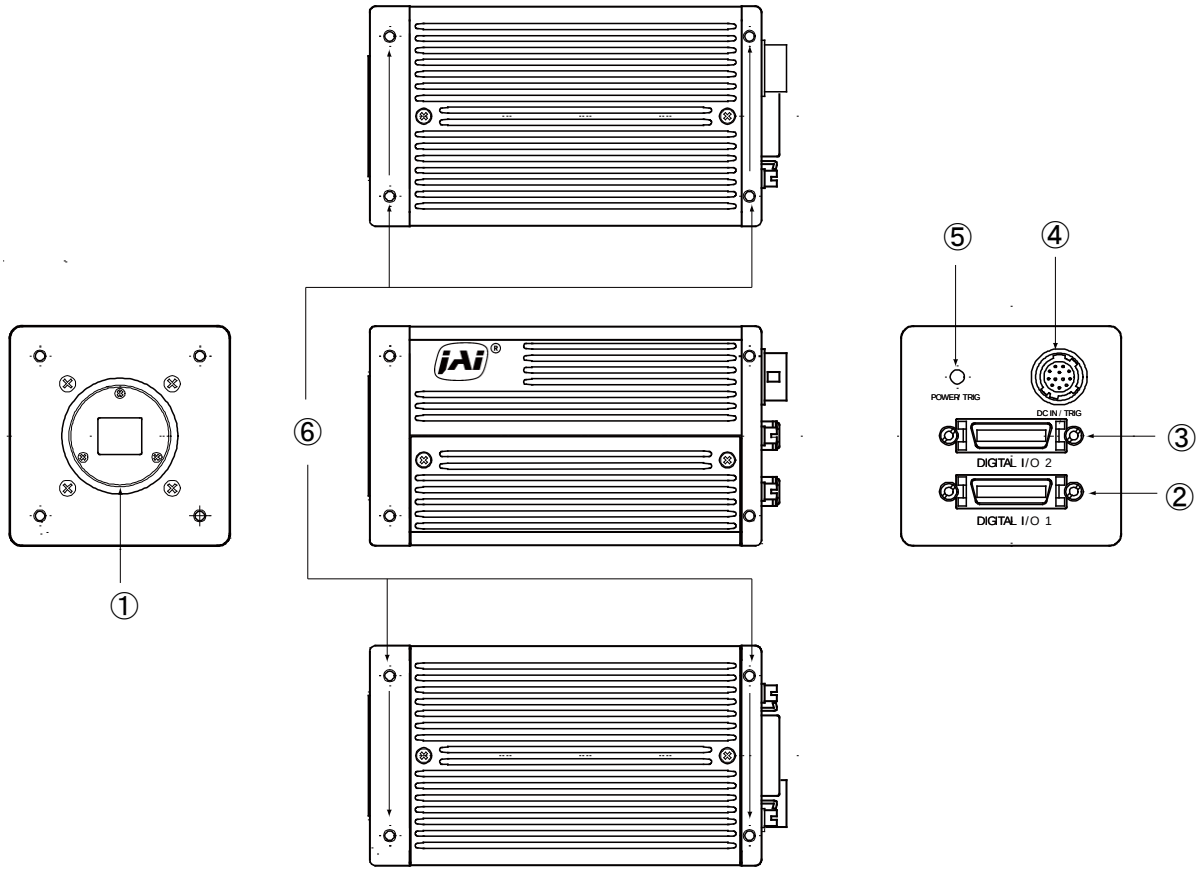
The standard camera composition consists of the camera main body and C-mount protection cap.

The camera is available in the following versions:
AT-140CL
Where A stands for "Advanced" family, T stands for "3 CCD", **140** represents the resolution "1.4 million pixels" , and **CL** stands for "Camera Link" interface.

3. Main Features

- 3 x 1/2" CCD progressive scan RGB color camera for vision applications
- 3 x 1392(h) x 1040 (v) 4.65μm effective square pixels
- Compact RGB prism for C-mount lenses
- Shading reduction permits wider choice of lenses
- 25.21 frames per second with 1392 (h) x 1040 (v) pixels
- 71.38 fps with 1392 (h) x 131 (v) pixels in 1/8 partial scan
- In addition to fixed rate partial scan, variable partial scan is available
- Vertical binning for higher sensitivity and frame rate of 40.98 fps
- 8-bit RGB output via single port Camera Link. 10-bit or 12-bit via dual port
- Gamma is selectable for 0.45 or 0.6 or LUT
- Linear matrix circuit with sRGB or Adobe RGB pre-setting
- Knee function available for knee point and knee slope settings.
- Noise reduction circuit (ON/OFF, level settings)
- Smearless mode available in EPS and PWC
- Edge Pre-select, Pulse Width Control and Reset Continuous Trigger modes
- Pre-set shutter in the range from OFF(1/25) and 1/60 to 1/53,000, 11 steps
- Common or individual programmable exposure for RGB
- Auto exposure capability
- Manual, continuous, one push or pre-set white balance
- Analog iris video output for lens iris control
- Setup by Windows XP software via RS 232C

4. Locations and Functions



1. Lens mount	Lens mount of C-mount type. *1)
2. Connector	Camera Link base connector 1 *2)
3. Connector	Camera Link medium connector 2 *2)
4. 12 pin connector	for DC power and trigger
5. LED	Power and trigger indication
6. Mounting holes	8 x M3 depth 5mm for tripod mount plate or direct installation *3)

*1) Note: Applicable C-mount lens should be designed for 3-CCD cameras. Rear protrusion on C-mount lens must be less than 4mm.
Be advised: when using a lens with the iris diaphragm fully open, vignetting on corners may occur.

*2) Note: When a Camera Link® cable is connected to the camera, please do not excessively tighten screws by using a driver. The Camera Link® receptacle on the camera might be damaged. For security, the strength to tighten screws is less than 0.291 Newton meter (Nm). Tightening by hand is sufficient in order to achieve this.

*3) Note: The tripod adapter plate MP-41 can be used.

Fig. 1. Locations

5. Pin Assignment

5.1. 12-pin Multi-connector (DC-IN/Trigger)

Type: HR10A-10R-12PB-01
(Hirose) male.
(Seen from rear of camera.)

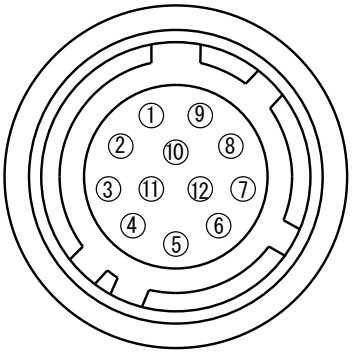
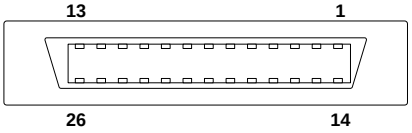


Fig. 2. 12-pin connector.

Pin no.	Signal	Remarks
1	GND	
2	+12 V DC input	
3	GND	
4	Iris video	Continuous and RCT modes only
5	GND	
6	-	
7	-	
8	GND	
9	XEEN out	Negative logic
10	Trigger in	*1)
11	-	
12	GND	

*1) 75 ohm termination can be selected by DIP SW600.

5.2. Digital Output Connector for Camera Link



Type: 26 pin MRD connector
3M 10226-1A10JL

Fig. 3. Camera Link connector

The digital output signals follow the Camera Link standardized multiplexed signal output interface. Camera Link base configuration is used for 3 x 8-bit RGB signal and medium configuration is used for 3 x10-bit or 3 x12-bit. The interface circuit is build around the NS type DS90CR285MTD.

Port 1 (24bits, 30 bits, 36 bits)

Pin No	In/Out	Name	Note
1,14		Shield	GND
2(-),15(+)	O	TxOUT0	Data out
3(-),16(+)	O	TxOUT1	
4(-),17(+)	O	TxOUT2	
5(-),18(+)	O	TxClk	Clock for CL
6(-),19(+)	O	TxOUT3	Data out
7(+),20(-)	I	SerTC (RxD)	LVDS Serial Control
8(-),21(+)	O	SerTFG (TxD)	
9(-),22(+)	I	CC1 (Trigger)	JAI Standard Trigger
10(+),23(-)	I	CC2 (Reserved)	
11,24		N.C.	
12,25		N.C.	
13,26		Shield	GND

Port2 (30bits, 36bits)

Pin No	In/Out	Name	Note
1,14		Shield	GND
2(-),15(+)	O	TxOUT0	Data out
3(-),16(+)	O	TxOUT1	
4(-),17(+)	O	TxOUT2	
5(-),18(+)	O	TxClk	Clock for CL
6(-),19(+)	O	TxOUT3	Data out
7(+),20(-)		N.C.	
8(-),21(+)		N.C.	
9(-),22(+)		N.C.	
10(+),23(-)		N.C.	
11,24		N.C.	
12,25		N.C.	
13,26		Shield	GND

5.3. DIP switch

5.3.1 SW-600

This switch can select ON or OFF of 75 ohm termination for trigger input.
The factory default setting is OFF which is TTL level.

No	Functions	Setting	
		ON	OFF
1	**Trigger input termination**	**75 Ω**	**TTL**
2	**NC**	**-**	**-**

5.3.2 SW-100

This switch can select the type of the signal which is output through 12-pin #10. The factory default is TTL (XEEN) and it can be changed to Open collector (EEN).

No	Functions	Setting	
		ON	OFF
1	**EEN output select**	**Open collector (EEN)**	**TTL (XEEN)**
2	**NC**	**-**	**-**

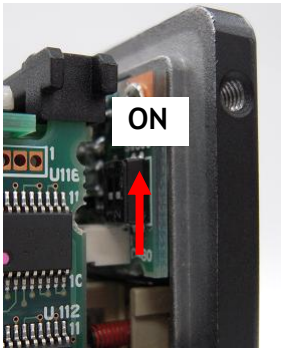


Fig.4. SW600 (On rear panel)

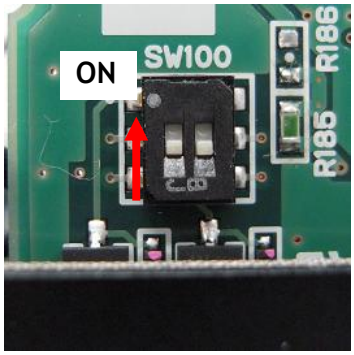


Fig.5. SW100 (Right board looking from the front)

5.4. Rear Panel indication

The rear panel mounted LED provides the following information:

- ● Amber : Power connected - initiating
- ● Steady green : Camera is operating in Continuous mode
- ❋ Flashing green : The camera is receiving external trigger

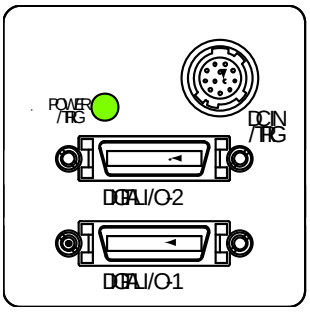


Fig.6. rear panel

6. Input and output circuits

This chapter introduces the basic diagram and bit allocation of digital output.

6.1. Iris video output

This signal can be used for lens iris control In Continuous and RCT modes. The signal is NUM luminance signal and passes through the gain circuit. However, due to reversed compensation applied, the gain settings do not influence this signal. The iris video output is 0.7 V p-p from 75 Ω and without sync. This signal is always output except EPS and PWC modes.

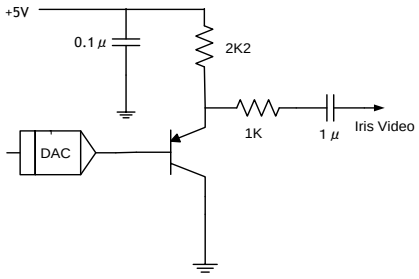


Fig. 7. Iris video output.

6.2. Trigger input

When TI=1, the trigger input is on pin #10 on the 12-pin connector. The input is AC coupled. To allow a long pulse width, the input circuit is a flip-flop, which is toggled by the negative or positive differentiated spikes caused by the falling or rising trigger edges.
The trigger polarity can be changed by TP=1. Trigger input level is 4 V ±2 V. It can be terminated by SW600 : ON for 75Ω. OFF for TTL. The trigger inputs can be changed to Camera Link. (TI=0 for CL)

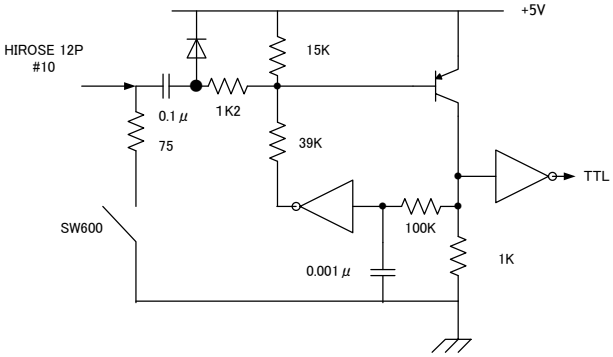


Fig. 8. Trigger input.

6.3. XEEN output

XEEN is found on pin #9 on 12-pin HR connector. The output circuit is 75 Ω complementary emitter followers. Output level ≥3 V from 75Ω. (No termination).
When the open collector is used, the maximum current is 120mA. However, if the current of more than 50mA is flowed, it is necessary to use bigger diameter wires for connecting pin#8 and 9. In case of narrower wires, due to its resistance, it may not work properly.

This output can be changed to Open collector signal by SW100.
EEN is found in Camera Link. It is high during exposure.

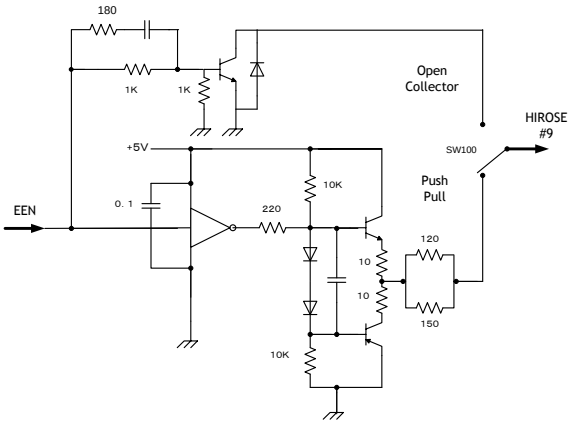


Fig.9. EEN output

6.4. Digital output interface (Camera Link® interface)

The video output is Camera Link with 3 x 8 bits RGB video placed in a base configuration, or 3 x 10 bits or 3 x 12 bits RGB placed in a Camera Link medium configuration. The digital output signals follow the Camera Link standardized multiplexed signal output interface. The Camera Link output driver is NS type DS90CR285MTD.
The data bits from the digital video, FVAL, LVAL, DVAL and EEN are multiplexed into the twisted pairs, which are a part of the Camera Link. Trigger signals and the serial camera control are fed directly through its own pairs. The trigger input can also be TTL on the 12-pin connector.
For details of the Camera Link® standard, visit the AIA web site www.machinevisiononline.org.

6.4.1 Camera Link® bit allocation

The AT-140CL outputs an RGB signal via Camera Link. A 3 x 8-bit signal is allocated via a Base configuration through port 1, while a 3 x 10-bit or 3 x 12-bit signal is allocated via a Medium configuration through both port 1 and port 2.

On the next page, there is bit allocation table.

