Preliminary

Digital monochrome / color
HDTV (1080p) CMOS camera

CV-A20CL
CV-A80CL

Operation Manual

1. General

The CV-A20CL/CV-A80CL uses a newly developed 2 million pixel HDTV (1080p) CMOS Monochrome and Bayer mosaic color sensor. The sensor has a 2/3 inch format and 16:9 aspect ratio. Total pixel number is 2,112 (H) x 1,188(V).
The CV-A20CL/CV-A80CL operates at 60 frames per second with full resolution and for higher frame rate it has the window-scanning mode.
The CV-A20CL/CV-A80CL has Camera Link standard interface and outputs 8-bit or 10-bit video.

The latest version of this manual can be downloaded from: www.jai.com
The latest version of Camera Control Tool for CV-A20CL/CV-A80CL can also be downloaded from: www.jai.com
For camera revision history, please contact your local JAI distributor.

2. Standard Composition

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

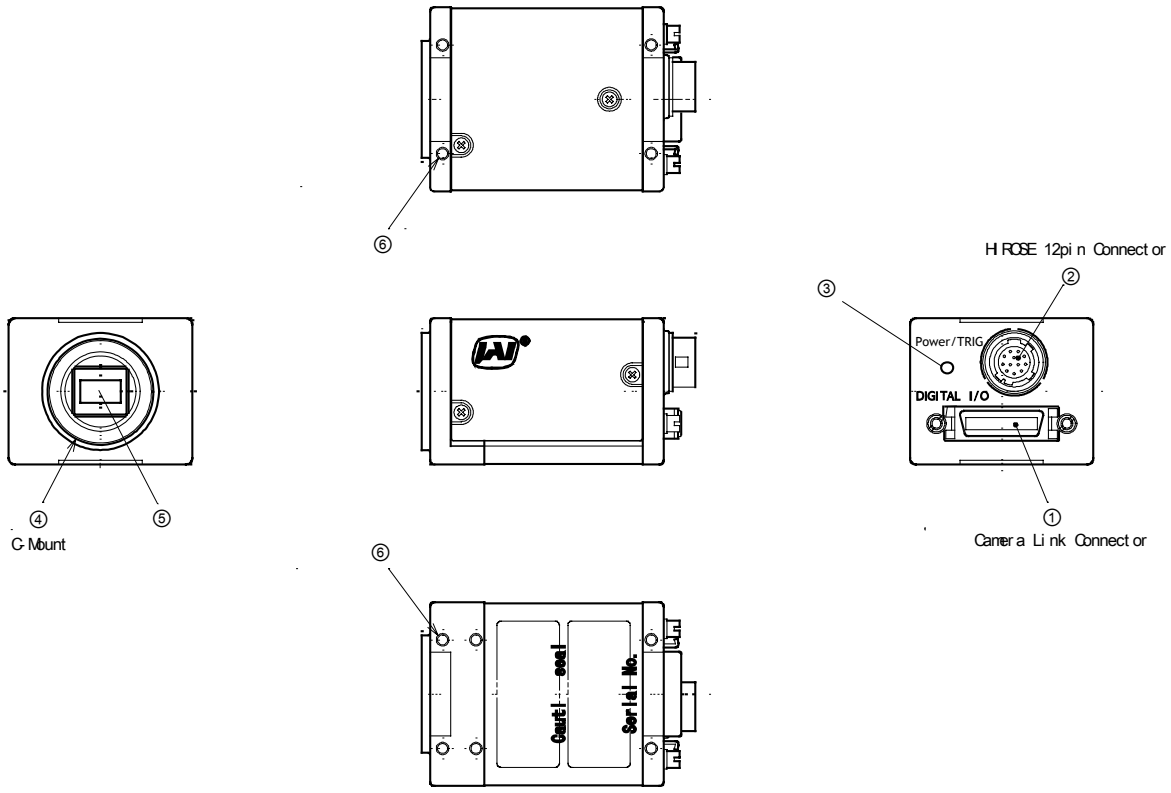
The camera is available in the following versions:

CV-A20 CL	2 million pixel HDTV format monochrome CMOS camera
CV-A80 CL	2 million pixel HDTV format Bayer mosaic color CMOS camera

3. Main Features

- Compact 2/3" progressive scan CMOS camera
- Monochrome and Bayer mosaic color versions
- HDTV format with 1920 (h) x 1080 (v) pixels
- 5.0 µm square pixels
- 60 frames/second with full resolution
- Rolling shutter with snap-shot trigger
- High sensitivity
- Low power consumption
- Shutter speed from 1/60 to 1/20,000 sec. in continuous mode
- Windowing mode for higher frame rate
- 10 or 8-bit output
- Setup by Windows NT/2000/XP via serial communication

4. Locations and functions



1. Camera Link Connector
2. 12-pin Hirose Connector for DC12V, Trigger and RS232C
3. LED indicator
4. C mount *
5. CMOS sensor
6. Mounting holes 10 x M3, depth 4mm

*) Note: Rear protraction on the C-mount lens must be less than 10mm.

Fig.1. Locations

5. Pin configuration

5.1. 12-pin multi connector

Type: HR10A-10R-12PB
Use the part number HR10A-10P-12S for the cable side

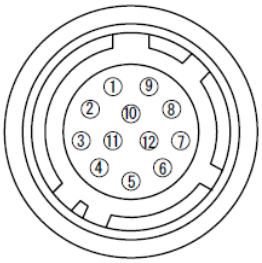


Fig. 2 Hirose 12-pin connector

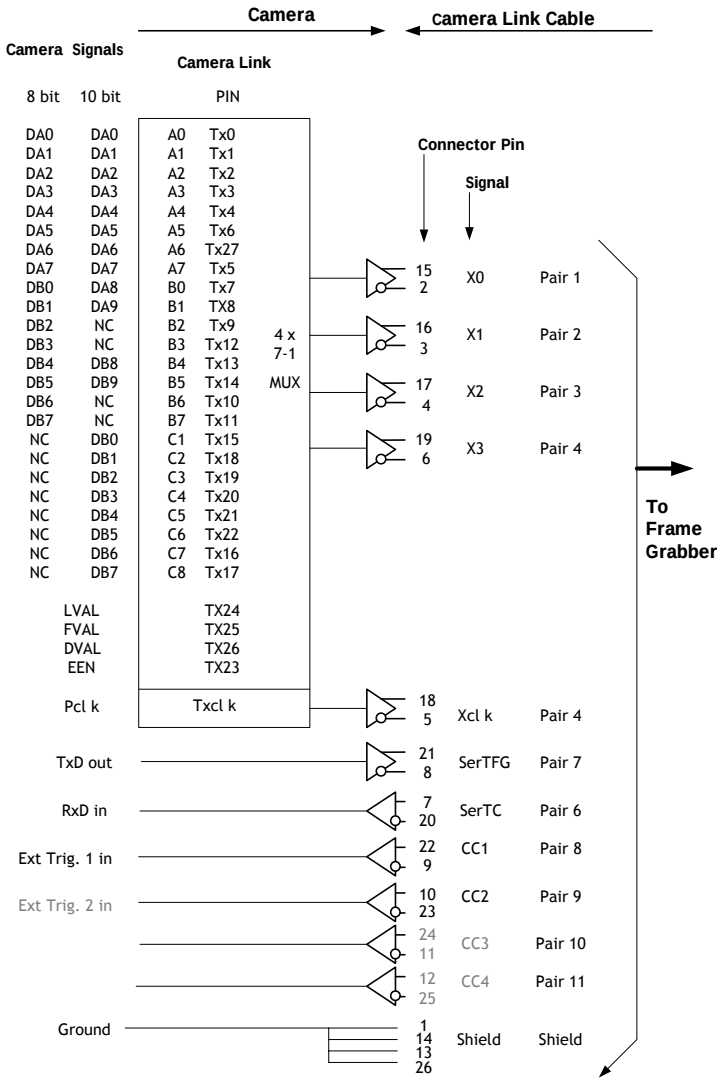
Pin	I/O	Name	Note
1	--	GND	
2	--	+12V	Power
3	--	GND	
4	O	IRIS VIDEO	Video signal for Auto Iris Lens
5	--	GND	
6	I	RXD	RS-232 C (default setting is CL serial communication)
7	O	TXD	
8	--	GND	
9	O	Strobe out	Exposure Enable (Active low)
10	I	Trigger	External Trigger Input
11	--	NC	
12	--	GND	

5.2. 26-pin connector (Digital Camera Link Interface)

Type: 26P MRD Connector 3M 10226-1A10JL

Fig.3. 26-pin connector

CV-A20 Connector Pin No.	Frame Grabber Connector Pin No.	I/O	Name	Note
1,13,14,26	1,13,14,26	--	GND	DC GND
7(+),20(-)	20(+),7(-)	I	RXD	RS232C
21(+),8(-)	6(+),19(-)	O	TXD	
10(+),23(-)	17(+),4(-)	(I)	Reserved	CC2
22(+),9(-)	5(+),18(-)	I	Trigger	CC1 Ext. Trigger
15(+),2(-)	12(+),25(-)	O	Txout0	Camera Link out
16(+),3(-)	11(+),24(-)	O	Txout1	
17(+),4(-)	10(+),23(-)	O	Txout2	
19(+),6(-)	8(+),21(-)	O	Txout3	
18(+),5(-)	9(+),22(-)	O	TxClk	Clock for CL



Port/ Signal	2tap		Pin No.
	8bit Output	10bit output	
Port A0	DA0(LSB)	DA0(LSB)	Tx0
Port A1	DA1	DA1	Tx1
Port A2	DA2	DA2	Tx2
Port A3	DA3	DA3	Tx3
Port A4	DA4	DA4	Tx4
Port A5	DA5	DA5	Tx6
Port A6	DA6	DA6	Tx27
Port A7	DA7(MSB)	DA7	Tx5
Port B0	DB0(LSB)	DA8	Tx7
Port B1	DB1	DA9(MSB)	Tx8
Port B2	DB2	NC	Tx9
Port B3	DB3	NC	Tx12
Port B4	DB4	DB8	Tx13
Port B5	DB5	DB9	Tx14
Port B6	DB6	NC	Tx10
Port B7	DB7(MSB)	NC	Tx11
Port C0	NC	DB0	Tx15
Port C1	NC	DB1	Tx18
Port C2	NC	DB2	Tx19
Port C3	NC	DB3	Tx20
Port C4	NC	DB4	Tx21
Port C5	NC	DB5	Tx22
Port C6	NC	DB6	Tx16
Port C7	NC	DB7	Tx17
LVAL			Tx24
FVAL			Tx25
DVAL			Tx26
EEN			Tx23

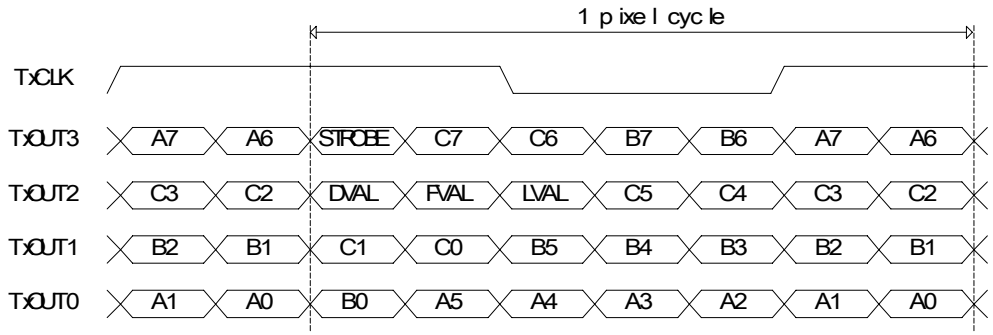


Fig.4. Principle diagram for Camera Link base configuration interface

5.3. Input and output circuits

In the following schematic diagrams, the input and output circuits for video and timing signals are shown.

