



*See the possibilities*

*Digital monochrome / color  
HDTV (1080p) CMOS camera*

# *CV-A20CL*

# *CV-A80CL*

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## *Operation Manual*

Document Version: 1.0

Camera Revision: 0



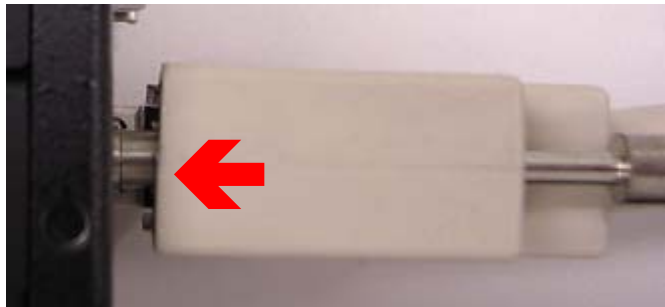
## Special Caution

When a Camera Link cable is connected to the camera, please do not excessively tighten screws by using a screw driver. The Camera Link receptacle on the camera might get damaged.

For security, the force used to tighten screws is less than 0.291 Newton Meter (Nm).

Tightening by hand is sufficient in order to achieve this.

*Plug the connector into the receptacle firmly.*



*Tighten the two screws securely by hand.*



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## 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 number of pixels is 2,112 (H) x 1,188(V).

The CV-A20CL/CV-A80CL operates at 60 frames per second with full resolution and at higher frame rate by using 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](http://www.jai.com)

The latest version of Camera Control Tool for CV-A20CL/CV-A80CL can also be downloaded from: [www.jai.com](http://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.

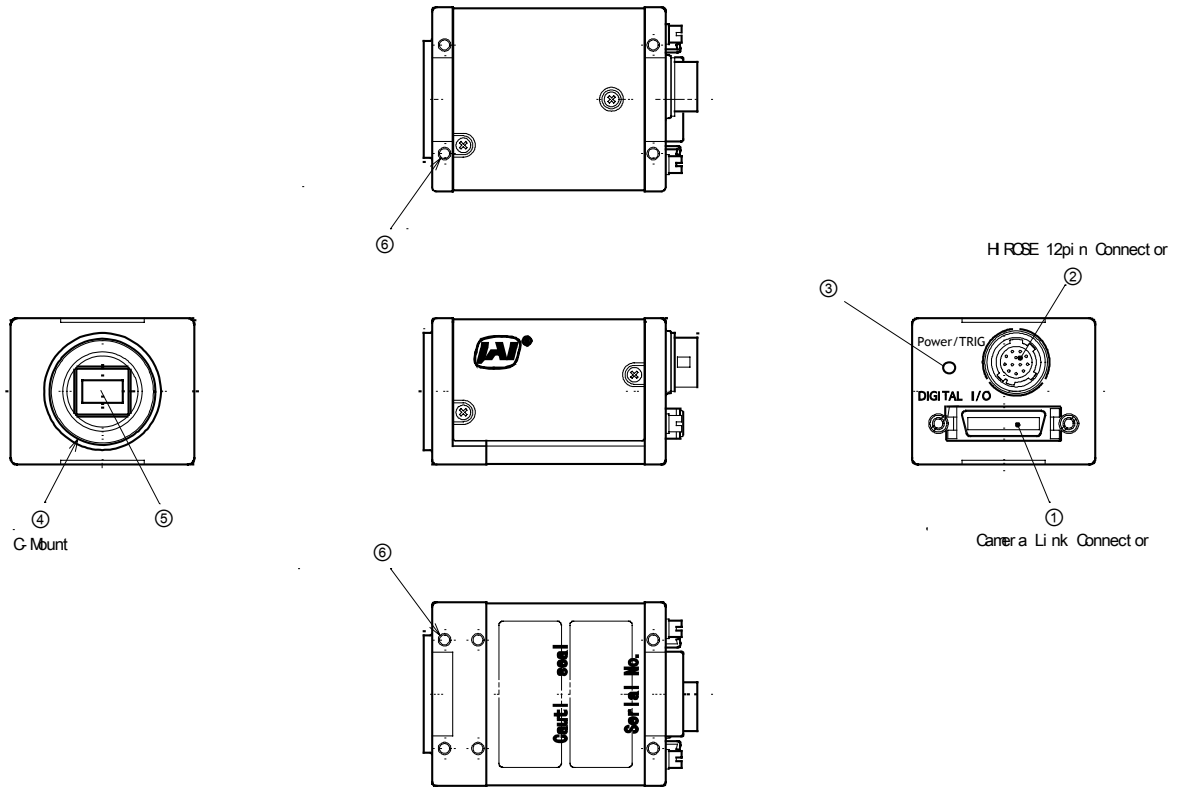
The camera is available in the following versions:

|          |  |
|----------|--|
| CV-A20CL | 2 million pixel HDTV format monochrome CMOS camera         |
| CV-A80CL | 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

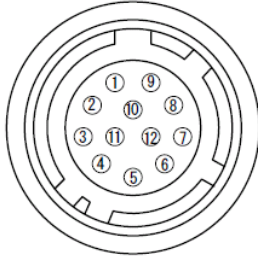


Fig. 2 Hirose 12-pin connector

| 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<br>(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        |  |

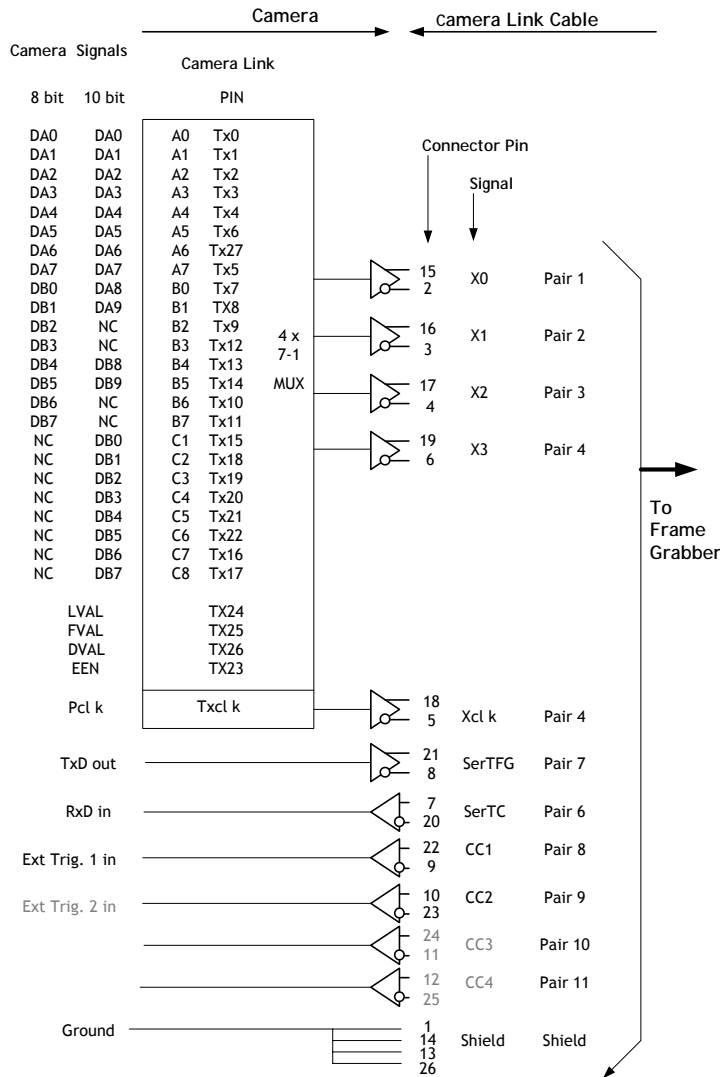
### 5.2. 26-pin connector (Digital Camera Link Interface)

Type: 26P MRD Connector 3M 10226-1A10PL



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   | TxCk     | Clock for CL     |



| Port/<br>Signal | 2tap<br>8bit<br>Output | 10bit<br>output | Pin<br>No. |
|-----------------|------------------------|-----------------|------------|
| 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       |

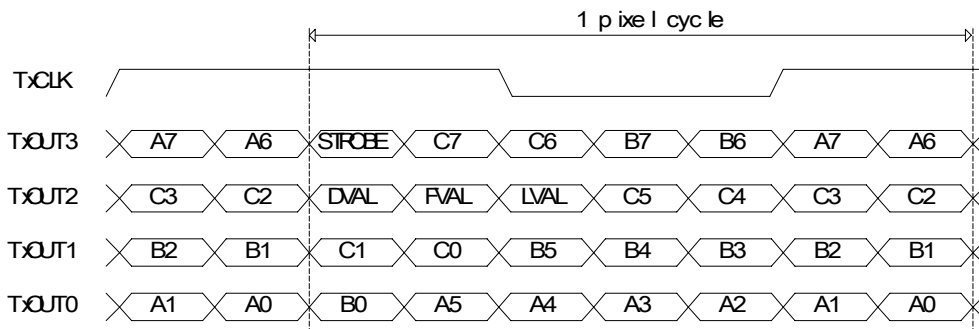


Fig.4. Principle diagram for Camera Link base configuration interface

### 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.

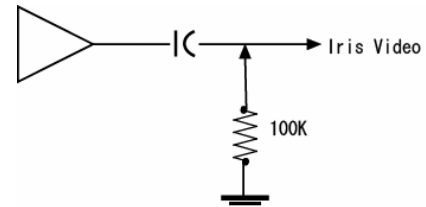


Fig.5 Iris video output

#### 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  $4V \pm 2V$ , TTL. By changing the camera internal switch (SW 1), the input impedance can be changed to 75  $\Omega$ .