RD9～RD0 : R Channel Camera Data(RD9=MSB, RD0=LSB)
GD9～GD0 : G Channel Camera Data(GD9=MSB, GD0=LSB)
BD9～BD0 : B Channel Camera Data(BD9=MSB, BD0=LSB)
× : Not in use

Port/Signal	24 bits output	30 bits output	36 bits output	Connector	Pin No.
Port A0	RD0	RD0	RD0	Port 1	Tx0
Port A1	RD1	RD1	RD1	Port 1	Tx1
Port A2	RD2	RD2	RD2	Port 1	Tx2
Port A3	RD3	RD3	RD3	Port 1	Tx3
Port A4	RD4	RD4	RD4	Port 1	Tx4
Port A5	RD5	RD5	RD5	Port 1	Tx6
Port A6	RD6	RD6	RD6	Port 1	Tx27
Port A7	RD7	RD7	RD7	Port 1	Tx5
Port B0	GD0	RD8	RD8	Port 1	Tx7
Port B1	GD1	RD9	RD9	Port 1	Tx8
Port B2	GD2	×	RD10	Port 1	Tx9
Port B3	GD3	×	RD11	Port 1	Tx12
Port B4	GD4	BD8	BD8	Port 1	Tx13
Port B5	GD5	BD9	BD9	Port 1	Tx14
Port B6	GD6	×	BD10	Port 1	Tx10
Port B7	GD7	×	BD11	Port 1	Tx11
Port C0	BD0	BD0	BD0	Port 1	Tx15
Port C1	BD1	BD1	BD1	Port 1	Tx18
Port C2	BD2	BD2	BD2	Port 1	Tx19
Port C3	BD3	BD3	BD3	Port 1	Tx20
Port C4	BD4	BD4	BD4	Port 1	Tx21
Port C5	BD5	BD5	BD5	Port 1	Tx22
Port C6	BD6	BD6	BD6	Port 1	Tx16
Port C7	BD7	BD7	BD7	Port 1	Tx17
Port D0	×	×		Port 2	Tx0
Port D1	×	×		Port 2	Tx1
Port D2	×	×		Port 2	Tx2
Port D3	×	×		Port 2	Tx3
Port D4	×	×		Port 2	Tx4
Port D5	×	×		Port 2	Tx6
Port D6	×	×		Port 2	Tx27
Port D7	×	×		Port 2	Tx5
Port E0	×	GD0	GD0	Port 2	Tx7
Port E1	×	GD1	GD1	Port 2	Tx8
Port E2	×	GD2	GD2	Port 2	Tx9
Port E3	×	GD3	GD3	Port 2	Tx12
Port E4	×	GD4	GD4	Port 2	Tx13
Port E5	×	GD5	GD5	Port 2	Tx14
Port E6	×	GD6	GD6	Port 2	Tx10
Port E7	×	GD7	GD7	Port 2	Tx11
Port F0	×	GD8	GD8	Port 2	Tx15
Port F1	×	GD9	GD9	Port 2	Tx18
Port F2	×	×	GD10	Port 2	Tx19
Port F3	×	×	GD11	Port 2	Tx20
Port F4	×	×		Port 2	Tx21
Port F5	×	×		Port 2	Tx22
Port F6	×	×		Port 2	Tx16
Port F7	×	×		Port 2	Tx17
LVAL				Port 1/2	Tx24
FVAL				Port 1/2	Tx25
DVAL				Port 1/2	Tx26
EEN				Port 1/2	Tx23

6.4.1 Digital Output (Bit allocation)

CCD out	Analog Signal	Digital Out(24bit)	Digital Out(30bit)	Digital Out(36bit)
Black	Setup 3.6%, 25mV	8LSB	32LSB	128LSB
200mV	700mV	222LSB	890LSB	3560LSB
230mV ↑	800mV	255LSB	1023LSB	4095LSB

Note: The above data is for the case when gamma is OFF.

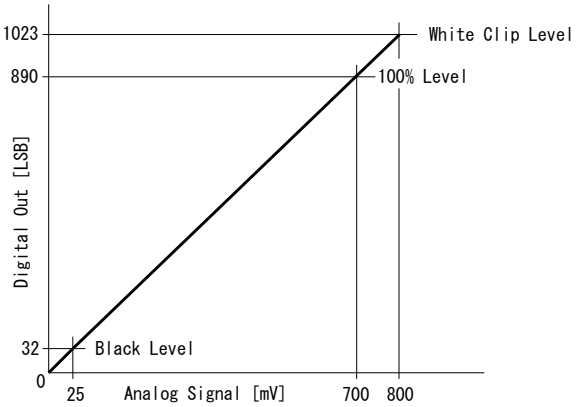


Fig.10. Digital output (10-bit output)

6.5. Auto iris video output level

This video output signal is NUM luminance signal and does not have SYNC. It is available only in Continuous mode and RCT mode. It is also not available in partial scan mode.
This signal is not affected by the gain control.

CCD out	Analog Out
200mV	700mV
230mV ↑	800mV

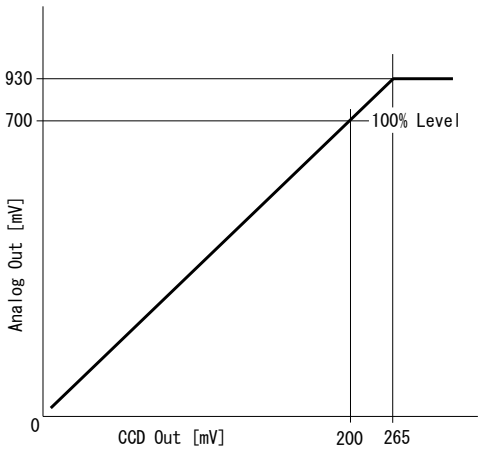


Fig.11. Iris video output

7. Functions and Operations

7.1. Basic construction

A 32-bit micro processor controls all functions in the AT-140CL camera. The CCD sensor output is normalized in CDS and preamplifiers. The signals are then digitized to 14 bits. Digital gain control, color matrix, look-up tables and setup can do signal processing in 14 bits before the signal is converted to a 12-, 10- or 8-bit Camera Link signal.

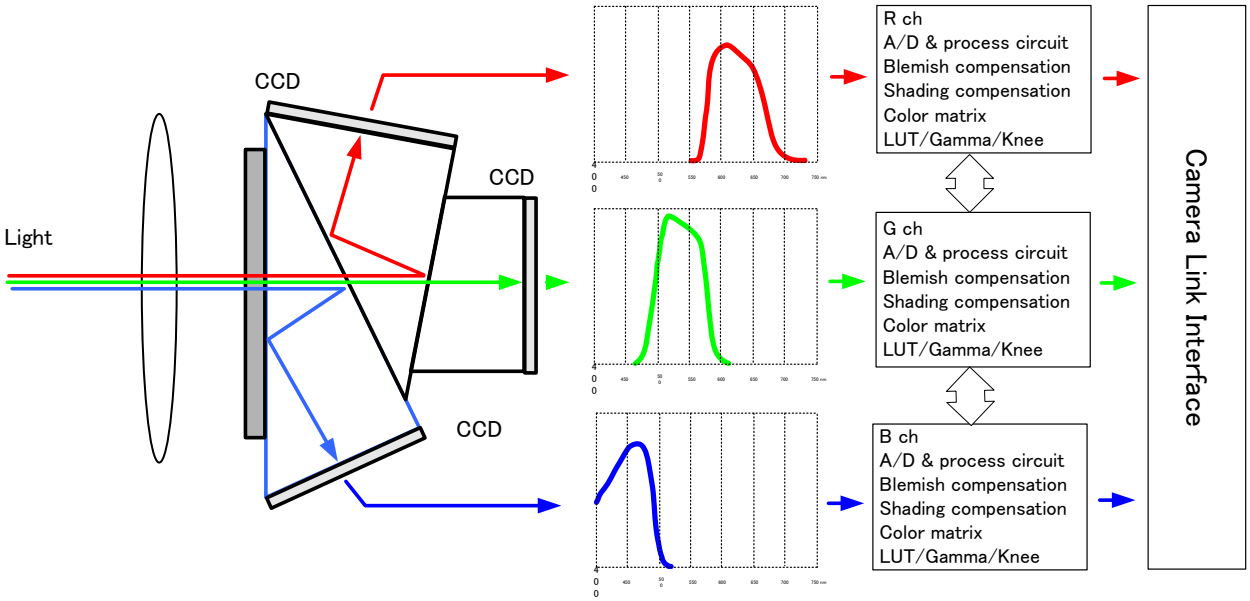
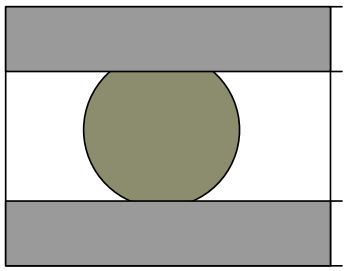


Fig. 12. Principle diagram for signal processing

7.2. Main functions

7.2.1 Partial scan (SC)

The partial scanning function uses the middle of the image vertically to achieve faster frame rates. This is very useful when capturing and inspecting an image which does not require the full height. The AT-140CL has 4 types of pre-set partial scan modes: 2/3, 1/2, 1/4 and 1/8.



Mode	Start line	End line	Frame Rate
2/3	173	867	33.49 fps
1/2	260	780	40.04 fps
1/4	390	650	56.77 fps
1/8	455	585	71.38 fps

Fig.13 Partial scan (pre-set)

In addition to pre-set partial scan modes, the AT-140CL has a variable partial scan mode. The start line can be set from the 1st line to 1040th line and the end line can also be set from the 1st line to the 1040th line. In actual use, the start line should always be set smaller than the end line and the end line should be larger than the start line. For instance, if the end line is set at 1040, the start line should be 1039 or smaller. If the start line is set at 1, the end line should be set at 2 or larger.

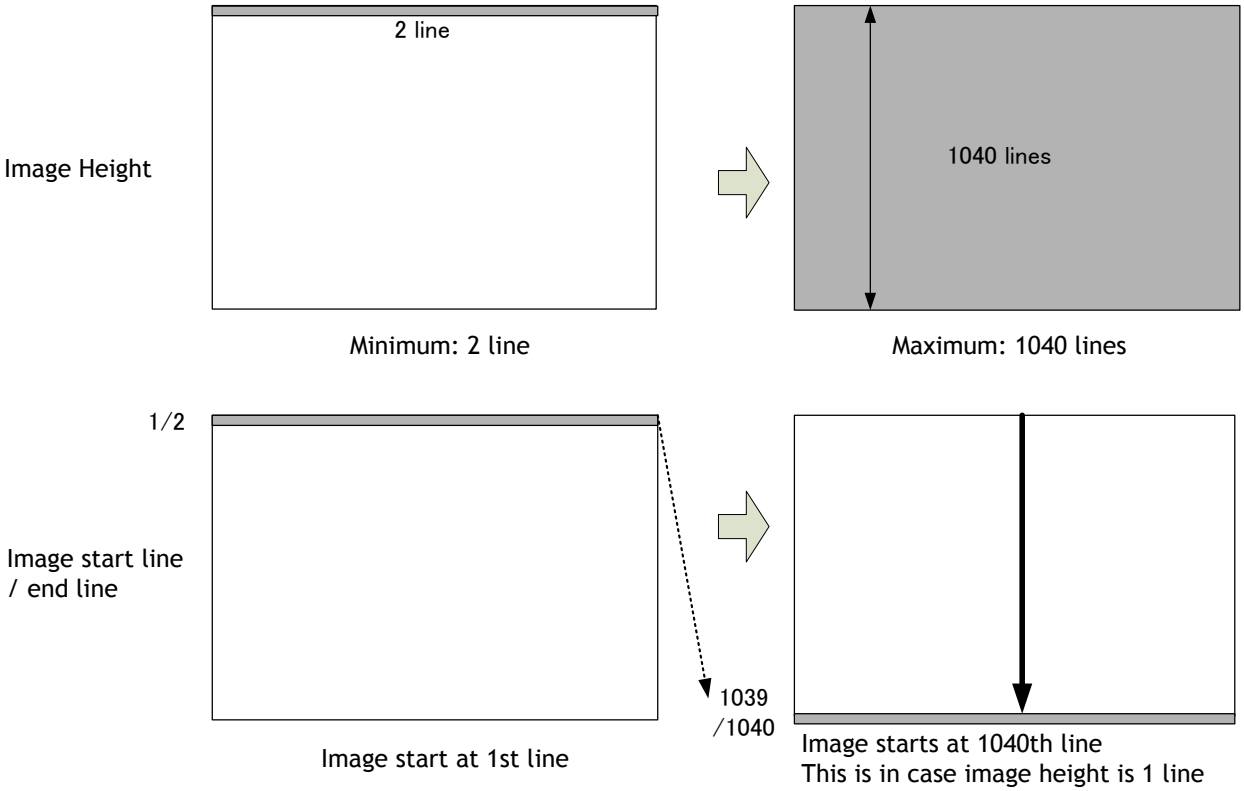


Fig.14. Variable Partial scan

◆ **How to calculate total line number and frame rate in variable partial scan mode**

Frame rate (fps) = Horizontal frequency(26.624KHz) / Total lines

Total lines = OB period + Fast Dump period in the upper part of the frame (L) + Effective image period (L) + Fast dump period in the lower part of frame (L) + Blank period (L)
Where,
OB period = 4L (Fixed)
Blank period = 7L (Fixed)

Fast dump period for the upper part = $\mathbf{Round\ up}\left(\frac{\mathbf{3 + Start\ line - 1}}{\mathbf{4}}\right) + \mathbf{1}$

Fast dump period for the lower part = $\mathbf{Roud\ up}\left(\frac{\mathbf{1040 - End\ line + 2}}{\mathbf{4}}\right)$

Calculation example
Read out: 1/2 partial at the center (521L), Start line (260), End line (780)

OB period = 4L
Blank period =7L
Fast dump period for the upper part = (3+260-1) ÷4 +1= 66.5 → 67
Fast dump period for the lower part = (1040-780+2) ÷ 4 =65.5 → 66
Total lines = 4+7+67+521+66=665
Frame rate = 26.624/ 665 =40.04 fps

7.2.2 Vertical Binning (VB)

Vertical Binning mode is a function where the signal charges from 2 adjacent (vertical) pixels are added together and read out as one pixel. Binning results in half vertical resolution but higher frame rate and sensitivity. The charge accumulated in 2 adjacent lines is added together in the horizontal CCD register. This is done by providing two pulses to the vertical CCD register for each line read out. Vertical binning cannot be used together with partial scanning.

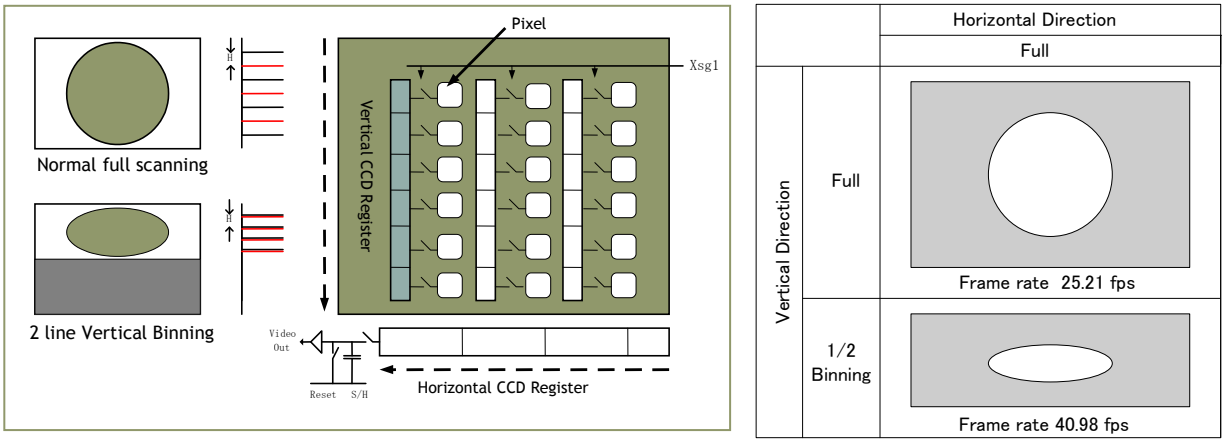


Fig. 15. Vertical Binning

Setting	Effective/total	Horizontal Frequency	Frame rate
Off (No V Binning))	1040 /1056	26.624 KHz	25.21 frames/sec.
2:1 V Binning	520 / 530	21.720 KHz	40.98 frames /sec.

7.2.3 Electronic shutter (SM)

The AT-140CL has the following shutter modes.

◆ **Pre-set shutter(SH)**

The setting command is from SH=0(OFF) to SH=11 (1/51,000)
OFF(1/20),1/60,1/100,1/120,1/250,1/500,1/1000,1/2,000,1/3,600,1/8,000,1/18,000 and 1/53,000s

Note: The actual exposure uses the programmable exposure (PE) method. When the camera receives a pre-set shutter value, it is converted to a programmable value inside the camera. So, the actual exposure might be slightly different from the pre-set value.

