See the possibilities

# User Manual

# AM-800CL
# AB-800CL

*8M Digital Progressive Scan Monochrome and color Camera*

**Document Version: ver.1.8**
**AMAB-800CL_Ver.1.8_Oct2013**

1027E-1102

# Notice

The material contained in this manual consists of information that is proprietary to JAI Ltd., Japan and may only be used by the purchasers of the product. JAI Ltd., Japan makes no warranty for the use of its product and assumes no responsibility for any errors which may appear or for damages resulting from the use of the information contained herein. JAI Ltd., Japan reserves the right to make changes without notice.

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# Warranty

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

# Certifications

## CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that AM-800CL-C, AM-800CL-F,AB-800CL-C and AB-800CL-F comply with the following provisions applying to its standards.
EN 61000-6-3 (Generic emission standard part 1)
EN 61000-6-2 (Generic immunity standard part 1)

## FCC

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into a outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

# Warning

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

# Supplement

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

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

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## 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（Pb） | 汞（Hg） | 镉（Cd） | 六价铬（Cr(VI)） | 多溴联苯（PPB） | 多溴二苯醚（PBDE） |
| 螺丝固定座 | × | ○ | ○ | ○ | ○ | ○ |
| 连接插头 | × | ○ | ○ | ○ | ○ | ○ |
| 电路板 | × | ○ | ○ | ○ | ○ | ○ |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... |

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

环保使用期限

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。

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

| 部件名称 | 有毒有害物质或元素 | | | | | |
|---|---|---|---|---|---|---|
| | 铅<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 ) |
| 螺丝固定座 | × | ○ | ○ | ○ | ○ | ○ |
| 光学滤色镜 | × | ○ | × | ○ | ○ | ○ |
| 连接插头 | × | ○ | ○ | ○ | ○ | ○ |
| 电路板 | × | ○ | ○ | ○ | ○ | ○ |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... |

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

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数字「15」为期限15年。

## - Contents -

## Before using AM-800CL and AB-800CL

The CCD sensor used in the AM-800CL and AB-800CL operates with four (4) taps and a 40MHz pixel clock. However, the video output through the Camera Link® interface is 2 taps for monochrome and Bayer color modes, and 1 tap for RGB color output.
Accordingly, the pixel clock at the Camera Link interface is 80MHz and users should make sure that the specifications and performance of connected frame grabber boards and PCs can support this clock speed. The maximum length of the Camera Link cable may also be impacted.

The AM-800CL and AB-800CL are high resolution and high frame rate cameras with 3296(h) x 2472(v) pixel resolution and a 17fps frame rate for monochrome and Bayer color.
Accordingly, the amount of data produced is very large. If the output is set at 10-bits or 12-bits per pixel, the total data stream is approx. 2.2 Gbit/sec. as a 16-bit process in the frame grabber board. A frame grabber board connected to the PCI-32bit bus has a bandwidth of 2.1 Gbits/sec and therefore, all frames may not be displayed.
In this case, it is recommended to use the PCI-64bit bus or to use a frame grabber board that can utilize the PCI Express Bus x 8.

JAI recommends using a PC with CPU better than i7.
It should be noted, even though you use the mentioned PC, you might not capture a full of 17fps image while you view full resolution images on the screen.

# 1. General

The AM-800CL is a 4/3 inch monochrome progressive scan CCD camera and the AB-800CL is the equivalent Bayer mosaic progressive scan CCD camera. Both have 8 million pixels resolution and 4 taps in the sensor. They provide 17 frames per second for continuous scanning with 3296 x 2472 full pixel resolution.

Both AM-800Cl and AB-800CL are suitable for automated optical inspection applications, such as solid state device inspection or material surface inspection.

They incorporates various processing circuits such as LUT, FFC(Flat Field Compensation), blemish compensation and Bayer interpolation. The AM-800CL and AB-800CL work in continuous, single frame, and multi-frame modes for acquisition control together with timed, trigger width and trigger controlled exposure controls. Both cameras also have edge-dump and PIV modes.

The AM-800CL has H and V binning modes and both the AM-800CL and AB-800CL have an AOI (Area Of Interest) mode for achieving a faster frame rate.

The digital output is through a Camera Link® digital interface with 8-bits , 10-bits or 12-bits of pixel bit depth.

The latest version of this manual can be downloaded from: www.jai.com
The latest version of Camera Control Tool for the AM-800CL and AB-800CL can be downloaded from: www.jai.com
For camera revision history, please contact your local JAI distributor.

### Special note:

In this manual, some new terminologies are used as compared to the terms used in previous JAI operation manuals.

| Previous | New |
|---|---|
| EPS | Timed |
| PWC | Trigger width |
| RCT(Reset Continuous) | Edge-dump |
| Partial scan | AOI (Area Of Interest) |
| Shutter | Exposure |
| Auto shutter | Exposure Auto |

## 2. Camera nomenclature

The standard camera composition consists of the camera main body and lens protection cap.

The camera is available in the following versions:
**AM-800CL-C**
**AM-800CL-F**
Where **A** stands for "Advanced" family, **M** stands for "Monochrome", **800** represents the resolution "8 million pixel" , **CL** stands for "Camera Link" interface and C for C-mount lens or F for F-mount lens

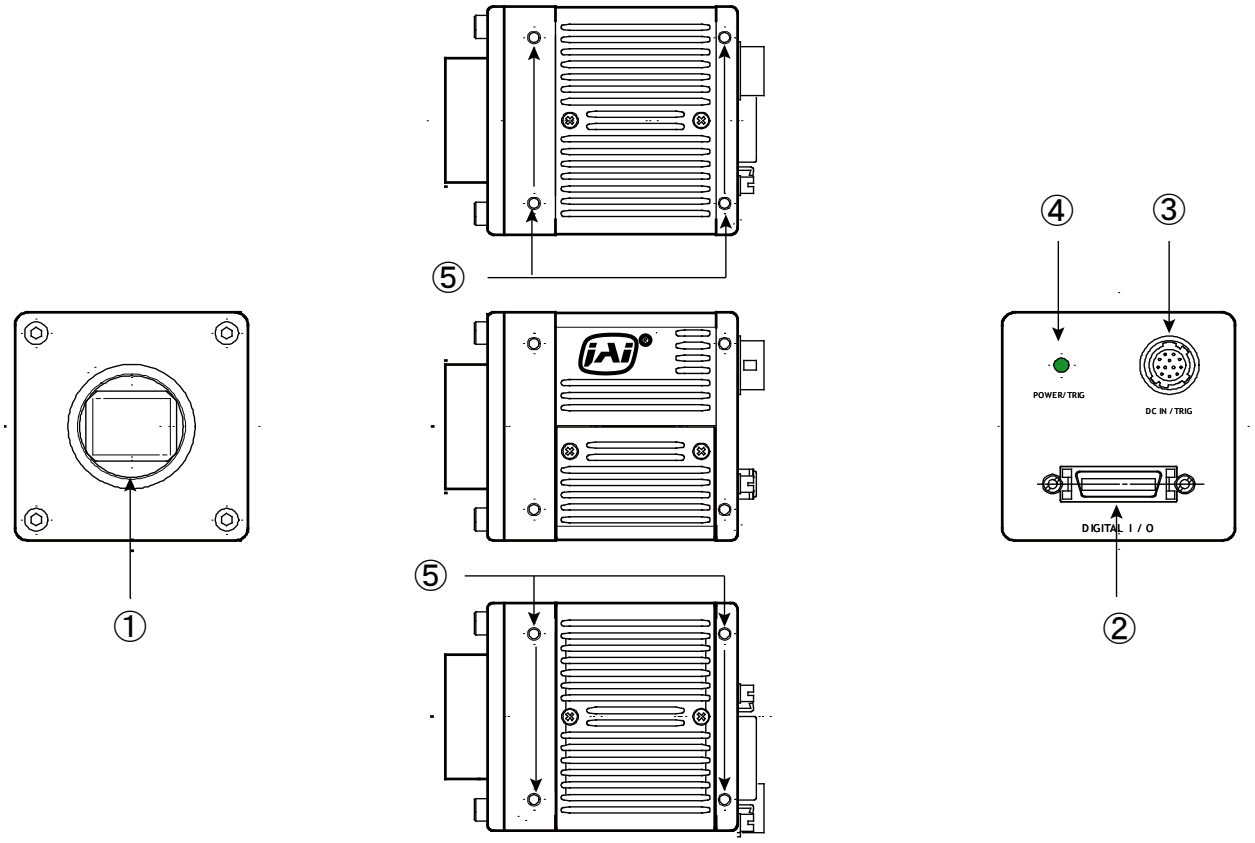
**AB-800CL-C**
**AB-800CL-F**
Where **A** stands for "Advanced" family, **B** stands for "Bayer mosaic color", **800** represents the resolution "8 million pixel" , **CL** stands for "Camera Link" interface and C for C-mount lens or F for F-mount lens

## 3. Main features

- C3 Advanced series 4/3 ” progressive scan camera
- Monochrome and Bayer mosaic color versions
- 3296 (h) x 2472 (v) active pixels
- 5µm square pixels
- 57dB or more S/N
- 8-bit, 10-bit or 12-bit output for monochrome and Bayer or 8-bit output RGB color
- 17 frames/second with full resolution in continuous operation for monochrome or Bayer output
- 8.5 frames/second for AB-800CL RGB output (in-camera interpolation)
- Various readout modes, horizontal and vertical binning (AM-800CL only) and AOI (Area Of Interest) modes for faster frame rate
- -3dB to +24dB gain control for AM-800CL and 0dB to +24dB for AB-800CL
- 10µs (1/100,000) to 2 seconds exposure control in 1µs step ( Exposure/Timed control mode)
- Timed ,trigger width for exposure control,
- Trigger-dump (RCT) and PIV modes for specific applications
- Auto gain control
- Various pre-processing circuits are provided
  Programmable LUT
  Gamma correction from 0.45 to 1.0
  Flat Field Correction
  Bayer white balance with manual or one-push auto (AB-800CL only)
  Bayer color interpolation (AB-800CL only)
  Blemish compensation
- Test pattern signal generator is built in
- Auto iris lens video output with H-sync
- Choice of lens mounts offered: C-mount or F-mount
- Setup by Windows XP/Vista/7 via serial communication

# 4. Locations and functions

## 4.1 Locations and functions (C-mount)




| | | |
|---|---|---|
| ① | Lens mount | C-mount (Note *1) |
| ② | 26-pin connector | Camera Link Interface ( Note *2) |
| ③ | 12-pin connector | DC+12V and trigger input |
| ④ | LED | Indication for power and trigger input |
| ⑤ | Mounting holes | M3 depth 4.5mm for fixing the camera to the mount plate or tripod mount plate (Note *3) |

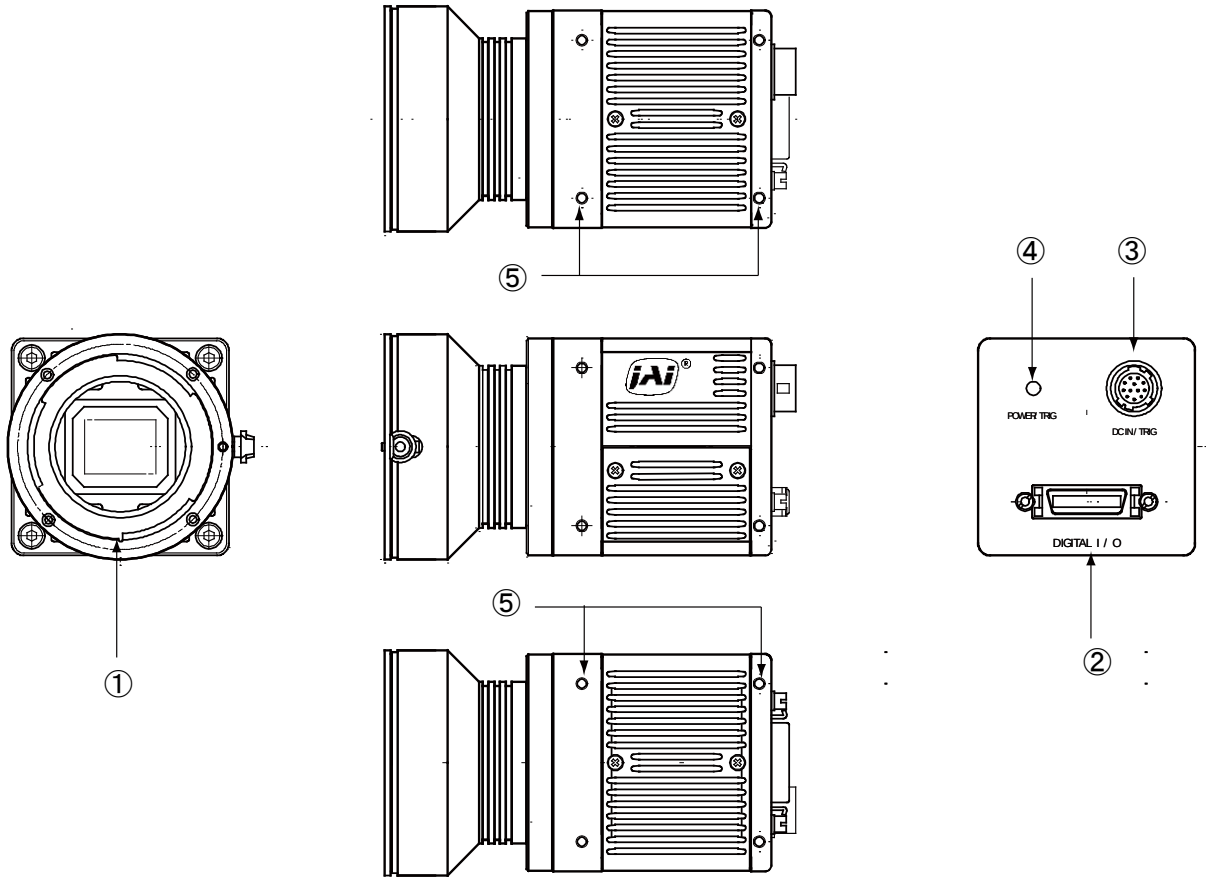
*1) Note: Rear protrusion on C-mount lens must be less than 10.0mm.

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

*3) Note: The part number for the tripod adapter plate (with 1/4"-20 thread) is MP-41 (option).

Fig. 1 Locations

## 4.2 Locations and functions (F-mount)




| | | |
|---|---|---|
| ① | Lens mount | F-mount (Note *1) |
| ② | 26-pin connector | Camera Link Interface ( Note *2) |
| ③ | 12-pin connector | DC+12V and trigger input |
| ④ | LED | Indication for power and trigger input |
| ⑤ | Mounting holes | M3 depth 4.5mm for fixing the camera to the mount plate or tripod mount plate (Note *3) |

*1) Note: Rear protrusion on F-mount lens must be less than 12.0mm.

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

*3) Note: The part number for the tripod adapter plate (with 1/4"-20 thread) is MP-41 (option).

Fig. 2 Locations

## 4.3 Rear panel

The rear panel mounted LED provides the following information:

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

Note: The interval of flashing does not correspond with external trigger duration.