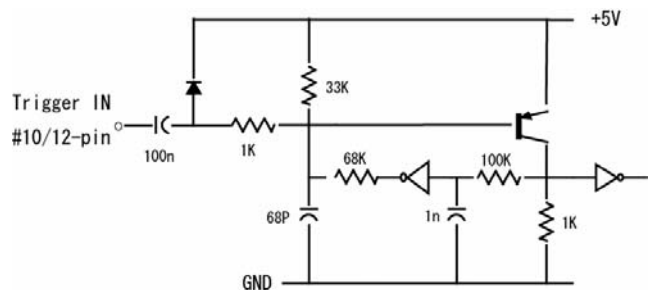


Fig.6 Trigger input circuit

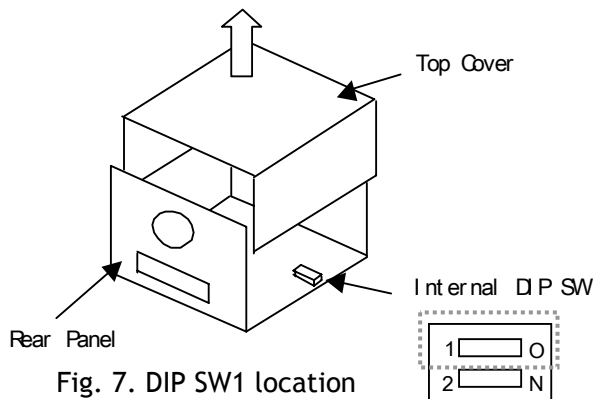


Fig. 7. DIP SW1 location

DIP SW 1  
Trigger input impedance  
ON : 75  $\Omega$   
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.

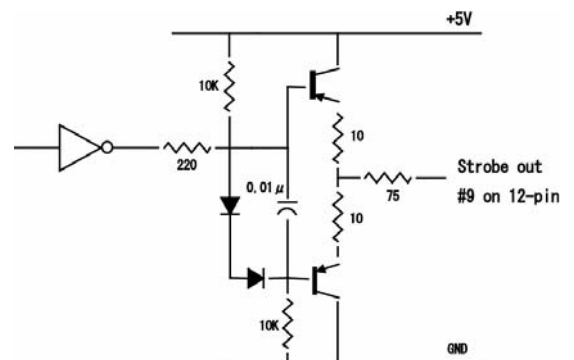


Fig.8 Strobe Output circuit



## 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.

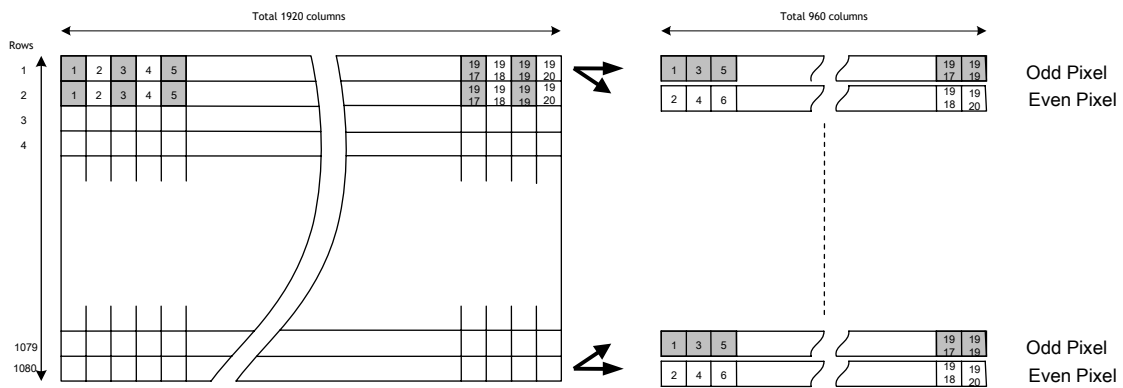


Fig. 9. Formatted Odd and Even interleaved output

#### 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.

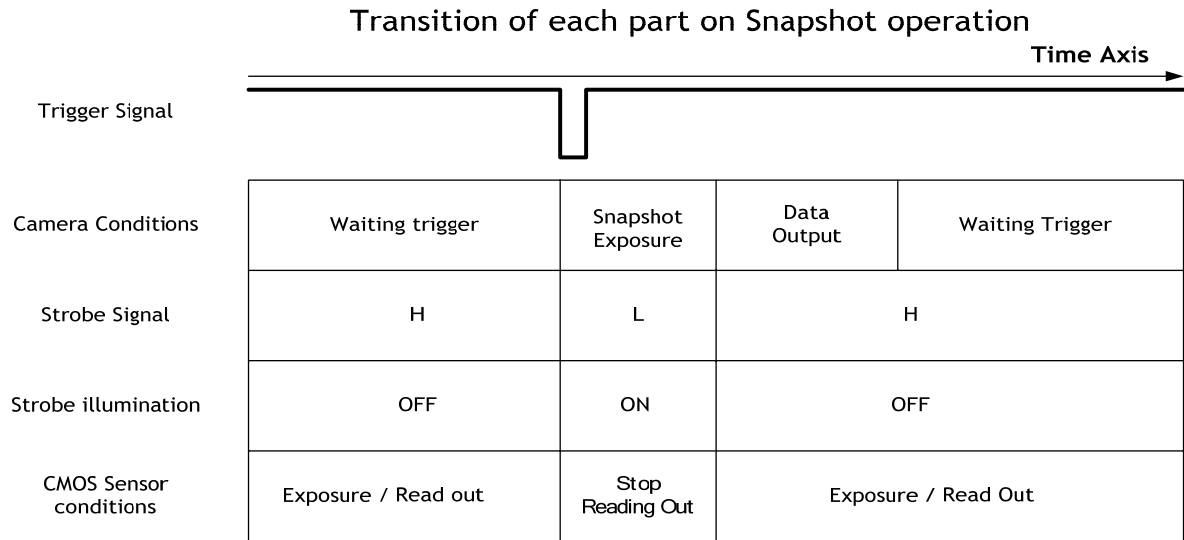
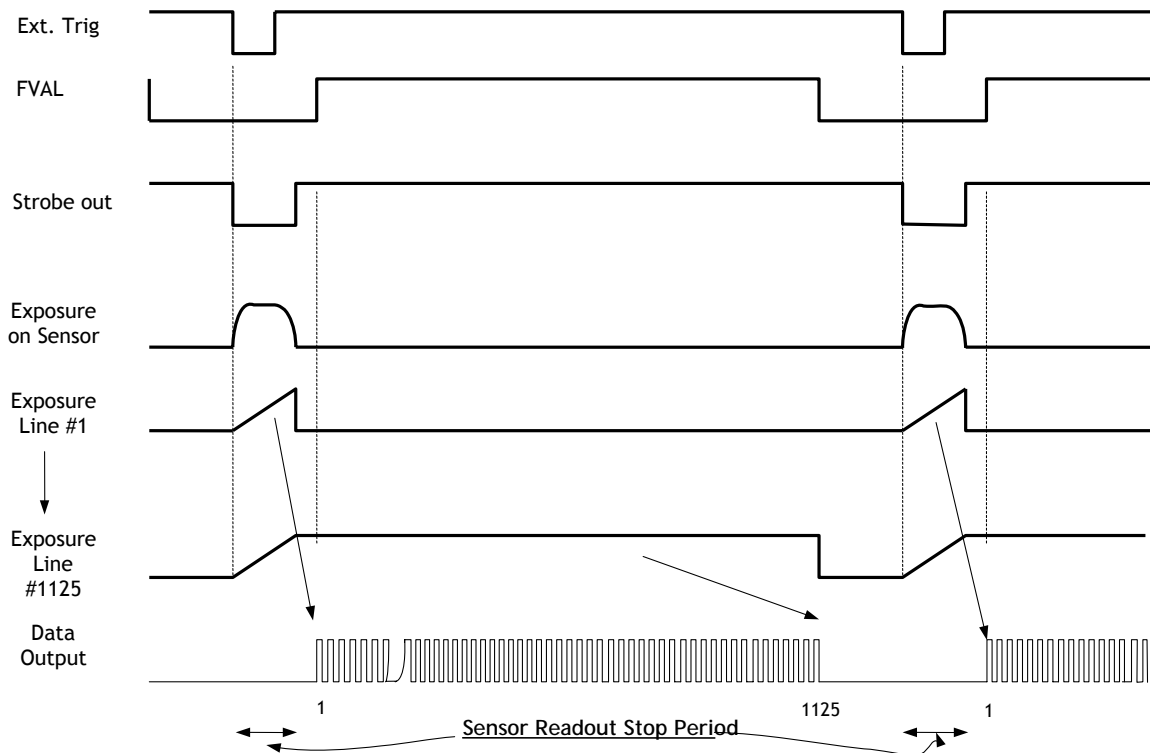