◆ **Programmable Exposure (PE)**

The setting command is PE and the exposure time can be controlled from 0L to 1056L in 1 LVAL units (37.56μs). Calculating actual shutter speed requires adding 0.5L to the setting value. This is because there is 0.5L overhead.
The resulting range is from 0.5LVAL to 1056LVAL. Setting 1056L is Shutter OFF.
The programmable exposure can be set for R, G and B together (SM=1) or individually (SM=2) in EPS mode.

The shutter speed for each operation mode is shown below.

Mode	Read Out	Minimum shutter speed	Maximum shutter speed
Continuous Edge Pre-select	Full Partial	18.78 µs at PE=0(1/53,000)	37.56µs x 1056L=1 Frame (39.66 ms)
	V binning	23.02 µs at PE=0(1/43,440s)	
Pulse Width	Full Partial	37.56 µs x 2L+18.78 µs(0.5L)= 93.9 µs （≒1/10,650s） (Note)	50 Frames (2 seconds)
	V Binning	46.04 µs x 2L + 23.02 µs(0.5L)= 115.1µs （≒1/8.700s） (Note)	

Note: In Pulse Width mode, the minimum trigger pulse width requires more than 2LVAL.

◆ Auto shutter

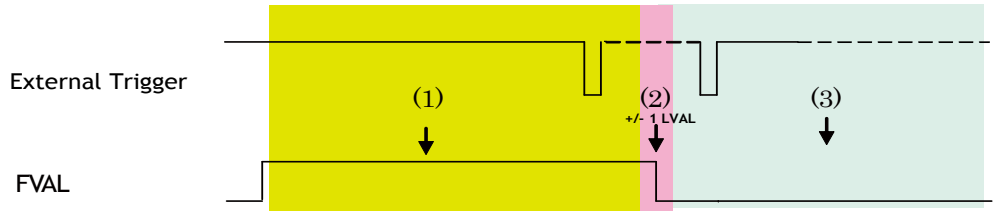
AT-140CL has an automatic shutter function which sets the video at an appropriate level depending on illumination.

Auto shutter range : 1/25 sec to 1/2400 sec

7.2.4 Auto-detect LVAL-sync / a-sync accumulation

This function replaces the manual setting found in older JAI cameras. Whether accumulation is synchronous or asynchronous in relation to LVAL depends on the timing of the trigger input. When a trigger is received while FVAL is high (during readout), the camera works in LVAL-synchronous mode, preventing reset feed-through in the video signal. There is a maximum jitter of one LVAL period from issuing a trigger and accumulation start.
When a trigger is received during FVAL low, the camera works in LVAL-asynchronous mode (no delay) mode.

This applies to both Edge Pre-select (EPS) trigger mode and Pulse Width Control (PWC) trigger mode.



(1) In this period camera executes trigger at next LVAL (prevents feed-through noise)

(2) Avoid trigger at FVAL transition (+/- LVAL period), as the function may randomly switch between " next LVAL " and " immediate ".

(3) In this period, camera executes trigger immediately (no delay).

Fig.16. Auto-detect LVAL sync/async accumulation

7.2.5 Shading compensation (SDM)

The AT-140CL implements a digital shading compensation circuit for the white shading which could be caused in the prism or optical system. The whole image is divided horizontally and vertically and uses the center level as the reference. The circuit will compensate the difference between the center and each divided area. The range for compensation is a maximum of 30%.

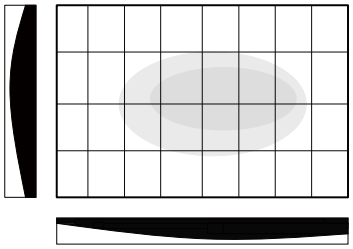


Fig.17 Shading compensation

Shading correction mode: SDM
0:OFF, 1:Factory shading, 2:User 1, 3:User2
These are used to load the stored data.

In order to calibrate the shading, use RS command, Recalibrate Shading correction. Param. 1 is used to store the calibration data in 0 for User 1 and 1 for User 2. User 1 and User 2 can store only one data set for either color shading or flat shading. Param. 2 can be set to 0 for Flat or 1 for Color and executes the shading correction and the storing of data.

Note: Conditions for lens used with AT-140CL

In order to get an appropriate picture, it is recommended to use 1/2 inch, 3CCD lenses. Shading is dependent on F value and focal length. Using a wide angle lens or using the lens fully open, will cause the shading characteristics to deteriorate.

AT-140CL has two shading compensation circuits.

1. Color shading compensation
   In this mode, the shading is compensated using the G channel as the reference. Adjust R and B channels to match the characteristics of the G channel. Use white balance to match R, G and B levels.

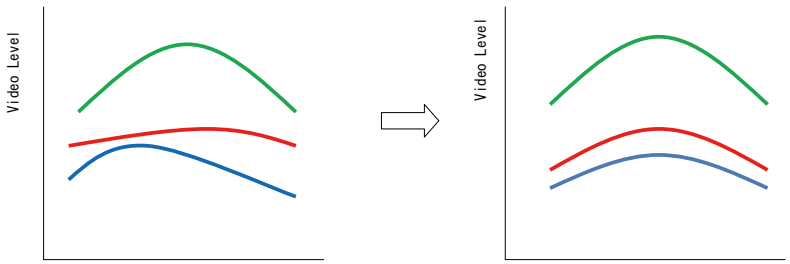


Fig.18 Conceptual drawing for color shading compensation

2. Flat shading compensation
   In this mode, each channel can be adjusted to achieve flat characteristics.

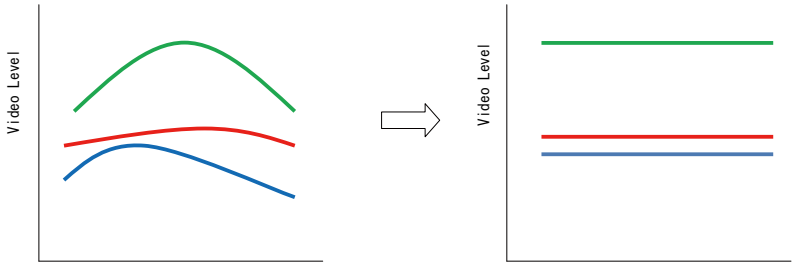


Fig.19 Conceptual drawing for flat shading compensation

7.2.6 White balance (WB)

The AT-140CL has 4 white balance modes: manual balance, one push auto white balance, continuous auto white balance and pre-set white balance.
The pre-set white balance can be set to 4000K, 4600K or 5600K.
The white balance of AT-140CL is set under 7800K lighting in factory. If the camera is started up at the first time, it is 7800K white balance and R and B gain settings are 0.

For executing the white balance, the entire image is
divided into 64 areas, 8 for horizontal and 8 for vertical.
The following drawing is an example of using a 2 x 2 area in the image center.

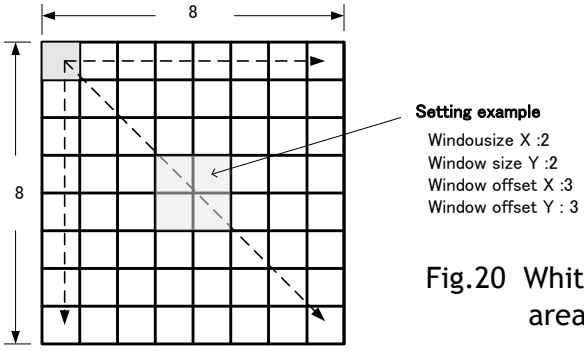


Fig.20 White balance measuring area

	Continuous	One push	Manual
Tracking range	4000K to 9,000K	4000K to 9,000K	4000K to 9,000K
Adjustable range	-6dB ～ +6dB	-6dB ～ +6dB	-6dB ～ +6dB
Store the setting value	No	Yes	Yes

Note: In continuous mode, if the white part is not enough to make an adjustment, the white balance may not achieve a proper white color.
Note: The completion of one push auto white requires a maximum of 5 seconds to complete.

7.2.7 Linear matrix (CMTX)

The AT-140CL incorporates a linear color matrix circuit to improve color reproduction.
As this circuit processes signals in the linear stage, before the gamma correction circuit, the gamma circuit does not affect color reproduction.

This circuit has:
1. Linear OFF
2. sRGB Standard which HP and Microsoft specify for printer and monitor. This preset is based on this standard.
3. Adobe RGB Standard which Adobe systems specify. This preset is based on this standard.
4. User User can manipulate R, G and B color relationships based on applications. Set the gain for R-R, R-G, R-B, G-R, G-G, G-B, B-R, B-G, B-B to adjust.

Important Note:
If sRGB or Adobe RGB is used, please note the following procedure.
1) Achieve the white balance under the condition of D65 (6500K) illumination.
2) Gamma should be set at 0.45 and set the linear matrix at either sRGB or Adobe RGB.
3) Monitor should comply with sRGB or Adobe RGB color reproduction capability.

7.2.8 Gamma setting (LUTC)

The AT-140CL has various gamma settings including LUT (Look Up Table). Gamma can be set OFF (1.0), 0.6, 0.45, or to exhibit characteristics set using LUT.
The following shows the typical characteristics in the case of gamma 0.6.

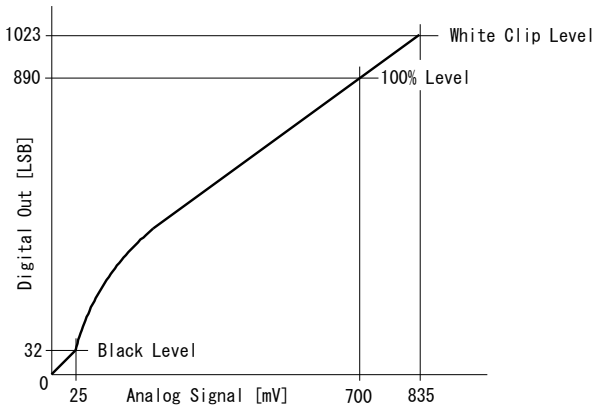


Fig.21. Gamma setting

CCD out	Analog Signal	Digital Out(36bit)	Digital Out(30bit)	Digital Out(24bit)
Black	Setup 3.6%, 25mV	128LSB	32LSB	8LSB
200mV	700mV	3560LSB	890LSB	222LSB
230mV ↑	800mV	4095LSB	1023LSB	255LSB

7.2.9 Knee compensation (KN)

If the relation of input and output is linear (1:1), the output signal is saturated at a certain level of the input signal and details cannot be reproduced in the saturated area. The knee compensation circuit maintains linear output up to a knee point and compresses the level after the knee point. This is set by a knee slope function. AT-140CL supports up to 200% signal compression by knee slope. Factory default is OFF.

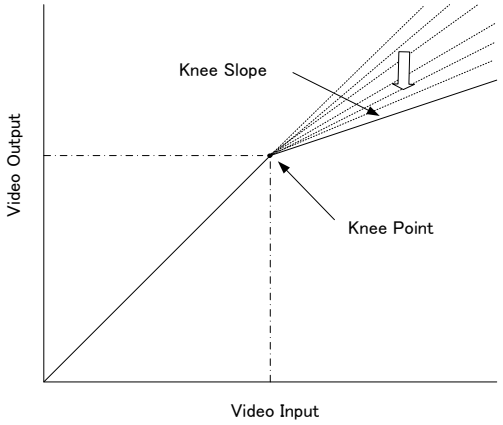


Fig.22. Example of Knee characteristics

Functions	Data length	Setting range
Knee Point	10bit	0LSB ～ 1023LSB
Knee Slope	12bit	0(x0.0005) ～ 4095(x2.0000)

7.2.10 Test pattern generator

The AT-140CL has an internal test pattern generator. These signals are output as the last process of the digital signal processing circuit and can be used for adjustment of the related system. The AT-140CL has a total of 15 test pattern types.

7.2.11 Center marker

AT-140CL is equipped with a center marker generator. The center marker can be selected from three types as described below.

Note: The center marker is displayed only on full scan mode.