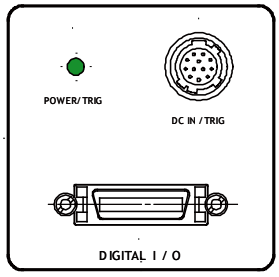


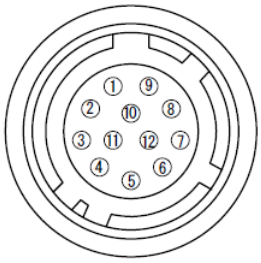

Fig. 3 Rear panel

# 5. Input and output

## 5.1 Connectors and pin assignment

### 5.1.1 Hirose 12Pin connector

#### 5.1.1.1 Figure




Type: HR10A-10R-12PB-01 (Hirose) male.
Use the part number HR10A-10P-12S for the cable side

Fig.4 Hirose 12-pin connector

#### 5.1.1.2 Pin assignment

| Pin no. | Signal | Remarks |
|---|---|---|
| 1 | GND | |
| 2 | DC input | +12V to +24V |
| 3 | GND | |
| 4 | Iris video | Only for Continuous and Trigger-dump modes. |
| 5 | GND | |
| 6 | NC | |
| 7 | NC | |
| 8 | GND | |
| 9 | XEEN out | *1) |
| 10 | Trigger in | TI=1 (or Camera Link TI=0). *2) |
| 11 | DC input | +12V to +24V |
| 12 | GND | |

*1) XEEN output can be configured with complementary emitter follower circuit or open collector by internal switch setting. The default is the complementary emitter follower circuit. See chapter 5.1.3 for the details.
*2) Factory default is trigger via Camera Link

### 5.1.2 Camera Link connector

#### 5.1.2.1 Figure

Type: 26-pin MDR connector (3M 10226-1A10PL)

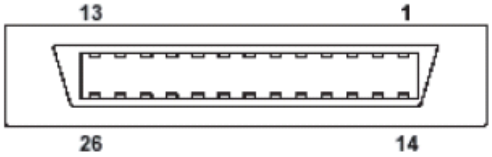



Fig.5 Camera Link connector

#### 5.1.2.2 Pin assignment

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

### 5.1.3 DIP switch SW500

The XEEN output through HIROSE 12-pin #9 can be connected to the complementary emitter follower circuit or the open collector circuit. DIP switch SW500 is used to change circuits.
Factory default setting is the complementary emitter follower circuit.

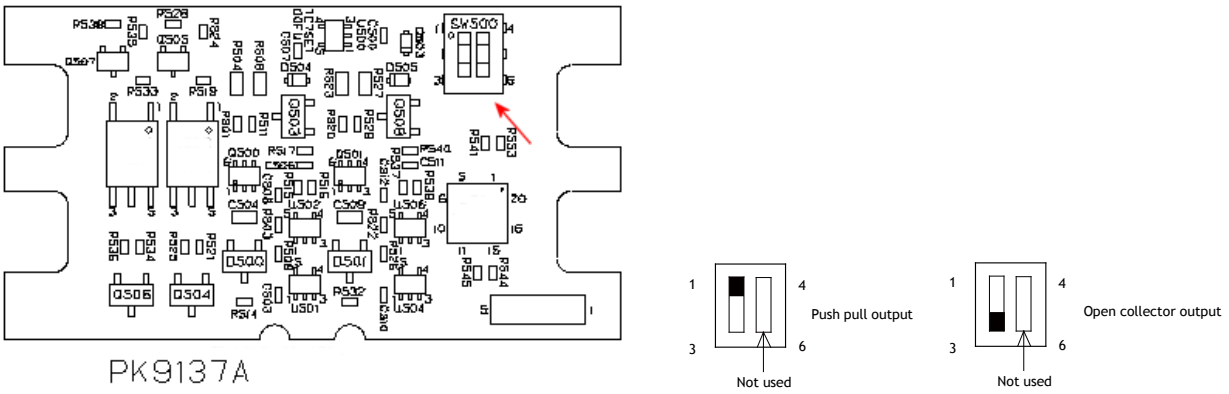
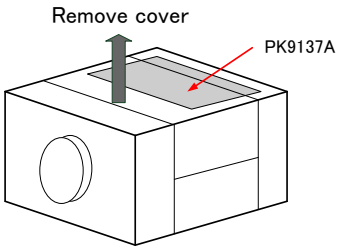



Fig.6 SW500

PK9137A board is located at the top part after removing the top cover.



## 5.2 Camera Link interface

| Port/Signal | 2-tap | | | 1-tap | Pin No. |
|---|---|---|---|---|---|
| | 8bit | 10bit | 12bit | RGB 8-bit | |
| Port A0 | TAP A0 | TAP A0 | TAP A0 | R0 | Tx0 |
| Port A1 | TAP A1 | TAP A1 | TAP A1 | R1 | Tx1 |
| Port A2 | TAP A2 | TAP A2 | TAP A2 | R2 | Tx2 |
| Port A3 | TAP A3 | TAP A3 | TAP A3 | R3 | Tx3 |
| Port A4 | TAP A4 | TAP A4 | TAP A4 | R4 | Tx4 |
| Port A5 | TAP A5 | TAP A5 | TAP A5 | R5 | Tx6 |
| Port A6 | TAP A6 | TAP A6 | TAP A6 | R6 | Tx27 |
| Port A7 | TAP A7 | TAP A7 | TAP A7 | R7 | Tx5 |
| Port B0 | TAP B0 | TAP A8 | TAP A8 | G0 | Tx7 |
| Port B1 | TAP B1 | TAP A9 | TAP A9 | G1 | Tx8 |
| Port B2 | TAP B2 | | TAP A10 | G2 | Tx9 |
| Port B3 | TAP B3 | | TAP A11 | G3 | Tx12 |
| Port B4 | TAP B4 | TAP B8 | TAP B8 | G4 | Tx13 |
| Port B5 | TAP B5 | TAP B9 | TAP B9 | G5 | Tx14 |
| Port B6 | TAP B6 | | TAP B10 | G6 | Tx10 |
| Port B7 | TAP B7 | | TAP B11 | G7 | Tx11 |
| Port C0 | | TAP B0 | TAP B0 | B0 | Tx15 |
| Port C1 | | TAP B1 | TAP B1 | B1 | Tx18 |
| Port C2 | | TAP B2 | TAP B2 | B2 | Tx19 |
| Port C3 | | TAP B3 | TAP B3 | B3 | Tx20 |
| Port C4 | | TAP B4 | TAP B4 | B4 | Tx21 |
| Port C5 | | TAP B5 | TAP B5 | B5 | Tx22 |
| Port C6 | | TAP B6 | TAP B6 | B6 | Tx16 |
| Port C7 | | TAP B7 | TAP B7 | B7 | Tx17 |
| LVAL | | | | | Tx24 |
| FVAL | | | | | Tx25 |
| DVAL | | | | | Tx26 |
| EEN | | | | | Tx23 |

## 5.3 Interface circuits

### 5.3.1 Iris video output

This signal can be used for lens iris control in Continuous and trigger-dump modes.
The signal for iris video output is taken from the video signal after the gain control. The signal is 1.0 V p-p (with H-sync) from 75 Ω without termination.

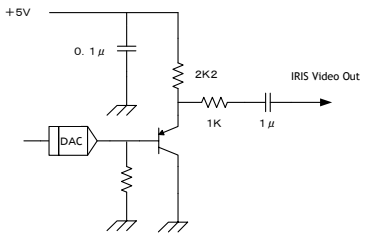



Fig. 7. Iris video

The iris video signal is composed to average the video level in the center area of each frame and can be output as a composite signal with H-sync. As shown in the following figure, each frame has its own video level which is averaged.

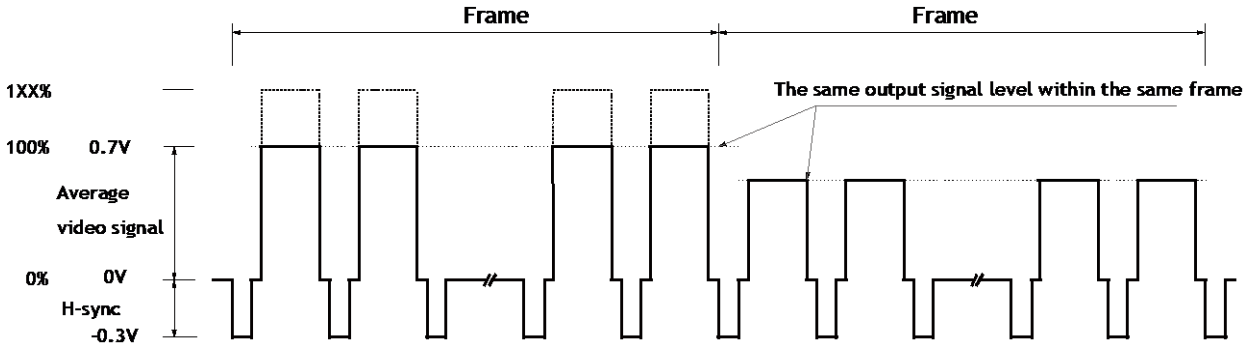



Fig. 8 Iris video output signal

### 5.3.2 Trigger input

An external trigger input can be applied to pin#10 of the 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 TA(Trigger Activation).
Trigger input level is 4 V ±2 V.
Trigger can also be applied through the Camera Link connector, when the command TI=0 has been sent.

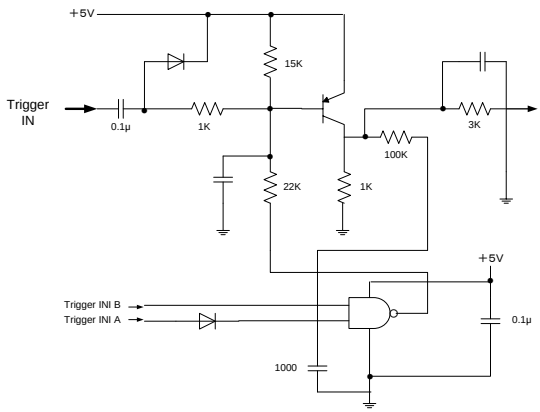



Fig.9 Trigger input circuit

### 5.3.3 XEEN output

XEEN is on pin#9 of the 12-pin Hirose connector.
The output uses either a complementary emitter follower circuit or open-collector. The output of the complementary emitter follower circuit is ≥ 3 V (no termination).
When the open collector output is used, the maximum current is 120mA. However, if the current is more than 50mA, use thicker cable for connecting pins #8 and #9. If a thinner cable is used, it might cause a malfunction due to the resistance of the cable.
The output can be selected by switch SW500 located inside the camera (trigger IF board).

EEN is also found in Camera Link.

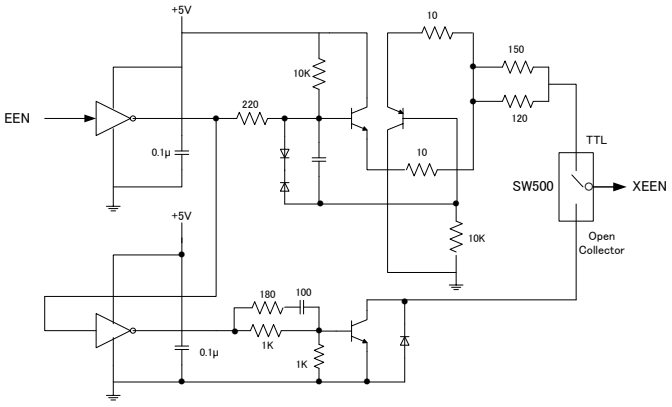



Fig.10 XEEN output from Hirse-12pin

## 5.4 Output

### 5.4.1 Digital output

#### 5.4.1.1 Bit allocation

| CCD out | | Analog Out (Equivalent) | Digital Out | | |
|---|---|---|---|---|---|
| | | | 8bit | 10bit | 12bit |
| Black | 0% | Setup 3.6%, 25mV | 8LSB | 32LSB | 128LSB |
| 300mV | 100% | 700mV | 222LSB | 890LSB | 3560LSB |
| 334mV ↑ | | 800mV | 255LSB | 1023LSB | 4095LSB |

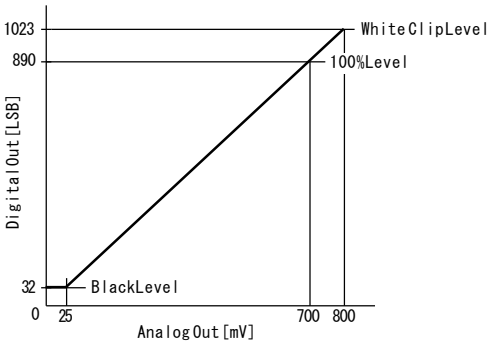



Fig.11 Bit allocation

#### 5.4.1.2 Camera link output

The AM-800CL and AB-800CL have a 4-tap readout from the CCD. The 4-tap output is combined horizontally to output 2 taps through the Camera Link interface.

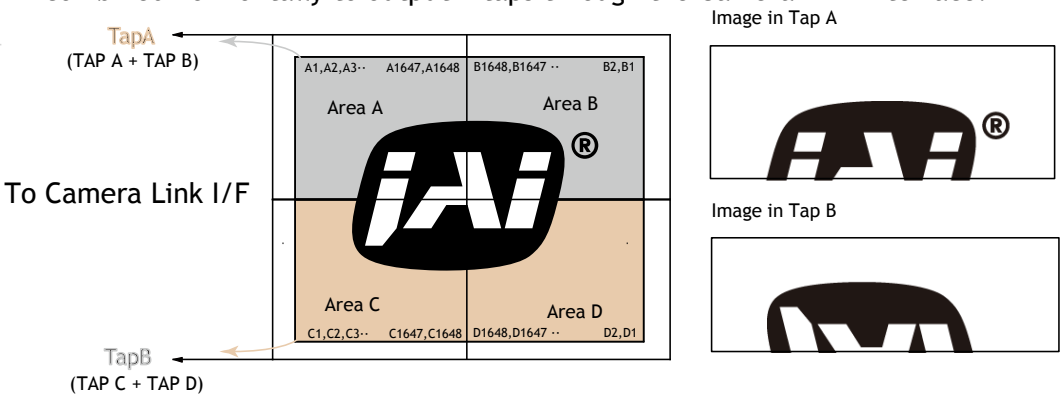



Fig.12 2-tap output

In the case of RGB interpolation, it is provided as 1-tap output.

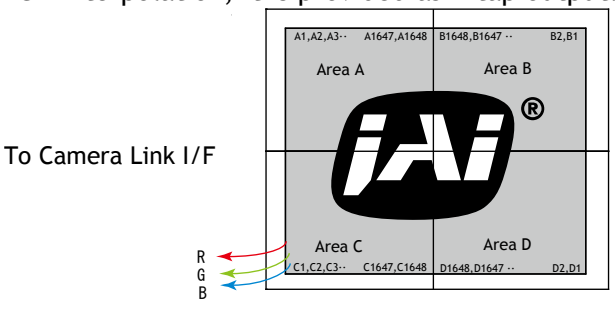



Fig.13 RGB 1-tap output

### 5.4.2 Partial scan readout (AOI) (Commands: STL, ETL)

The AOI works like partial scanning. By using the AOI function, a faster frame rate can be achieved. The start line of the image (Offset Y) and the image height (Height) can be set as desired. However, the start pixel and/or end pixel of each line cannot be changed. In the AM-800CL and AB-800CL RGB output, The Offset Y and Height can be set in 1 line increments. For the AB-800CL Bayer mode, output can be set in 2-line steps.