5.3.1. **Iris video output**

This signal can be used for lens iris control in Continuous mode. The signal is taken from the PGA out in the sensor. This video output is without sync. The signal is 0.7 V p-p with low impedance.

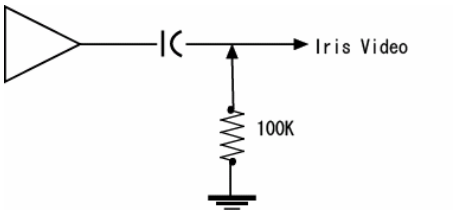


Fig.5 Iris video output

5.3.2. **Trigger input**

An external trigger input can be applied to pin 10 of 12-pin Hirose connector (when the command TI=1 has been set). The input is AC coupled. To allow long pulses the input circuit is designed as a flip-flop circuit. The leading and trailing edges of the trigger pulse activate the circuit.
The trigger polarity can be changed by TP=1.
The default trigger input level is 4V ± 2V, TTL.
By changing the camera internal switch (SW 1), the input impedance can be changed to 75 Ω

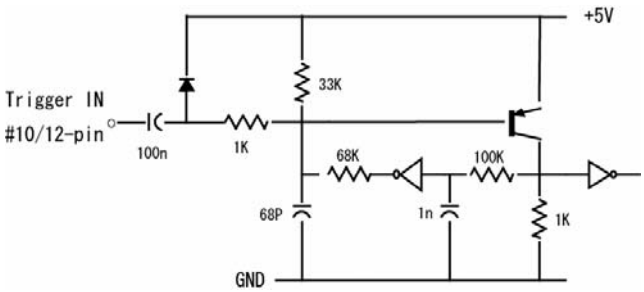


Fig.6 Trigger input circuit

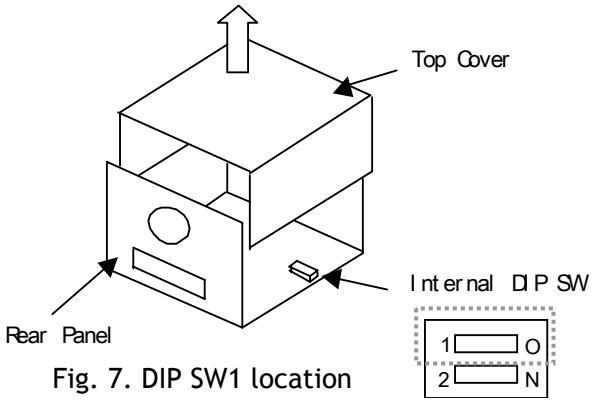


Fig. 7. DIP SW1 location

DIP SW 1
Trigger input impedance
ON : 75 Ω
OFF : TTL (Default)

5.3.3. **Strobe output**

The Strobe output is available at pin 9 of 12-pin connector. This signal controls the timing of Strobe flashing. In continuous mode, it is high during the blanking period. When the camera is set to snap-shot trigger mode, the output is high during the exposure period.

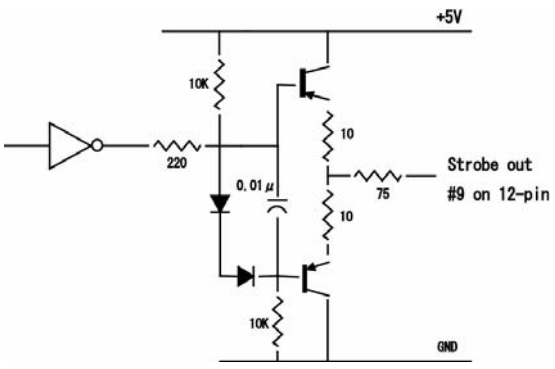


Fig.8 Strobe Output circuit

6. Functions and Operations

The CV-A20CL/CV-A80CL uses a rolling shutter CMOS image sensor and outputs digital 10-bit or 8-bit video, formatted as Odd and Even Interleaved output. The camera operates in Continuous and Snap-shot Trigger modes. The camera allows Windowing for faster frame rates. The CV-A20CL/CV-A80CL provides a Strobe output to control the timing of strobe flash.

6.1. Basic Functions

6.1.1. **Formatted Odd and Even Interleaved output**

Although the CV-A20CL CMOS sensor operates at 148.5MHz, the output pixel rate is a half of that, 74.25MHz due to using the Formatted Odd and Even Interleaved output.
Odd pixels of lines and even pixels of lines are output respectively as shown the below.

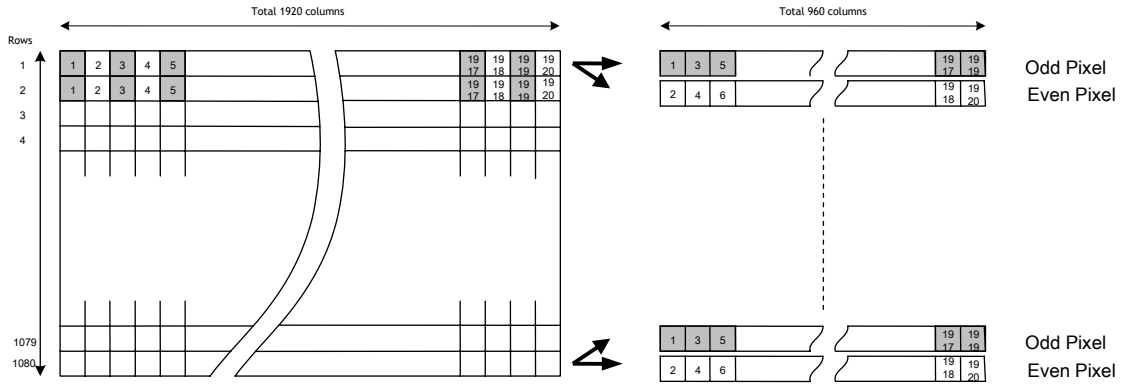


Fig. 9. Formatted Odd and Even interleaved output

6.1.2. **Strobe-preset Snap-Shot trigger operation**

The snap-shot trigger mode allows the capture of a complete frame when used in conjunction with a strobe light or a mechanical shutter. The scene to be captured must be shielded from all ambient light. The Strobe output can be used to synchronized strobe illumination / mechanical shutter to ensure that the sensor is exposed in the proper period.

Fundamental operating procedure:

1. After the external trigger is received, the strobe out signal is output. The delay and width of the strobe pulse can be programmed by the using the commands "RB", "ENL" and "ENP". See chapter 6.3.2 for details.
2. The strobe light illuminates the scene.
3. The sensor is read out at the end of the strobe period. At this time the sensor must again be shielded from ambient light.

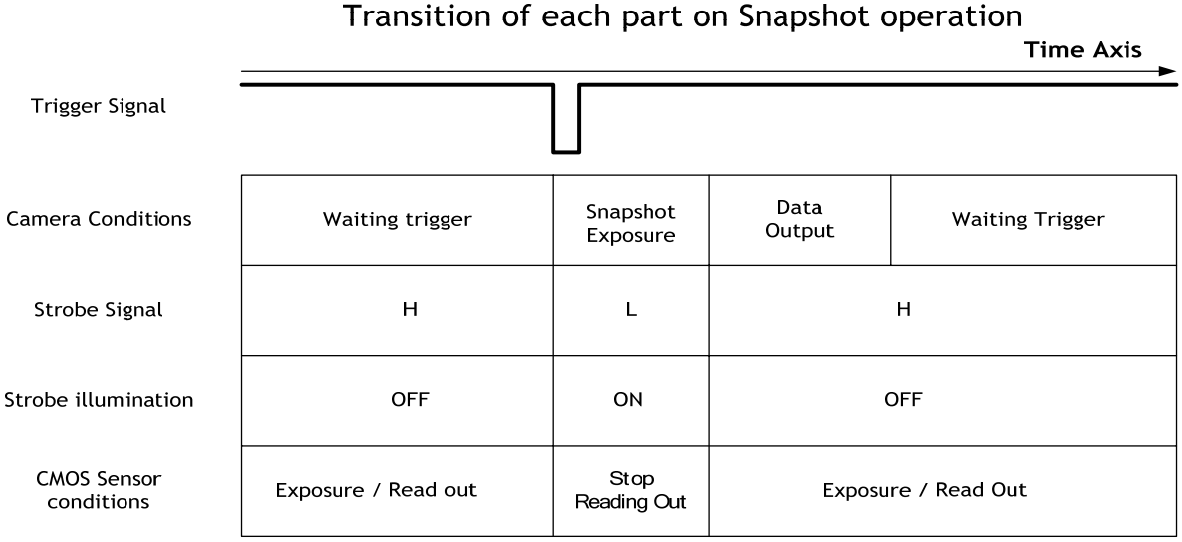
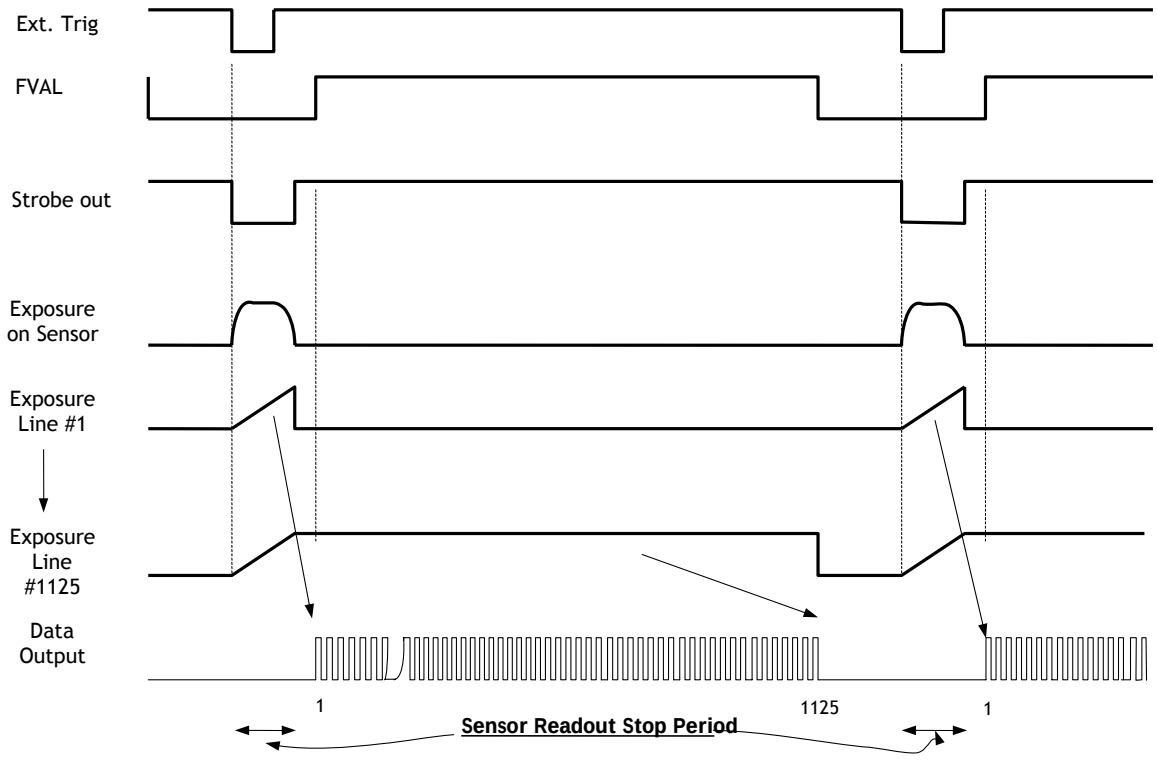


Fig.10. Transition of each part of Snap-shot trigger operation



Note: The above drawing shows the case of "Strobe Delay Time = 0".