Fig. 23 Center marker

8. Sensor Layout and timing

8.1. CCD Sensor Layout

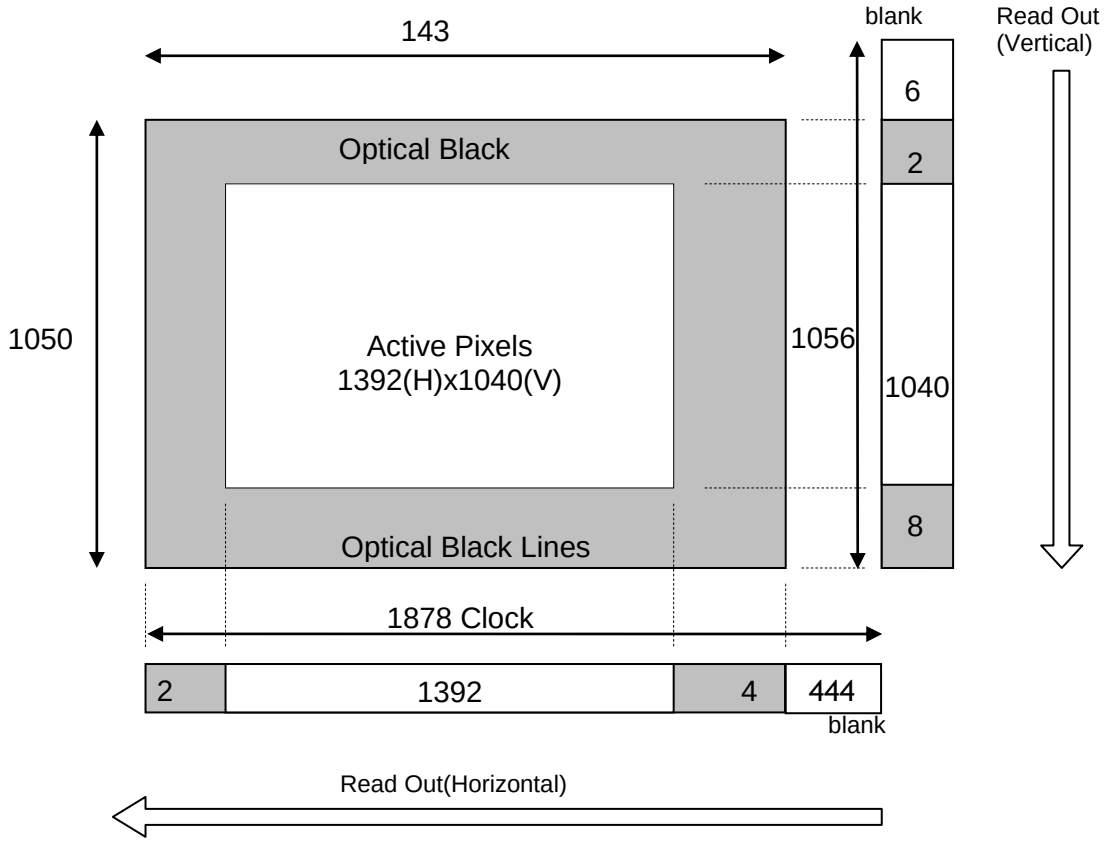


Fig. 24. CCD sensor layout

8.2. Normal continuous mode timing

8.2.1 Horizontal timing

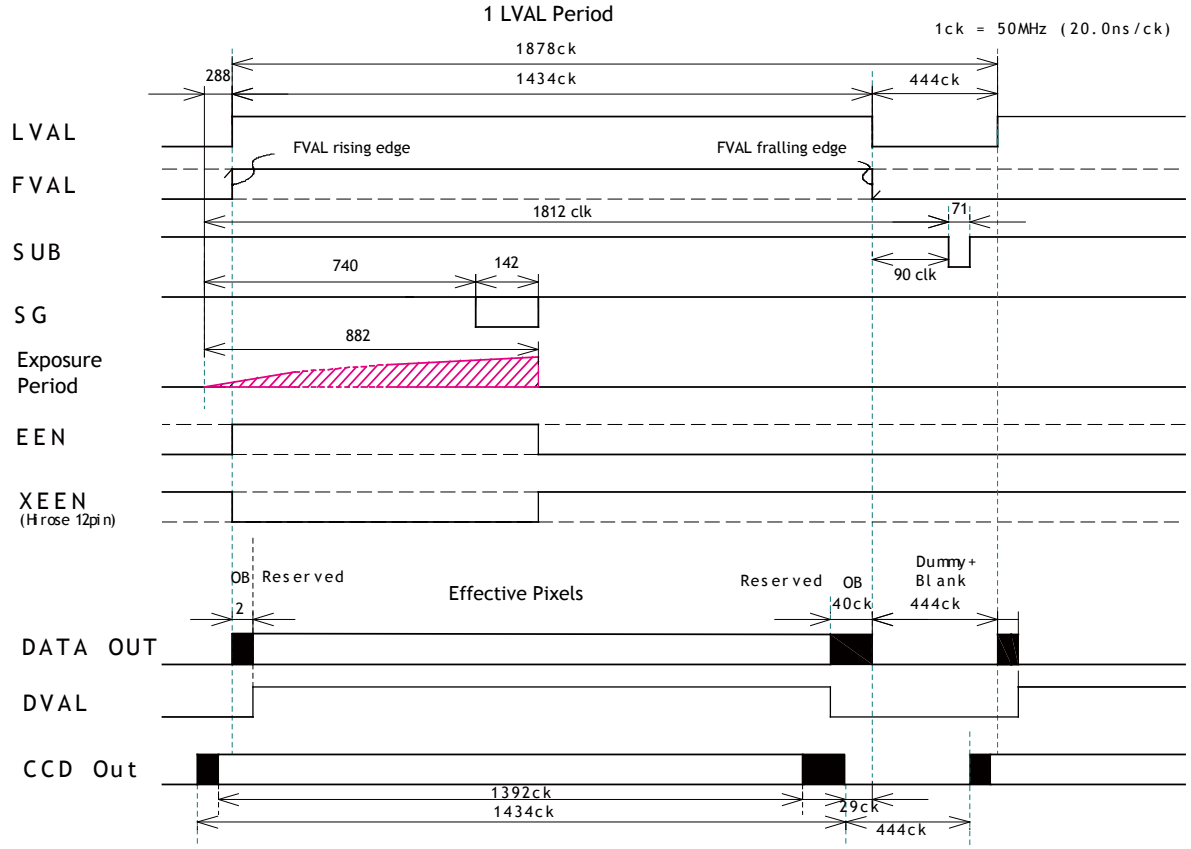


Fig. 25. Horizontal timing

8.2.2 Vertical timing

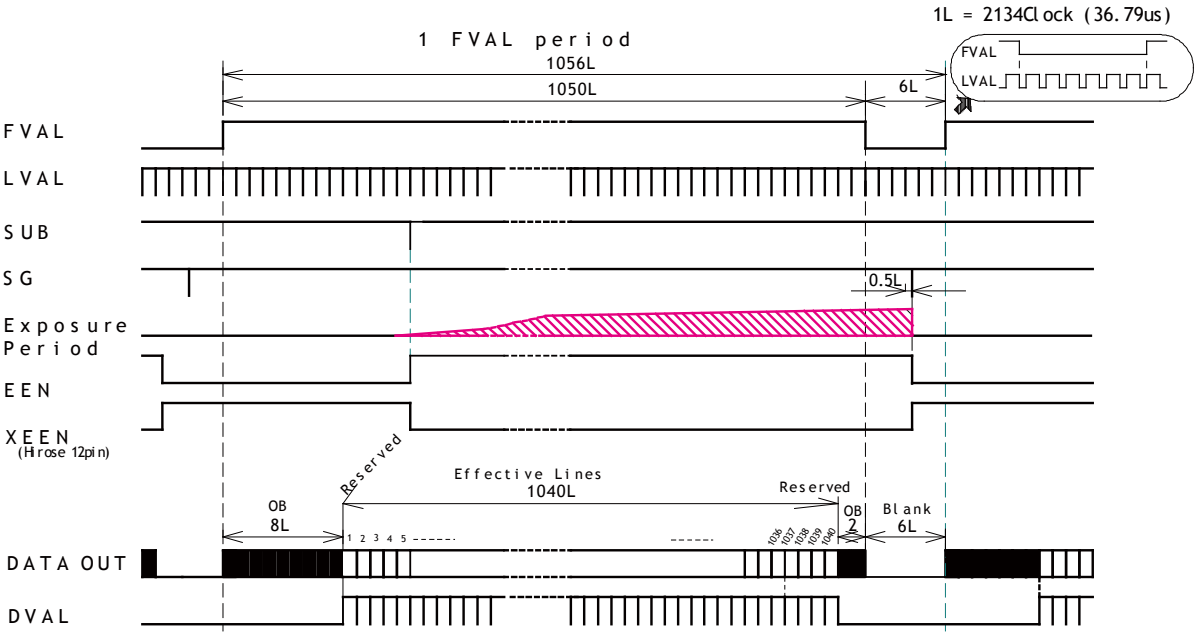


Fig. 26. Vertical timing for full scan

8.3. Partial scan timing

8.3.1 Horizontal timing

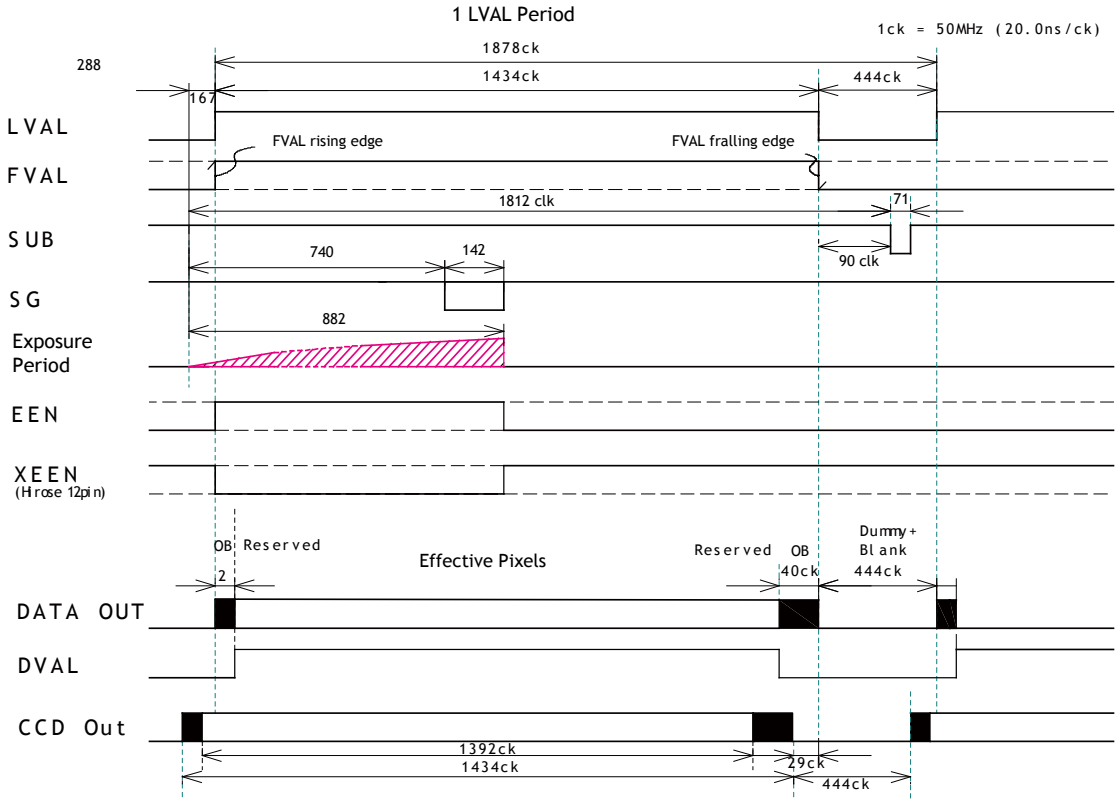


Fig.27 Horizontal timing (Partial scan, the same as normal continuous)

8.3.2 Vertical timing

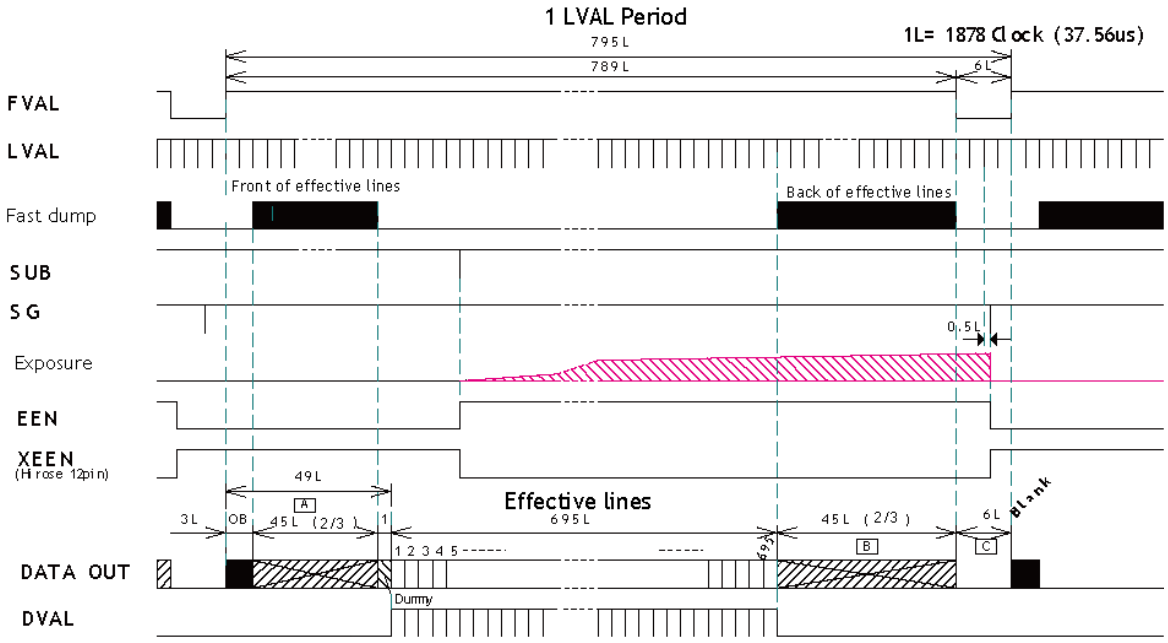


Fig. 28 Vertical timing (2/3 partial scan)

	Option	Start line (Line)	End line (Line)	No. of lines (Lines)	Output image	Front of Frame -A-	Back of Frame -B-	Blank Of Frame -C-
0	Full screen	1	1040	1040	Full Frame	8	2	6
1	2/3 screen	173	867	695	Partial Scan	49	45	6
2	1/2 screen	260	780	521		71	67	6
3	1/4 screen	390	650	261		103	99	6
4	1/8 screen	455	585	131		120	116	6

8.4. Vertical binning

8.4.1 Vertical timing

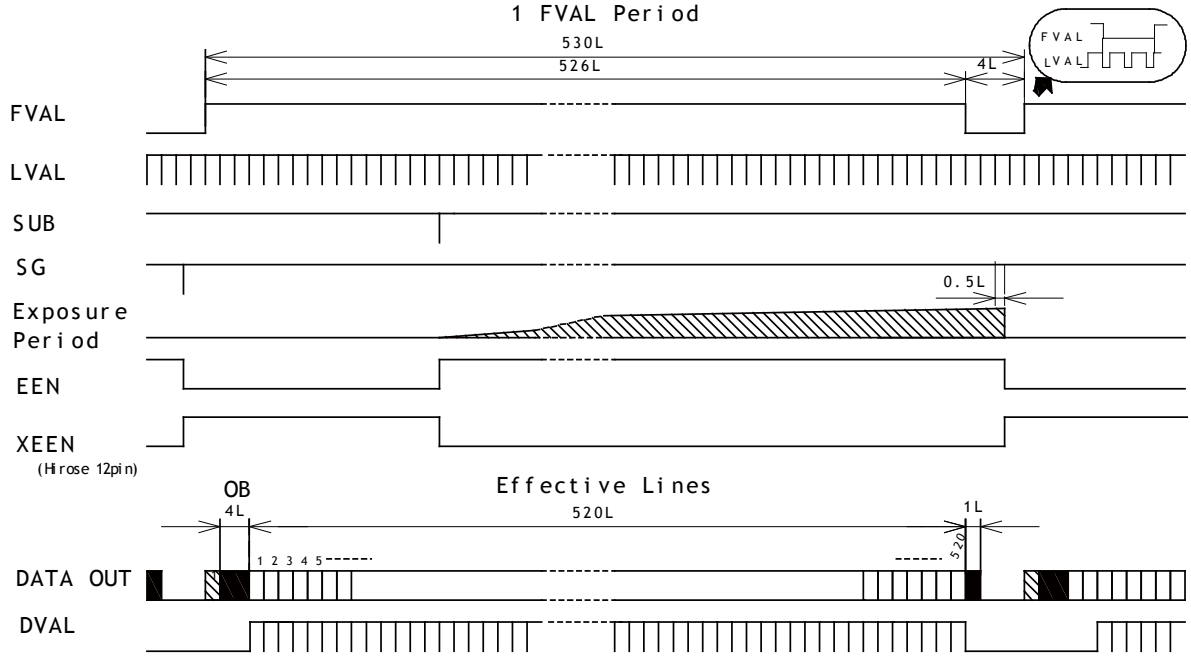


Fig.29. Vertical timing for V binning.

8.4.2 Horizontal timing

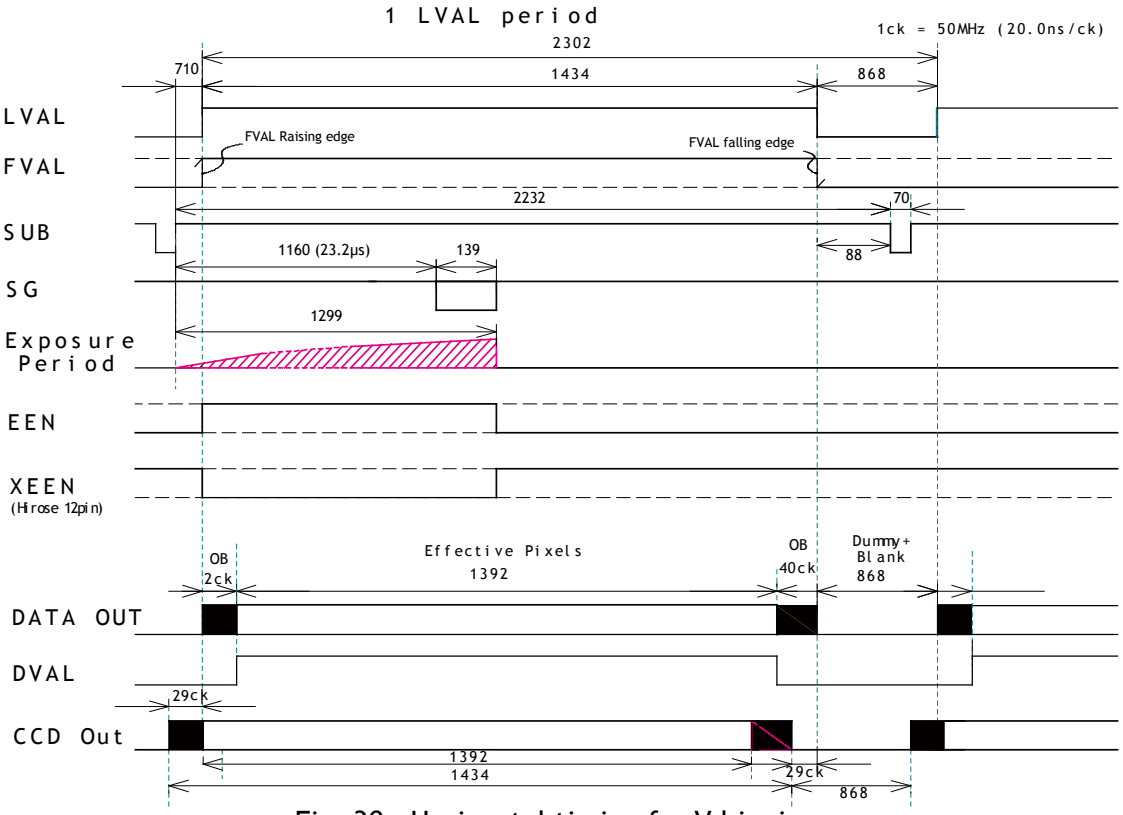


Fig. 30 Horizontal timing for V binning.

9. Operation Modes

This camera can operate in 5 primary modes.