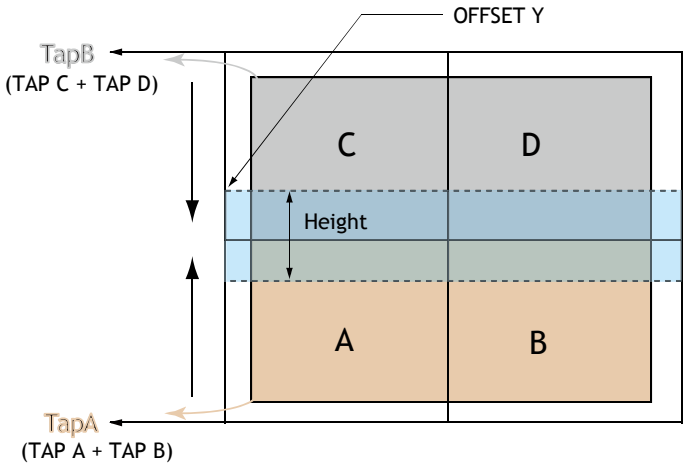



Fig.14 AOI setting

Note for AOI setting

In the AM-800CL and AB-800CL, the frame rate setting has priority. If AOI is used, the frame rate setting should use fewer lines that that of AOI height.

For AOI setting, if the upper TAP and lower TAP have the same duration, the fastest frame rate can be achieved. Thus, if the AOI is centered vertically within the image, the frame rate is maximized. Examples of the settings are shown in sections 5.4.2.4 and 5.4.2.5.

#### 5.4.2.1 Frame rate calculation if AOI is set

The calculation method for the frame rate in AOI mode depends on the setting conditions of offset, height, Bit Allocation and binning control.
It also depends on the position of the readout such as the upper TAP, lower TAP and covering both TAPs.

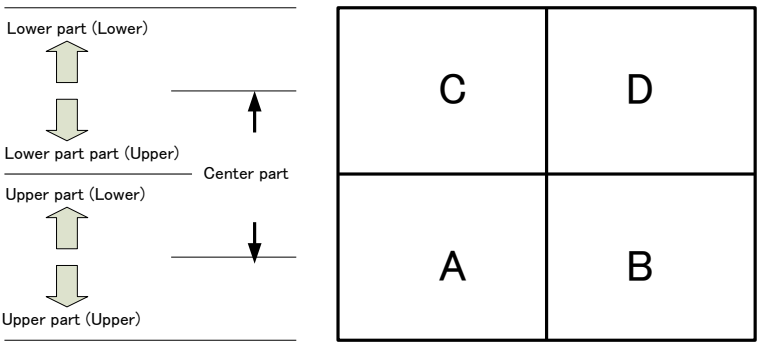



Fig.15 the position of the readout

**5.4.2.2 If bit allocation is set to 8,10 or 12bit and the binning control is OFF or 2x1**

1) For a centered readout which covers both the upper and lower TAPS
Use the following two formulas to calculate frame lines (A) and frame lines (B).
Use the larger number of frame lines for calculating the frame rate.
If they are the same number of lines, either one can be used.

Frame lines (A) = Roundup (Offset/4) +(1236 –Offset) +26
Frame lines (B) = Roundup{[2473-(Offset+Height)]/4} + [(Offset + Height)-1236] +26

Frame rate(Hz) = 1/ (frame lines number x 0.00004655)

2) If the readout is only in the upper TAP
In this case, Offset < 1236 and (Offset + Height) ≤ 1236

Roundup{(Offset + 1 )/4} + {1236 –Roundup (Offset + height)/4} + Height +26
= Frame lines number
Frame rate (Hz)= 1/(Frame number x 0.00004655)

3) If the readout is only in the lower TAP
In this case, Offset > 1236

{2473 – Roundup[(Offset + Height)/4]} + Roundup(Offset -1236) + Height + 26 =
Frame lines number
Frame rate(Hz) = 1/(Frame lines number x 0.00004655)

**5.4.2.3 If bit allocation is set to 8,10 or 12bit and the binning control is 1x2 or 2x2**
**Note: In this case, offset and height should use only even numbers.**

1) For a centered readout which covers both the upper and lower TAPS
Use the following two formulas to calculate frame lines (A) and frame lines (B).
Use the larger number of frame lines for calculating the frame rate.
If they are the same number of lines, either one can be used.

Frame lines (A) = Roundup (Offset/4) +(1236 –Offset) +20
Frame lines (B) = Roundup{[2473-(Offset+Height)]/4} + [(Offset + Height)-1236] +20

Frame rate(Hz) = 1/ (frame lines number x 0.0000500655)

2) If the readout is only in the upper TAP
In this case, Offset < 1236 and (Offset + Height) ≤ 1236

Roundup{(Offset + 1 )/4} + {1236 –Roundup (Offset + height)/4} + Height/2 +20
= Frame lines number
Frame rate (Hz)= 1/(Frame number x 0.000050055)

3) If the readout is only in the lower TAP
In this case, Offset > 1236

{2473 – Roundup[(Offset + Height)/4]} + Roundup(Offset -1236) + Height/2 + 20 =
Frame lines number
Frame rate(Hz) = 1/(Frame lines number x 0.000050055)

#### 5.4.2.4 If the bit allocation is set to RGB

In this case, the binning control is not available. So there is only one calculation method.

Roundup{(Offset + 1 )/4} + Roundup {(2472 – Height+Offset)/4} + Height + 46 = Frame number

Frame rate(Hz) = 1/(Frame lines number x 0.00004655)

#### 5.4.2.5 Setting example 1

Bit allocation is 8-,10- or 12-bit and the binning control is OFF or 2x1

| AOI | Position | Offset | Height | Frame line | Frame Frequency (Hz) |
|---|---|---|---|---|---|
| Full pixels | | 0 | 2472 | 1263 | 17.01 |
| 1/2 | Upper TAP | 0 | 1236 | 1263 | 17.01 |
| | **Center** | **618** | **1236** | **799** | **26.89** |
| | Lower TAP | 1236 | 1236 | 1262 | 17.02 |
| 1/4 | Upper TAP, upper | 0 | 618 | 800 | 26.85 |
| | Upper TAP, lower | 616 | 618 | 800 | 26.85 |
| | **Center** | **926** | **618** | **568** | **37.82** |
| | Lower TAP, upper | 1236 | 618 | 799 | 26.89 |
| | Lower TAP, lower | 1852 | 618 | 799 | 26.89 |
| 1/8 | Upper TAP, upper | 0 | 310 | 569 | 37.75 |
| | Upper TAP, lower | 924 | 310 | 569 | 37.75 |
| | **Center** | **1080** | **310** | **452** | **47.53** |
| | Lower TAP, upper | 1236 | 310 | 568 | 37.82 |
| | Lower TAP, lower | 2160 | 310 | 568 | 37.82 |
| 1/16 | Upper TAP, upper | 0 | 154 | 452 | 47.53 |
| | Upper TAP, lower | 1080 | 154 | 452 | 47.53 |
| | **Center** | **1158** | **154** | **394** | **54.52** |
| | Lower TAP, upper | 1236 | 154 | 451 | 47.63 |
| | Lower TAP, lower | 2316 | 154 | 451 | 47.63 |

#### 5.4.2.6 Setting example 2

Bit allocation is 8-,10- or 12-bit and the binning control is 1x2 or 2x2)

| AOI | Position | Offset | Height | Frame line | Frame Frequency (Hz) |
|---|---|---|---|---|---|
| Binning V x2 | | 0 | 2472 | 639 | 30.96 |
| 1/2 | Upper TAP | 0 | 1236 | 639 | 30.96 |
| | **Center** | **618** | **1236** | **484** | **40.87** |
| | Lower TAP | 1236 | 1236 | 638 | 31.01 |
| 1/4 | Upper TAP, upper | 0 | 618 | 485 | 40.79 |
| | Upper TAP, lower | 616 | 618 | 485 | 40.79 |
| | **Center** | **926** | **618** | **407** | **48.61** |
| | Lower TAP, upper | 1236 | 618 | 484 | 40.87 |
| | Lower TAP, lower | 1852 | 618 | 484 | 40.87 |
| 1/8 | Upper TAP, upper | 0 | 310 | 408 | 48.49 |
| | Upper TAP, lower | 924 | 310 | 408 | 48.49 |
| | **Center** | **1080** | **310** | **368** | **53.76** |
| | Lower TAP, upper | 1236 | 310 | 407 | 48.61 |
| | Lower TAP, lower | 2160 | 310 | 407 | 48.61 |
| 1/16 | Upper TAP, upper | 0 | 154 | 369 | 53.61 |
| | Upper TAP, lower | 1080 | 154 | 369 | 53.61 |
| | **Center** | **1158** | **154** | **349** | **56.68** |
| | Lower TAP, upper | 1236 | 154 | 368 | 53.76 |
| | Lower TAP, lower | 2316 | 154 | 368 | 53.76 |

#### 5.4.2.7 Setting example 3

Bit allocation is RGB

| Partial | Offset | Height | FrameLine | Frame Freqency |
|---|---|---|---|---|
| Full | 0 | 2472 | 2519 | 8.53 |
| 1/2 | Any value | 1236 | 1592 | 13.49 |
| 1/4 | Any value | 618 | 1129 | 19.03 |
| 1/8 | Any value | 310 | 898 | 23.92 |
| 1/16 | Any value | 154 | 781 | 27.51 |

### 5.4.3 Binning (Command : BNC) (Only for AM-800CL)

This function is available only for AM-800CL. In binning mode, adjacent pixels in the horizontal direction and/or vertical direction are combined and output as one pixel. The possible combinations are shown below.

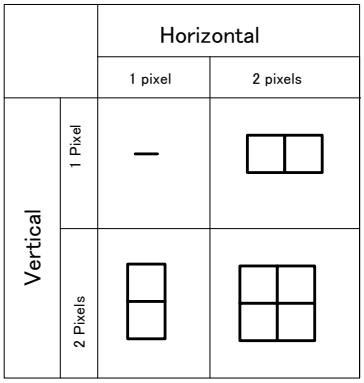



Fig. 16 Binning modes

Binning achieves a higher frame rate, as well as better sensitivity.
On the other hand, the resolution becomes less than the full frame readout.

| H x V (Pixels) | Sensitivity | Spatial resolution | |
|---|---|---|---|
| | | H direction | V direction |
| 1 x 2 | 2 times | Unchanged | 1/2 |
| 2 x 1 | 2 times | 1/2 | Unchanged |
| 2 x 2 | 4 times | 1/2 | 1/2 |

### 5.4.4 Bayer output pattern

The AB-800CL starts with GRG on odd lines and BGB on even lines as shown below. If AOI is used, Offset Y can be set every 2 lines and therefore, it always starts with a GRG sequence.

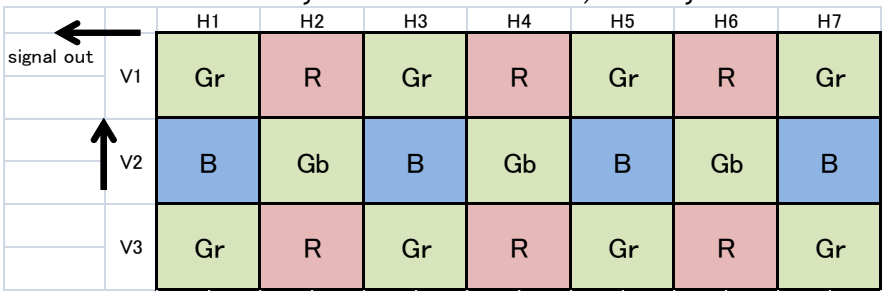



Fig. 17 Bayer sequence

# 6. Sensor layout and timing

## 6.1 Sensor layout

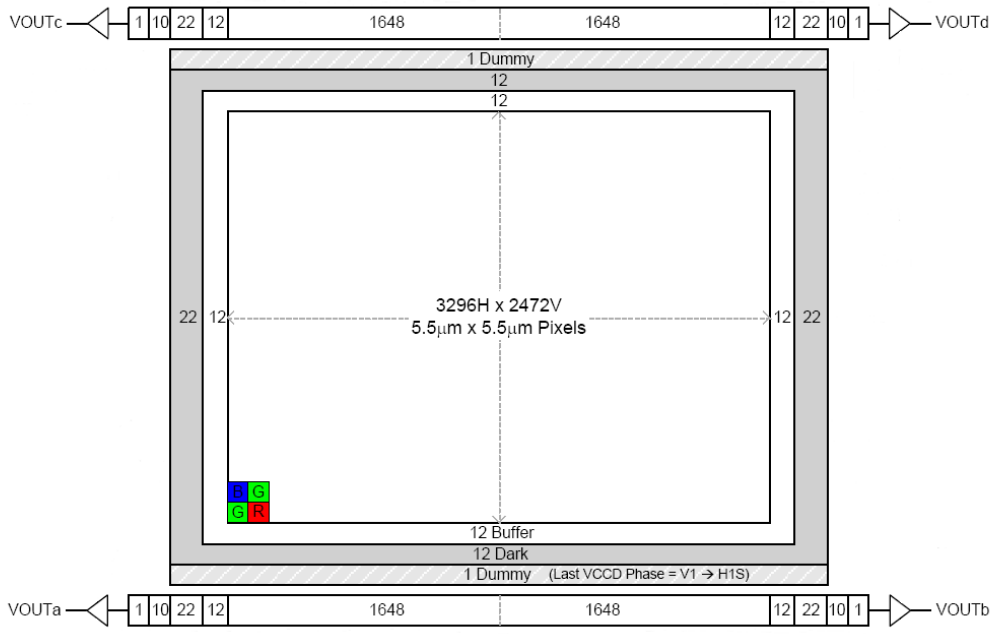
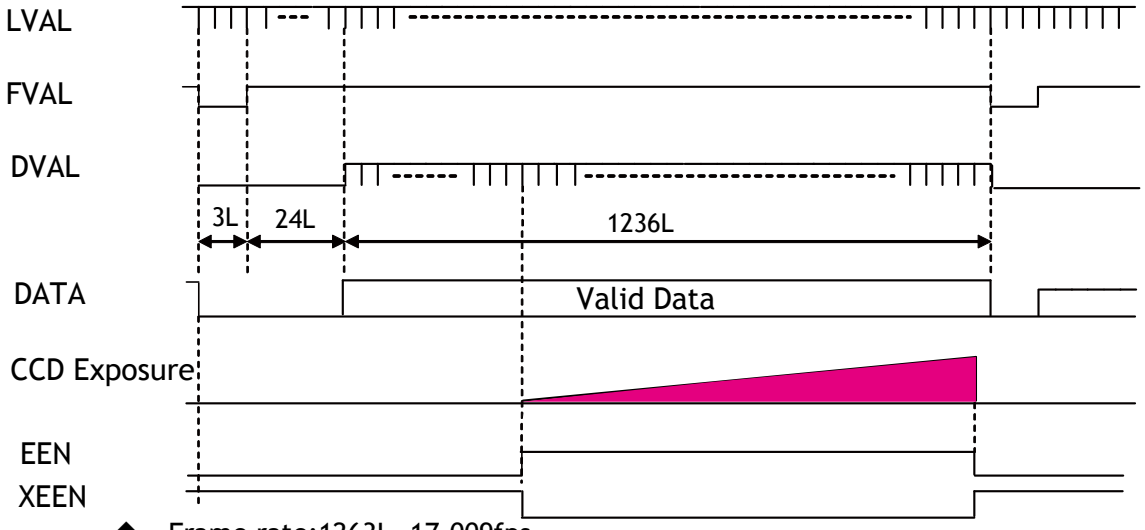