Fig.10. Transition of each part of Snap-shot trigger operation



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

**Important Note:**

The CMOS sensor does not have a mechanism that allows pixels to be reset at one time, and is therefore accumulating and reading out continuously. Due to this, a residual image of the previous frame may be superimposed on the frame being shot. To avoid this, the scene to be captured must be shielded from ambient light and only illuminated by strobe illumination.

Fig.11. General explanation of Snap-Shot 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.

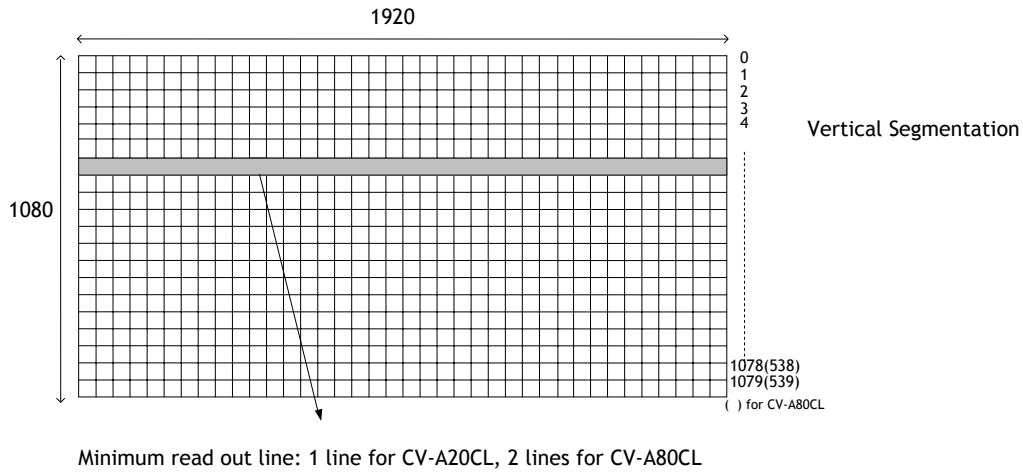


Fig.12. Window Scan Layout

### Setting commands for windowing scan

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

### Setting example of windowing scan

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

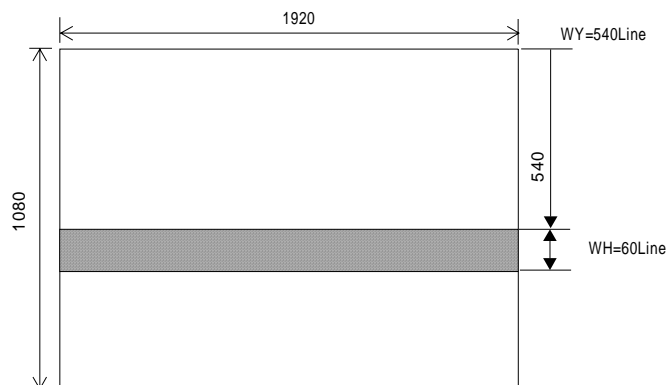


Fig.13. Example of window scan

#### 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  $67,500 \div (45 + 540) = 115.3 \text{ Hz}$

#### 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.

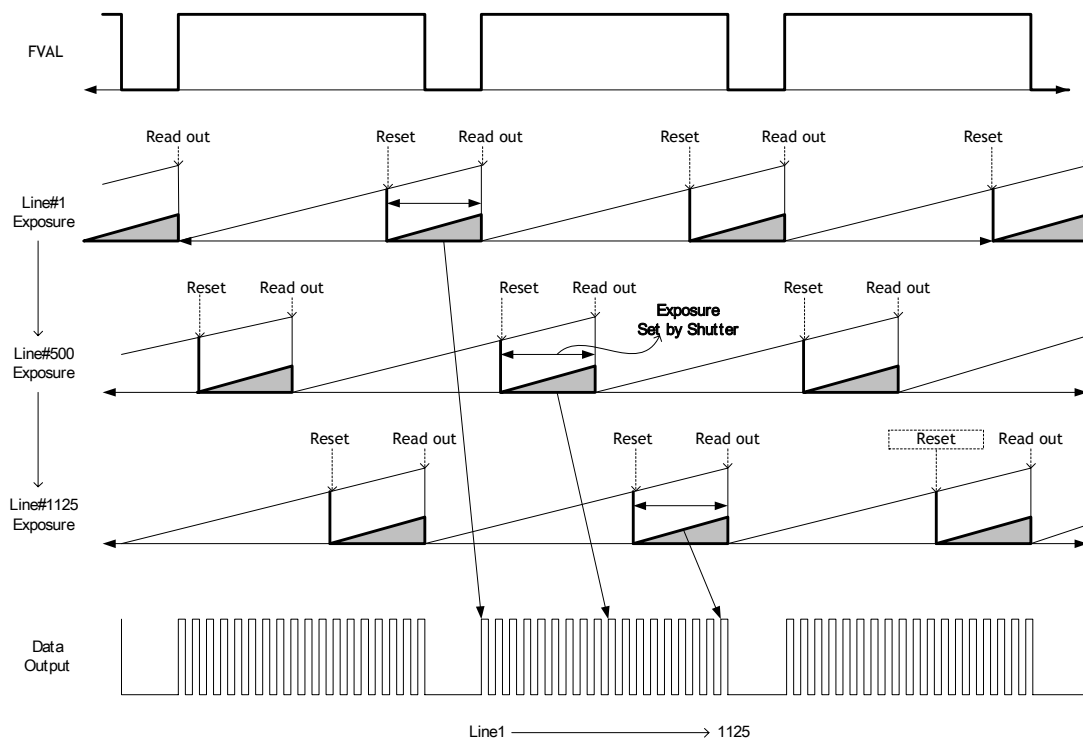


Fig.14. The relation between the picture area and the exposure time

|              |  |
|--------------|--|
| Command SM:  | Shutter mode<br>SM=0 Preset shutter SM=1 Programmable exposure   |
| Command SM=0 | Preset shutter<br>0=OFF(1/60) 1=1/120 2=1/250 3=1/500 4=1/1000 5=1/2000<br>6=1/5000 7=1/ 10,000 8=1/20,000   |
| Command SM=1 | Programmable exposure<br>The exposure time can be set in 1 LVAL unit in the range from 2LVAL to 1,125 LVAL.<br>Maximum shutter time Command: PE=1125<br>$14.815\mu s \times 1125 \text{ LVAL} = 16.67\text{ms}$<br>Minimum shutter time Command: PE=2<br>$14.815\mu s \times 2 \text{ LVAL} = 29.63 \mu s$<br>LVAL period = 14.815 $\mu s$ . |