Important Note:
Used CMOS sensor does not have a frame reset function and the sensor is continuously accumulating and reading out. Due to this, a residual image of the previous frame may be superimposed on the frame being shot. Therefore the scene to be captured must be shielded from ambient light.

Fig.11. General explanation of SnapShot operation

6.1.3. **Window Scan**

The CV-A20CL/CV-A80CL permits "Windowing" in the vertical direction. This reduces the number of lines being read out, thus increasing the frame rate. For the CV-A20CL the increment is 1 line and for the CV-A80CL the increment is 2 lines. Depending on the number of lines selected the frame rate can be varied from 60 fps for full line read out to 1125 fps.

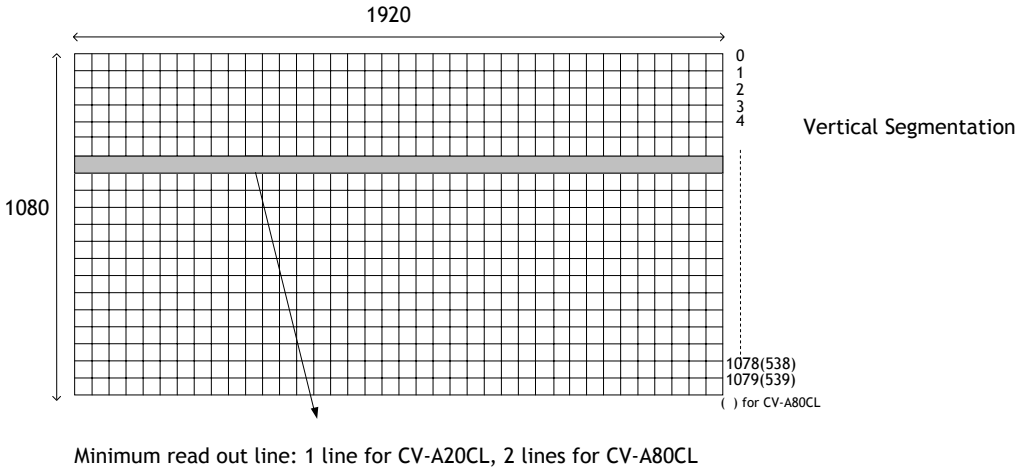


Fig.12. Window Scan Layout

Setting commands for windowing scan

Command WS : 0= Full Frame 1 = Window
Command WY : Window Scan Starting line — CV-A20CL 0 to 1079; CV-A80CL 0 to 1078
Command WH : Height of Window, lines — CV-A20CL 1 to 1080; CV-A80CL 2 to 1080

Setting example of windowing scan

The following drawing is the example of WY=540 and WH=60.

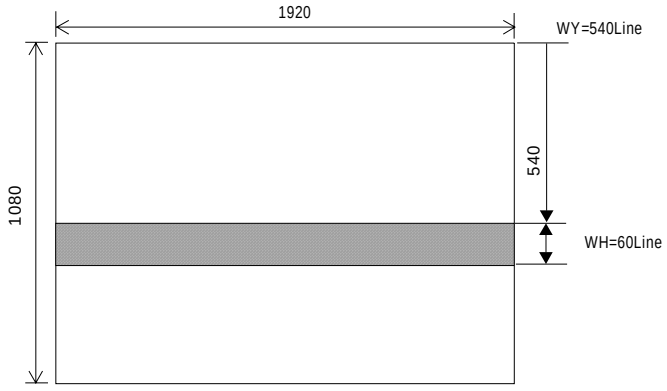


Fig.13. Example of window scan

6.1.4. Frame rate for Window Scan Mode

The frame rate is calculated as follows;

Frame frequency = 1L [67,500] divided by (Blanking Period [45] + windowing scan period [lines])

For instance, in the case that the vertical window is set at 540 lines the frame frequency is 67,500 ÷ (45 + 540) = 115.3 Hz

Important note:

1. Line frequency, 67.5 kHz, is not changed.
2. In continuous mode, the synchronous counter in the sensor will automatically reset after changing the setting of windowing. Therefore, the first frame right after changing the setting of window does not correctly show the effective area.
3. In Strobe-Preset Snapshot mode, the new windowing setting is effective from the following frame when the setting is changed during the trigger operation.

6.1.5. Electronic shutter

The electronic shutter employed in this camera is the rolling shutter system.
Exposure time can be adjusted by varying the shutter time of sensor.
There is approximately one frame time difference of the exposure between the first scanning line and the last scanning line.
The electronic shutter is available only in continuous mode.

The below figure shows relationship between picture area (line position) and exposure time.
The exposure time can be controlled in 1 LVAL steps by the pre-set shutter or the programmable exposure.

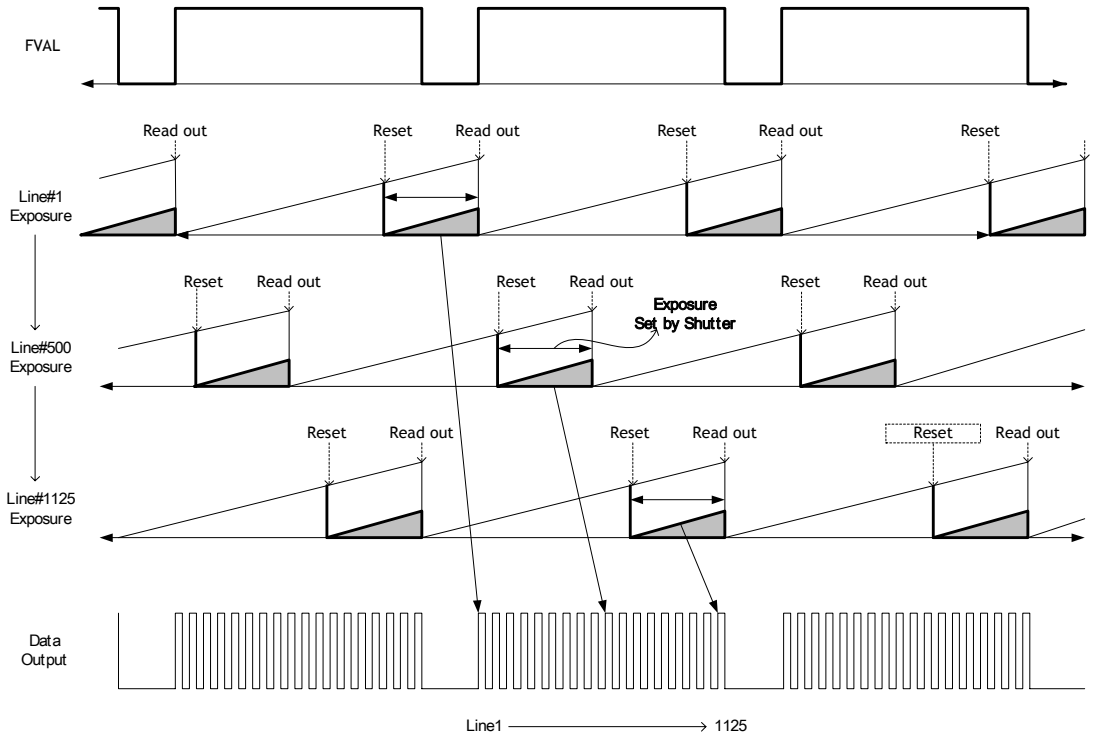


Fig.14. The relation between the picture area and the exposure time

Command SM: Shutter mode
SM=0 Preset shutter SM=1 Programmable exposure

Command SM=0 Preset shutter
0=OFF(1/60) 1=1/120 2=1/250 3 =1/500 4=1/1000 5=1/2000
6=1/5000 7=1/ 10,000 8=1/20,000

Command SM=1 Programmable exposure
The exposure time can be set in 1 LVAL unit in the range from 2LVAL to 1,125 LVAL.
Maximum shutter time Command: PE=1125
14.815µ s x 1125 LVAL = 16.67ms
Minimum shutter time Command: PE=2
14.815us * 2 LVAL = 29.63 µs
LVAL period = 14.815 µs.

Important Note:

- The electronic shutter is available together with Window scan, but it is effective only when the preset shutter value (LVAL) is set at a value less than the Window height. If the shutter value is larger than the window height (lines), the shutter is automatically set to OFF.
- When the Strobe-Preset Snapshot trigger mode is selected the shutter is automatically set to OFF.

6.2. Image sensor

6.2.1. Sensor Layout

The CMOS sensor layout is as shown below with respect to rows and columns.