Fig.18 Sensor layout

## 6.2. Vertical timing (8bit, 10 bit or 12bit for Bit allocation)

### 6.2.1 If the binning control is BNC=0(OFF) or BNC=2(2x1)

#### 6.2.1.1 AOI default setting ( Offset=0, Height=2472)




◆ Frame rate:1263L, 17.009fps

Fig.19 Vertical timing (AOI default)

#### 6.2.1.2 AOI setting

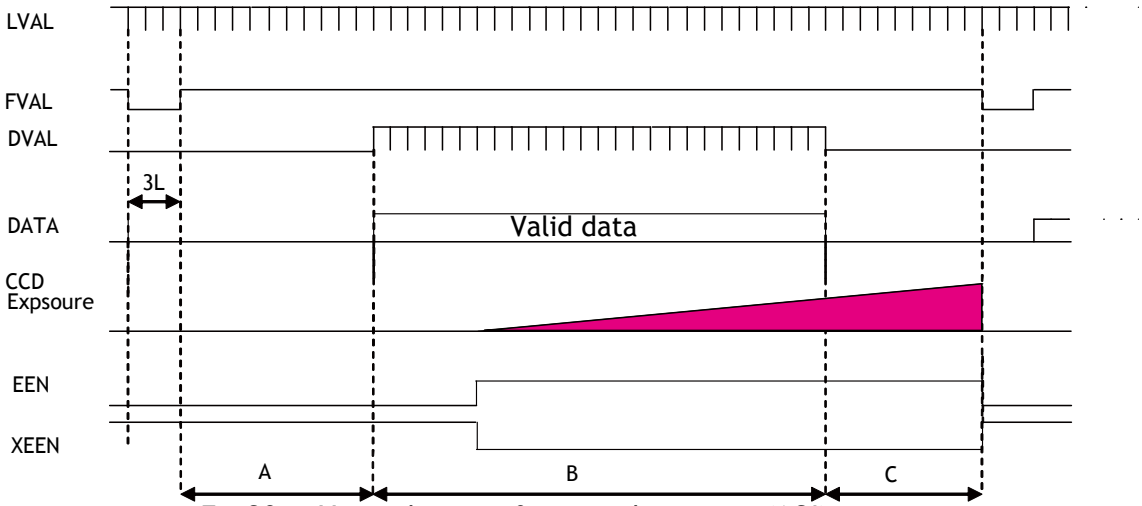


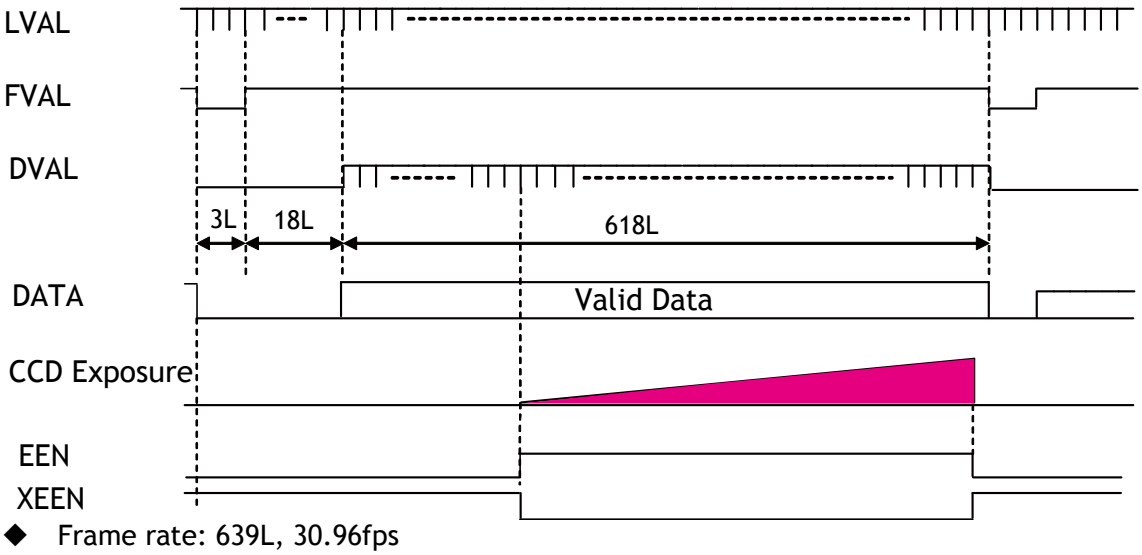

Fig.20 Vertical timing for partial scanning (AOI)

Frame rate examples when the start line and the end line are set as follows

| Offset | HEGHT | A (L) | B (L) | C (L) | Total line (L) | Frame rate (Hz) |
|---|---|---|---|---|---|---|
| 618 | 1236 | 181 | 618 | 0 | 799 | 26.89 |
| 927 | 618 | 258 | 309 | 0 | 567 | 37.89 |
| 309 | 618 | 104 | 618 | 78 | 800 | 26.85 |
| 463 | 309 | 142 | 309 | 116 | 567 | 37.89 |

### 6.2.2 If the binning control is BNC=1(1x2) or BNC=3(2x2)

#### 6.2.2.1 AOI initial setting (Offset=0, Height=2472)




◆ Frame rate: 639L, 30.96fps

Fig.21 Vertical timing for the vertical binning

#### 6.2.2.2 AOI setting

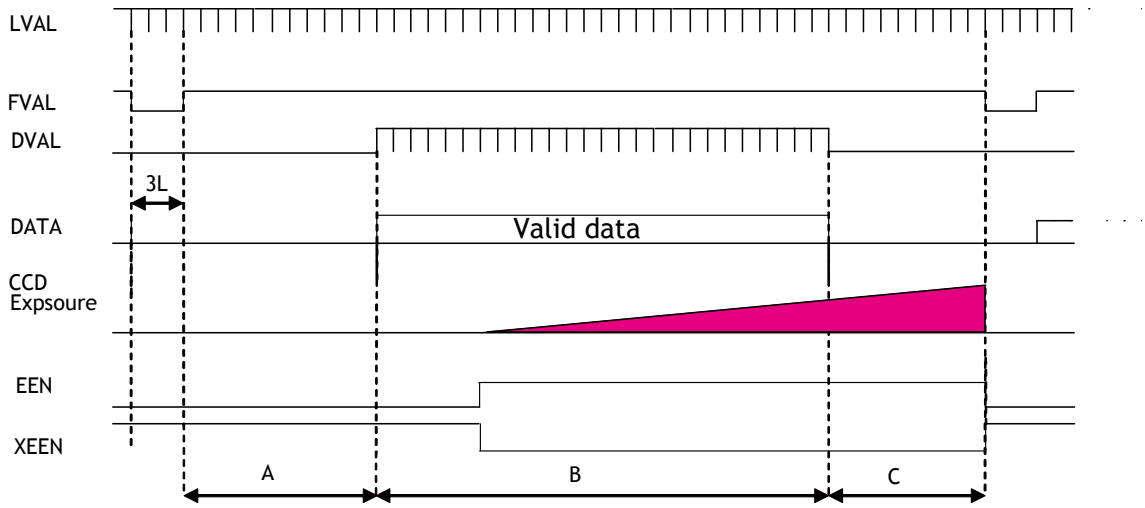
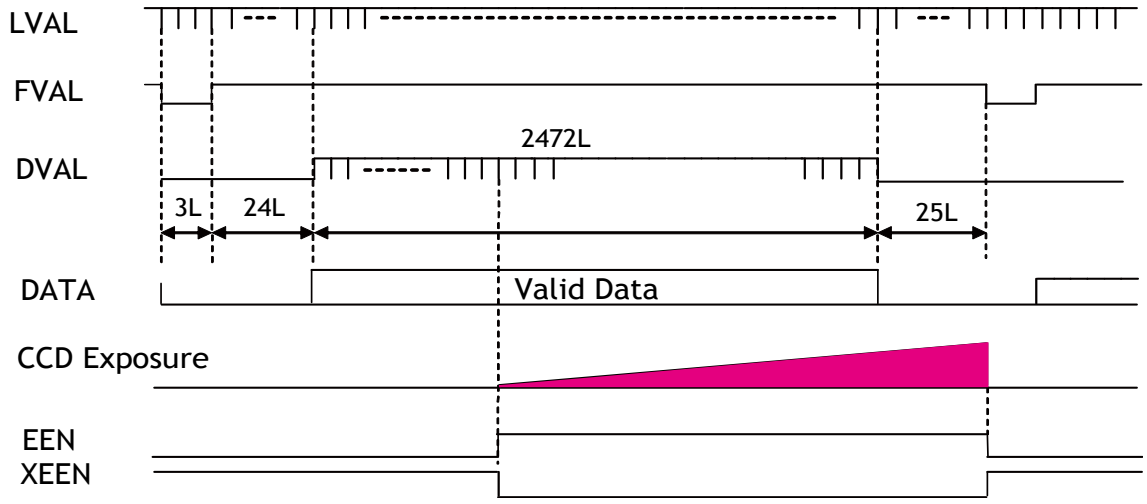



Fig.22 Vertical timing (Vertical binning, AOI setting)

| Offset | HEGHT | A (L) | B (L) | C (L) | Total line (L) | Frame rate (Hz) |
|---|---|---|---|---|---|---|
| 618 | 1236 | 175 | 309 | 0 | 484 | 40.87 |
| 926 | 618 | 98 | 309 | 0 | 407 | 48.61 |
| 308 | 618 | 98 | 309 | 78 | 485 | 41.19 |
| 462 | 310 | 136 | 155 | 116 | 407 | 49.08 |

## 6.3. Vertical timing (Bit allocation = RGB)

### 6.3.1 AOI initial setting




Frame rate: 2524L, 8.5fps

Fig.23 Vertical timing (RGB output mode, AOI setting)

### 6.3.2 AOI setting

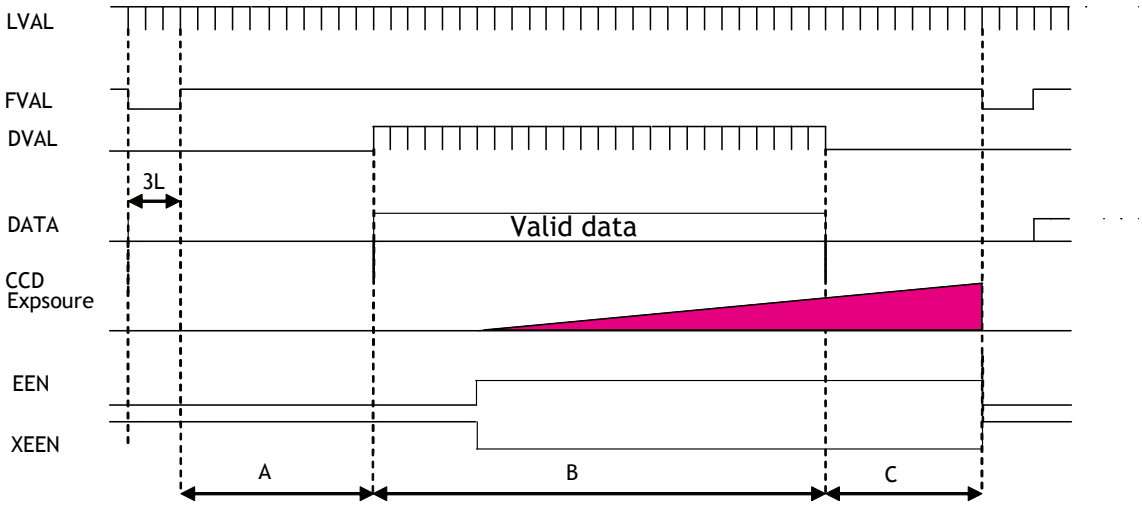
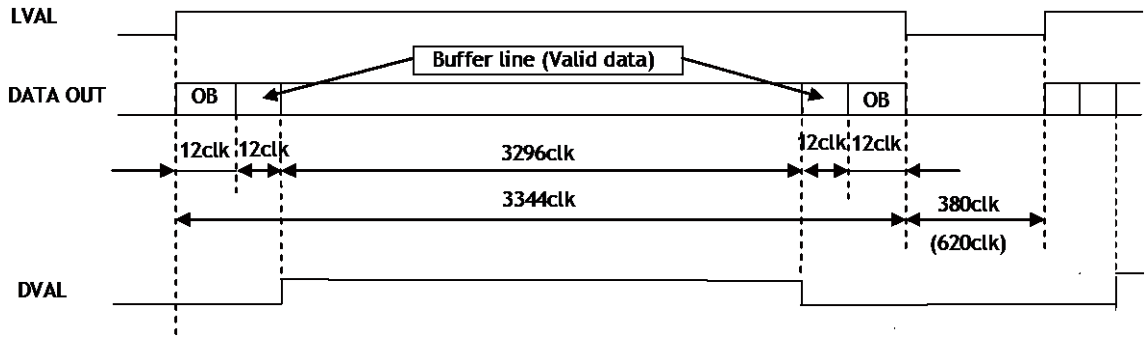



Fig.24 Vertical timing (RGB output mode, AOI setting)

| Offset | HEGHT | A (L) | B (L) | C (L) | Total line (L) | Frame rate (Hz) |
|---|---|---|---|---|---|---|
| 412 | 1648 | 130 | 1648 | 123 | 1901 | 11.30 |
| 618 | 1236 | 181 | 1236 | 175 | 1592 | 13.49 |
| 928 | 618 | 259 | 618 | 252 | 1129 | 19.03 |
| 1082 | 310 | 297 | 310 | 290 | 897 | 23.95 |

## 6.4. Horizontal timing

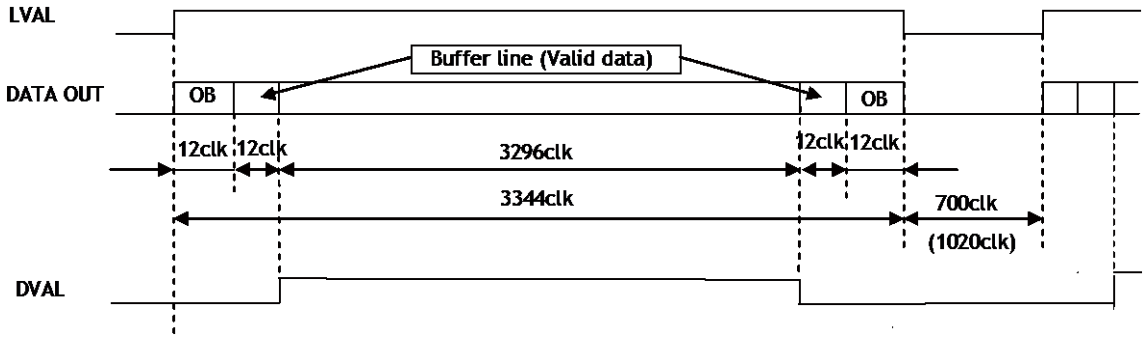
### 6.4.1 If the binning control is 0=OFF or 2=2x1




1LVAL 3724clk = 46.55μs 1clk=25ns (via Camera Link)
(Exposure start line 1LVAL 3964 clk = 49.55μs)

Fig.25 Horizontal timing (Vertical binning OFF)

### 6.4.2 If the binning control is 1=1x2 or 3=2x2




1LVAL 4044clk = 50.55μs 1clk=25ns (via Camera Link)
(Exposure starting line 1LVAL 4364 clk = 54.55μs)

Fig.26 Horizontal timing (Vertical binning ON)

### 6.4.3 DVAL output if the Binning control is set to 2=2x1or 3=2x2

If the Binning control is set to 2=2x1 or 3=2x2, DVAL is output in one pixel period within the effective output period. Data is output by adding two pixels in horizontally as described below.