**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.

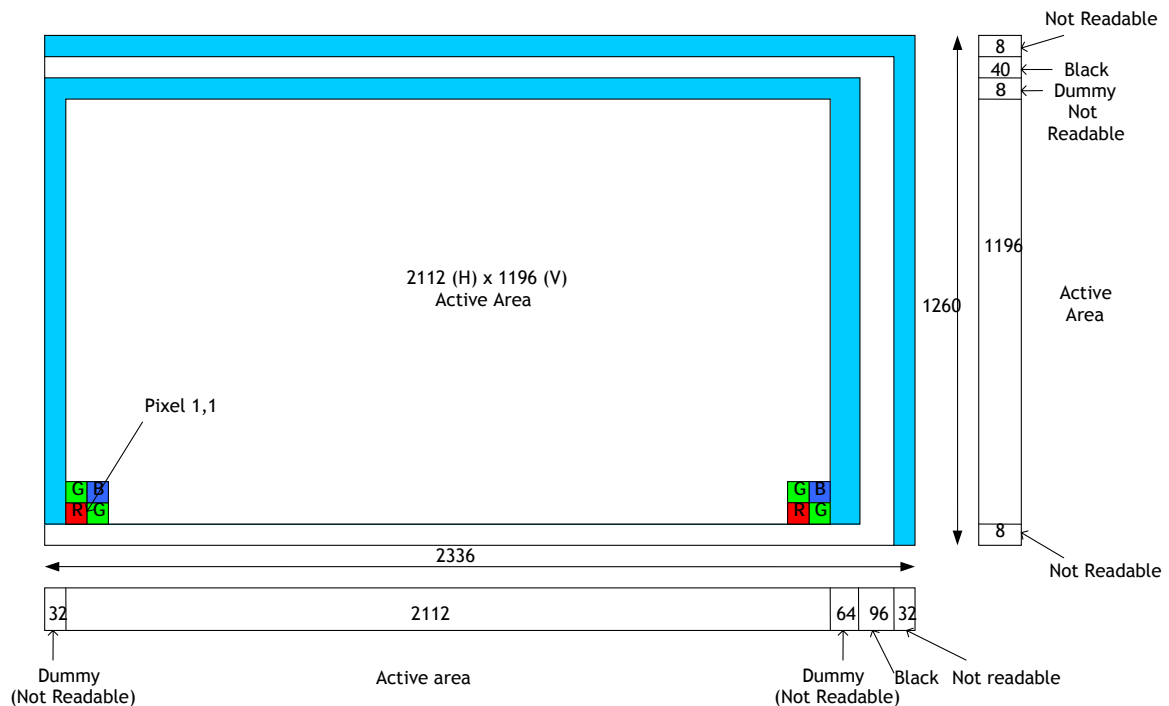


Fig.15. Sensor Layout

## 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)

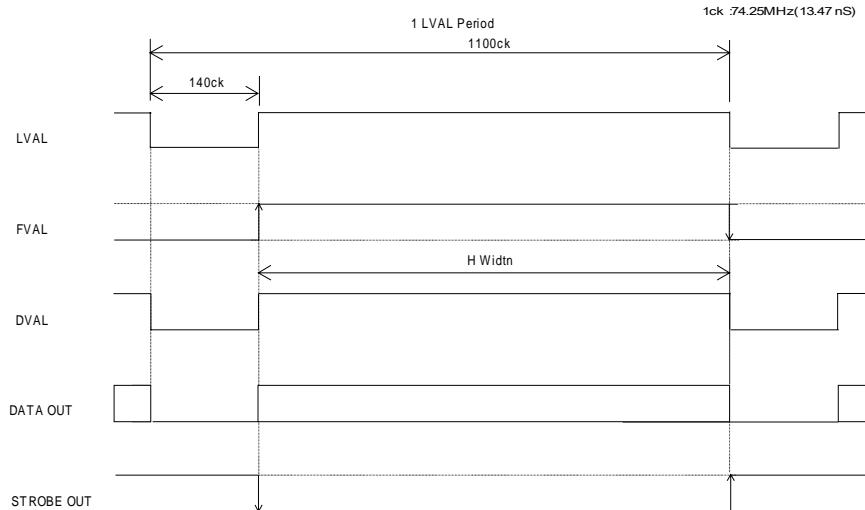


Fig.16. Horizontal timing (Full Frame)

### FVAL Period (Continuous, Full Frame)

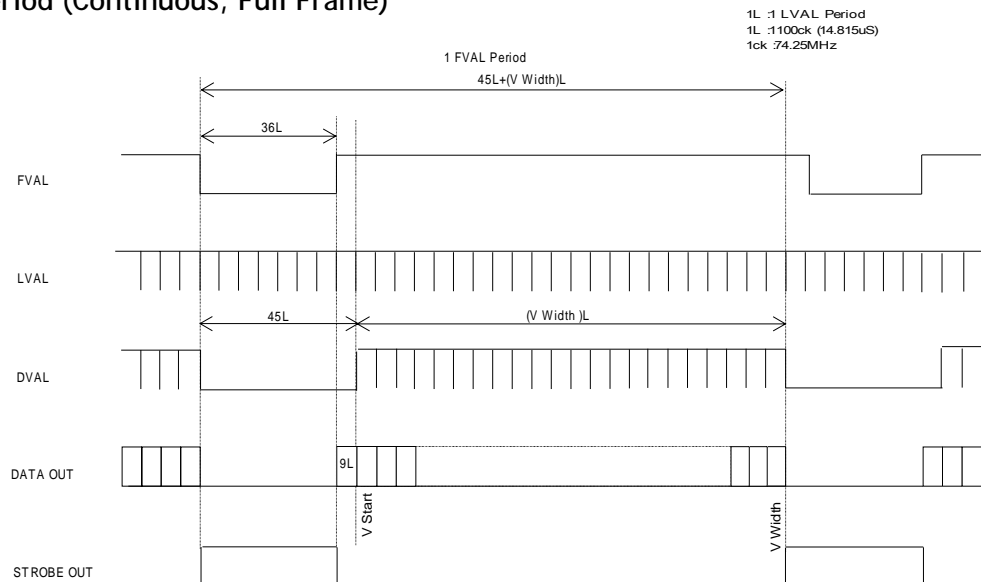


Fig.17. Vertical timing (Full Frame)

### 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 TTL or  $4.0Vp-p \pm 2.0Vp-p$  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 = 14.815 $\mu$ s)

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  $\mu$ s)

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 20 $\mu$ s delay is required, calculate 20 $\mu$ s divided by 14.815  $\mu$ s (LVAL)

⇒ This results in 1 (LVAL) and the remainder is 5.19  $\mu$ s

Therefore set the delay parameters as follows:

ENL : set to 1

ENP : set to 77 (5.19  $\mu$ s  $\div$  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  $35 \text{ clk} \pm 1 \text{ clk}$  (  $471.45 \text{ ns} \pm 13.5 \text{ ns}$  ).

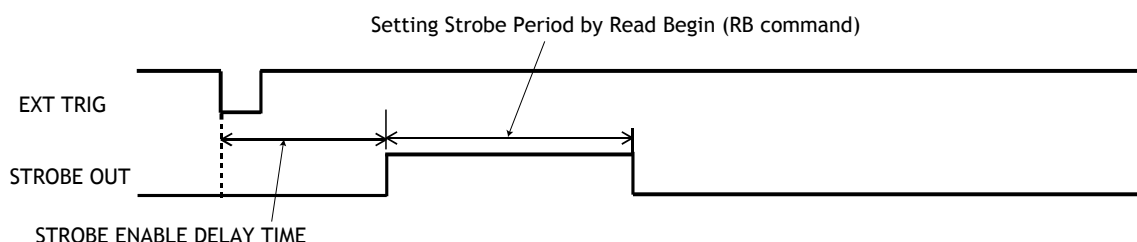


Fig.19. Strobe output timing for Strobe-Preset Snap-Shot trigger mode

## 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<br>WY=0 to 1078 for CV-A80CL |
|               | Window scan height                       | WH=1 to 1080 for CV-A20CL<br>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

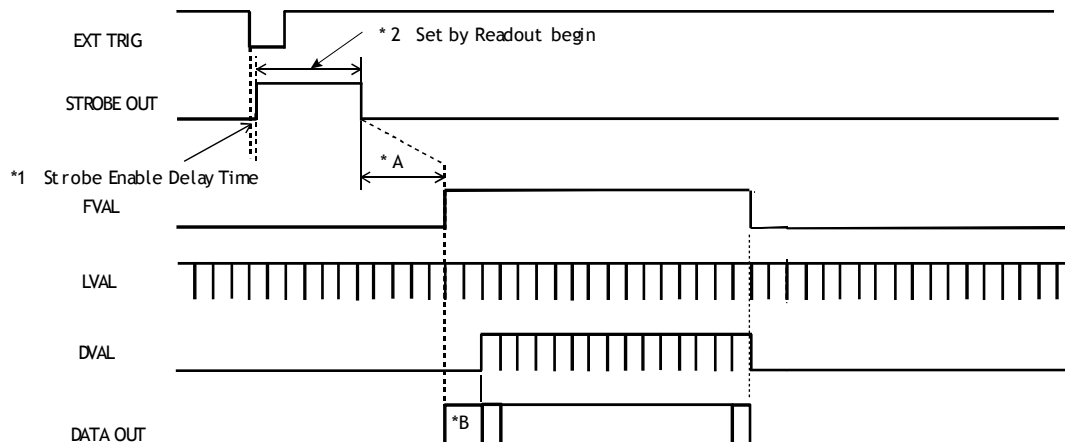
Set function:

Trigger mode "Strobe-Preset Snapshot"  
 Trigger Input Camera Link or 12-pin Hirose  
 Trigger polarity Active-LOW or Active-HIGH  
 Window scan select "Full" "Window"  
 If used

TR = 1  
 TI = 0 or 1  
 TP = 0 or 1  
 WS=0 or 1

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.