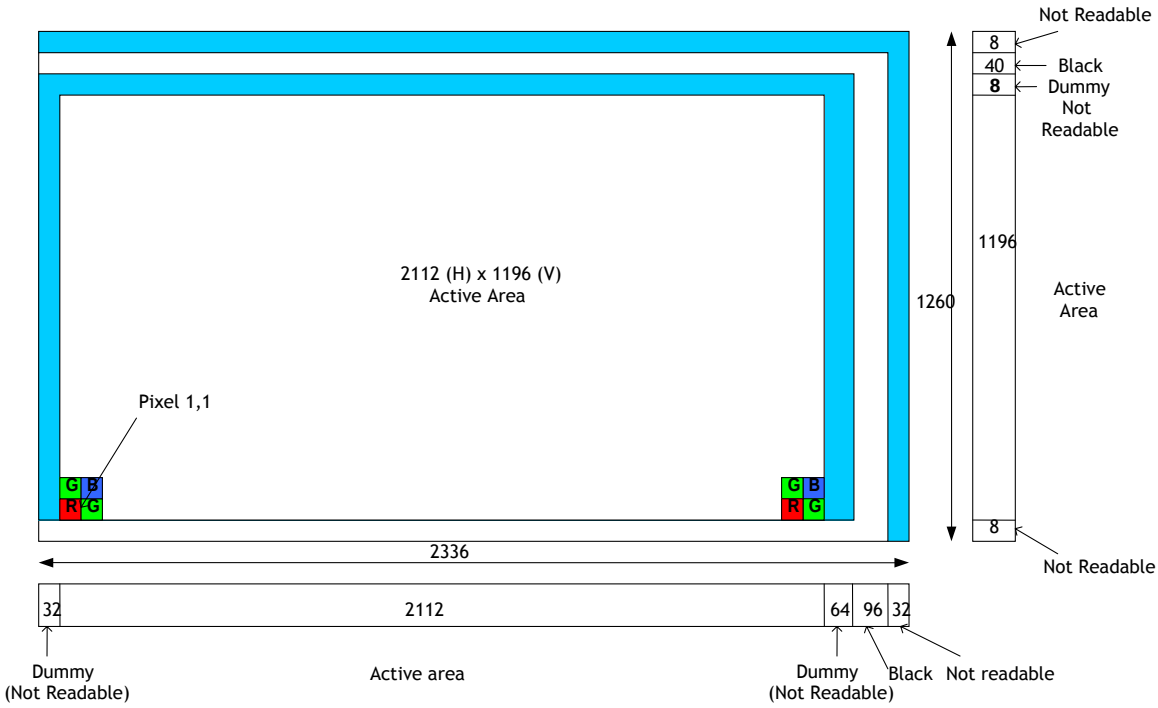


Fig.15. Sensor Layout

6.2.2. **Video output timing via Camera Link**

Definition **FVAL** : Frame Valid is defined HIGH for valid lines.
LVAL : Line Valid is defined HIGH for valid lines.
DVAL : Data Valid is defined HIGH when data is valid.
EEN : Enable Exposure

LVAL Period (Continuous, Full Frame)

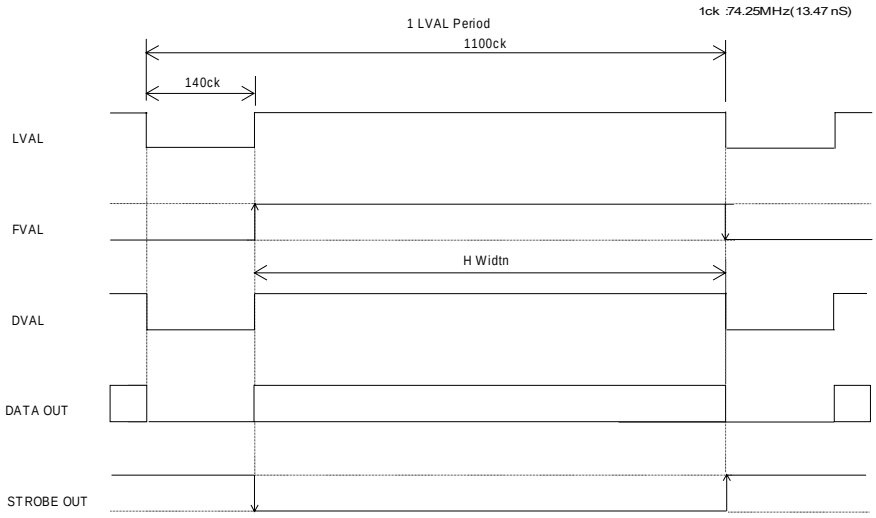


Fig.16. Horizontal timing (Full Frame)

FVAL Period (Continuous, Full Frame)

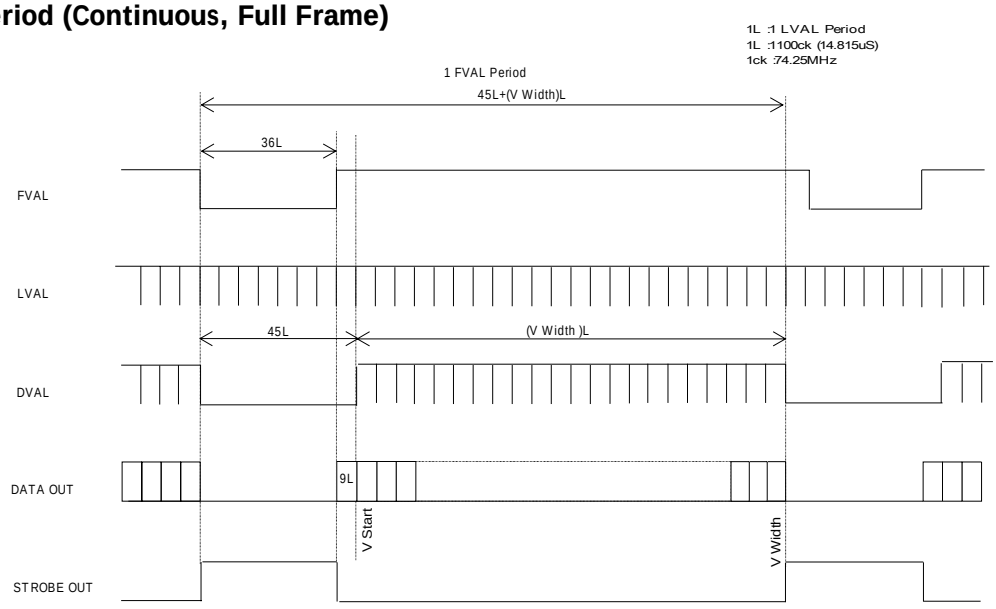


Fig.17. Vertical timing (Full Frame)

6.3. Inputs and output signals

6.3.1. External trigger - Input

The external trigger can be input via pin 10 on 12-pin Hirose connector or through Camera Link connector.
At the 12-pin connector the input level should be 4.0Vp-p ± 2.0Vp-p from a 75-ohm source.

Two software commands allow the selection of trigger input (TI) and trigger polarity (TP)

Command TI Trigger input
TI=0 through Camera Link and TI=1 through Hirose 12-pin connector

Command TP Trigger polarity
TP=0 is Active low which is Factory default setting and TP=1 is Active-High.

6.3.2. Strobe signal - Output

This signal can be used to control strobe flashes (LED / Xenon). In order to adjust the timing between the trigger and the strobe flashing timing, the strobe output signal can be delayed from 0 (no delay) up to 1125H with in steps of 67ns (5 clocks) . The settings can be controlled via serial communication.

Command RB Readout Begin
This is effective only when TR=1 (Strobe-Preset Snap-Shot trigger mode)
This command determines the Strobe period.
Range: 2 to 1125L (1 LVAL steps, 1 LVAL = 14.815μs)

Command ENL Strobe Enable Delay - Lines
The command sets delay the start of Strobe light in LVAL increments.
Range: 0 to 1125L (1 LVAL steps, 1 LVAL = 14.815 μs)

Command ENP Strobe Enable Delay - Pixels
The command sets delay the start of Strobe light in one pixel increments.
Range: 0 to 219 steps (1 Step = 67.5 ns)

Example of using strobe delay:
If 20μs delay is required, calculate 20μs divided by 14.815 μs (LVAL)
⇒ This results in 1 (LVAL) and the remainder is 5.19 μs
Therefore set the delay paramters as follows:
ENL : set to 1
ENP : set to 77 (5.19 μs ÷ 67.5 ns = 76.8 steps ⇒ 77)

Strobe output timing in Continuous mode
The Strobe output is effective on the leading edge of FVAL and is the same period of FVAL.

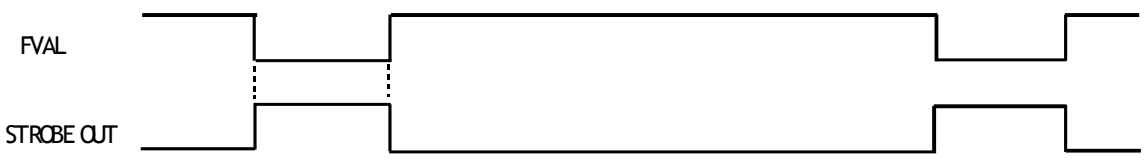


Fig.18. Strobe output timing for Continuous mode

Strobe output in Strobe-Preset Snap-Shot mode
The strobe output is initiated by the falling edge of External Trigger pulse and it can be delayed by commands ENL (Strobe Enable Delay - Lines) and ENP (Strobe Enable Delay - Pixels).
The Strobe Period is determined by command RB (Read Begin) and after the setting period by Read Begin, the data read out will start.

Note : When ENL and ENP are set to "0", the delay between the trigger signal and the strobe out is 35 clk ± 1 clk (471.45 ns ± 13.5 ns).

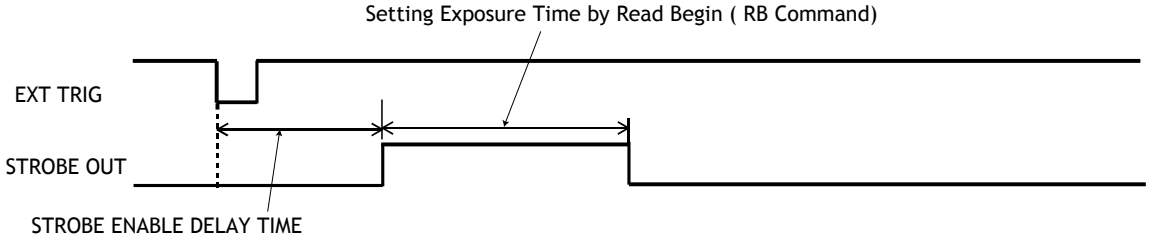


Fig.19. Strobe output timing for Strobe-Preset Snap-Shot trigger mode

6.4. Operation Modes

6.4.1. **Continuous operation**

In this mode camera is continuously running without external trigger. Window scan can be used in this mode.
Please refer the timing details in Fig. 17 and Fig. 18 as well as chapter 6.1.3 for the windowing timing chart.

To use this mode

Set function:	Trigger mode "Continuous"	TR = 0
	Shutter Mode "Pre-set" or "Programmable"	SM=0 or 1
	Window scan select "Full" or "Window"	WS=0 or 1
	If used	
	Window scan start	WY=0 to 1079 for CV-A20CL
		WY=0 to 1078 for CV-A80CL
	Window scan height	WH=1 to 1080 for CV-A20CL
		WH=2 to 1080 for CV-A80CL

Shutter operation for Window mode (Continuous)
The electronic shutter is available together with Window scan, but it is effective only when the preset shutter value (LVAL) is set at a value less than the Window height. If the shutter value is larger than the window height (lines), the shutter is automatically set to OFF.

Important note:
When the Window scan read-out area is changed, the synchronous counter inside the image sensor is automatically reset. Therefore, the first frame after changing the scan area will not have the selected number of lines.