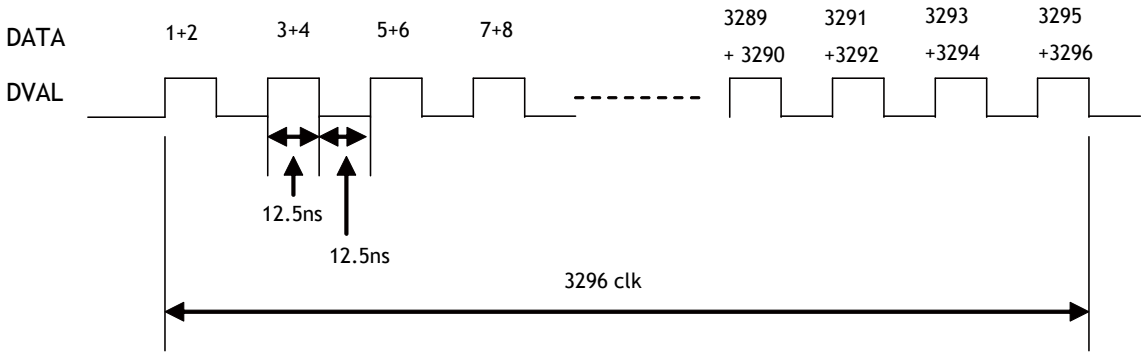



Fig.27 DVAL in the vertical binning

### 6.4.4 LVAL-LOW level period

1. When waiting for a trigger signal or at the exposure start line, LVAL-LOW period varies as shown in the following table.

| Binning Control | LVAL-LOW period | | LVAL cycle | |
|---|---|---|---|---|
| | Ordinary | Exposure start | Ordinary | Exposure start |
| OFF, 2x1 | 380clk | 620clk | 3724clk 46.55μs | 3964clk 49.55μs |
| 1x2, 2x2 | 700clk | 1020clk | 4044clk 50.55μs | 4364clk 54.55μs |

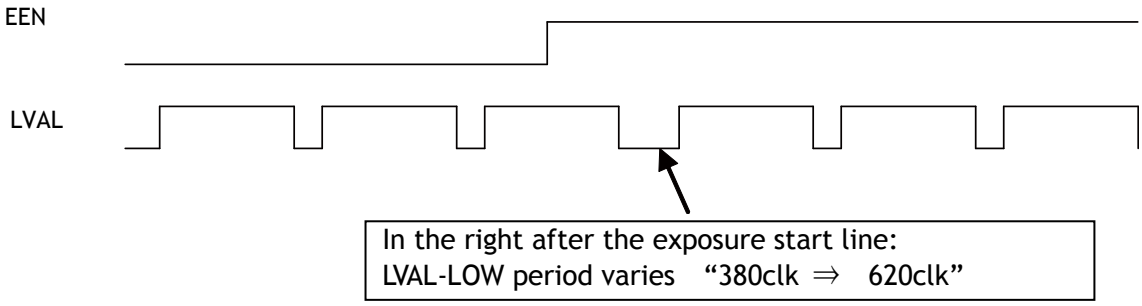



Fig.28 LVAL-LOW period varies

2. When the trigger control mode is set to ON and Overlap is set to Readout, LVAL-LOW period is 1LVAL as the maximum.

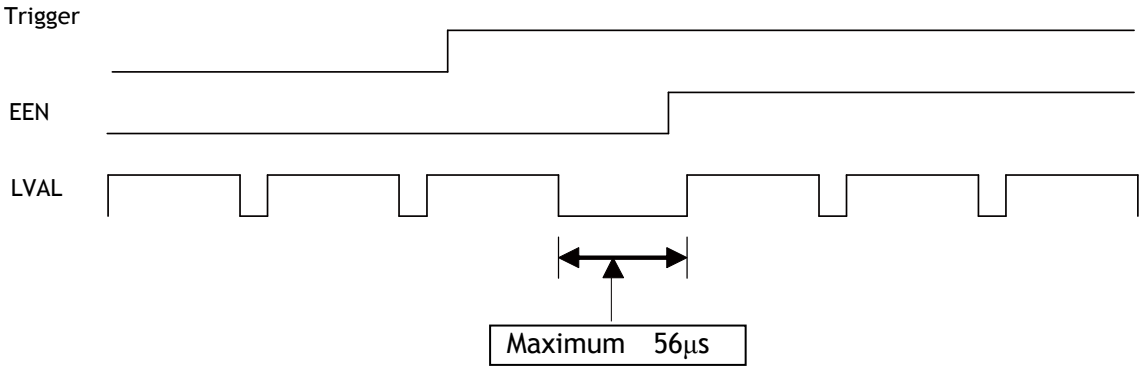
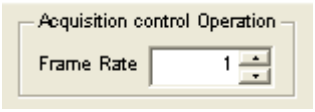



Fig.29 LVAL-LOW period if Overlap is set to Readout

# 7. Operating modes

The following controls are related to capturing the image.

## 7.1. Acquisition control (Change the frame rate)




With Exposure Mode set to OFF, the frame rate can be set longer than 1 frame (the normal period needed to capture all pixels). By doing this, the sensitivity of the image can be increased. Maximum recommended exposure time is 2 seconds. This function is available when the trigger mode is OFF.
The setting range is:

| Shortest | ~ | Longest |
|---|---|---|
| 17.026Hz (1 frame period)<br>(58.7326658ms) | ~ | 0.5Hz<br>(2.0 seconds) |

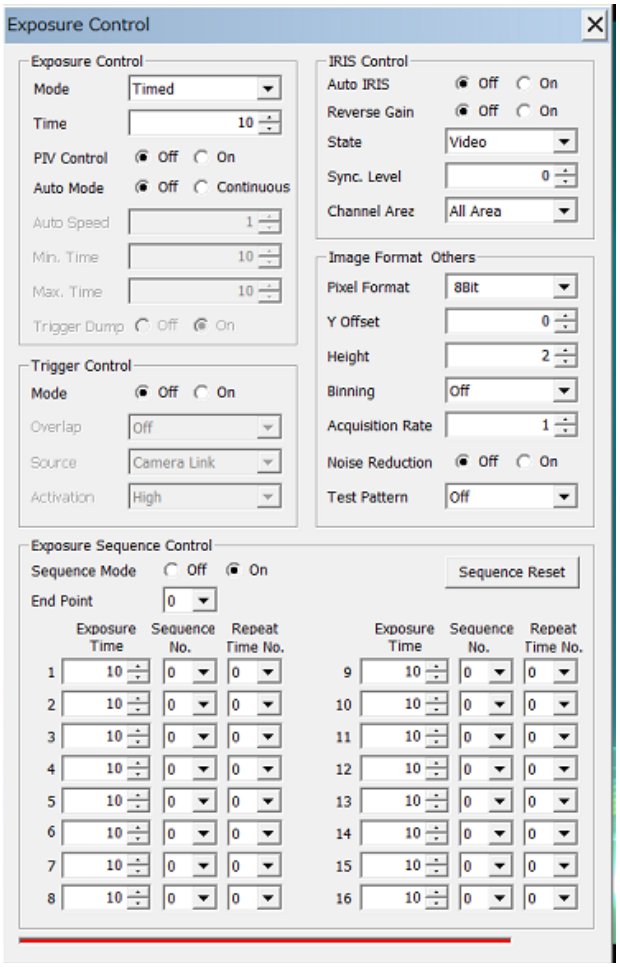
**Notes for setting**

1. The value for setting is the number of line.
2. The actual frame rate is calculated in the following formula.

   Frame rate = 1/ [( Setting value (Line number) x ( 1 line period))
   Where, 1 line period is 46.5μs

3. Default setting is 1263 line
4. The available longest framer rate is 1.998s (0.501fps)

## 7.2. Exposure setting




### 7.2.1 Mode

The AM-800CL and AB-800CLhave the following exposure modes.

1. *EM=0* *OFF*
2. *EM=1* *Timed*
3. *EM=2* *Trigger width*

### 7.2.2 Exposure time setting (Command: PE)

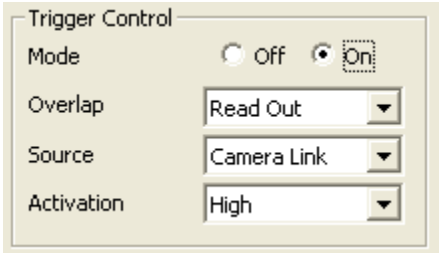
PE command can be set if EM (Exposure mode) is set at 1 or 2.

| | | Minimum exposure time | ~ | Maximum exposure time |
|---|---|---|---|---|
| Full pixels | | 10μs | ~ | 2 sec(Note) |
| Binning (HxV) | 1 x 2 | | | |
| | 2 x 1 | | | |
| | 2 x 2 | | | |

Note: The AM-800CL and AB-800CL are designed so that frame rate has priority over exposure time. Accordingly, if the exposure time is set at a longer accumulation time than 1 frame (58.7326ms), the frame rate should be set at a longer time than the exposure time.

**7.2.3 Exposure sequence (Commands EXSQ,PES(N), PER(N), EXSR, EXSEP, PE1 ～PE16)**
Up to 16 exposure settings can be preset as a sequence. Each setting can also be repeated. This function is effective only when the trigger mode is ON, the exposure mode is set to Timed and the exposure sequence is ON.

## 7.3. Trigger Control




**7.3.1 Selection of the trigger input(Command: TI)**
The command "TI" can select the trigger input. At TI=0, the input through Camera Link (line 0) is active and at TI=1, the input through the Hirose 12-pin connector is active. The factory default setting is the Camera Link input.

**7.3.2 Trigger activation(Command: TA)**
The command "TA" can select how to activate the trigger.

| | | |
|---|---|---|
| TA=0 | Rising edge | At the rising edge of the pulse, the accumulation and the readout will start. |
| TA=1 | Falling edge | At the falling edge of the pulse, the accumulation and the readout will start. |

If Exposure Mode(EM) is set to EM=2 Trigger Width)

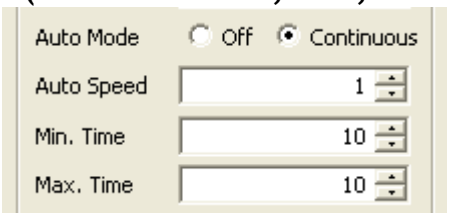
| | | |
|---|---|---|
| TA=0 | High | During the high level of trigger, the accumulation is activated and at the low level, the read out is activated. |
| TA=1 | Low | During the low level of trigger, the accumulation is activated and at the high level, the read out is activated. |

**7.3.3 Trigger Overlap (Command: TO)**
This function sets if a trigger pulse can be accepted while data is being read out or not.

| | | | |
|---|---|---|---|
| TO=0 | OFF | : | The trigger pulse is not accepted during CCD readout. This works the same as the LVAL asynchronous mode. |
| TO=1 | Read Out | : | The trigger pulse can be accepted during CCD readout. If the trigger pulse is input during CCD readout, it operates as LVAL synchronous and if the trigger is input while the CCD is not being read out, it operates as LVAL asynchronous. |

**7.3.4 Trigger Dump (Command: TD)**
The trigger edge dump has TD=0(disable) and TD=1(enable) modes.
This command can be used with EM=1 (Timed) and it operates the same as RCT mode.
If this mode is "enabled":
Until the trigger is input, the camera operates continuously and the video signal for the auto-iris lens is output. When the trigger is input, the fast dump is activated to read out the electronic charge very quickly, after which the accumulation and the readout are performed. When the signal is read out, FVAL , LVAL and DVAL are output too.

## 7.4. Auto shutter control (Commands: ASC,ASCS,ASCEA,ASCEI)




This turns the auto exposure function “ON” or “OFF” and provides settings for various parameters.
ASC=0 (OFF), ASC=1 (ON)
ASCS: ASC tracking speed setting. Range is from 1 to 16 (Default is 8).
ASCEA: Maximum exposure time in the ASC mode. Range is from 10 to 1048575 (μs).
ASCEI: Minimum exposure time in the ASC mode. Range is from 10 to 1048575 (μs).

This function is available on the continuous operation and trigger-dump ON.

## 7.5. Normal continuous operation

This is used for applications which do not require triggering. In this mode, the video signal for the auto-iris lens is available.
For the video timing, refer to the chapters 6.2 ,6.3 and 6.4.
The frame rate of full pixels readout is 17.0263fps for AM-800CL and 8.5fps for AB-800CL.

**Primary settings to use this mode**

Acquisition Frame Rate: AR=1～42964

Trigger control
Trigger mode: TM=0 (OFF)

**Exposure settings**
Exposure mode: EM=1
Exposure time: PE= 10μs ～ 2000000μs
or
**Select Auto shutter control(ASC)**
Exposure time auto: ASC=1 (ON)
Exposure time auto speed : ASCS= 1～16 (Deafult is 8)
Exposure time auto max: ASCEA= 10μs ～ 1048575μs
Exposure time auto min: ASCEI= 10μs ～ 1048575μs

Minimum interval of the image

| Readout mode | FULL | 2/3 AOI | 1/2 AOI | 1/4 AOI | 1/8 AOI |
|---|---|---|---|---|---|
| Minimum frame line | 2072 | 1561 | 1303 | 916 | 724 |

Note: The AM-800CL and AB-800CL are designed to give priority to the frame rate rather than the exposure time. If the exposure time is set at a longer time than 58.732658ms(1frame time), the frame rate must be set at a longer time than the exposure time.

## 7.6. Timed mode (so-called EPS operation)

This mode allows a single image frame to be captured with a preset exposure time by using the external trigger. Additional settings determine if the trigger pulse can be accepted during the exposure period.
The frame rate of full pixels readout is 17.0263fps for AM-800CL and 8.5fps for AB-800CL.

**Primary settings to use this mode**

**Acquisition control**
Acquisition frame rate: AR= 1～42964

**Exposure control**
Exposure mode: EM=1 (Timed)
Exposure time: PE=10μs ～ 2000000μs

**Trigger control**
Trigger mode: TM=1 (ON)
Trigger overlap: TO=0 (OFF) or 1=(Readout)
OFF: LVALsync Readout: LVALsync/async automatic setting
Trigger source: TI=0 (Camera Link, default) or 1 (Hirose 12-pin)
Trigger Activation: TA=0 (Rising edge), 1=（Falling edge）

Note：The AM-800CL and AB-800CL prioritize the frame rate over the exposure time. If the exposure time is set at longer than 58.73ms (1 frame period), the frame rate must be increased so that it is longer than the exposure time.