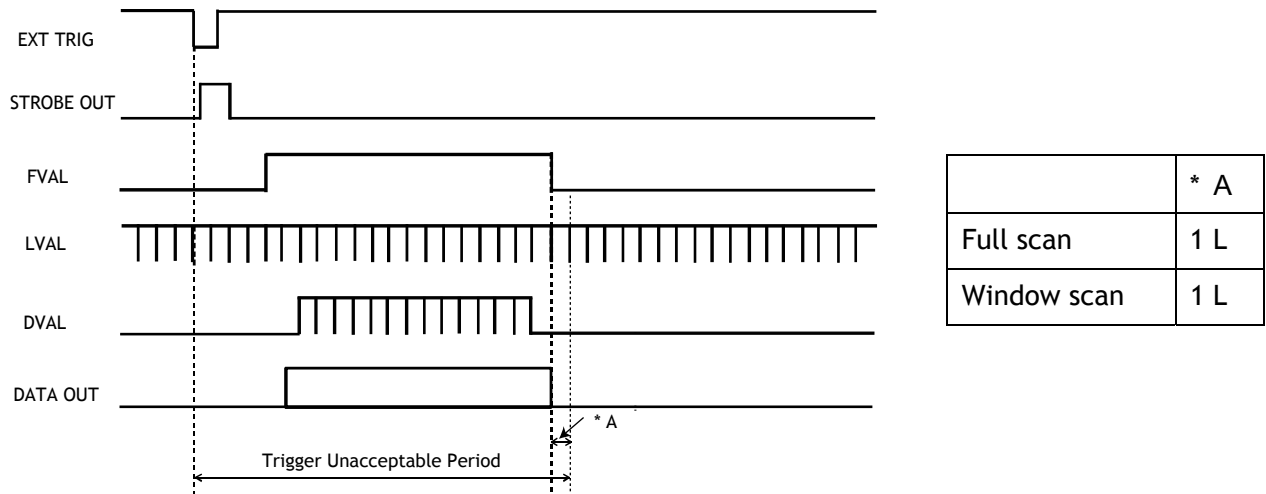


Fig.21. Minimum Trigger period

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

Whereby, Strobe delay 0 is inherent delay which is fixed at  $35 \text{ clk} \pm 1 \text{ ck}$ ,  
 Strobe delay time is determined by Strobe Enable Delay Time  
 Strobe out period is determined by Readout Begin Period  
 $38L + (0 \text{ to } 1L) + 9L(\text{OB})$  and  $2L+1L$  are fixed values.  
 Effective period may vary depending on scanning format.

#### 6.4.3. Widowing Timing Chart

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

##### FVAL Period (Continuous, Windowing)

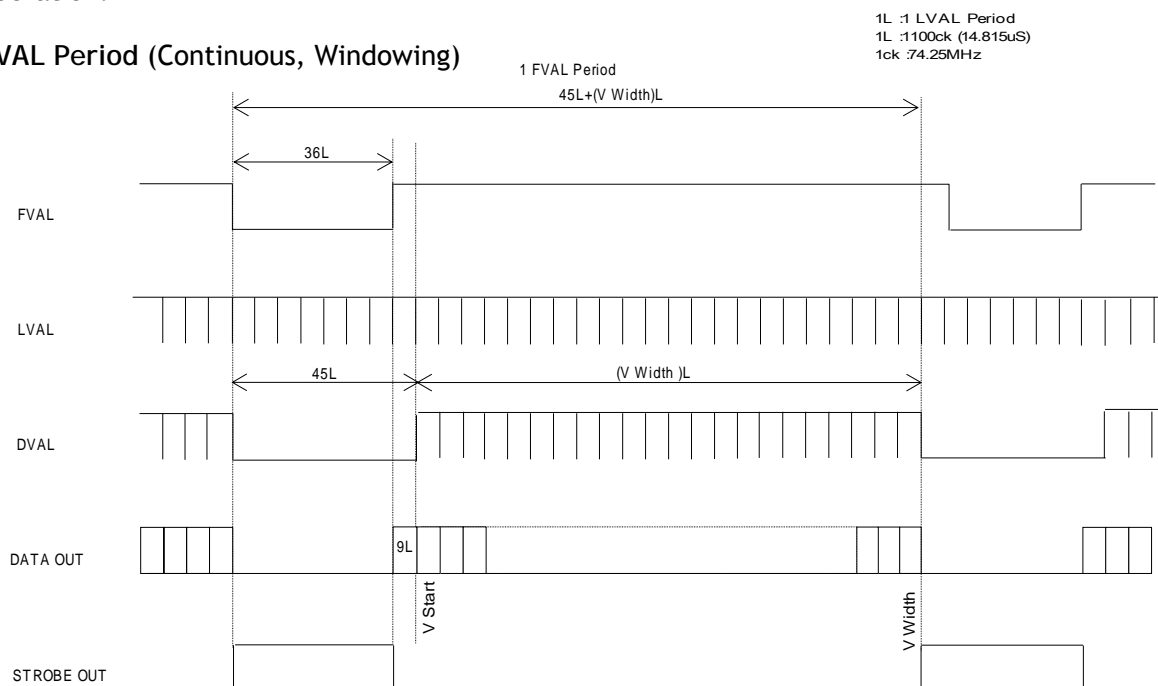


Fig.22. Vertical timing, Window scan

### LVAL Period (Continuous, Windowing)

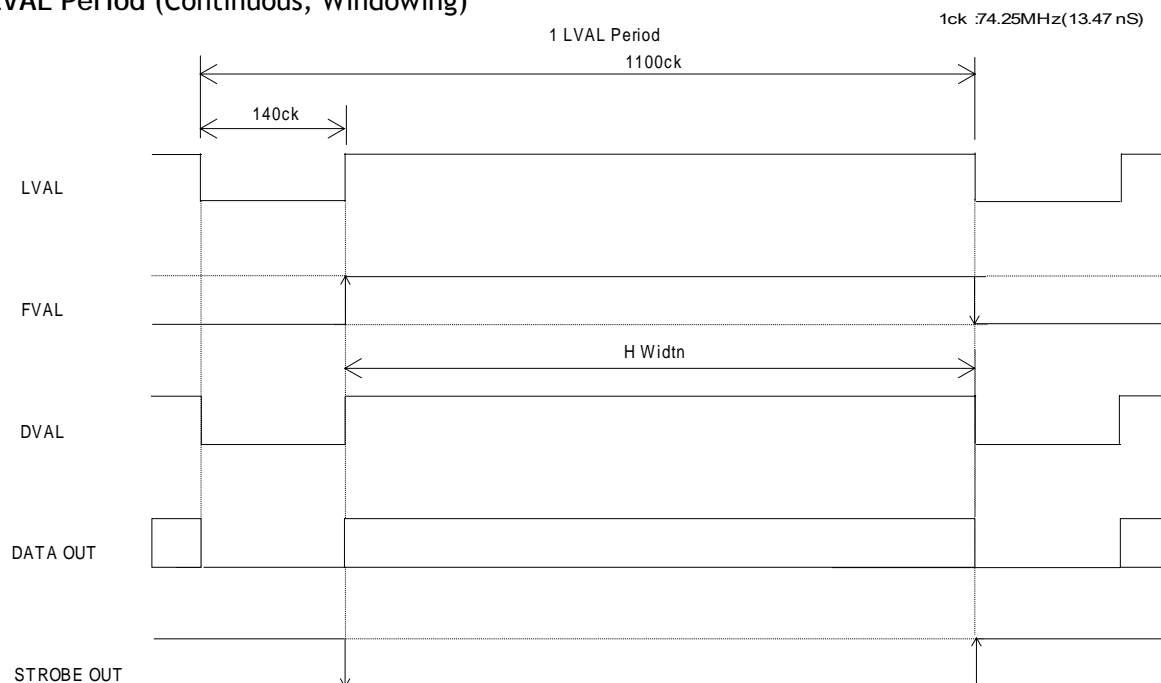


Fig.23. Horizontal timing, Window scan

### 6.4.4. Mode and function compatibility matrix

| Mode                    | Shutter                |                        | Windowing          | Strobe out         |
|-------------------------|------------------------|------------------------|--------------------|--------------------|
|                         | Pre-selected<br>SM = 0 | Programmable<br>SM = 1 |                    |                    |
| Continuous              | Yes                    | Yes                    | Yes <sup>(1)</sup> | Yes                |
| Strobe-preset Snap-Shot | No                     | No                     | Yes                | Yes <sup>(2)</sup> |