1.	*TR=0*	*Con*	*Normal continuous Mode*	Pre-selected exposure.
2.	*TR=1*	*EPS*	*Edge Pre-select Mode*	Pre-selected exposure.
3.	*TR=2*	*PWC*	*Pulse Width Control Mode*	Pulse width controlled exposure.
4.	*TR=3*	*RCT*	*Reset Continuous Mode*	Pre-select exposure
5.	*SL*		*Smearless Mode*	

9.1. Continuous operation

For applications not requiring asynchronous external triggering, this mode should be used. In this mode it possible to use a lens with video controlled iris.
For timing details, refer to fig.26. through fig. 31.

To use this mode:

Set function:	Trigger mode to “Continuous”	TR=0
	Scanning	SC=0, 1
	Vertical binning	VB=0, 1
	Shutter mode normal, programmable	SM=0 through 3
	Shutter speed	SH=0 through 11
	Programmable exp.	PE=0 through 1056
	Other functions and settings	

9.2. Edge Pre-select Trigger Mode

An external trigger pulse initiates the capture, and the exposure time (accumulation time) is the fixed shutter speed set by SH or PE. The accumulation can be automatically set either LVAL synchronous or LVAL asynchronous in relation to FVAL and trigger timing.
Refer to chaper 7.2.4
The resulting video signal will start to be read out after the selected shutter time.

For timing details, refer to fig26 . through fig34.

To use this mode:

Set function:	Trigger mode to “Edge Pre-select”	TR=1
	Scanning	SC=0, 1
	Vertical binning	VB=0, 1
	Shutter mode to normal or programmable	SM=0 through 2
	Shutter speed	SH=0 through 11
	Programmable exp.	PE=0 through 1056
	Other functions and settings	
Input:	Ext. trigger. Camera Link or 12 HiRose	TI=0, TI=1

Important notes on using this mode

- Active Trigger pulse >2 LVAL to <1 FVAL
- Minimum Trigger interval is shown in the following table.

Mode	**Minimum trigger interval**
LVAL Sync	1056L + 3L
LVAL Async	Exposure time + 1056L + 3L
Smearless is ON	Smearless time(265L) + Maximum exposure time +1056L + 3L
Note: 1) On the above table, 1252L is FVAL interval on normal continuous mode 2) In the vertical binning mode, 1L is different from the normal scanning. So, the minimum trigger interval will be different.	

9.2.1 EPS timing

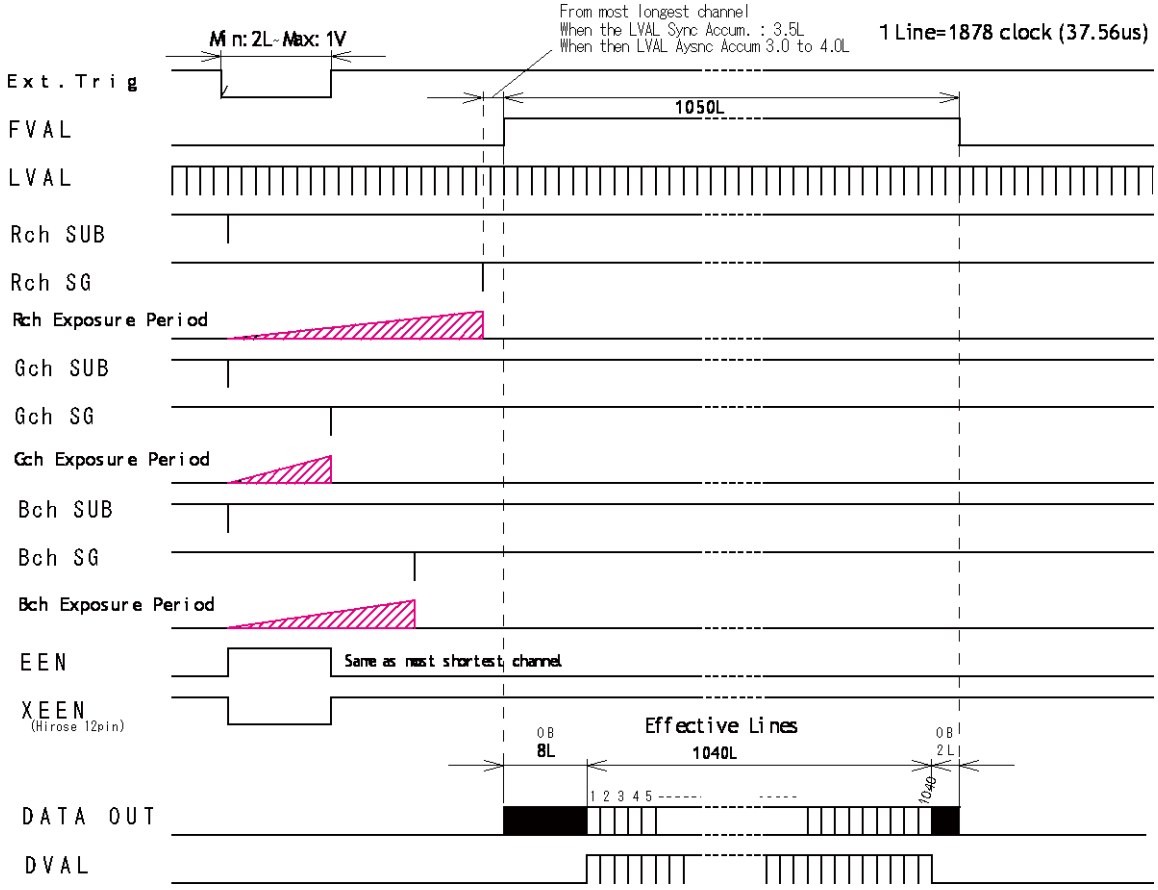


Fig.31. Edge Pre-select.

9.2.2 EPS timing LVAL sync details

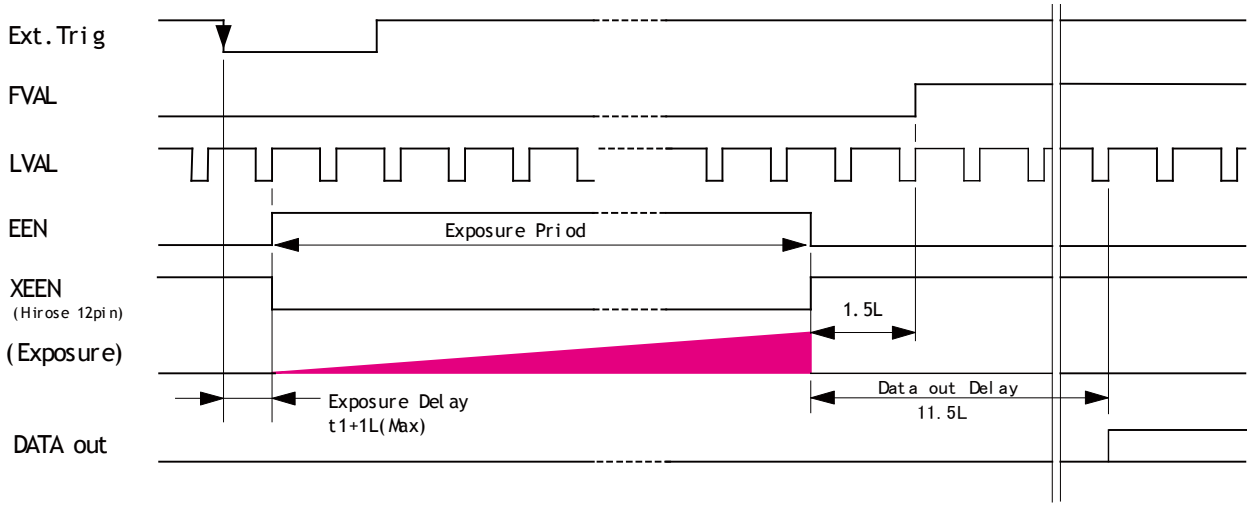


Fig.32 Edge Pre-select LVAL SYNC details

9.2.3 EPS timing LVAL async details

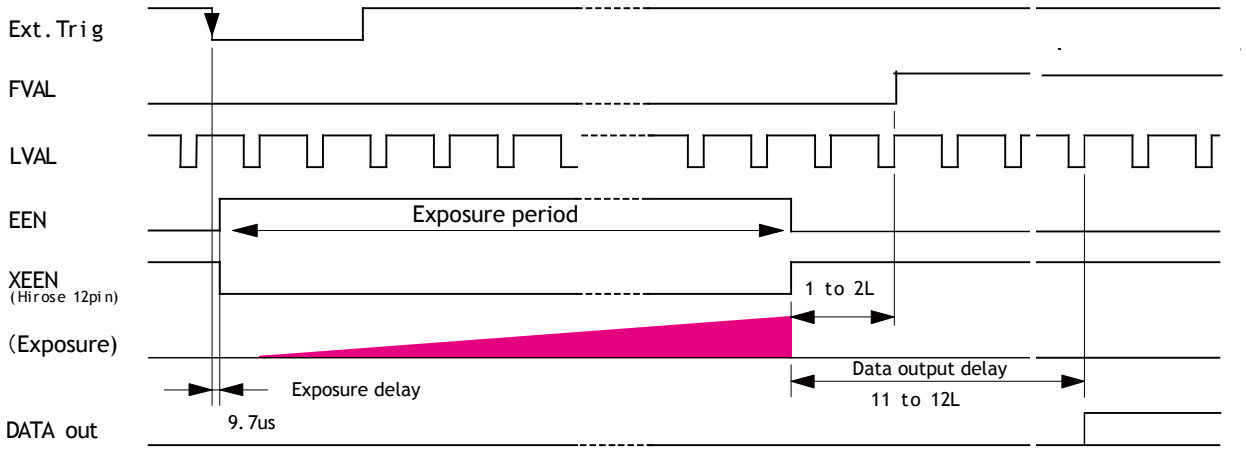


Fig.33 Edge Pre-select LVAL ASYNC details

9.3 Pulse Width Control Trigger Mode

In this mode the accumulation time is equal to the trigger pulse width. Here it is possible to have a long time exposure. The accumulation can be automatically set either LVAL synchronous or LVAL asynchronous in relation to FVAL and trigger timing. Refer to chapter 7.2.4. The maximum recommended exposure time is <2 seconds.
The resulting video signal will start to be read out after the trigger's rising edge.
For timing details, refer to fig.27 through fig.32 . and fig.36 through fig.38 .

To use this mode:

Set function:	Trigger mode to "Pulse width control".	TR=2
	Scanning	SC=0 ,1
	Vertical binning	VB=0, 1
	Other functions and settings	
Input:	Ext. trigger. Camera Link or 12 Hirose	TI=0, TI=1

Important notes on using this mode

- Trigger pulse width >2 LVAL to <2 seconds.
- Minimum trigger interval is shown in the following table.

Mode	Minimum trigger interval
LVAL Sync	1.Exposure time < 1056L 1056L + 3L 2.Exposure time ≥ 1056L Exposure time +2L
LVAL aSync	Exposure time + 1056L + 3L
Smearless is ON	Smearless time (265L) + Exposure time + 1056L + 3L
Note: 1) On the above table, 1252L is FVAL interval on normal continuous mode 2) In the vertical binning mode, 1L is different from the normal scanning. So, the minimum trigger interval will be different.	

9.3.1 PWC timing

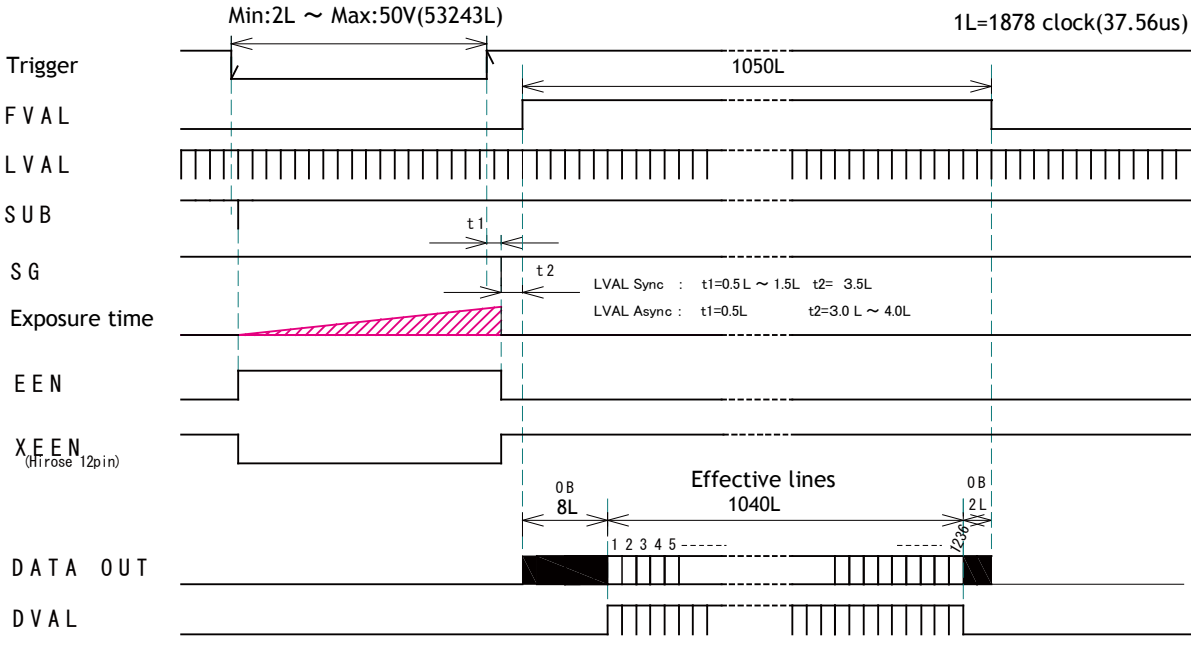


Fig. 34. Pulse width control.

9.3.2 PWC timing - LVAL sync details

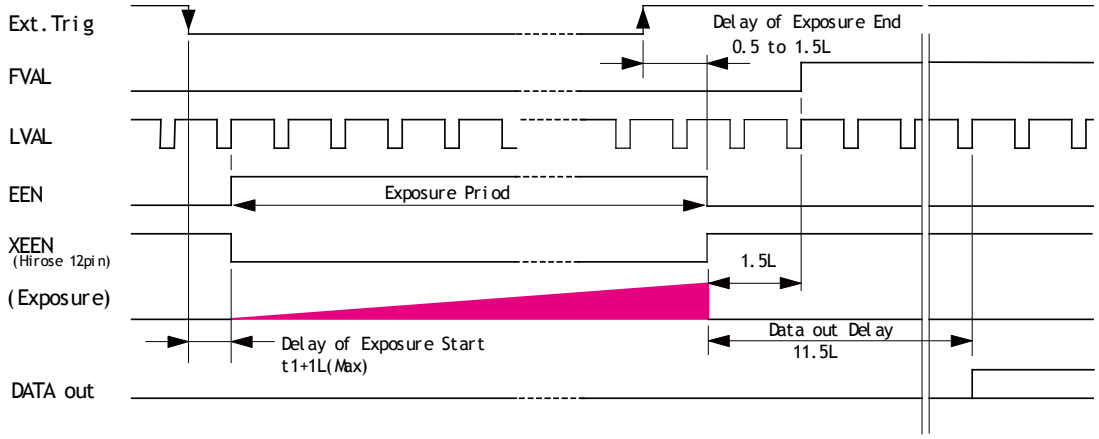
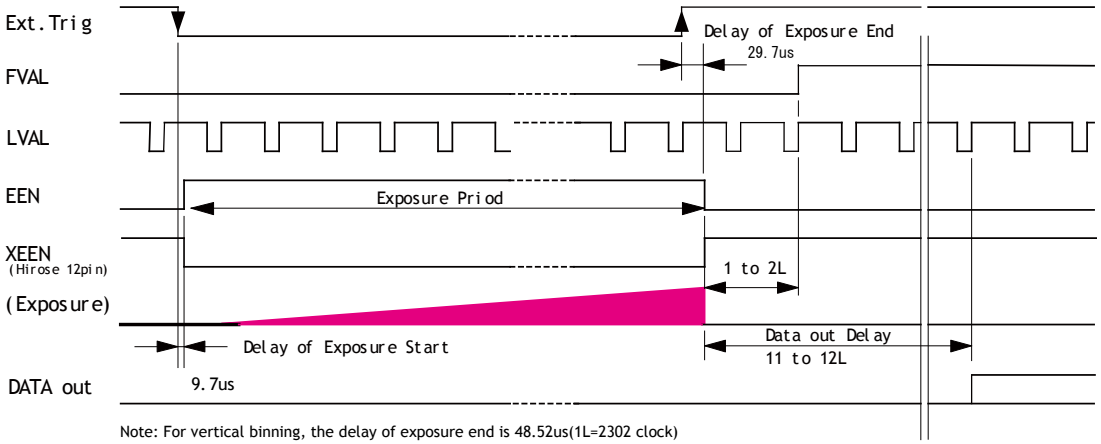


Fig.35 Pulse Width Control LVAL SYNC details

9.3.3 PWC timing - LVAL async details



Note: For vertical binning, the delay of exposure end is 48.52us(1L=2302 clock)

Fig.36 Pulse Width Control LVAL ASYNC Details

9.4. Reset Continuous Trigger (RCT)

The RCT mode operates like EPS (Edge Pre-select) mode with smearless function. An external trigger pulse will immediately stop the video read out, reset and restart the exposure, then operate as normal mode until the next trigger. After the trigger pulse is input, a fast dump read out is performed. In the AT-140CL, this period is 9.92ms which is 264L. The exposure time is determined by the pre-set shutter speed. If no further trigger pulses are applied, the camera will continue in normal mode and the video signal is not output. The fast dump read out has the same effect as "smearless read out". Smear over highlight areas is reduced for the trigger frame. The reset continuous trigger mode makes it possible to use triggering in conjunction with a lens with video controlled iris.
RCT mode is available only in LVAL asynchronous.