Minimum interval of the trigger pulse

| Readout mode | FULL | 2/3 AOI | 1/2 AOI | 1/4 AOI | 1/8 AOI |
|---|---|---|---|---|---|
| Minimum frame lines | 2077 | 1566 | 1308 | 921 | 729 |

### 7.6.1 If the overlap setting is “OFF”

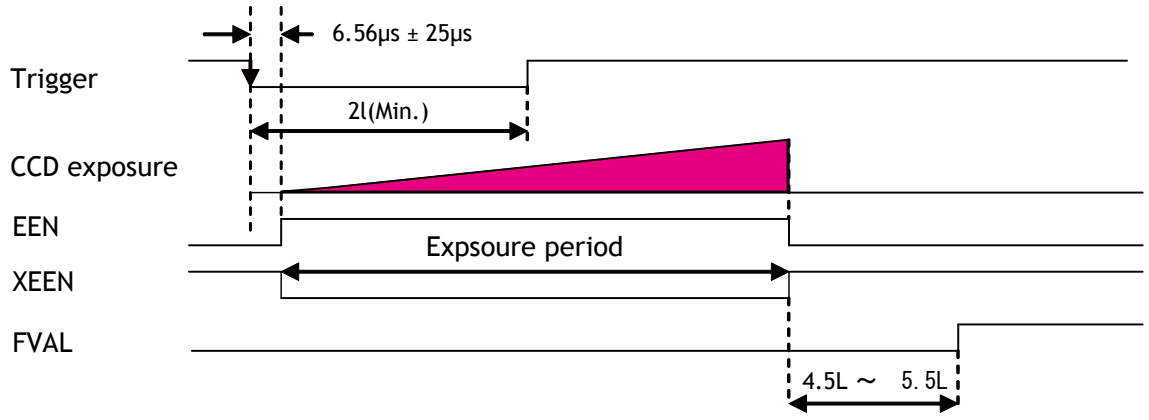
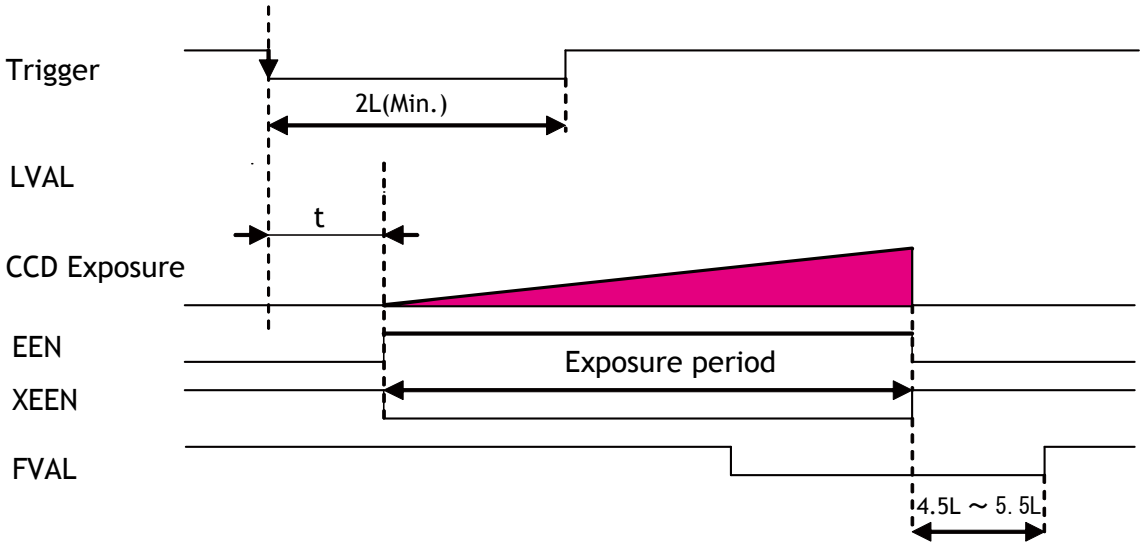



Fig.30 Non Overlap

### 7.6.2 If the overlap setting is “Readout”




| Trigger input | Binning Control | t |
|---|---|---|
| Trigger is input during CCD readout (Sync) | OFF, 2x1 | 53μs ± 25ns |
| | 1x2, 2x2 | 61μs ± 25ns |
| Trigger is while CCD readout is not activated (Async) | — | 6.56μs ± 25ns |

Fig.31 Readout

## 7.7. Trigger width mode (so-called PWC)

In this mode, the exposure time is equal to the trigger pulse width. Accordingly, longer exposure times are supported. Additional settings determine if the trigger pulse can be accepted during the exposure period.

**Primary settings to use this mode**

**Acquisition control**

Acquisition frame rate: AR= 1～42964

**Exposure control**

Exposure mode: EM=2 (Trigger width)

**Trigger control**

Trigger mode: TM=1 (ON)
Trigger overlap: TO=0 (OFF) or 1=(Readout)
OFF: LVALsync、Readout:LVALsync/async automatic setting
Trigger source: TI=0 (Camera Link, default) or 1(Hirose 12-pin)
Trigger Activation: TA=0 (High), 1=（Low）

Minimum interval of the trigger pulse

| Readout mode | FULL | 2/3 AOI | 1/2 AOI | 1/4 AOI | 1/8 AOI |
|---|---|---|---|---|---|
| Minimum frame lines | 2077 | 1566 | 1308 | 921 | 729 |

### 7.7.1 If the overlap setting is “Non Overlap”

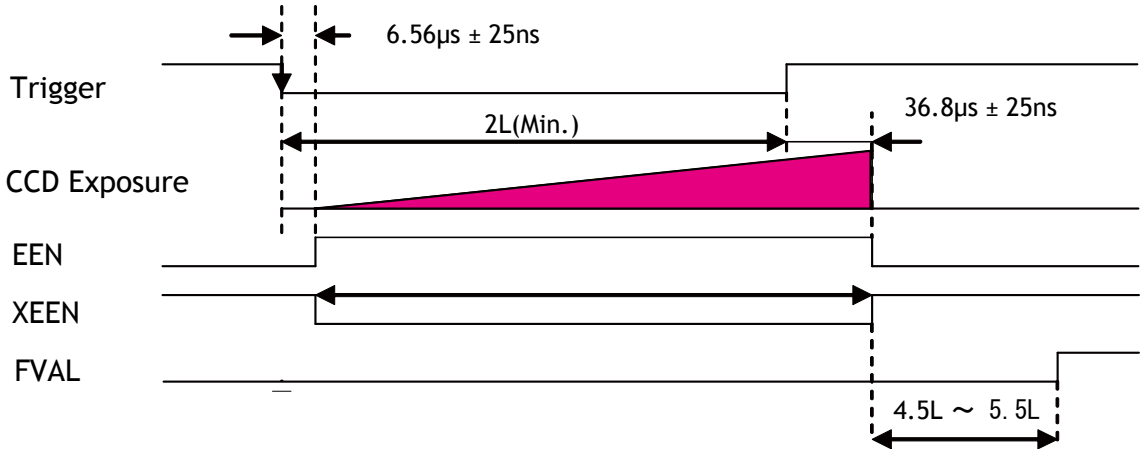



Fig.32 Overlap = OFF

### 7.7.2 If the overlap setting is “Readout”

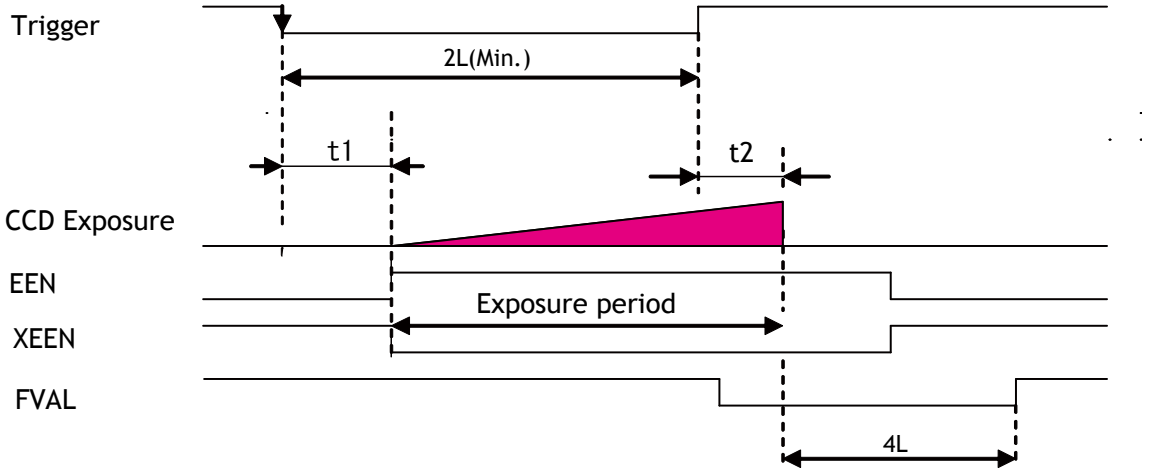



Fig.33 Readout

| Trigger input | Binning Control | t1 | t2 |
|---|---|---|---|
| Trigger is input during CCD readout (Sync) | OFF, 2x1 | 53µs ± 25ns | 83.2µs ± 25ns |
| | 1x2, 2x2 | 61µs ± 25ns | 87.2µs ± 25ns |
| Trigger is while CCD readout is not activated (Async) | — | 6.56µs ± 25ns | 36.8µs ± 25ns |

## 7.8. Edge-dump mode (so-called RCT)

Until the trigger is input, the camera operates continuously and the video signal for the auto-iris lens is output. At this moment, the video signal, FVAL and LVAL are output but DVAL is not output. When the trigger is input, the fast dump is activated to read out the electronic charge very quickly, after which the accumulation and the readout are performed. This fast dump period is 17.19ms. When the accumulated signal against the trigger is read out, FVAL , LVAL and DVAL are output too.
The frame rate for full pixels readout is;
AM-800CL is "17.0263fps + Fast dump period + Exposure time"
AB-800CL is "8.5fps + Fast dump period + Exposure time"

**Primary settings to use this mode**
**Acquisition control**
Acquisition frame rate: AR= 1～42964

Exposure mode: EM=1 (Timed)
Auto mode: ASC=1 (Continuous)
Trigger dump: TD=1 (Dump ON)

Note : The AM-800CL and AB-800CL gives priority to the frame rate over the exposure time. If the exposure time is set at longer than 58.73ms (1 frame period), the frame rate must be increased so that it is longer than the exposure time.

Minimum interval of the trigger pulse

| Readout mode | FULL | 2/3 AOI | 1/2 AOI | 1/4 AOI | 1/8 AOI |
|---|---|---|---|---|---|
| Minimum frame line | 2772 | 2261 | 2003 | 1616 | 1424 |

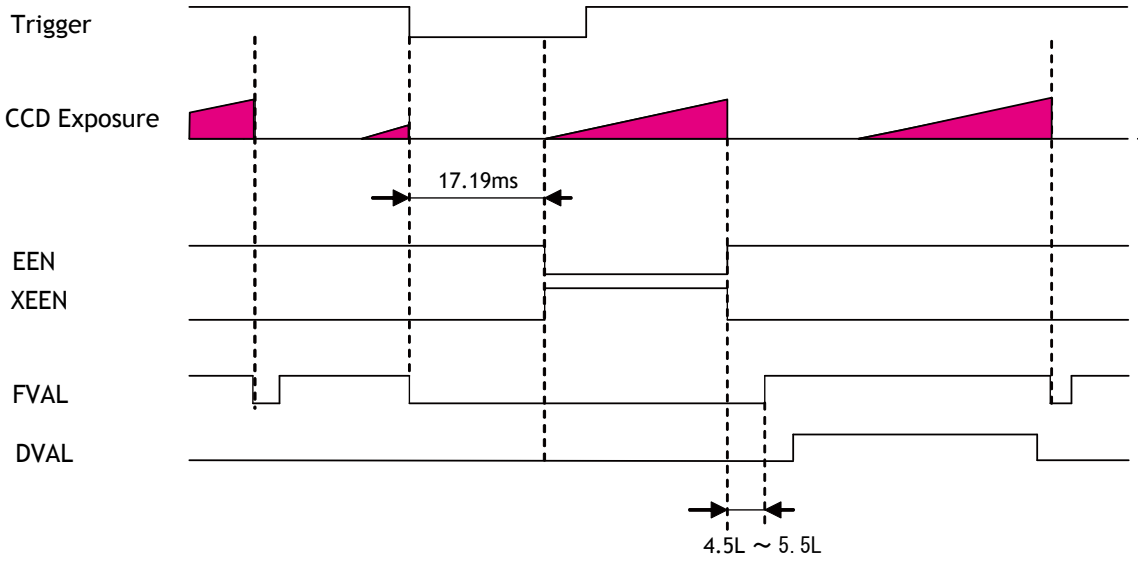


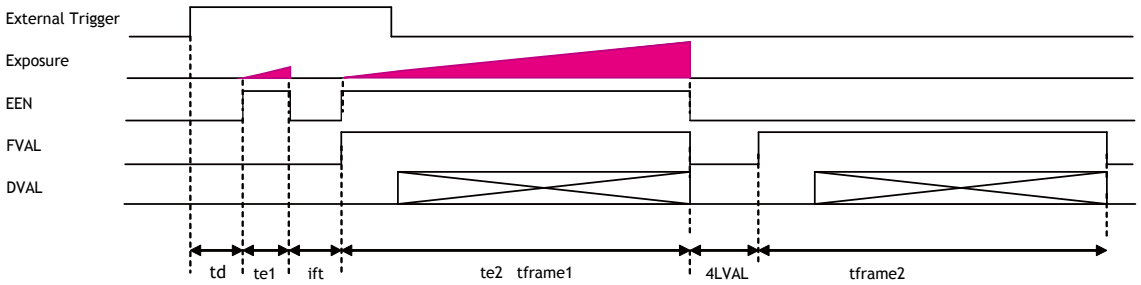

Fig.34 Trigger dump mode timing

## 7.9. PIV(Particle Image Velocimetry)

The Particle Image Velocimetry mode can be used in applications where 2 images should be taken with a very short time interval. It can only be used with strobe flash as illumination. The first accumulation time is 10μsec to 58.73ms. Then, the second exposure will be taken. The accumulation is LVAL asynchronization. The first strobe is activated in the first exposure duration and the scond strobe is taken during the first frame being readout. In this way, two strobe lights take two video outputs.
The frame rate for full pixels readout is 8.5fps for both AM-800CL and AB-800CL.

**Primary Settings**

Exposure mode : Timed
PIV control : ON
Trigger mode: TM=1 (ON)




| time name | description | time |
|---|---|---|
| td | Exposure beginning delay | 5us |
| te1 | First exposure time period | 10us ～ 58.73ms |
| te2 | Second exposure time | 58.73ms max |
| itf | Inter framing time | 7.9us |
| tframe1 | First Frame read out | 58.73ms max |
| tframe2 | Second Frame read out | 58.73ms max |

Fig.35 PIV mode

## 7.10. Operation and function matrix

| Operation mode | Exposure control | Expsoure auto | Binning | AOI | Auto Iris output | Overlap | Note |
|---|---|---|---|---|---|---|---|
| Continuous | ○ | ○ | ○ | ○ | ○ | --- | |
| Timed (EPS) | ○ | × | ○ | ○ | × | ○ | |
| Trigger width(PWC) | --- | × | ○ | ○ | × | ○ | |
| Trigger Dump (RCT) | ○ | ○ | ○ | ○ | ○ | OFF | |
| JAI_PIV | ○ | × | ○ | ○ | × | OFF | |
| Exposure Sequence | ○ | × | ○ | ○ | × | OFF | |

# 8. Other functions

## 8.1 Black level control (Command : BL)

This function adjusts the setup level.
Command value : -1024 to 1023
Variable range : -256 to 255 LSB (at 10-bit output)

## 8.2 Gain control (Relative commands GA,GJUT1,2,3)

The AM-800CL can adjust the gain level from -3dB to +24dB using 0dB as the reference (Factory default). In the AB-800CL, the master gain can be adjusted from 0dB to +24dB and R and B gains can be adjusted in the range of -7dB to + 10dB using the master gain as the reference.