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<br>This can select ON or OFF><br>AS=0 OFF for Manual gain control, AS=1 ON for Auto gain control  |
| Command AG | AGC Reference<br>This sets the reference of AGC. This is available only for AS=1.  |
| Command GA | Manual Gain Control<br>This command sets the gain setting from -3 to +12. The step is approximately 1 dB. Therefore, GA=12 means approx. 12dB, etc.<br>The negative values follow a different scale: GA=-3 for -6dB, -2 for -3dB |

and -1 for -2dB.

|              |   |
|--------------|---|
| Command GAF  | Gain Fine level<br>This command sets the gain level with a fine granularity.  |
| Command BL   | Offset / Black level<br>This can change the offset / black level (set-up) level manually.                                   |
| Command BRMO | Black Reference (for continuous mode)<br>This can select Auto or Manual for black level control. Factory setting is Manual. |
| Command BROO | Black Reference value (for continuous mode)<br>This value is used in conjunction BRMO when it is set to Auto.               |

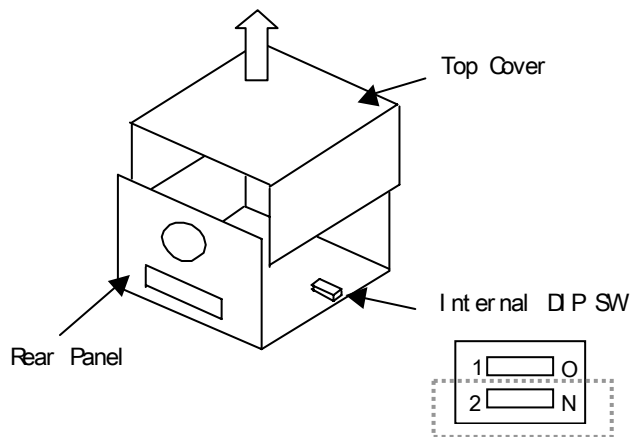
## 7. Configuring the Camera

### 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.

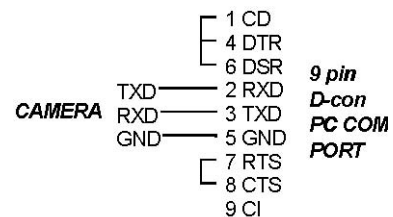


**DIP SW 2**  
 Serial communication interface  
 ON: Camera Link ( Default )  
 OFF: RS-232C, Hirose 12-pin

Fig. 25. DIP switch 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><br>EB?<CR><LF> | 0=Echo off<br>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)  |

*CV-A20CL / CV-A80CL*

|   |                            |                                      |   |   |
|---|----------------------------|--------------------------------------|---|---|
|   | 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><br>UD?<CR><LF>   |   | User can save and load free text.<br>(max 16 char.) |
| <b>B - Shutter</b>                                    |                            |                                      |   |   |
| 1   | Shutter mode               | SM=[Param.]<CR><LF><br>SM?<CR><LF>   | 0= Preset shutter<br>1= Programmable exposure   | When TR=1, the shutter is not available.            |
| 2   | Preset shutter             | SH=[Param.]<CR><LF><br>SH?<CR><LF>   | 0=1/60, 1=1/120, 2=1/250,<br>3=1/500, 4=1/1000, 5=1/2000,<br>6=1/4000, 7=1/10000,<br>8=1/20000, | Available when TR=0 and SM=0.                       |
| 3   | Programmable exposure      | PE=[Param.]<CR><LF><br>PE?<CR><LF>   | 2 - 1125L<br>(Set in step 1; 1L=14.815us)   | Available when TR=0 and SM=1.                       |
| 4   |                            |                                      |   |   |
| <b>C - Trigger mode and trigger related functions</b> |                            |                                      |   |   |
| 1   | Trigger Mode               | TR=[Param.]<CR><LF><br>TR?<CR><LF>   | 0=Continuous<br>1=Strobe-Preset Snapshot  |   |
| 2   | Trigger Input              | TI=[Param.]<CR><LF><br>TI?           | 0=Camera-Link<br>1=Hirose12-pin- Pin #10  |   |
| 3   | Trigger Polarity           | TP=[Param.]<CR><LF><br>TP?           | 0=Active-Low<br>1=Active-High   |   |
| 4   | Strobe Enable Delay Lines  | ENL=[Param.]<CR><LF><br>ENL?<CR><LF> | 0 to 1125   | Available when TR=1                                 |
| 5   | Strobe Enable Delay Pixels | ENP=[Param.]<CR><LF><br>ENP?<CR><LF> | 0 to 219  | Available when TR=1                                 |
| 6   | Readout Begin              | RB=[Param.]<CR><LF><br>RB?<CR><LF>   | 2 - 1125L<br>(Set in step 1; 1L=14.815us)   | Available when TR=1.                                |
| <b>D - Scan Format and video output</b>               |                            |                                      |   |   |
| 1   | Window Scan Select         | WS=[Param.]<CR><LF><br>WS?<CR><LF>   | 0=Full Frame<br>1=Window Scan   |   |
| 2   | Window Scan Start          | WY=[Param.]<CR><LF><br>WY?<CR><LF>   | 0 to 1079   | CV-A20CL<br>1 line step                             |
|   |                            |                                      | 0 to 1078   | CV-A80CL<br>2 lines step                            |
| 3   | Window Scan Height         | WH=[Param.]<CR><LF><br>WH?<CR><LF>   | 1 to 1080   | CV-A20CL<br>1 line step                             |
|   |                            |                                      | 2 to 1080   | CV-A80CL<br>2 lines step                            |
| 4   | Camera Link Bit Allocation | BA=[Param.]<CR><LF><br>BA?<CR><LF>   | 0=10 bit<br>1=8 bit   |   |
| <b>E - Gain and signals setting</b>                   |                            |                                      |   |   |
| 1   | AGC Select                 | AS=[Param.]<CR><LF><br>AS?<CR><LF>   | 0=OFF (Manual Gain Control)<br>1=ON (Auto Gain Control)   |   |
| 2   | AGC Reference              | AG=[Param.]<CR><LF><br>AG?<CR><LF>   | 150-1023  | Available when AS=1                                 |

*CV-A20CL / CV-A80CL*

|  |   |  |  |   |
|--|---|--|--|---|
| 3  | Manual Gain Level                         | GA=[Param.]<CR><LF><br>GA?<CR><LF>     | -3 to 12<br>(-1=-6dB, -2 = -3dB, -1 = -2dB ,<br>0=0dB, 1=1dB, ... 12=12dB)         |   |
| 4  | Pixel Gain ON/OFF                         | PG=[Param.]<CR><LF><br>PG?<CR><LF>     | 0 = OFF ( Main Gain )<br>1 = ON ( Pixel Gain )                                     | For CV-A80 only   |
| 5  | Pixel Gain of 1st pixel in RGB 2x2 matrix | PG1=[Param.]<CR><LF><br>PG1?<CR><LF>   | -3 to 12<br>(-3=-6dB, -2=-3dB, -1=-2dB,<br>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><br>PG2?<CR><LF>   | -3 to 12<br>(-3=-6dB, -2=-3dB, -1=-2dB,<br>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><br>PG3?<CR><LF>   | -3 to 12<br>(-3=-6dB, -2=-3dB, -1=-2dB,<br>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><br>PG4?<CR><LF>   | -3 to 12<br>(-3=-6dB, -2=-3dB, -1=-2dB,<br>0=0dB, 1=1dB, 2=2dB,...12=12dB)         | For CV-A80CL only                                       |
| 9  | Black level                               | BL=[Param.]<CR><LF><br>BL?<CR><LF>     | -255 to 255  | This is for SET UP Level.                               |
| 10   | BLACKREF Mode in the continuous mode      | BRM0=[Param.]<CR><LF><br>BRM0?<CR><LF> | 0=Auto<br>1=Manual ( Default )   |   |
| 11   | BLACKREF value in the continuous mode     | BR00=[Param.]<CR><LF><br>BR00?<CR><LF> | 0 to 1023  | This is for black level adjust.                         |
| <b>F - Saving and loading data in EEPROM</b> |   |  |  |   |
| 1  | Load Settings (from Camera EEPROM)        | LD=[Param.]<CR><LF>                    | 0=Factory data<br>1=User 1 area<br>2=User 2 area<br>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<br>2=User 2 area<br>3=User 3 area<br>The parameter 0 is not allowed. |   |
| 3  | EEPROM Current Area No. Request.          | EA?<CR><LF>                            | 0=Factory data<br>1=User 1 area<br>2=User 2 area<br>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](http://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 Tool 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.