To use this mode:

Set function:	Trigger mode	TR=3
	Scanning	SC=0, 1
	Vertical binning	VB=0, 1
	Shutter	SM=0 through 2
	Programmable Shutter	1 to 1056 L
	Accumulation(Auto)	LVAL async
	Other functions	
Input:	External Trigger , Camera link or Hirose 12P	TI=0, 1

Important notes on using this mode

- Active Trigger pulse >2 LVAL to <1 FVAL
- Minimum Trigger interval is shown in the following table.

Mode	Minimum trigger interval
LVAL Async	Smearless time(265L) + Maximum exposure time +1252L + 3L

Note: 1) On the above table, 1252L is FVAL interval on normal continuous mode
2) In the vertical binning mode, 1L is different from the normal scanning. So, the minimum trigger interval will be different.

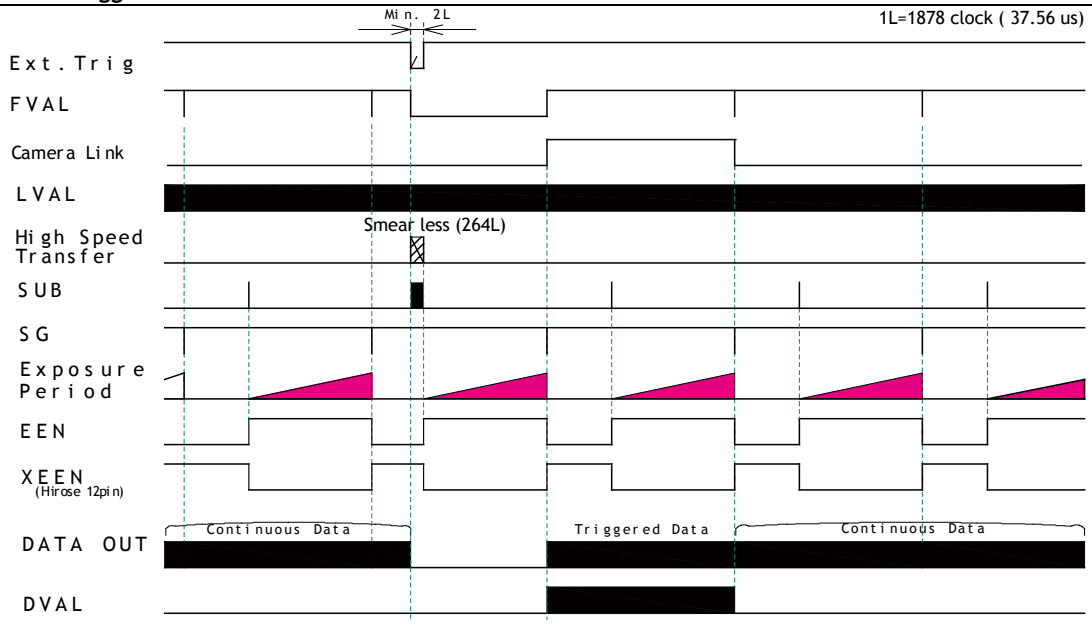


Fig.37 RCT mode

Note: In this mode, if the next trigger is input while the data is read out, the data can be immediately transferred. The minimum trigger interval should be kept.

9.5. Smearless mode

This function can be used to reduce the smear coming from bright parts of the object. This is effective for both EPS and PWC trigger modes. Before the accumulation starts, charge that is stored in the pixel is dumped by a high-speed transfer. This can reduce the smear at the upper part of the object but the lower part is unaffected.
At the falling edge of the trigger pulse the high speed transfer starts. This period is 7.08ms which is 180L. Thereafter the residual charge in the horizontal CCD register is read out in 1L and the new exposure starts. This function is available for both full scan and partial scan.

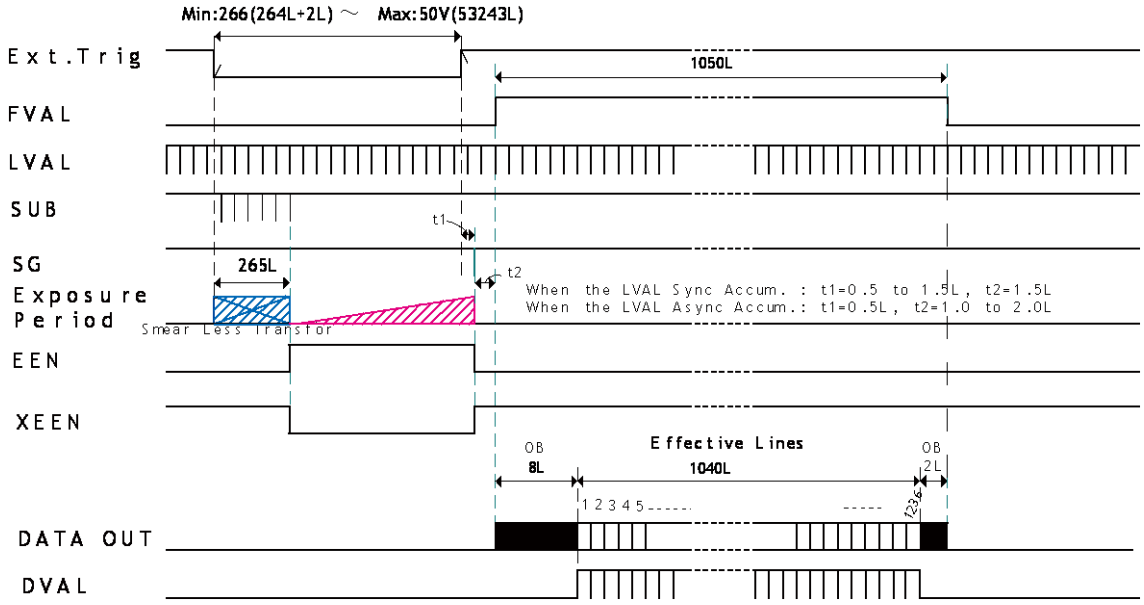


Fig.38 Smearless mode

9.6. Trigger mask

AT-140CL has a trigger mask function. When this is ON, triggers which are input in shorter intervals than the minimum interval, are disabled. Refer to each trigger mode for information about minimum intervals.

9.7. Mode and functions matrix

	Mode	Shutter Preset / Programmable	Auto shutter	V Binning	Partial scan	Smear less	LVAL Sync/Async	Auto Iris output
1	Continuous	○	○	○	○	×	---	○
2	EPS	○	×	○	○	×	Auto	×
						○	Async	
3	PWC	---	×	○	○	×	Auto	×
						○	Async	
4	RCT	○	○	○	○	○	Async only	○

10. Configuring the Camera

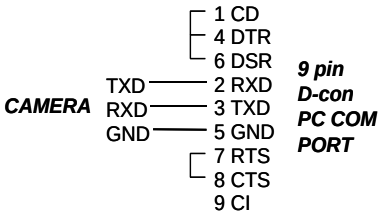
10.1. RS-232C control

All configuration of the AT-140CL camera is done via Camera Link. The camera can be set up from a PC running terminal emulator software, or using JAI´s camera control software. Below is the description of the ASCII based short command protocol.

10.2. Communication setting.

Baud Rate	9600 bps
Data Length	8 bit
Start Bit	1 bit
Stop Bit	1 bit
Parity	None
Xon/Xoff Control	None

RS 232C cable



Protocol.

Transmit setting to camera:
NN=[Parameter]<CR><LF> (NN is any kind of command. Capital or small letters.)

The camera answers:
COMPLETE<CR><LF>

Note: Some commands can only be requested.

To have all communication visible on the emulator screen, start with:
EB=1<CR><LF>
The camera answers:
COMPLETE<CR><LF>

Transmit request command to camera:
NN?<CR><LF> (NN is any kind of command.)
The camera answers:
NN=[Parameter]<CR><LF>

Transmit the following to have the camera's actual settings:
ST?<CR><LF>
The camera answers:
A complete list of the current settings

Transmit the following to have a command list:
HP?<CR><LF>
The camera answers:
A list with all commands and possible settings

Invalid parameters sent to camera: (99 is an invalid parameter)
SH=99<CR><LF>
The camera answers:
02 Bad Parameters!!<CR><LF>

To see firmware number.
VN?<CR><LF>
To see camera ID. It shows the manufacturing lot number.
ID?<CR><LF>

10.3. AT-140CL command list

	Command Name	Format	Parameter	Remarks
A - General settings and useful commands				
EB	Echo Back	EB=[Param.]<CR><LF>	0=echo off 1=echo on	Off at power up
ST	Camera Status request	ST?<CR><LF>		Actual setting
HP	Online Help request	HP?<CR><LF>		Command list
VN	Firmware version	VN?<CR><LF>		3 digits version
ID	Camera ID request	ID?<CR><LF>		12 characters
MD	Model Name request	MD?<CR><LF>		≤ 12 characters
UD	User ID (Free text)	UD=[Param.]<CR><LF> UD?<CR><LF>	User can save and load free text	≤ 12 characters
B - Shutter				
SM	Shutter Mode	SM=[Param.]<CR><LF> SM?<CR><LF>	0=Preset Shutter 1=Programmable exposure (RGB common) 2=Programmable exposure (RGB individual) 3=Auto exposure	
SH	Preset Shutter	SH=[Param.]<CR><LF> SH?<CR><LF>	0=Off, 1=1/60, 2=1/100,3=1/120, 4=1/250, 5=1/500, 6=1/1000, 7=1/2000, 8=1/4000, 9=1/10000, 10=1/16000 11=1/50000	
PE	Programmable Exposure (RGB common set)	PE=[Param.]<CR><LF> PE?<CR><LF>	0 to 1040	SM=1
PER	Programmable Exposure(R)	PER=[Param]<CR><LF> PER?<CR><LF>	0 to 1040	SM=2
PEG	Programmable Exposure(G)	PEG=[Param]<CR><LF> PEG?<CR><LF>	0 to 1040	SM=2
PEB	Programmable Exposure(B)	PEB=[Param]<CR><LF> PEB?<CR><LF>	0 to 1040	SM=2
C - Trigger mode				
TR	Trigger mode	TR=[Param.]<CR><LF> TR?=<CR><LF>	0=Continuous 1=EPS 2=PWC 3=RCT	
TP	Trigger polarity	TP=[Param.]<CR><LF> TR?=<CR><LF>	0= active low 1= active high	
TI	Trigger Input	TI=[Param.]<CR><LF> TI?=<CR><LF>	0= Camera Link 1=Hirose12P	
SL	Smear less	SL=[Param.]<CR><LF> SL? <CR><LF>	0=OFF 1=ON	
LS	LVAL SYNC/ASYNC	LS=[Param.]<CR><LF> LS? <CR><LF>	0=Auto 1=Sync 2=Async	
TRGM	Trigger Mask	TRGM=[Param.]<CR><LF> > TRGM? <CR><LF>	0=Mask ON 1=No Mask	
D - Image format				
BA	Bit Allocation	BA=[Param.]<CR><LF> BA?<CR><LF>	0=8-bit 1=10-bit 2=12-bit	
SC	Scan Format	SC=[Param.]<CR><LF> SC? <CR><LF>	0=Full Frame 1=Partial	
PRGP	Programmable partial	PRGP=[Param]<CR><LF> PRGP? <CR><LF>	0=Programmable 1=2/3 Partial 2=1/2 Partial 3=1/4 Partial 4=1/8 Partial	Set at SC=1
STL	Variable partial start line	STL=[Param.]<CR><LF> VB?<CR><LF>	1 ～ 1040	Start line < End line
ETL	Variable partial end line	ETL=[Param.]<CR><LF> VB?<CR><LF>	1 ～ 1040	End line > Start line
VB	V-Binning	VB=[Param.]<CR><LF> VB?<CR><LF>	0=OFF 1=On	Set at SC=o
E- Gain ,Knee ,Black and signal settings				
GA	Master Gain	GA=[Param.]<CR><LF> GA?<CR><LF>	-92 ～ 347 (-3dB ～ +12dB ,0.035dB step)	
GAR	R Gain	GAR=[Param.]<CR><LF> GAR?<CR><LF>	-200 ～ 200(-7dB ～ +7dB,0.035dB step)	Specification is -6dB to +6dB
GAB	B Gain	GAB=[Param.]<CR><LF> GAB?<CR><LF>	-200 ～ 300 (-7dB～+10.5dB,0.035dB step)	Specification is -6dB to +6dB
AGC	Gain Mode	AGC=[Param.]<CR><LF> AGC?<CR><LF>	0=Manual Gain Control 1=Auto Gain Control	

AASX	AGC Window Size X	AASX=[Param.]<CR><LF> AASX?<CR><LF>	1 to 8	
AASY	AGC Window Size Y	AASY=[Param.]<CR><LF> AASY?<CR><LF>	1 to 8	
AAOX	AGC Window offset X	AAOX=[Para.]<CR><LF> AAOX?<CR><LF>	0 to 7	
AAOY	AGC Window offset Y	AAOY=[Para.]<CR><LF> AAOY?<CR><LF>	0 to 7	
AGCS	AGC Speed	AGCS=[Param]<CR><LF> AGCS?<CR><LF>	0=slow 1=standard 2=fast	AGC tracking speed setting Default=standard
AGCF	AGC Reference	AGCF=[Para.]<CR><LF> AGCF?<CR><LF>	512 to 14240	AGC Reference Level at 14bit
SDM	Shading Correction Mode	SDM=[Param.]<CR><LF> SDM?<CR><LF>	0=Off, 1=Factory Shading. 2=User1, 3=User2	
RS	Recalibrate Shading Correction	RS=[Param1],[Param2]<CR><LF>	Param1：0=User1,1=User2 Param2：0=Flat, 1=Color	
SDTH	Shading Threshold	SDTH=[Param.]<CR><LF>SDTH?<CR><LF>	16384 to 65535	
KN	Knee On/Off	KN=[Param.]<CR><LF> KN?<CR><LF>	0=Off, 1=On	
KSR	Knee Slope - Red	KSR=[Param]<CR><LF> KSR?<CR><LF>	0 to 16383	X1 at 16383
KSM	Knee Slope - Green	KSM=[Param]<CR><LF> KSM?<CR><LF>	0 to 16383	X1 at 16383
KSB	Knee Slope - Blue	KSB=[Param]<CR><LF> KSB?<CR><LF>	0 to 16383	X1 at 16383
KPR	Knee Point - Red	KPR=[Param]<CR><LF> KPR?<CR><LF>	0 to 4095	
KPM	Knee Point - Green	KPM=[Param]<CR><LF> KPM?<CR><LF>	0 to 4095	
KPB	Knee Point - Blue	KPB=[Param.]<CR><LF> KPB?<CR><LF>	0 to 4095	
SP00	Setup -Green	SP00=[Param.]<CR><LF> SP00?<CR><LF>	±128	
SPR0	Setup -Red	SPR0=[Param.]<CR><LF> SPR0?<CR><LF>	±128	
SPB0	Setup -Blue	SPB0=[Param.]<CR><LF> SPB0?<CR><LF>	±128	
F - AWB,LUT and other				
WB	White Balance Mode	WB=[Param.]<CR><LF> WB?<CR><LF>	0=Manual/One push AWB 1=Continuous 2=4000K 3=4600K 4=5600K	
AW	One-push AWB	AW=[Param.]<CR><LF>	1=Activates one-push AWB	
WASX	White Balance Window Size X	WASX=[Param.]<CR><LF> WASX?<CR><LF>	1 to 8	
WASY	White Balance Window Size Y	WASY=[Param.]<CR><LF> WASY?<CR><LF>	1 to 8	
WAOX	White Balance Window offset X	WAOX=[Param.]<CR><LF> WAOX?<CR><LF>	0 to 7	
WAOY	White Balance Window offset Y	WAOY=[Param.]<CR><LF> WAOY?<CR><LF>	0 to 7	
AWRS	Request the Result of One Push AWB	AWRS?<CR><LF>	0=Complete. 1=Too Bright. 2=Too dark. 3=Timeout Error. 4=Busy 5=Limit. 6= Trig is not set as Normal.	
LUTC	LUT Control	LUTC=[Param.]<CR><LF> LUTC?<CR><LF>	0=off, 1=0.45 γ ,2=0.6 γ ,3=LUT	
LUTR	LUT data communication (For Red)	LUTR=[Param.]<CR><LF> LUTR?<CR><LF>	transfer by a serial method. The number of the data is 512. Param: 0 to 8191	
LUTG	LUT data communication (For Green)	LUTG=[Param.]<CR><LF> LUTG?<CR><LF>	transfer by a serial method. The number of the data is 512. Param: 0 to 8191	