The AM-800CL and AB-800CL has the resolution of x0.00012/step using both analog gain(0.00359db/step) and digital gain. In the AB-800CL, blue and red channels can adjust in x0.00012/step by using digital gain.

Refer to the following drawing.

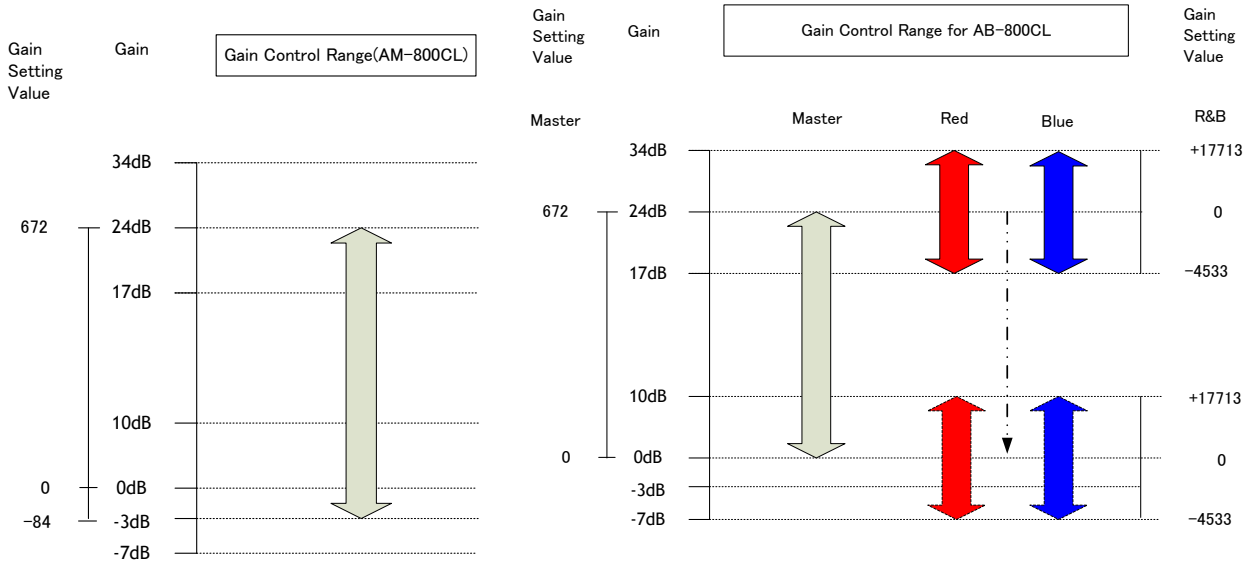



Fig. 36 Gain control

## 8.3 Tap control (Relative commands AWA,ABA,GJUT1, GJUT2,GJUT3)

The Tap control function adjusts automatically or manually the OFFSET and the gain differences between the upper and lower taps, and the right and left taps. The sensor used in the AM-800CLand AB-800CL divides the effective image area into 4(four) areas as shown in the figure 30 in order to achieve its fast frame rate.
The reference tap for all adjustments is Tap ”A”.

AWA: Adjust the differences of the gain among taps automatically
ABA: Adjust the differences of the OFFSET among taps automatically
GJUT1: Adjust the gain of the TAP1R(B) manually
GJUT2: Adjust the gain of the TAP2L(C) manually
GJUT3: Adjust the gain of the TAP2R(D) manually

Note: 1) The OFFSET cannot be adjusted individually.
2) TAP A cannot be adjusted individually.

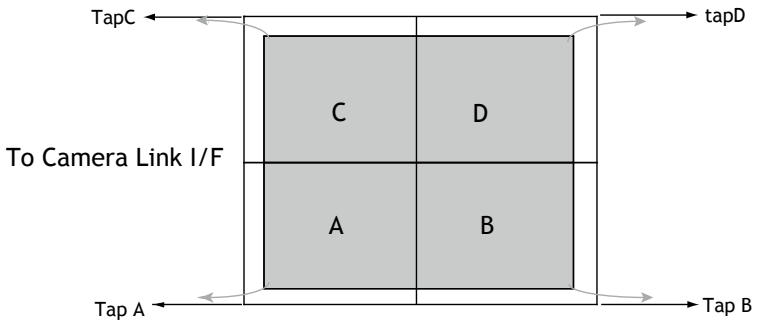



Fig.37 Tap control

## 8.4. Exposure auto (Related Commands : ASC=1(ON),ASCS,ASCEA,ASCEI)

The exposure can be automatically controlled by setting the command ASC to ON. The adjusting range is 58.733 ms to 10μs. The tracking speed can also be set.

| | Command | Value |
|---|---|---|
| Adjusting range | ASCEA, ASCEI | 10μs to 58.733ms |
| Tracking speed | ASCS | 1 to 16 (Default:8) |

ASCEA: Sets the maximum exposure in the ASC mode
ASCEI: Sets the minimum exposure in the ASC mode

Note: This function works only in continuous mode or edge-dump mode.

## 8.5. Auto white balance (Related commands:AWB, PGS, PGR, PGGR, PGGB, PGB)

In this function, the gain of each R, Gr, Gb and B color can be individually adjusted to get the proper white balance.

| | | |
|---|---|---|
| B1 | Gb1 | B2 |
| Gr1 | R | Gr2 |
| B3 | Gb2 | B4 |

Fig. 38 Auto white balance

To adjust white balance, the AB-800CL has three methods: manual adjustment, one-push auto white balance, and continuous auto white balance.

AWB: 0 OFF (Manual adjustment)
1 Once (One-push auto white balance)
2 Continuous (always tracking)

This function can be used with full resolution read out, as well as with AOI readout.
This does not work in trigger mode.

## 8.6. Blemish compensation

The AM-800CL and AB-800CL have a blemish compensation circuit. This function compensates blemishes on the CCD sensor (typically pixels with extremely high response or extremely low response). This applies to both monochrome and color versions. Pixels that fulfill the blemish criteria can be compensated by adjacent pixels on both columns and, in the case of the AB-800CL, the defective pixels can be compensated by the same Bayer color pixels in both adjacent columns. The number of pixels that can be compensated is up to 64 pixels per tap, for a total of 256 pixels.
The built-in compensation circuit for the AM-800CL and AB-800CL uses compensation data collected in the factory and can be turned ON or OFF. The default setting is OFF.

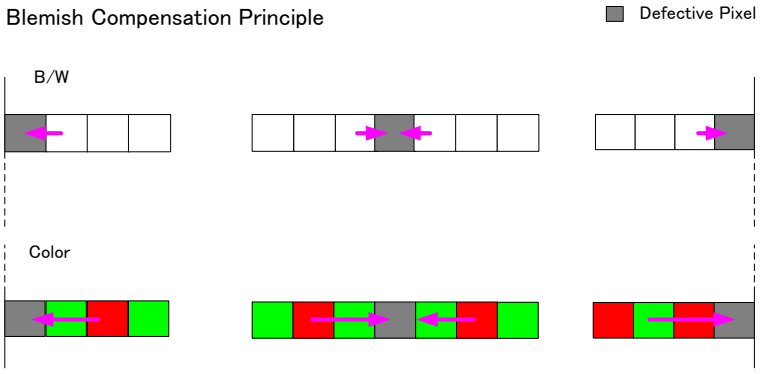



Fig. 39 Blemish compensation

Note: If defective pixels are found consecutively in the horizontal direction, the blemish compensation circuit does not work.

## 8.7. LUT (Relative commands LUTC,LUTR,LUYG, LUTB)

This function can be used to convert the input to the desired output characteristics.
The Look Up Table (LUT) has 256 points for setup and each point has an 8-bit gain value. The output level can be created by multiplying the gain data by the input level.
In the AB-800CL, the same LUT characteristic is applied independent of the color value.

If input data is not in the LUT, the weighted mean average data from upper point and the lower point are used.

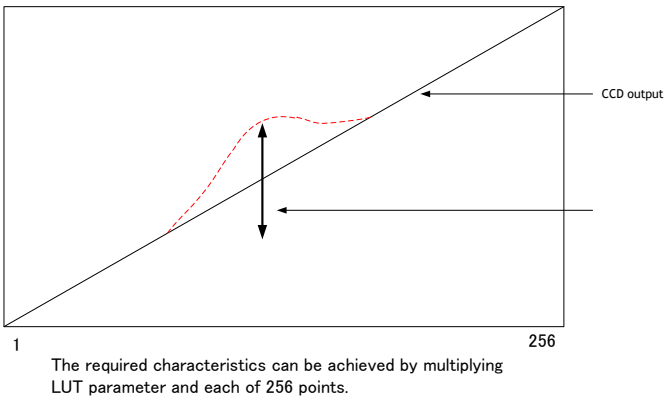



Fig.40 LUT concept drawing

## 8.8. Gamma (Command: GAMS)

This command is used for the fine tuning of the set gamma characteristics if the gamma is set to 0.45 or 0.6. The parameter of GAMS is 0 to 31 and the default is 16.
If GAMS is 16 (default), the normal 0.45 or 0.6 gamma curve is unaffected. By changing the value of GAMS, the 0.45 or 0.6 gamma curve can be modified.

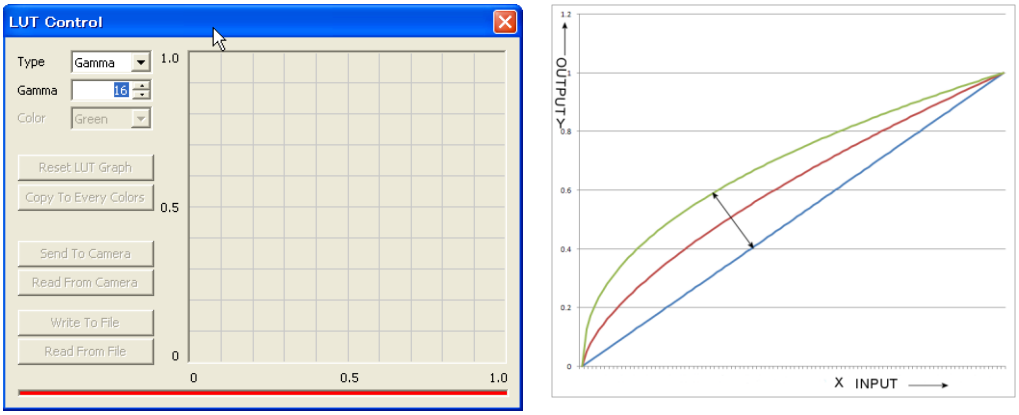



Fig. 41 Gamma compensation

## 8.9. Flat Field Correction (FFC) (Command: SDR)

This function compensates for shading caused by the lens or the light source used. The method to compensate the shading is to measure the highest luminance level in the image and use that data as the reference. Luminance levels of other areas are then adjusted so that the level of the entire area is equal. The block for compensation is 64 pixels x 64 pixels and the complementary process is applied to produce the compensation data with less error.

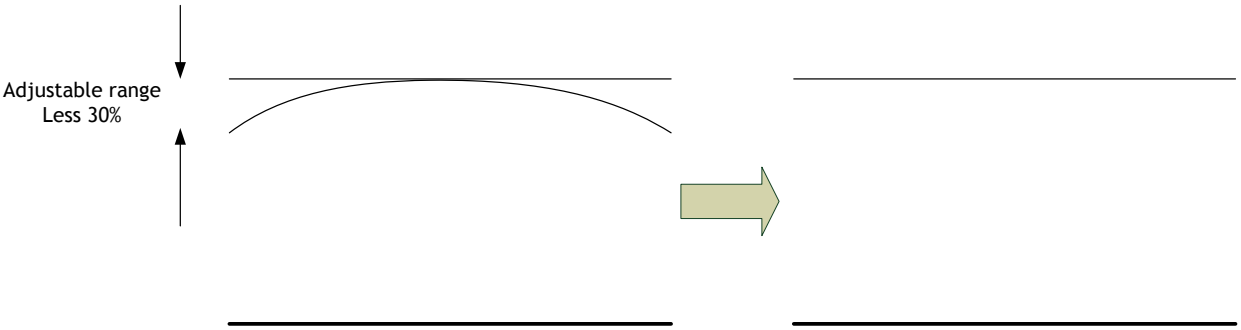



Fig. 42 FFC compensation concept drawing

Note: Under the following conditions, the FFC circuit may not work properly.

- If there is some area in the image with a video level less than 70%
- If part of the image or the entire image is saturated
- If the highest video level in the image is less than 300LSB (at 10-bit output)

SDM: 0=OFF, 1=Factory (Use factory data), 2=User (User setting data)
To generate user data for setting FFC:
Execute the command RS (FFC re-calibration) and store the result in the user area.

## 8.10. Bayer color interpolation (Command : BCIC) (Only for AB-800CL)

This function is available only for AB-800CL. The AB-800CL uses a CCD with an RGB Bayer pattern. If the Bayer color interpolation is not used, the following RAW data can be output.

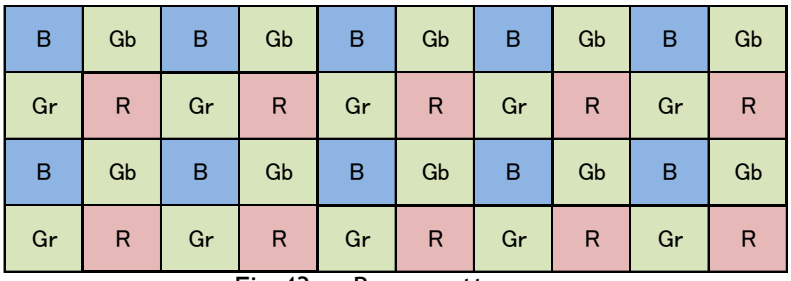



Fig.43 Bayer pattern

The RAW data contains only luminance information for each color and outputs as a monochrome signal. The Bayer color interpolation can complement lacking color information on each pixel and output RGB color data as the result. Color interpolation compensates for the lack of color information by using information from adjacent pixels. The following is the concept drawing for the color interpolation process.