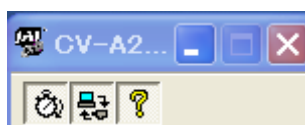
### 8.1. Camera Control Tool Interface

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.

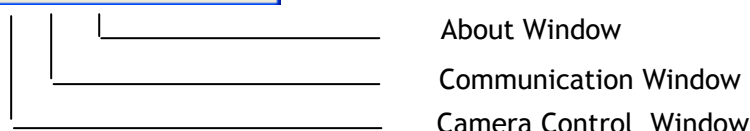
### 8.2. Camera Control Tool Bar

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

For CV-A20CL



For CV-A80CL

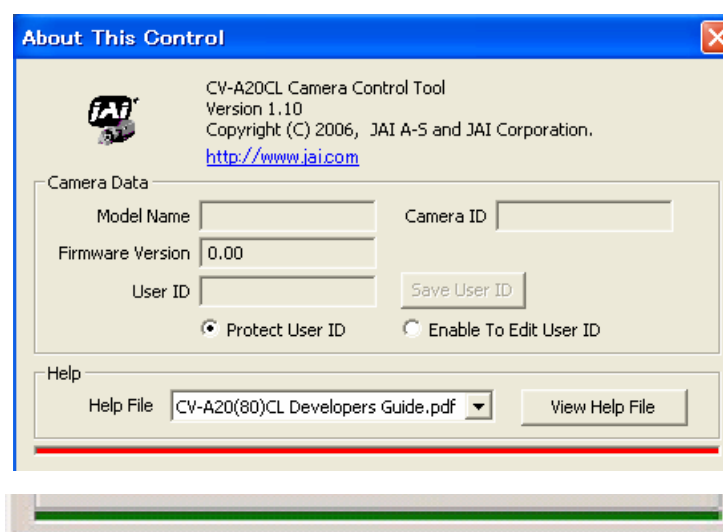


### 8.3. The About Window

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 "downloads" section at the JAI website: <http://www.jai.com>

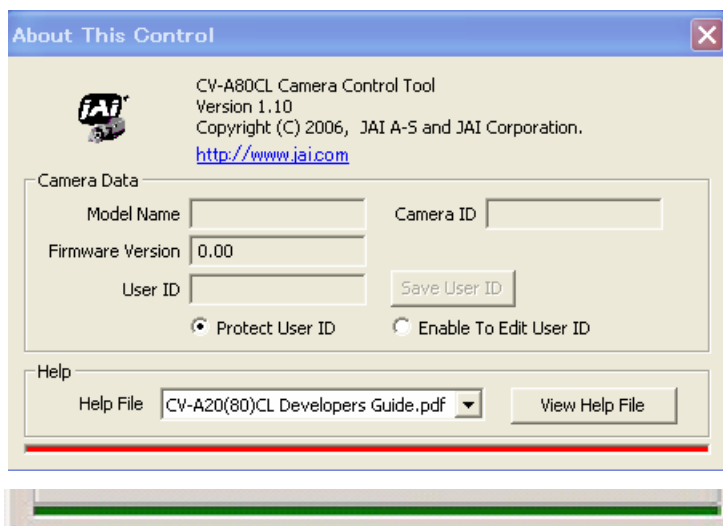
An updated manual can be saved in the (default) folder address mentioned above. It will then automatically be included in the list of help files.

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

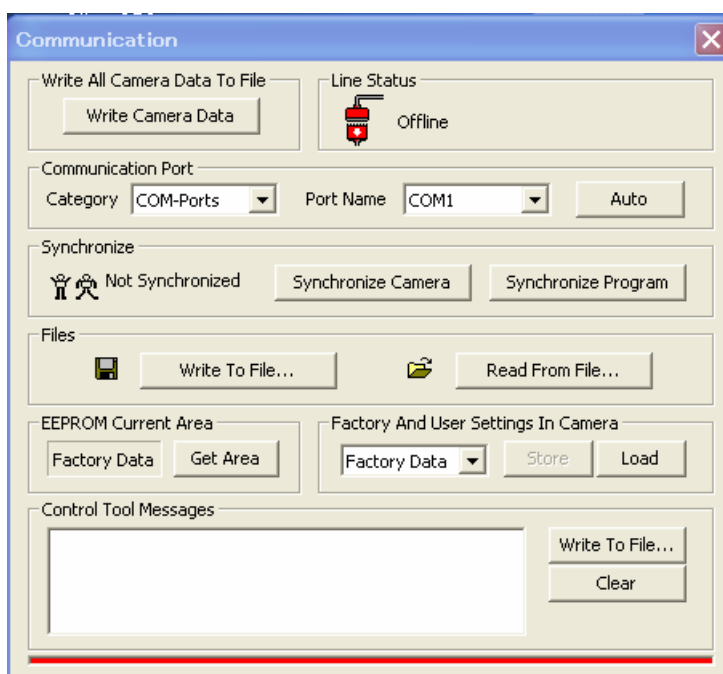
The Communication Window is used to connect the Camera Control Tool with the JAI camera. Depending of camera there are 2 possible ways to communicate with a JAI camera.

##### 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 loses 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.

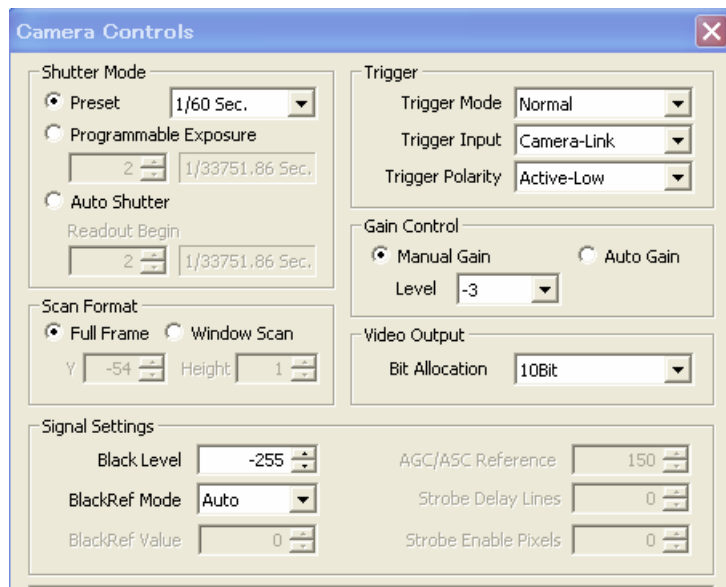


### 8.5. Camera Control Window

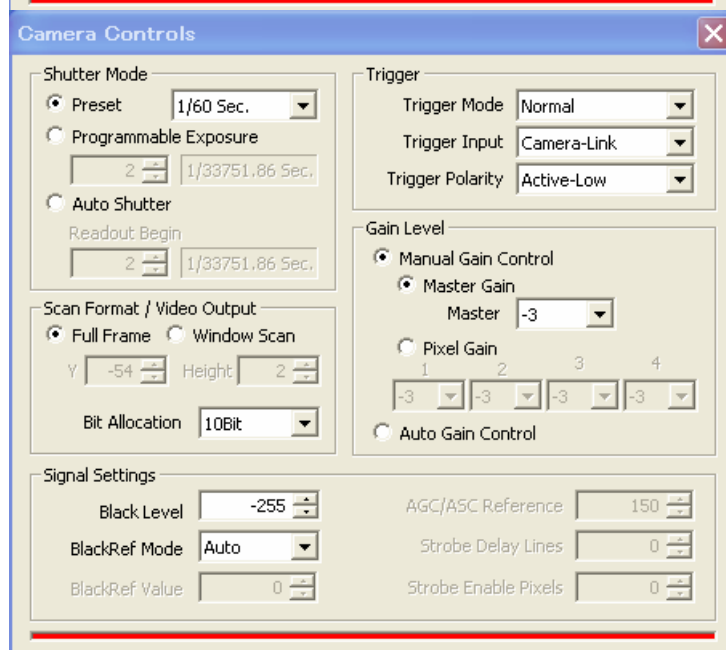
The Camera Control Window contains the fundamental camera setting functions.