LUTB	LUT data communication (For Blue)	LUTB=[Param.]<CR><LF> LUTB?<CR><LF>	transfer by a serial method. The number of the data is 512. Param: 0 to 8191	
TPN	Test pattern	TPN=[Param.]<CR><LF> TPN?<CR><LF>	0=OFF 1 to 15 pattern	
RF	RCT FVAL Type	RF=[Param.]<CR><LF> RF?<CR><LF>	0=Camera Link Standard 1=JAI Standard	
CM	Center Marker	CM=[Param.]<CR><LF> CM?<CR><LF>	Upper 4bit Center marker RGB Indicate Bit6 bit5 bit4 R-Ch G-Ch B-Ch 1:on 1:on 1:on 0:off 0:off 0:off Lower 4bit 0=Normal Mode, 1=Vertical Bar 2=Horizontal Bar ,3=Both	
CMTX	Color Matrix	CMTX=[Param.]<CR><LF> CMTX?<CR><LF>	0=Linear 1=sRGB 2=Adobe RGB 3=User	
BLM	Blemish Control	BLM=[Param]<CR><LF> BLM?<CR><LF>	0=off, 1=Black, 2=White, 3=Both	
MGRR3	R_R_MATRIX_GAIN	MGRR3=,[Param.]<CR><LF> MGRR3?<CR><LF>	-2048 to 2047	
MGRG3	R_G_MATRIX_GAIN	MGRG3=[Param.]<CR><LF> MGRG3?<CR><LF>	-2048 to 2047	
MGRB3	R_B_MATRIX_GAIN	MGRB3=[Param.]<CR><LF> MGRB3?<CR><LF>	-2048 to 2047	
MGGR3	G_R_MATRIX_GAIN	MGGR3=[Param.]<CR><LF> MGGR3?<CR><LF>	-2048 to 2047	
MGGG3	G_G_MATRIX_GAIN	MGGG3=[Param.]<CR><LF> MGGG3?<CR><LF>	-2048 to 2047	
MGGB3	G_B_MATRIX_GAIN	MGGB3=[Param.]<CR><LF> MGGB3?<CR><LF>	-2048 to 2047	
MGBR3	B_R_MATRIX_GAIN	MGBR3=[Param.]<CR><LF> MGBR3?<CR><LF>	-2048 to 2047	
MGBG3	B_G_MATRIX_GAIN	MGBG3=[Param.]<CR><LF> MGBG3?<CR><LF>	-2048 to 2047	
MGBB3	B_B_MATRIX_GAIN	MGBB3=[Param.]<CR><LF> MGBB3?<CR><LF>	-2048 to 2047	
NRC	Noise reduction	NRC=[Param.]<CR><LF> NRC?<CR><LF>	0=FF 1=ON	
NRS	Noise reduction threshold	NRS=[Param.]<CR><LF> NRS?<CR><LF>	0 to 255	0=FF, 255=max
TMS	Temperature sensor	TMS?<CR><LF>	-880 to 2400	/16 -= ℃ (-55 to 150℃)
G - Saving and loading data in EEPROM				
LD	Load settings from camera EEPROM	LD=[Param.]<CR><LF>	0=Factory data 1=User 1 area 2=User 2 area 3=User 3 area	Latest used data defa. at power up
SA	Save settings to camera EEPROM	SA=[Param.]<CR><LF>	1=User 1 area 2=User 2 area 3=User 3 area	Parameter = 0 is not allowed
EA	EEPROM area request	EA?<CR><LF>	0=Factory data 1=User 1 area 2=User 2 area 3=User 3 area	Return latest used area

!! Do not try to use commands not shown in this list.

11. Camera Control Tool for AT-140CL

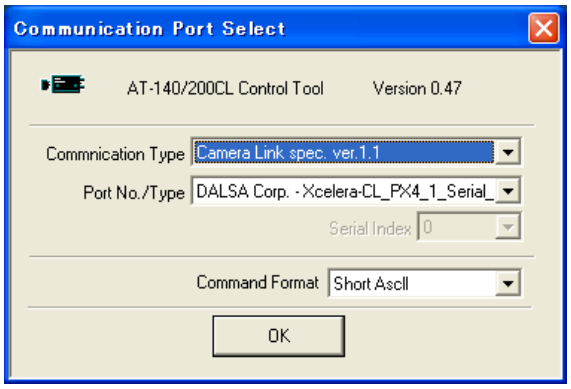
A Camera Control Tool for AT-140CL can be downloaded from the JAI web site www.jai.com
This control tool is based on the Windows XP operating system.

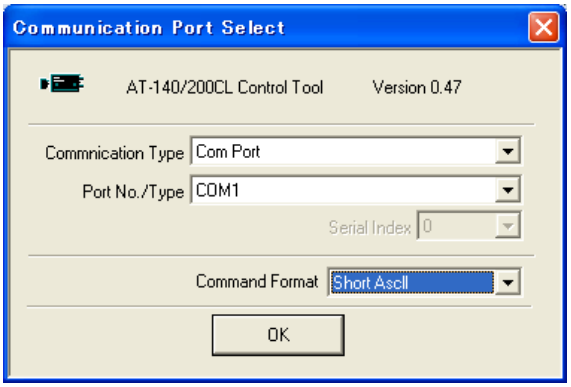
11.1. Software installation

Run AT-140_200CL.exe file from the folder downloaded. As the setup program initiates, start to set up according to screen instructions.

11.2. Run the software

Connect the camera with PC via a Camera link communication cable and set the camera power ON. In the Windows Stat menu, select “program” and then “JAI A-S” and click “AT-200CL Control Tool”. If the frame grabber boards are already installed in the PC, the control tool shows all installed frame grabber boards and it is OK to use. Click “OK”.
If the frame grabber board is not used, select an appropriate port and click “OK”.





If the following error message comes up, please check the connection cable and the camera power.

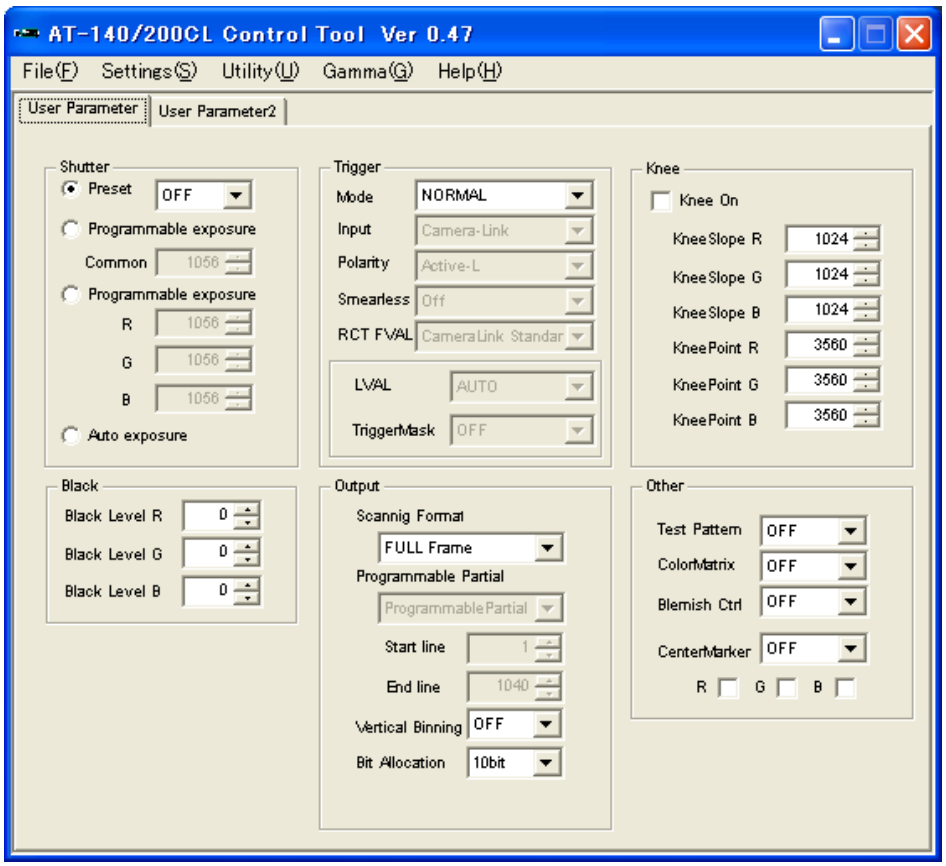
11.3. Camera Control screen

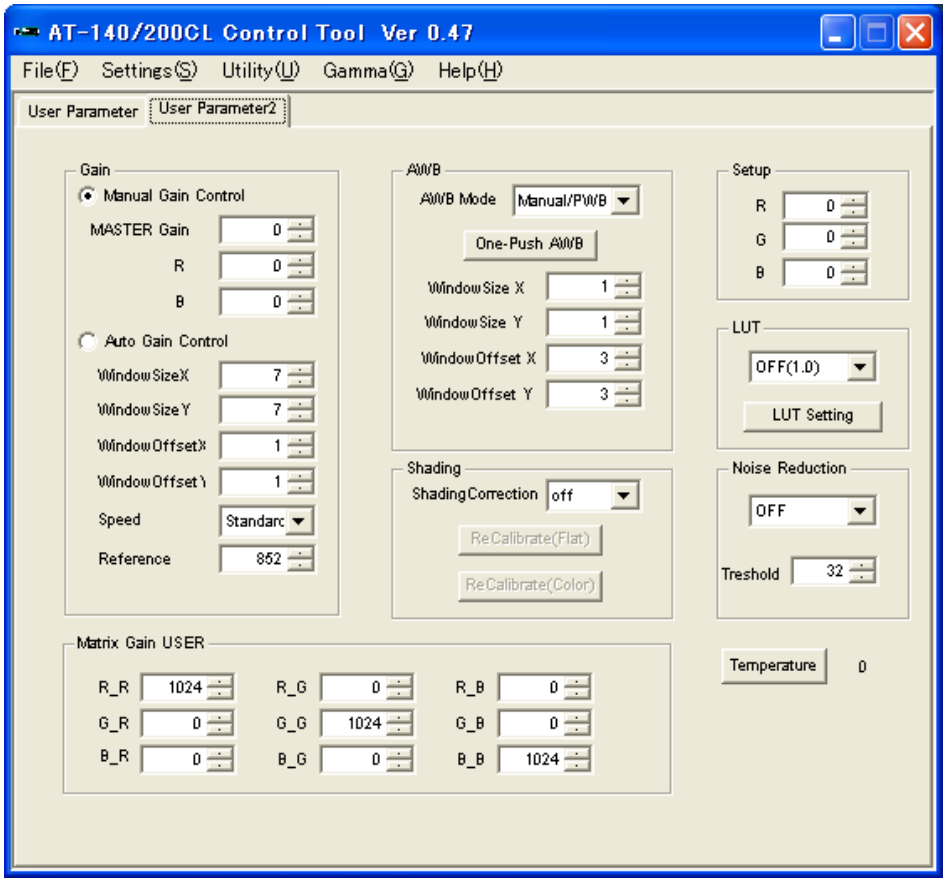
When the communication between PC and the camera is established, the current settings in the camera are loaded to the control tool and the control tool presents the current camera settings.
There are two screens for the camera control, “User Parameter1” and “User Parameter2”.

Using each screen, the following parameters can be set.

User Parameter 1
Shutter, Trigger, Output format, Knee, Test pattern, Color matrix, Blemish ON/OFF, Center marker

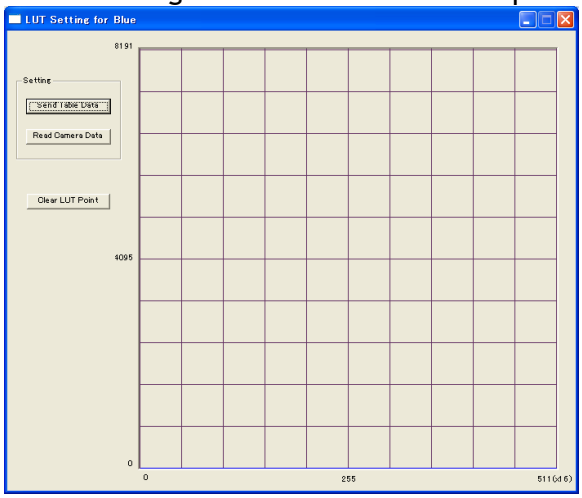
User Parameter 2
Gain, AWB, Matrix gain user, Shading, Setup, LUT, Noise reduction ON/OFF, Temperature



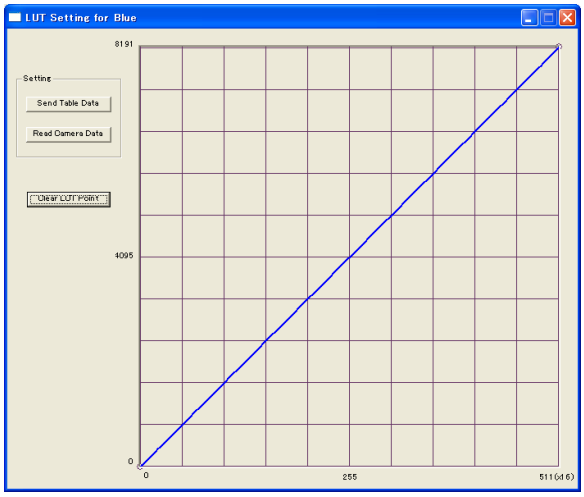


11.4. LUT set up

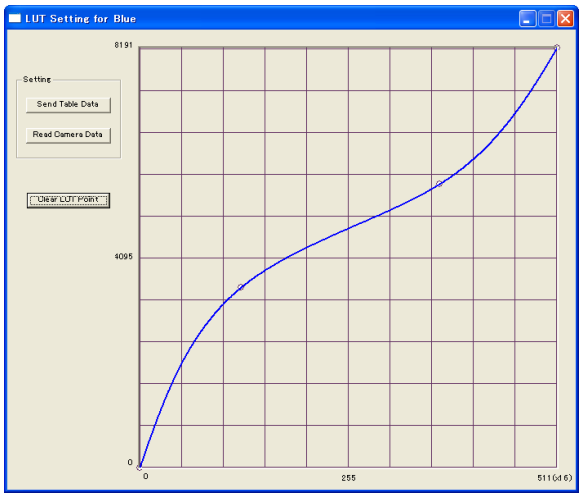
Click “settings” button on the tab to open the following windows.