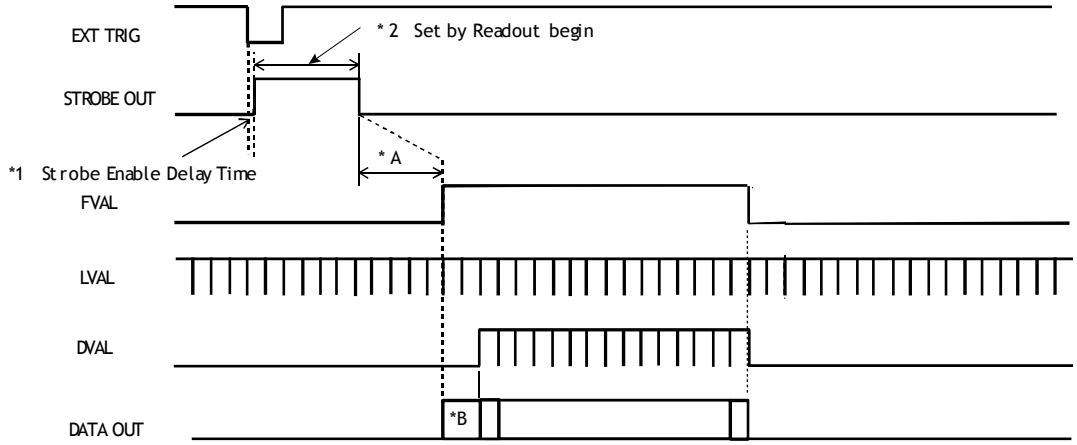
6.4.2. **Strobe-Preset Snapshot mode**

When the trigger is input, the exposure starts at the leading edge of the trigger. When the Strobe-Preset Snapshot trigger mode is selected the shutter is automatically set to OFF.

To use this mode

Set function:	Trigger mode "Strobe-Preset Snapshot"	TR = 1
	Trigger Input Camera Link or 12-pin Hirose	TI = 0 or 1
	Trigger polarity Active-LOW or Active-HIGH	TP = 0 or 1
	Window scan select “Full” “Window”	WS=0 or 1
	If used	
	Window scan start	WY=0 to 1079 for CV-A20CL WY=0 to 1078 for CV-A80CL
	Window scan height	WH=1 to 1080 for CV-A20CL WH=2 to 1080 for CV-A80CL

FVAL Period



	* A	* B
Full scan	38L + (0 to 1H)	9 L
Window scan	38L + (0 to 1H)	9 L

Fig.20. FVAL timing for Strobe-Preset Snapshot mode

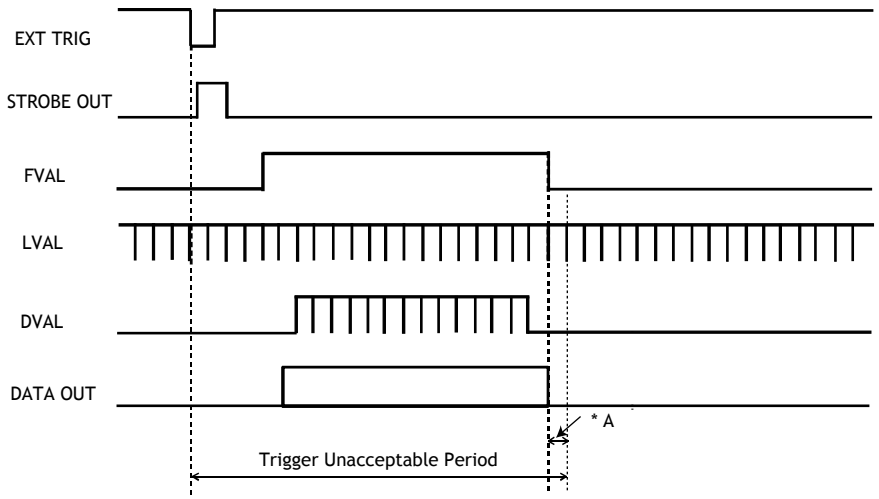
* 1 : Strobe Delay Time
The duration from the trigger input to the Strobe signal output can be delayed.
* 2: Readout Begin Period
The Strobe signal is asynchronous in relation to the line rate. FVAL is output synchronous to LVAL when the Strobe signal is changed from HIGH level to LOW level.

LVAL Period

The timing for LVAL period is the same as the timing for Continuous mode and Windowing.

Trigger minimum interval

The following timing chart explains the period required for new trigger input after the data is output.



	* A
Full scan	1 L
Window scan	1 L

Fig.21. Minimum Trigger period

The following equation is used for calculating the minimum trigger interval.
(Strobe delay 0 + Strobe Delay Time) + Strobe out period + (0to1L) + 38L + 9L(OB) + Effective period + 2L + 1L

6.4.3. **Widowing Timing Chart**

The following drawings show vertical and horizontal timing for Windowing mode on continuous operation.

FVAL Period (Continuous, Windowing)

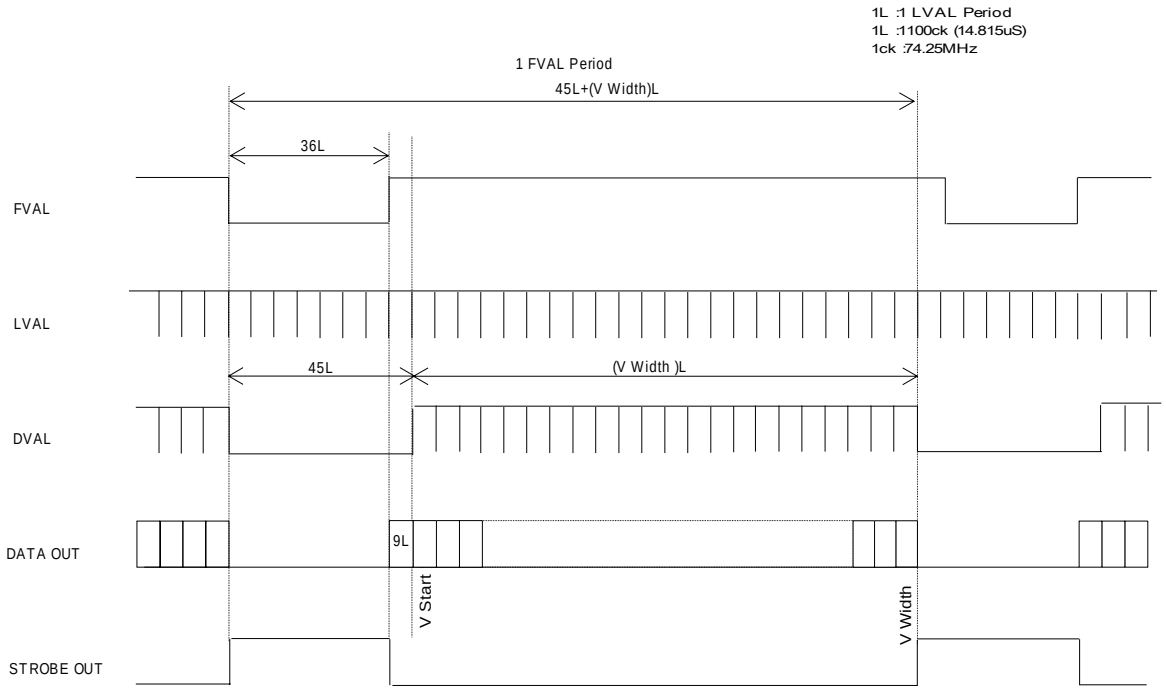


Fig.22. Vertical timing, Window scan

LVAL Period (Continuous, Windowing)

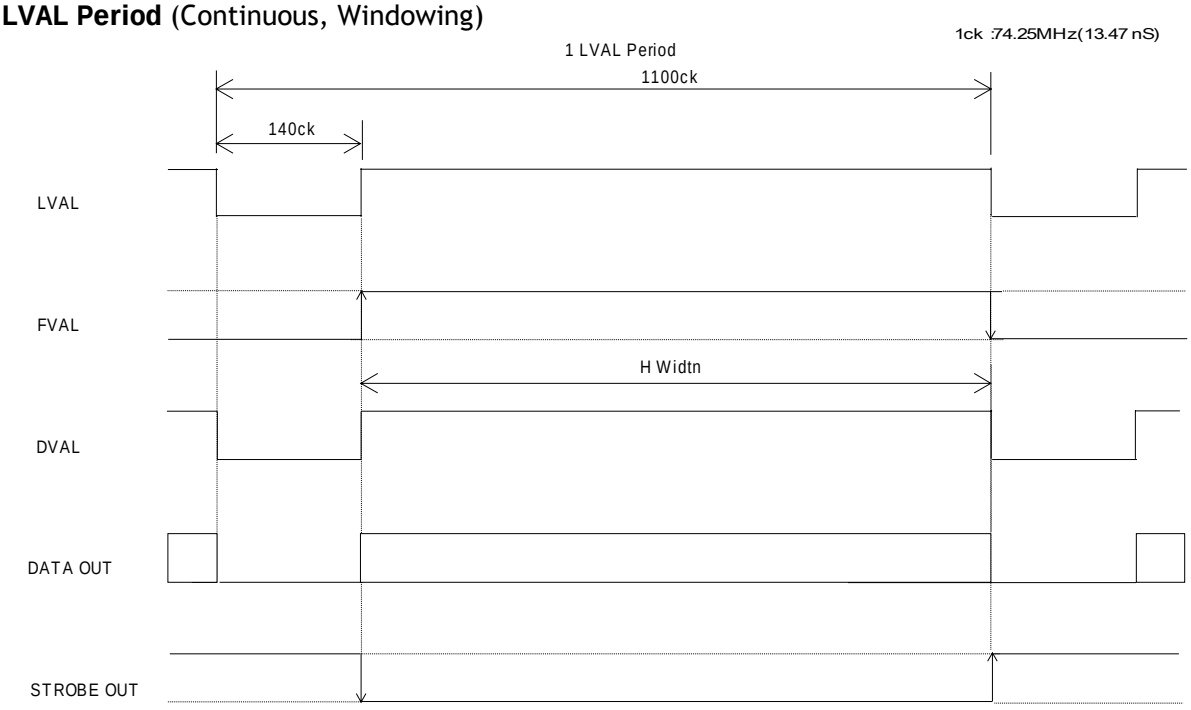


Fig.23. Horizontal timing, Window scan

6.4.4. **Mode and function compatibility matrix**

Mode	Shutter		Windowing	Strobe out
	Pre-selected SM = 0	Programmable SM = 1		
Continuous	Yes	Yes	Yes(1)	Yes
Strobe-preset Snap-Shot	No	No	Yes	Yes(2)
Note 1: See chapter 6.4.1 for precaution on shutter setting in Continuous mode in conjunction with Windowing. Note 2: See chapter 6.3.2 for controlling the Strobe timing in Strobe-preset Snap-Shot trigger mode.				

Fig.24. Mode and function matrix chart

6.4.5. **Setting gain and offset**

Command AS AGC select
This can select ON or OFF>
AS=0 OFF for Manual gain control, AS=1 ON for Auto gain control

Command AG AGC Reference
This sets the reference of AGC. This is available only for AS=1.

Command GA Manual Gain Control
This command sets the gain setting from -3 to +12. The step is approximately 1 dB. Therefore, GA=12 means approx. 12dB, etc.
The negative values follow a different scale: GA=-3 for -6dB, -2 for -3dB

and -1 for -2dB.

Command GAF Gain Fine level
This command sets the gain level with a fine granularity.

Command BL Offset / Black level
This can change the offset / black level (set-up) level manually.

Command BRMO Black Reference (for continuous mode)
This can select Auto or Manual for black level control. Factory setting is Manual.

Command BROO Black Reference value (for continuous mode)
This value is used in conjunction BRMO when it is set to Auto.