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

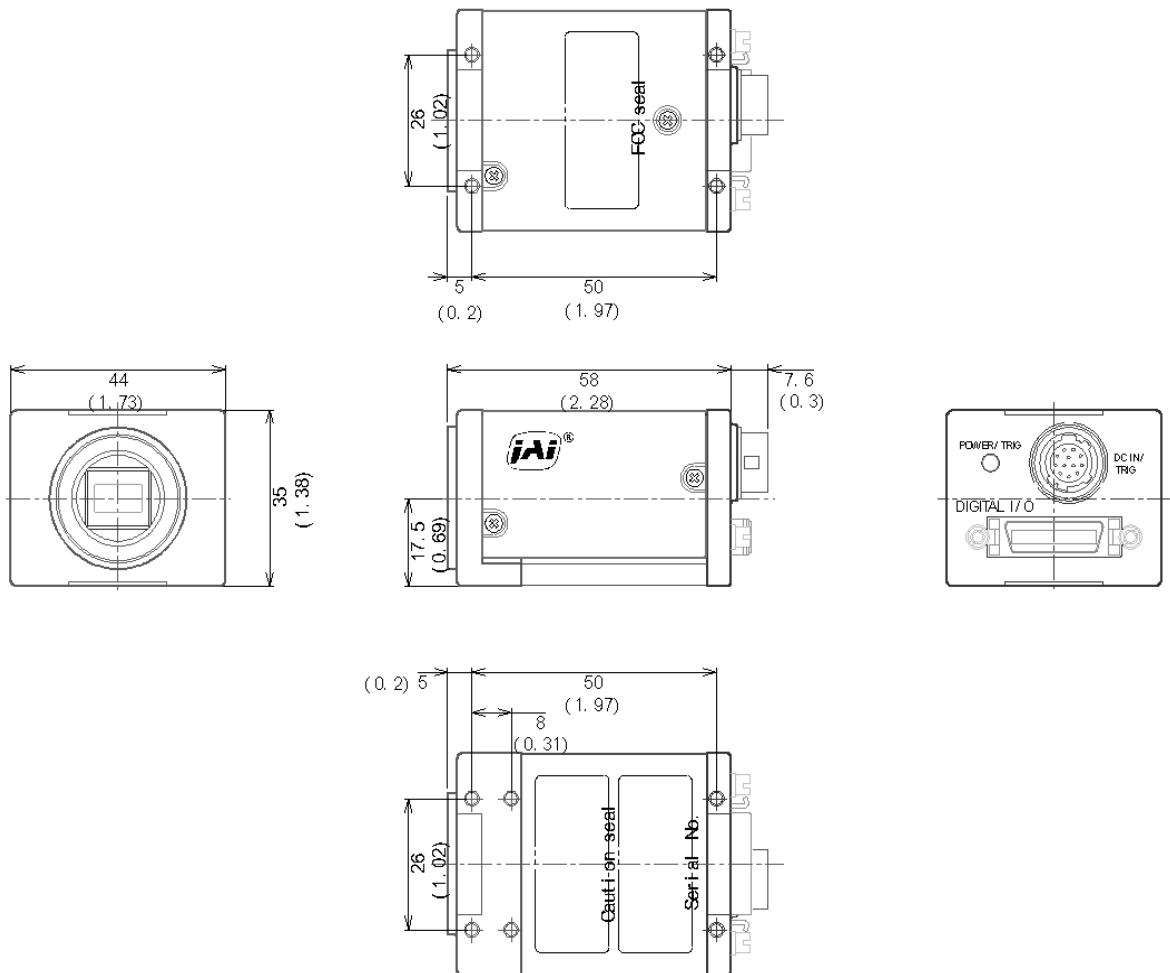


Fig.26. Dimensions

## 10. Specifications

### 10.1. Spectral response

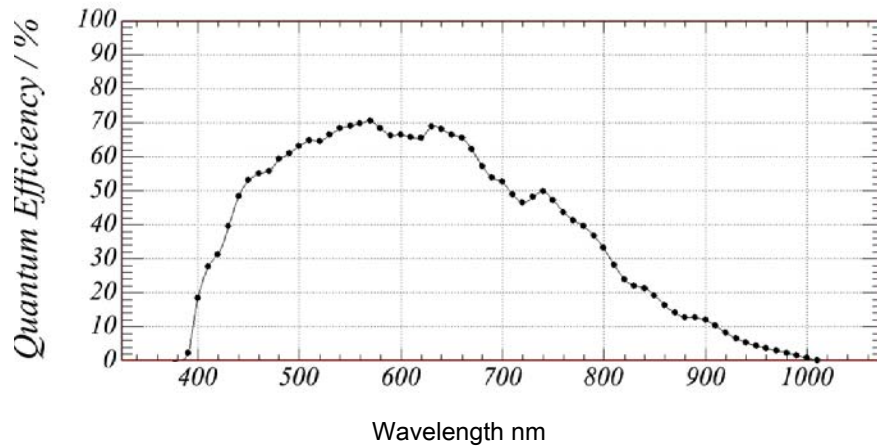


Fig. 27. Spectral response for monochrome CMOS

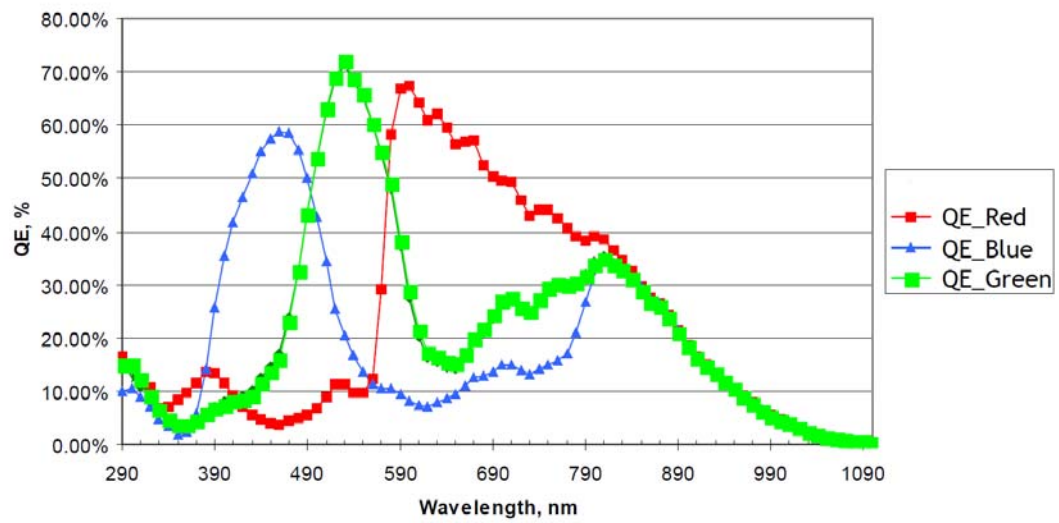


Fig.28. Spectral response for Bayer Color CMOS  
(Shown without 700 nm IR-cut filter)

## 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  | 0.7 Lux  | 2.3 Lux                    |
| SN ratio                       | ( Shutter: OFF, Gain=max, 50% output, CV-A80CL with IR filter)<br>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<br>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          |
| 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.<br>Continuous mode: During blanking (H level)<br>Trigger mode: During exposure period (H Level) |                            |
| Control Interface              | Camera control : RS232C ( 9,600 bps )<br>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.

#### Rolling Shutter

The CMOS sensor used in this camera has a Rolling Shutter. This means that accumulation and read-out is performed in a shifting fashion, line by line. There is therefore a time lag between the accumulation and read-out from the first line to the last line. When capturing objects during motion, this will manifest itself as a geometric distortion.

#### V. Aliasing

When the CMOS camera captures stripes, straight lines or similar sharp patterns, the edges of these objects may appear jagged.

#### 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.

#### Fixed Patterned Noise

When the sensor captures a dark object at high temperature or is used with a short exposure time or increased gain, 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.*

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User's Mode Settings.

User's Modifications.



### 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

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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

有毒，有害物质或元素名称及含量表

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<br>( Pb ) | 汞<br>( Hg ) | 镉<br>( Cd ) | 六价铬<br>( Cr(VI) ) | 多溴联苯<br>( PPB ) | 多溴二苯醚<br>( PBDE ) |
| 光学滤色镜  | ×           | ○           | ×           | ○                 | ○               | ○                 |
| .....  | .....       | .....       | .....       | .....             | .....           | .....             |
| <div>○：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。</div> <div>×：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。</div> <div>（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。）</div> |             |             |             |                   |                 |                   |



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电子信息产品中含有的有毒有害物质或元素在正常使用的条件下不会发生外泄或突变、电子信息产品用户使用该电子信息产品不会对环境造成严重污染或对基人身、财产造成严重损害的期限。  
数字「15」为期限15年。