Click “Clear LUT point” button and then “ $\gamma = 1$ ” graph will be shown.



It is possible to set up an appropriate gamma characteristics by dragging the necessary point in a line.



Click “Send table data” button and send the data to the camera.
When “Read camera data” is clicked, the current camera data is downloaded in the camera control software.

11.5. Menu

11.5.1 File Menu

Open: Transfer the setting parameter data in HDD to the camera.
Extension is .cam

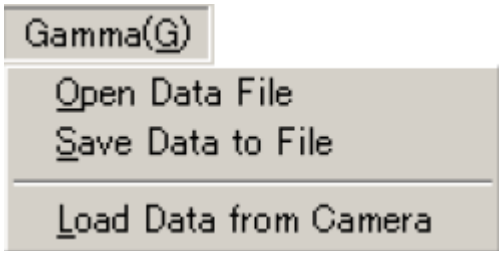
Save as: Save the setting parameter data in HDD.
Extension is .cam

Exit: Finish the software.

11.5.2 Settings menu

Reload: Read the setting parameters in the RAM inside the camera.
Load settings: Load the setting parameters in the EEPROM inside the camera. Select from Factory, User 1, User 2, User3.
Store settings: Store the setting parameters in the EEPROM inside the camera. Select from User 1, User 2, User3.

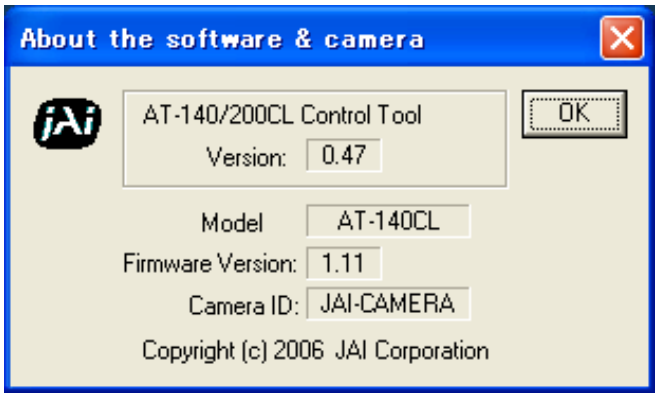
11.5.3 Gamma menu



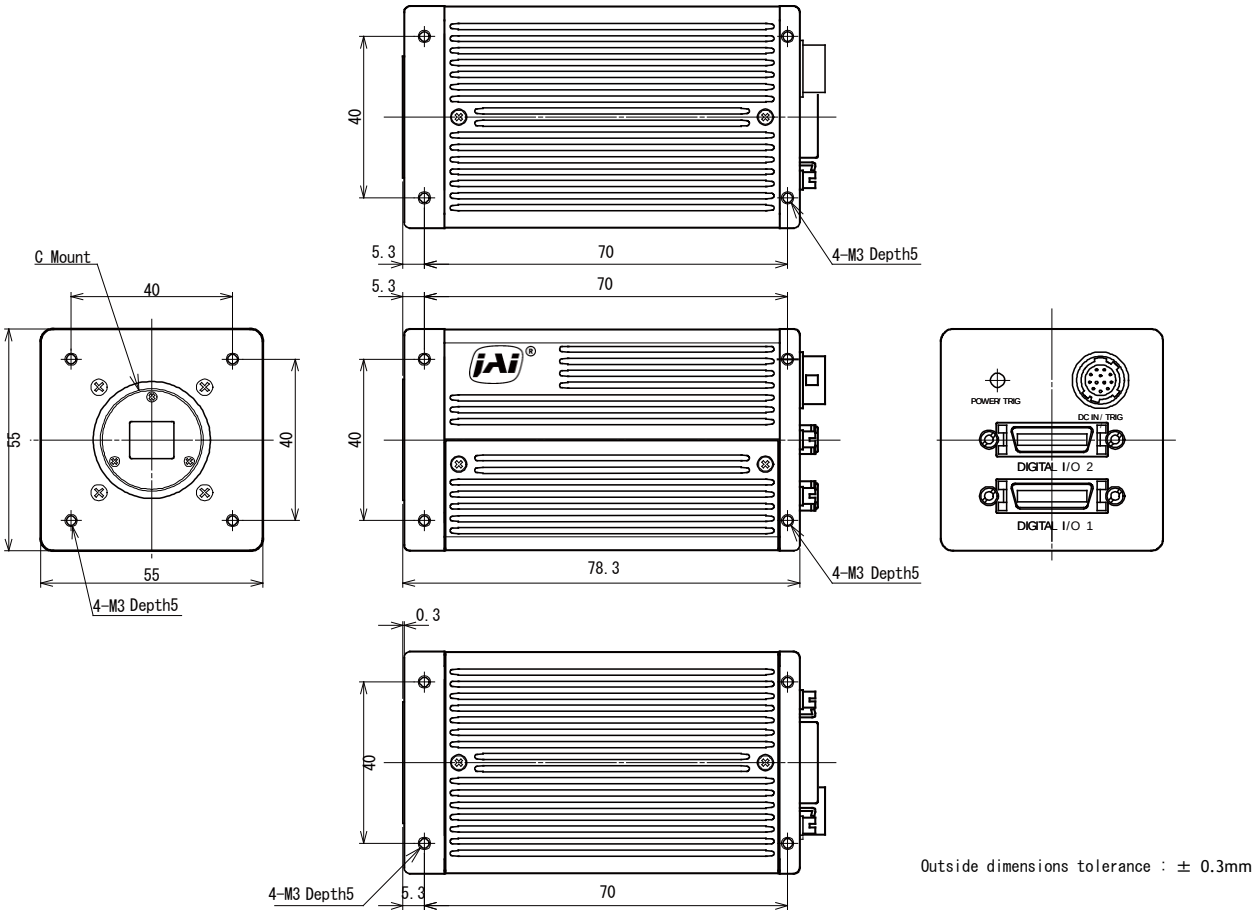
Open Data file: Read the LUT data stored in HDD to the Camera Control. Extension is .csv.
Save Data to File: Store the LUT data created in the Camera Control to the HDD. Extension is .csv.
Load Data from Camera: Load the current LUT data to the Camera Control. Select from User 1, User 2, User 3.

11.5.4 Help

Display the Camera Control Software version, Model name and camera ID.



12. External Appearance and Dimensions



***Note**: Rear protrusion on C-mount lens must be less than 4.0mm*

Fig. 40. Outline.

13. Specifications

13.1. Spectral sensitivity for sensor

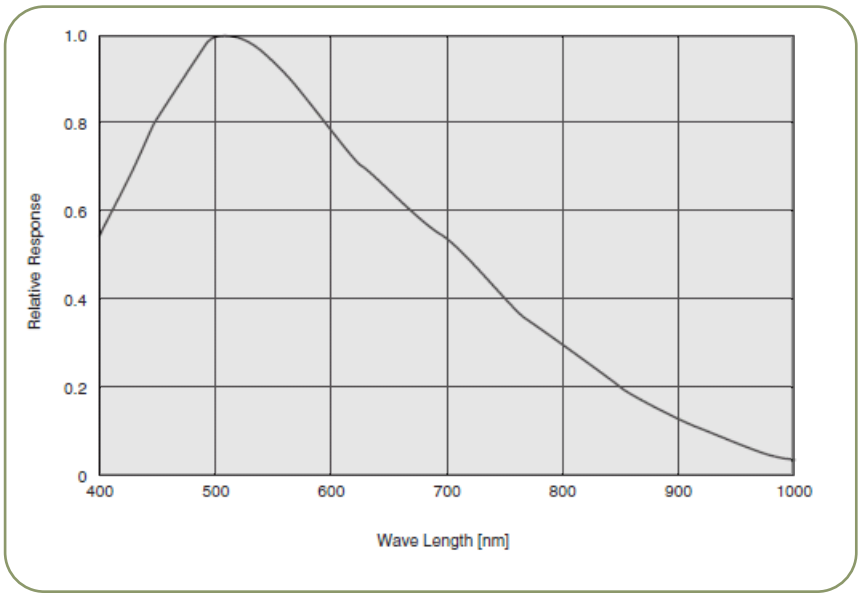


Fig. 41. Spectral sensitivity for AT-140CL sensor

13.2. Specification table

Specifications	AT-140CL
Optical system	1/2 inch F4.0 prism
Scanning system	Progressive
Frame rate full frame	25.21 frames/second (1056 lines per frame)
Pixel clock	50 MHz
Line frequency V binning	26.624 kHz (1878 clk per line) 21.720 kHz (2302 clk per line)
CCD sensors	3 x 1/2" IT CCD on prism. Sony ICX267AL
Sensing area	6.4 (h) x 4.8 (v) mm 1/2 inch diagonal
Cell size	4.65 (h) x 4.65 (v) μm
Active pixels	1392 (h) x 1040 (v)
Pixels in video output full 2/3 partial 1/2 partial 1/4 partial 1/8 partial Variable partial V binning	1392 (h) x 1040 (v) 25.21 fps. (1056 lines per frame) 1392 (h) x695 (v) 33.49 fps (795 lines per frame) 1392 (h) x 521 (v) 40.04 fps. (665 lines per frame) 1392 (h) x 261 (v) 56.77 fps. (469 lines per frame) 1392 (h) x 131 (v) 71.38 fps. (373 lines per frame) Programmable start line and height, start line 1 to 1040, height 1 to 1040 1392 (h) x 520 (v) 40.98 fps. (530 lines per frame)
Sensitivity (on sensor) (minimum)	1.25 Lux, max gain, 50% video
S/N ratio	>50 dB. (On Green)
Digital Video outputs.	3 x 8-bit RGB via single port Camera Link base configuration or 3 x 10-bit RGB via dual port Camera Link medium configuration or 3 x 12-bit RGB via dual port Camera Link medium configuration
Iris video output	0.7 V p-p, 75 Ω NUM luminance signal w/o Sync
Inputs TTL Camera Link	Ext. trigger 4 Vp-p ±2 V. (TTL or 75 Ω) Ext. trigger (LVDS)
Outputs TTL Camera Link	XEEN output 4 V p-p from 75 Ω source (TTL) RGB 8/10/12-bit video output. D0 – D9 Pixel clock, DVAL, LVAL, FVAL and EEN (LVDS)
White balance Tracking range	Manual/one push, continuous, preset(4000K, 4600K,5600K) -6 to +6 dB. (4000K to 9000K) White balance setting in factory:7800K (R and B gain settings=0)
Gain Gain range	Manual for all 3 colors Master -3 to +12 dB. R and B –6 to +6 dB
Gamma	1.0 (OFF) , 0.6, 0.45 or LUT (Look Up Table)
Knee correction	Knee point and knee slope for R, G and B channel
Shading Compensation	ON/OFF
Linear Matrix	Manual for R, G and B / Preset (sRGB, Adobe RGB)
Noise reduction	ON / OFF
Synchronization	Int. X-tal
Trigger modes	Continuous, Edge Pre-select, Pulse Width Control, Reset continuous
Trigger function	LVAL synchronous or LVAL asynchronous auto detect
Shutter speed (Preset)	OFF,1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/3600, 1/8000, 1/18,000 and 1/53,000 sec. R, G and B can be set individually
Programmable exposure	1L – 1056L. RGB common or individual. (L=37.56 μs.)
Auto shutter	1/25 to 1/2400 sec
Pulse Width Control	2L to 53243 L
LVAL accumulation	SYNC/ASYNC auto detect
Smear less mode	Available for EPS and PWC
Control interface	serTC and serTFG via Camera Link
Functions controlled by Camera Link	Trigger, shutter, scanning, readout, polarity, gain, set-up, white balance, gamma, knee point and slope, linear matrix, blemish, shading compensation
Operating temperature	-5°C to +45°C.
Humidity	20 - 80% non-condensing
Storage temp./humidity	-25°C to 60°C./20% - 80 % non-condensing

Specifications	AT-140CL
Vibration	3 G (15 Hz – 200 Hz in XYZ)
Shock	50 G
Regulations	CE (EN 61000-6-2, EN 61000-6-3), FCC part 15 class A, RoHS
Power	10.8V to 26.4V DC. 0.51A (Typical , Full frame ,12V input) 0.54 A (Typical ,1/8 partial, +12V input)
Lens mount	C-mount (Rear protrusion on C mount must be less than 4mm) The lens used should be designed for 3CCD cameras.
Flange back	17.526mm, Tolerance +0 –0.05mm
Optical axis	Center ±0.1mm
Dimensions	55 x 55 x 78.3 mm (HxWxD)
Weight	290 g

Note: Above specifications are subject to change without notice
Specifications are valid after a 30 min. warm up period.

14. Appendix

14.1. Precautions

Personnel not trained in dealing with similar electronic devices should not service this camera.
The camera contains components sensitive to electrostatic discharge. The handling of these devices should follow the requirements of electrostatic sensitive components.
Do not attempt to disassemble this camera.
Do not expose this camera to rain or moisture.
Do not face this camera towards the sun, extreme bright light or light reflecting objects.
When this camera is not in use, put the supplied lens cap on the lens mount.
Handle this camera with the maximum care.
Operate this camera only from the type of power source indicated on the camera.
Power off the camera during any modification such as changes of jumper and switch setting.

14.2. Typical Sensor Characteristics

The following effects may be observed on the video monitor screen. They do not indicate any fault of the camera, but do associate with typical sensor characteristics.

V. Aliasing
When the CCD camera captures stripes, straight lines or similar sharp patterns, jagged image on the monitor may appear.

Blemishes
All cameras are shipped without visible image sensor blemishes.
Over time some pixel defects can occur. This does not have a practical effect on the operation of the camera. These will show up as white spots (blemishes).
Exposure to cosmic rays can cause blemishes to appear on the image sensor. Please take care to avoid exposure to cosmic rays during transportation and storage. It is recommended using sea shipment instead of air flight in order to limit the influence of cosmic rays on the camera.
Pixel defects/blemishes also may emerge due to prolonged operation at elevated ambient temperature, due to high gain setting, or during long time exposure. It is therefore recommended to operate the camera within its specifications.

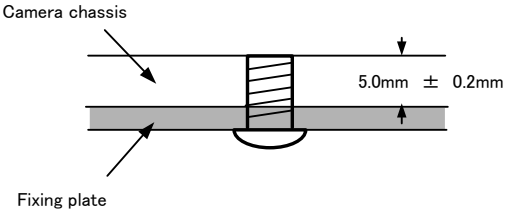
Patterned Noise
When the sensor captures a dark object at high temperature or is used for long time integration, fixed pattern noise may appear on the video monitor screen.

14.3. Caution when mounting a lens on the camera

When mounting a lens on the camera dust particles in the air may settle on the surface of the lens or the image sensor of the camera. It is therefore important to keep the protective caps on the lens and on the camera until the lens is mounted. Point the lens mount of the camera downward to prevent dust particles from landing on the optical surfaces of the camera. This work should be done in a dust free environment. Do not touch any of the optical surfaces of the camera or the lens.

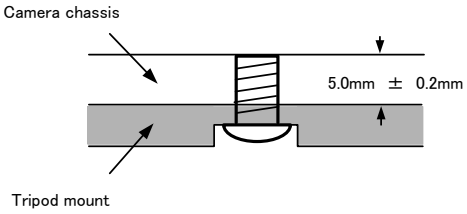
14.4. Caution when mounting the camera

When you mount the camera on your system, please make sure to use screws of the recommended length described in the following drawing. Longer screws may cause serious damage to the PCB inside the camera.



Mounting the camera to fixing plate

If you mount the tripod mounting plate, please use the provided screws.



Attaching the tripod mount

14.5. Exportation

When exporting this product, please follow the export regulation of your own country.

14.6. References

1. This manual can and datasheet for AT-140CL can be downloaded from www.jai.com
2. Camera control software can be downloaded from www.jai.com
3. Specifications for the CCD sensor Sony ICX-274AL can be found on www.jai.com

Change tracking

Date	Revision	Changes
Oct 2009	1.0	New issue
May 2012	1.1	Delete Blemish Compensation circuit

User's Record

Camera type: **AT-140CL**

Revision: ……..

Serial No. ……..

Firmware version. ……..

For camera revision history, please contact your local JAI distributor.

User's Mode Settings.

User's Modifications.

Europe, Middle East & Africa	*Asia Pacific*	*Americas*
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Visit our web site at www.jai.com