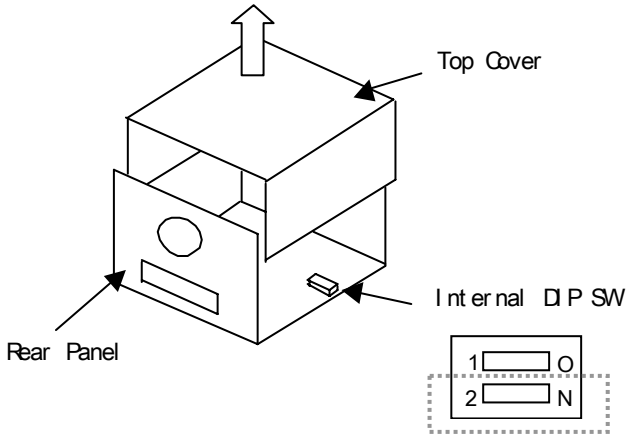
7. Configuring the Camera

7.1. Switch settings

The CV-A20CL/CV-A80CL can communicate by serial communication via the Camera Link connector or via RS232C in the 12-pin Hirose connector. The Baud Rate is fixed at 9600 bps. Switch SW2 inside the camera is used to select which way the serial communication is set up.

SW	Function	Setting	
		ON	OFF
1	External trigger input termination	75 ohm	TTL (default)
2	Select serial communication path	Camera Link (default)	Hirose 12-Pin

The factory default is Camera Link serial communication.

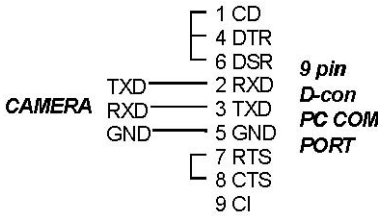


DIP SW 2
Serial communication interface
ON:Camera Link (Default)
OFF: RS-232C, Hirose 12-pin

Fig. 25. DIP swich location

7.2. RS-232C control

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



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>
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 actual setting:
ST?<CR><LF>
The camera answers:
A complete list of the current settings

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

Invalid parameters send 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>

7.3. Save and Load Functions.

The following commands are for storing and loading camera settings in the camera EEPROM.

Load settings. LD.
This command will load previous stored settings to the camera. 3 user settings can be stored in the camera EEPROM. 1 factory setting is also stored in the camera. The settings stored in the last save user area will be used as default settings at power up.

Save Settings. SA.
This command will store the actual camera settings to 1 of the 3 user area in the camera EEPROM.

EEPROM Area. EA.
The camera returns the last used user area number.

7.4. CV-A20CL / CV-A80CL Command List

	Command Name	Format	Parameter	Remarks
A – General settings and useful commands.				
1	Echo Back	EB=[Param.]<CR><LF> EB?<CR><LF>	0=Echo off 1=Echo on	Off at power up
2	Camera Status Request	ST?<CR><LF>		Actual setting
3	Online Help Request	HP?<CR><LF>		Command list
4	Firmware Version	VN?<CR><LF>		3 digits (e.g)

	Request			100 = Version 1.00
5	Camera ID Request	ID?<CR><LF>		max 10 characters
6	Model Name Request	MD?<CR><LF>		max 10 characters
7	User ID	UD=[Param.]<CR><LF> UD?<CR><LF>		User can save and load free text. (max 16 char.)
B - Shutter				
1	Shutter mode	SM=[Param.]<CR><LF> SM?<CR><LF>	0= Preset shutter 1= Programmable exposure	When TR=1, the shutter is not available.
2	Preset shutter	SH=[Param.]<CR><LF> SH?<CR><LF>	0=1/60, 1=1/120, 2=1/250, 3=1/500, 4=1/1000, 5=1/2000, 6=1/4000, 7=1/10000, 8=1/20000,	Available when TR=0 and SM=0.
3	Programmable exposure	PE=[Param.]<CR><LF> PE?<CR><LF>	2 - 1125L (Set in step 1; 1L=14.815us)	Available when TR=0 and SM=1.
4	Readout Begin	RB=[Param.]<CR><LF> RB?<CR><LF>	2 - 1125L (Set in step 1; 1L=14.815us)	Available when TR=1.
C - Trigger mode				
1	Trigger Mode	TR=[Param.]<CR><LF> TR?<CR><LF>	0=Continuous 1=Strobe-Preset Snapshot	
2	Trigger Input	TI=[Param.]<CR><LF> TI?	0=Camera-Link 1=Hirose12pin- Pin #10	
3	Trigger Polarity	TP=[Param.]<CR><LF> TP?	0=Active-Low 1=Active-High	
D - Scan Format and video output				
1	Window Scan Select	WS=[Param.]<CR><LF> WS?<CR><LF>	0=Full Frame 1=Window Scan	
2	Window Scan Start	WY=[Param.]<CR><LF> WY?<CR><LF>	0 to 1079	CV-A20CL 1 line step
			0 to 1078	CV-A80CL 2 lines step
3	Window Scan Height	WH=[Param.]<CR><LF> WH?<CR><LF>	1 to 1080	CV-A20CL 1 line step
			2 to 1080	CV-A80CL 2 lines step
4	Camera Link Bit Allocation	BA=[Param.]<CR><LF> BA?<CR><LF>	0=10 bit 1=8 bit	
E – Gain and signals setting				
1	AGC Select	AS=[Param.]<CR><LF> AS?<CR><LF>	0=OFF (Manual Gain Control) 1=ON (Auto Gain Control)	
2	AGC Reference	AG=[Param.]<CR><LF> AG?<CR><LF>	150-1023	Available when AS=1
3	Manual Gain Level	GA=[Param.]<CR><LF> GA?<CR><LF>	-3 to 12 (-1=-6dB,-2 = -3dB, -1 = -2dB , 0=0dB, 1=1dB, … 12=12dB)	
4	Pixel Gain ON/OFF	PG=[Param.]<CR><LF> PG?<CR><LF>	0 = OFF (Main Gain) 1 = ON (Pixel Gain)	For CV-A80 only

5	Pixel Gain of 1st pixel in RGB 2x2 matrix	PG1=[Param.]<CR><LF> PG1?<CR><LF>	-3 to 12 (-3≈-6dB, -2≈-3dB, -1≈-2dB, 0≈0dB, 1≈1dB, 2≈2dB,…12≈12dB)	For CV-A80CL only
6	Pixel Gain of 2nd pixel in RGB 2x2 matrix	PG2=[Param.]<CR><LF> PG2?<CR><LF>	-3 to 12 (-3≈-6dB, -2≈-3dB, -1≈-2dB, 0≈0dB, 1≈1dB, 2≈2dB,…12≈12dB)	For CV-A80CL only
7	Pixel Gain of 3rd pixel in RGB 2x2 matrix	PG3=[Param.]<CR><LF> PG3?<CR><LF>	-3 to 12 (-3≈-6dB, -2≈-3dB, -1≈-2dB, 0≈0dB, 1≈1dB, 2≈2dB,…12≈12dB)	For CV-A80CL only
8	Pixel Gain of 4th pixel in RGB 2x2 matrix	PG4=[Param.]<CR><LF> PG4?<CR><LF>	-3 to 12 (-3≈-6dB, -2≈-3dB, -1≈-2dB, 0≈0dB, 1≈1dB, 2≈2dB,…12≈12dB)	For CV-A80CL only
9	Black level	BL=[Param.]<CR><LF> BL?<CR><LF>	-255 to 255	This is for SET UP Level.
10	Strobe Enable Delay Lines	ENL=[Param.]<CR><LF> ENL?<CR><LF>	0 to 1125	Available when TR=1
11	Strobe Enable Delay Pixels	ENP=[Param.]<CR><LF> ENP?<CR><LF>	0 to 219	Available when TR=1
12	BLACKREF Mode in the continuous mode	BRM0=[Param]<CR><LF> BRM0?<CR><LF>	0=Auto 1=Manual (Default)	
13	BLACKREF value in the continuous mode	BR00=[Param.]<CR><LF> BR00?<CR><LF>	0 to 1023	This is for black level adjust.
F - Saving and loading data in EEPROM				
1	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 AREA becomes default at next power up.
2	Save Settings (to Camera EEPROM)	SA=[Param.]<CR><LF>	1=User 1 area 2=User 2 area 3=User 3 area The parameter 0 is not allowed.	
3	EEPROM Current Area No. Request.	EA?<CR><LF>	0=Factory data 1=User 1 area 2=User 2 area 3=User 3 area	The camera returns the latest used DATA AREA?

Note: Do not try to use commands not shown in this list.

8. Camera Control Tool for CV-A20CL/CV-A80CL

The Camera Control Tool for Windows 2000/XP can be downloaded from www.jai.com.
The control tool contains a camera control program and a developer's kit for integrating the control tool in your own software. For the integrator and experienced user, the Camera Control Toll is much more than a program with a window interface. It also provides an easy and efficient ActiveX interface built for MS Windows 2000/XP. The OCX interface has the ability to connect to the camera using the serial interface of the PC by reading and writing properties for the camera. This integration requires simple programming skills within Visual Basic, Visual C++ or similar languages in a Microsoft Windows environment.

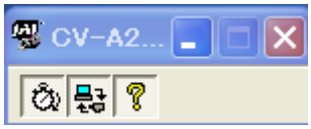
8.1. Camera Control Tool Interface

The Camera Control Tool Software is based on a main Tool Bar and a number of associated Tool Windows. Each button in the Tool Bar pops up a separate Tool Window when pressed. The layout of the program can be adjusted by arranging the windows the way it is preferred. The program will store this information and recreate this layout, when the program is restarted. All Camera Control Tools have a Communication Window and an About Window. The other window(s) contains camera control commands.

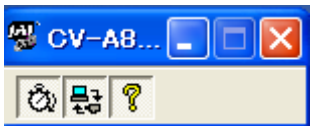
8.2. Camera Control Tool Bar

This is a Camera Control Tool Bar and when the button of each widow, each control GUI can be initiated.

For CV-A20CL



For CV-A80CL



About Window

Communication Window

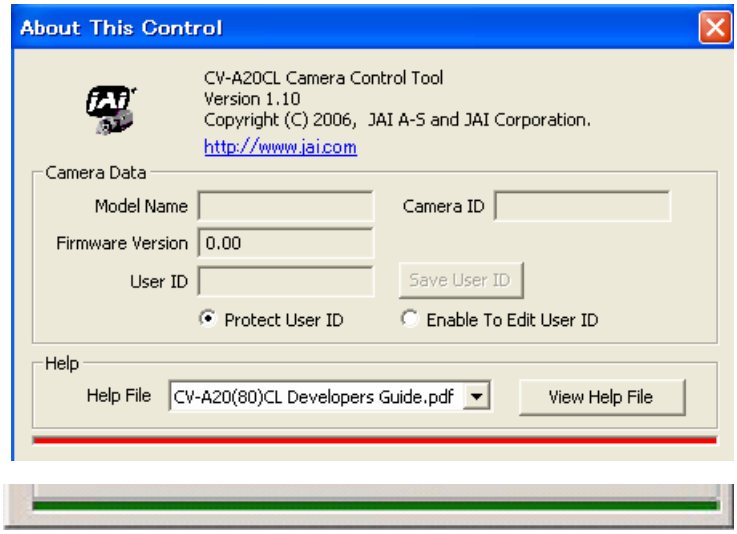
Camera Control Window

8.3. The About Window

The about shows information about the version of the program, as well as a hyperlink to the JAI web page and access to the help documents.

The drop-down box labeled "Help File" will list all files which have the extension .pdf and that are found in the program (default) folder.

C:\Program Files\JAI A-S\"control tool name"

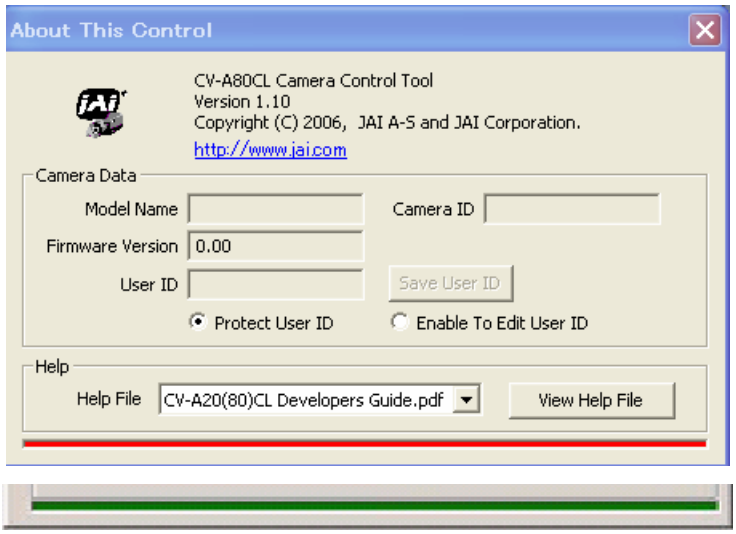


It is possible to download updated operation manuals from the JAI website:
http://www.jai.com/camera/manuals.asp/sprog=uk
An updated manual can be saved in the (default) folder address mentioned above. it will then automatically be included in the list of help files.

For newer camera models the About Window also shows
Model Name, camera ID and User ID. It is possible to edit and save free text in User ID.

At the bottom of the windows there is a colored bar. The bar is green when the Camera Control Tool is connected to a camera and the camera is turned on.
The bar is red when the Camera Control Tool is not connected to a camera or when the camera is turned off.

The illustration to the right shows an example of the on-line indicator for the CV-A80CL control tool.

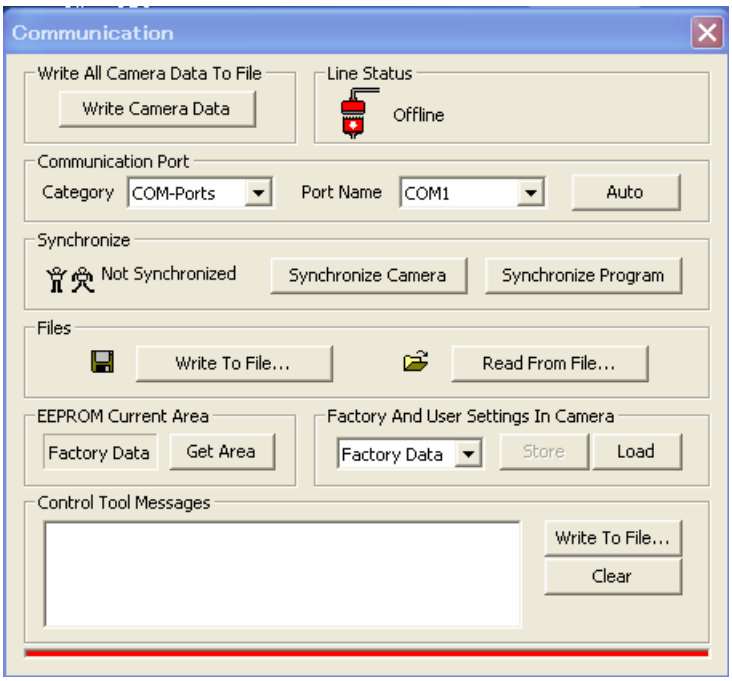


8.4. Communication Window

The Communication Window is used to connect the Camera Control Tool with the JAI camera. Depending of camera there are 2 possible ways to communicate with a JAI camera.

RS-232:
Select the communication port, where the serial cable is connected from the list box in the 'Communication Port' field, or click the 'Auto' button to search for a camera on communication port 1 to 16. The camera control program automatically sends a camera request on every communication port. The user is prompted to use a communication port if a camera answers the request.

RS-232 and Camera Link:
The Communication Window looks a bit different when it is possible to communicate with the camera using Camera Link and RS-232 com port. The Communication area contains 2 list boxes.



RS-232 communication:

1. Select 'COM-ports' from the 'CL Manufacturer/COM-ports' list Box.
2. Select the communication port, where the serial cable is connected to the camera from

the 'Serial Port' list box or click the 'Auto' button to search for a camera on communication port 1 to 16.

The Serial Port list box and the Auto search button are only active when COM-ports is selected.

Camera Link communication:
The 'CL Manufacturer/COM-ports' list box also contains DLL file names (or frame grabber names) for all Camera Link frame grabbers that are installed in the pc. This is done by using a DLL file called "clserial.dll" to upload all frame grabber DLLs that are found in the pc.
Just select the option for the frame grabber that is installed in the pc.

Auto search
Click the auto button to search for a camera on communication port 1 to 16. The camera control program automatically sends camera request on every communication port. The user is prompted to use a communication port if a camera answers the request.
This button is only used for RS-232 communication.

Off/On-line mode
The Camera Control Tool Application can run Offline (without a camera attached) and all functions are fully functional in offline mode.

Off line mode is indicated in The Communication Window, where a status field with graphic and text indicates the on/off-line status. The on-line/off-line status is also indicated by colored bar at the bottom of all windows.
Changing the selected communication port (from the communication window) changes the online/off-line status. If a camera is found on the selected communication port the application runs online.

Changing the settings in the application will automatically update the camera settings when the application is online.
If the application looses connection with the camera it will automatically go to offline mode and it is indicated in the communication window.

Synchronize program and camera
The Camera Control software has the ability to synchronize either the camera or the program. Click Synchronize camera to write all settings from the program to the camera or click the Synchronize program to load all settings from the camera to the program.

Files
When clicking the Write to File or Read from File button, the user is prompted for a file using a standard file dialog. New files are created if they do not already exist.
Files for camera settings have the extension cam. Information about the communication port is not stored in the files. All settings are automatically sent to the camera when a file has been loaded (if the camera is online).

Factory and User Settings
Use the Store button to store the current camera settings into the user settings area in EEPROM. Current camera settings are not saved when the camera is turned off. To save current camera settings you have to save them on the available user areas.
Use the Load button to restore previously saved camera settings from either the Factory or the User EEPROM area.

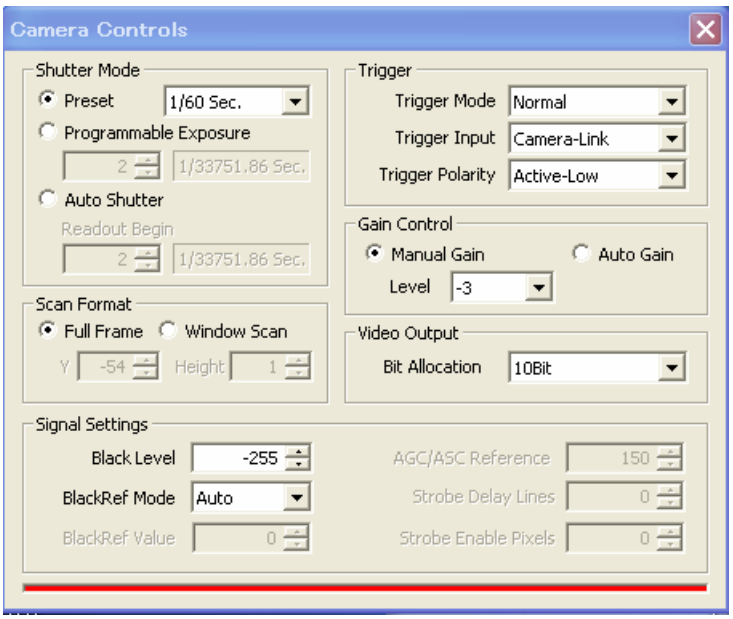
Write All Camera Data to File.
Click the “Write Camera Data” button to save all camera settings into a text file. The information that can be saved is:
Model Name, Camera ID, User ID, Firmware Version, Current Settings, Factory Settings and the available User Areas.
The file is formatted as shown in the picture below:

EEPROM Current Area.
Click the ‘Get Area’ button to read the power up settings area number.

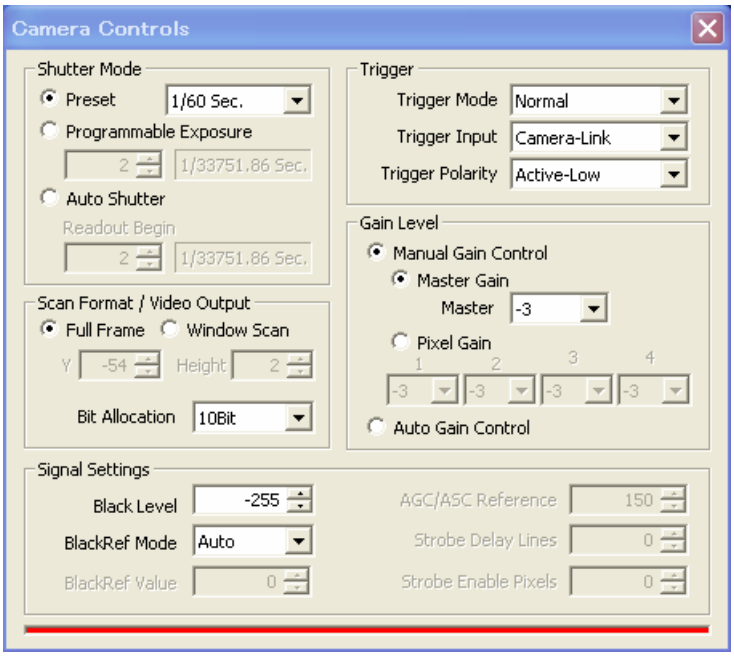
8.5. Camera Control Window

The Camera Control Window contains the fundamental camera setting functions.
It is possible to set the shutter mode, Trigger mode, scan format, gain control and black setting.

For CV-A20CL



for CV-A80CL



8.6. Using the Camera Control Tool

Here is some practical information about the Camera Control Tool:

1. The Camera Control Tool bar is always on top of other windows.
2. When you minimize the Camera Control Tool bar all open windows will close.
3. It is possible to work with the Camera Control Tool when the camera is online and when the camera is offline.
4. The newer JAI cameras always start up with the last used user area (but for some old models it will start up with the last saved user area.)
5. The Camera Control Tool saves the last used settings (not the user area), which don't have to be the same as for the last saved user area.
6. The setup file 'CameraName.ini' stores all information about camera settings. When the program is started the last settings for the program are loaded from the file 'CameraName.ini'
7. When you turn on the camera and the Camera Control Tool, it is possible that the Camera Control Tool does not show the actual camera settings (see 4. and 5.).
    a. To obtain the camera settings click "Synchronize Program".
    b. To send the settings, that are saved in the Camera Control Tool (last used settings), to the camera click "Synchronize Camera".
    c. To see which area the camera has started up in click "Get Area".

9. External Appearance and Dimensions

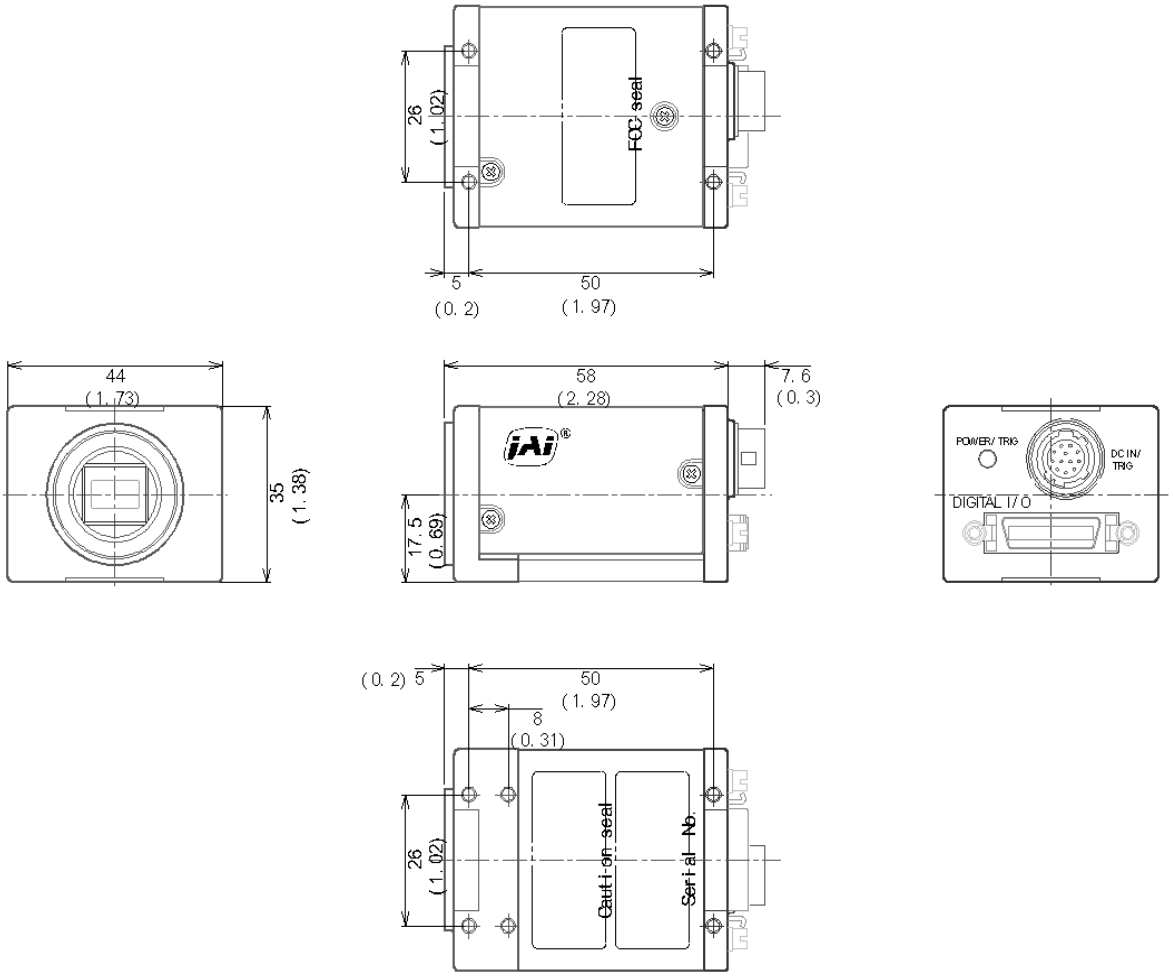


Fig.26. Dimensions

10. Specifications

10.1. Spectral response

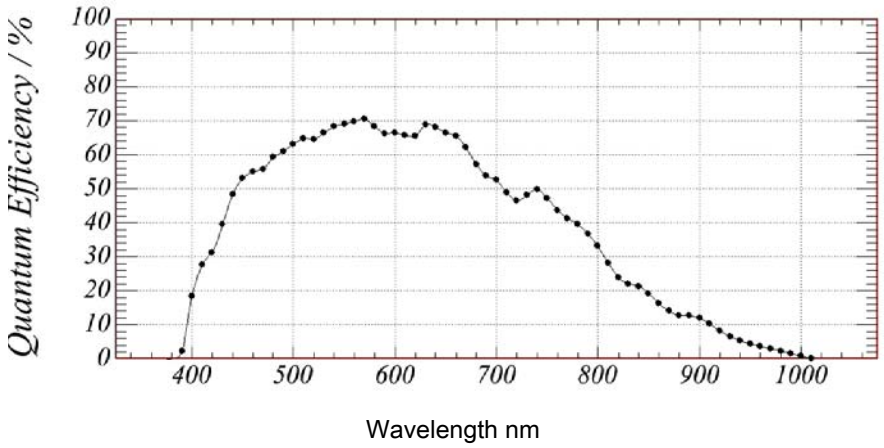


Fig. 27. Spectral response for monochrome CMOS

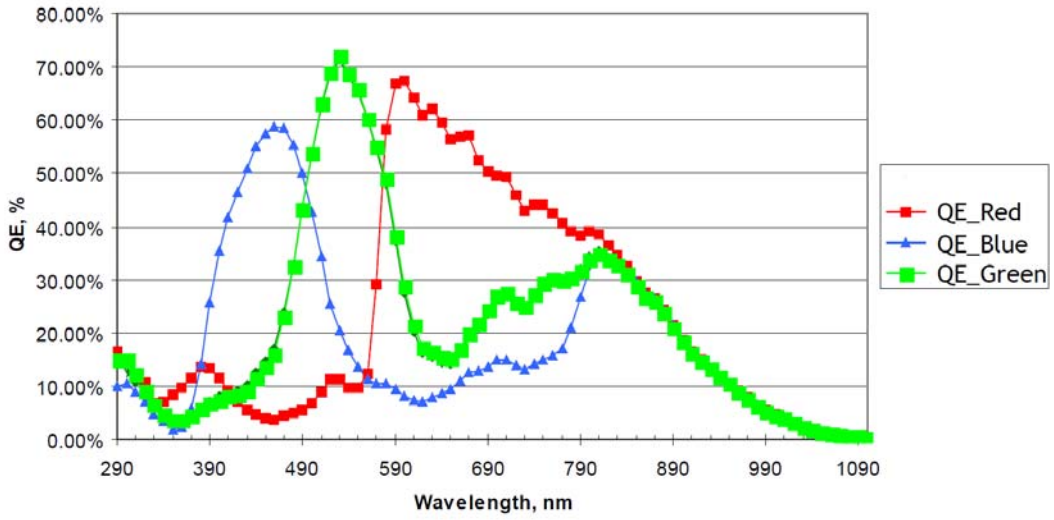


Fig.28. Spectral response for Bayer Color CMOS
(Shown without 700 nm IR-cut filter)

10.2. Specifications Table

Specification	CV-A20CL	CV-A80CL
Image sensor	Monochrome CMOS	Bayer mosaic color CMOS
Scan system	Rolling shutter	
Frame rate	60 frames / sec. (at full frame)	
Pixel Clock	2 x 74.25 MHz (interleaved odd and even pixels)	
Horizontal Frequency	67.50 kHz (2200H) x 6.73ns=14.815μs	
Vertical Frequency	60Hz (1125V) x 14.815μs=16.667ms	
Image sensor	CMOS Image sensor Monochrome	
sensor size	2/3 inch	
Aspect ratio	16:9	
Total pixels	2,112 (H) x 1188 (V)	
Cell size	5 μm x 5 μm	
Effective Video out pixels	1,920 (H) x 1,080(V)	
Scanning lines	1,125 lines (effective: 1,080 lines)	
Minimum Sensitivity on Sensor	2.6 Lux	3.8 Lux
	(Shutter: OFF, Gain=max, 50% output, IR filter)	
SN ratio	More than 50dB (Gain=0dB, Shutter=OFF)	
Digital Video output	Camera Link 10 bit / 8 bit	
Gain	Manual / Auto Range : -3dB to +12dB (approx.1dB step)	
Pixel Gain	-	R, Gr, B, Gb -3dB to +12dB
AGC	ON/OFF selectable (0dB to 12 dB)	
Synchronization	Internal / External Snap-shot trigger	
Preset Electronic shutter	1/60(OFF),1/120,1/250,1/500,1/1,000,1/2,000,1/4,000 1/10,000,1/20,000 in 9 steps	
Programmable Exposure	2 LVAL to 1125 LVAL in 1 LVAL increments	
Windowing Scan (Vertical only)	1 line increment	2 lines increment
	Set the start line and window height	
Trigger mode	Continuous, Strobe-Preset Snap-shot	
Gamma	1.0	
Black level compensation	Manual / Auto	
Strobe signal	Strobe signal controls the flash timing of strobe light. Continuous mode: During blanking (H level) Trigger mode: During exposure period (H Level)	
Control Interface	Camera control : RS232C (9,600 bps) External trigger : Camera Link or Hirose 12-pin	
Lens mount	C mount	
Power consumption	DC +12V (±10%), 190mA ±15mA	
Operation temp/humidity	-10 deg. C to +50 deg. C / 20% to 90% (non-condensing)	
Storage temp / Humidity	-25 deg. C to +60 deg. C / 20% to 90% (non-condensing)	
Vibration	10G (20Hz to 200Hz, XYZ)	
Shock	70G	
EMC	CE(EN61000-6-2, + EN61000-6-3), FCC Part15, UL94	
Dimensions	44(W) x 35 (H) x 58(D) mm	
Weight	200 g	

Note: Above specifications are subject to change without prior notice.

11. Appendix

11.1. 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.
Remove power from the camera during any modification work, such as changes of jumper and switch settings.

11.2. 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 to 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 in the image.

Caution when mounting a lens on the camera
When mounting a lens on the camera dusts 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.

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

12. User's Record

Camera type: **CV-A20 CL / CV-A80 CL**

Revision: **……..**

Serial No. **……..**

Firmware version. **……..**

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

User's Mode Settings.

User's Modifications.

CE

DECLARATION OF CONFORMITY
AS DEFINED BY THE COUNCIL DIRECTIVE
89/336/EEC
EMC (ELECTROMAGNETIC COMPABILITY)
WE HEREWITH DECLARE THAT THIS PRODUCT
COMPLIES WITH THE FOLOWING PROVISIONS APPLYING TO IT.
EN61000-6-2
EN61000-6-3

Europe, Middle East & Africa	*Asia Pacific*	*Americas*
Phone +45 4457 8888 *Fax +45 4491 8880*	*Phone +81 45 440 0154* *Fax +81 45 440 0166*	*Phone (toll-free) +1 800 445 5444* *Phone +1 408 383 0300*

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