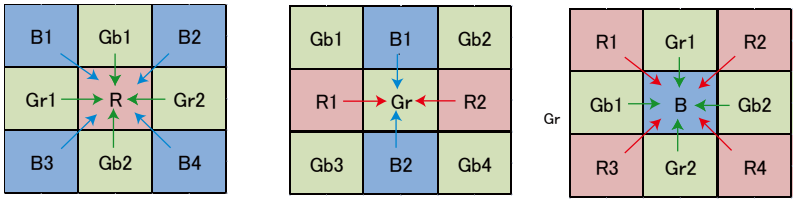
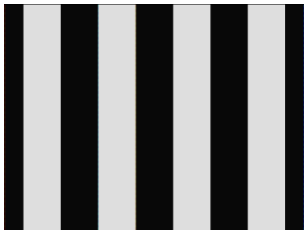



Fig.44 Color interpolation concept drawing

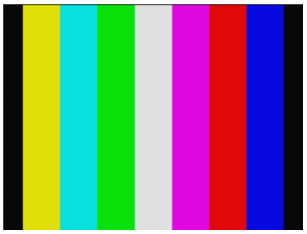
## 8.11. Test pattern (Command: TPN)

**TPN=0** : Test pattern off

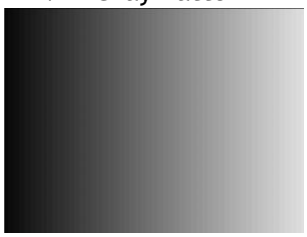
**TPN=1** : AM-800:Black-Wihte



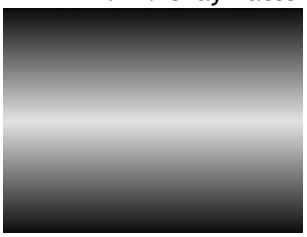
AB-800: Color bar



**TPN=2** Gray Pattern1



**TPN=3**: Gray Pattern2



**TPN=4**: white (100%)



Fig.45 Test pattern

## 8.12. Temperature sensor (Command : TMPO)

This function reads out the temperature inside the camera.
The measuring range : -55 to +125°C
Resolution : 0.0625 °C

The following table shows examples of values which can be read out by the TMPO command.

| TEMPERATURE (°C) | DIGITAL OUTPUT(1) (BINARY) | HEX |
|---|---|---|
| 150 | 0100 1011 0000 0111 | 4B07 |
| 125 | 0011 1110 1000 0111 | 3E87 |
| 25 | 0000 1100 1000 0111 | 0C87 |
| 0.0625 | 0000 0000 0000 1111 | 000F |
| 0 | 0000 0000 0000 0111 | 0007 |
| –0.0625 | 1111 1111 1111 1111 | FFFF |
| –25 | 1111 0011 1000 0111 | F387 |
| –55 | 1110 0100 1000 0111 | E487 |

The display resolution in the JAI camera control tool is 1 °C.

## 8.13 ALC

In the AM-800CL and AB-800CL, auto gain, auto shutter and auto iris functions can be combined to provide a wide ranging automatic exposure control from dark to bright or vice versa.
The functions are applied in the sequence shown below and if one function is disabled, the linkage between the other two is maintained.

If the lighting condition is changed from bright to dark AIC — ASC — AGC
If the lighting condition is changed from dark to bright AGC — ASC — AIC

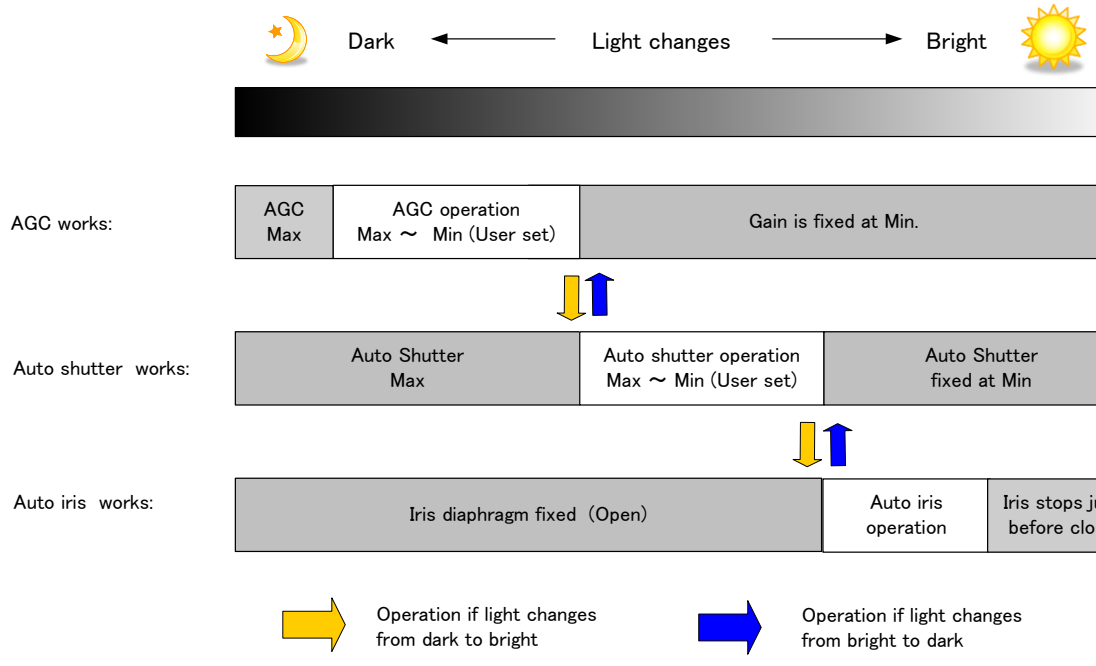



Fig.46 ALC function concept

GainAutoReferecne will determine the target video level for AGC, Auto Shutter and/or Auto iris. For instance, if GainAutoReference is set to 100% video level, AGC, Auto Shutter and/or Auto iris will function to maintain 100% video level.

■ Please note that ALC function is available only for the continuous mode.

# 9. Configuring the camera

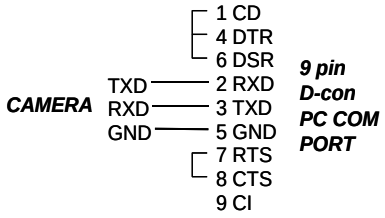
## 9.1 RS-232C control

All configuration of the AM-800CL and AB-800CL cameras are done via Camera Link. The camera can be set up from a PC running terminal emulator software, or using JAI´s camera control software.
Below is the description of the ASCII based short command protocol.

## 9.2 Communication setting.

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

RS 232C cable




**Protocol.**

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

The camera answers:
**COMPLETE<CR><LF>**
Note: Some commands can only be requested.

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

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

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

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

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

## 9.3. 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 previously 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 used user area are used as default settings at power up.

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

***EEPROM Area**. EA.*
If received, the camera will return the last used user area number.

## 9.4 Command list

| | Command Name | Format | Parameter | Remarks |
|---|---|---|---|---|
| **A - General settings and utility commands.** | | | | |
| 1 | Camera Status Request | **ST**?<CR><LF> | | Actual setting |
| 2 | Online Help Request | **HP**?<CR><LF> | | Command list |
| 3 | Firmware Version | **VN**?<CR><LF> | | 3 digits<br>(e.g) 100 = Version 1.00 |
| 4 | Camera ID Request | **ID**?<CR><LF> | | max 12 characters |
| 5 | Model Name Request | **MD**?<CR><LF> | | max 12 characters |
| 6 | User ID | **UD**=[Param.]<CR><LF><br>UD?<CR><LF> | | User can save and load free text.(12 or less characters) |
| 7 | Error code | **ERRER=[Param.]<CR><LF>**<br>ERRER?<CR><LF> | One of following values will be replied from the camera<br>0=One-Push has not been finished yet.<br>1=Succeeded.<br>2=Error1. Green image was too bright.<br>3=Error2. Green image was too dark.<br>4=Error3. Timeout-error occurred. | |
| **B – Image format control** | | | | |
| 1 | Height | **ETL**=[Param.]<CR><LF><br>ETL?<CR><LF> | SC=1: :2 to 2472 | AB-800 : 2Line step<br>AM-800 : 1Line step |
| 2 | Offset Y | **STL**=[Param.]<CR><LF><br>STL?<CR><LF> | SC=1: :1 to 2471 | AB-800 : 2Line step<br>AM-800 : 1Line step |
| 3 | Binning Vertical | **BNC=[Param.]<CR><LF>**<br>BNC?<CR><LF> | 0=off<br>1=1x2, | Only AM-800CL |

| | Command Name | Format | Parameter | Remarks |
|---|---|---|---|---|
| | | | 2=2x1<br>3=2x2 | |
| 4 | PixelFormat | **BA**=[Param.]<CR><LF><br>BA?<CR><LF> | 0=8bit, 1=10bit , 2=12bit,<br>3=RGB | |
| **C – Test image selector** | | | | |
| 1 | Test Image selector | **TPN=[Param.]<CR><LF>**<br>TPN?<CR><LF> | 0=OFF<br>1=Color bar (AB-xxx) /<br>Black-White (AM-xxx)<br>2= Gray horizontal ramp<br>3= Gray Vertical ramp<br>4= White | |
| **D – Acquisition control** | | | | |
| 1 | Acquisition Frame Rate | **AR=[Param.]<CR><LF>**<br>AR?<CR><LF> | 1 to 1048575 | In JAI control tool, 42964 is upper limit. |
| **E – Trigger control** | | | | |
| 1 | Trigger Mode | **TM**=[Param.]<CR><LF><br>TM?<CR><LF> | 0=off<br>1=on | |
| 2 | Trigger source | **TI**=[Param.]<CR><LF><br>TI? <CR><LF> | 0= Line0(Camera Link)<br>1= Line1(Hirose 12pin) | |
| 3 | Trigger Activation | **TA**=[Param.]<CR><LF><br>TA? <CR><LF> | 0= Rising edge<br>1=Falling edge | If EM-2, 0=High, 1=Low |
| 4 | Trigger overlap | **TO**=[Param.]<CR><LF><br>TO?<CR><LF> | 0= off<br>1= Read out | |
| **F – Exposure control** | | | | |
| 1 | Exposure Mode | **EM**=[Param.]<CR><LF><br>EM?<CR><LF> | 0=OFF<br>1=Timed<br>2=Trigger width | |
| 2 | Exposure time | **PE**=[Param.]<CR><LF><br>PE?<CR><LF> | 10μs ～ 2000000μs | Available when EM=1 |
| 3 | ExposureAuto | **ASC=[Param.]<CR><LF>**<br>ASC?<CR><LF> | 0=off , 1=Continuous | |
| 4 | ExposureAuto speed | **ASCS=[Param.]<CR><LF>**<br>ASCS?<CR><LF> | 1 to 16 | ASC Tracking speed setting, Default=8 |
| 5 | ExposureAuto Max | **ASCEA=[Param.]<CR><LF>**<br>ASCEA?<CR><LF> | 10 to 1048575 us unit | Maximum Exposure value when ASC is 1 |
| 6 | ExposureAuto Min | **ASCEI=[Param.]<CR><LF>**<br>ASCEI?<CR><LF> | 10 to 1048575 us unit | Minimum Exposure value when ASC is 1 |
| 7 | Trigger edge Dump | **TD**=[Param.]<CR><LF><br>TD? <CR><LF> | 0= Dump off<br>1=Dump on | |

| | Command Name | Format | Parameter | Remarks |
|---|---|---|---|---|
| 8 | JAI PIV | **JPIV=[Param.]<CR><LF>**<br>JPIV?<CR><LF> | 0=PIV off<br>1=PIV on | When E M = Timed<br>This is effective |
| **G – Analog control** | | | | |
| 1 | GainAnalog All | **GA**=[Param.]<CR><LF><br>GA?<CR><LF> | -84 to 672 (AM-800CL)<br>0 to 672 (AB-800CL) | for AFE 1L, 1R, 2L, 2R |
| 2 | FineGain Digital All | **FGA**=[Param.]<CR><LF><br>FGA?<CR><LF> | -2393～3379<br>(Data+8192)/ 8192<br>±3dB | for AFE 1L, 1R, 2L, 2R |
| 3 | Gain Auto | **AGC**=[Param.]<CR><LF><br>AGC?<CR><LF> | 0=OFF<br>1=Continuous | |
| 4 | Gain Auto Reference | **AGCF**=[Param.]<CR><LF><br>AGCF?<CR><LF> | 0 to 1023 | |
| 5 | Gain Auto speed | **AGCS**=[Param.]<CR><LF><br>AGCS?<CR><LF> | 1 to 16 | AGC tracking speed Setting ,Default=8 |
| 6 | Gain Auto Maximum gain value | **AGCGA=[Param.]<CR><LF>**<br>AGCGA?<CR><LF> | 0 to 672 (AM-800CL)<br>84 to 672 (AB-800CL) | |
| 7 | Gain Auto Minimal gain value | **AGCGI=[Param.]<CR><LF>**<br>AGCGI?<CR><LF> | -84 to 588 (AM-800CL)<br>0 to 588 (AB-800CL) | |
| 8 | Black Level | **BL**=[Param.]<CR><LF><br>BL?<CR><LF> | -1024 to 1023 | Digital User Setup Master |
| H – Balance Ratio | | | | |
| 1 | BalanceRatio RED | **PGR=[Param.]<CR><LF>**<br>PGR?<CR><LF> | -4533～17713<br>(Data+8192)/ 8192<br>-7～+10dB | (Only AB-800CL)<br>Pixel Gain for WB |
| 2 | BalanceRatio Blue | **PGB=[Param.]<CR><LF>**<br>PGB?<CR><LF> | -4533～17713<br>(Data+8192)/ 8192<br>-7～+10dB | (Only AB-800CL)<br>Pixel Gain for WB |
| 3 | Blance White auto | **AWB=[Param.]<CR><LF>** | 0=OFF<br>1=Once (Run)<br>2=Continuous | Only AB-800CL |
| 4 | Request the Result of Blance white auto | AWRS?<CR><LF> | 0=Complete.<br>1=Too Bright.<br>2=Too dark.<br>3=Timeout Error.<br>4=Busy.<br>5=Limit.<br>6= Trig is not set as Normal. | Only AB-800CL |
| **I – LUT control** | | | | |
| 1 | LUT selector | **LUTC=[Param.]<CR><LF>** | 0=off | |

| | Command Name | Format | Parameter | Remarks |
|---|---|---|---|---|
| | | LUTC?<CR><LF> | 1=Gamma<br>2=LUT | |
| 2 | Gamma Selector | **GAMS=[Param.]<CR><LF>**<br>GAMS?<CR><LF> | 0(1.0) to 16(0.45) | ( Only Gamma) |
| 3 | LUT data communication for Red | **LUTR=[Param.]<CR><LF>**<br>LUTR?<CR><LF> | transfer by a serial method. The number of the data is 512.<br>Param=0 to 8191 | After sending consecutive 512 data, LUT data can be renewed |
| 4 | LUT data communication for Green | **LUTG=[Param.]<CR><LF>**<br>LUTG?<CR><LF> | transfer by a serial method. The number of the data is 512.<br>Param=0 to 8191 | After sending consecutive 512 data, LUT data can be renewed |
| 5 | LUT data communication for Blue | **LUTB=[Param.]<CR><LF>**<br>LUTB?<CR><LF> | transfer by a serial method. The number of the data is 512.<br>Param=0 to 8191 | After sending consecutive 512 data, LUT data can be renewed |
| **J – Gain and black level for TAP balance** | | | | |
| 1 | Gain auto Tap Balance | **AWA=[Param.]<CR><LF>** | 0=OFF<br>1=Once(Run)<br>2=Continuous | |
| 2 | Request the Result of Gain auto Tap balance | WBRS?<CR><LF> | 0=Complete.<br>1=Too Bright.<br>2=Too dark.<br>3=Timeout Error.<br>4=Busy.<br>5=Limit.<br>6= Trig is not set as Normal. | |
| 3 | Fine Gain for Tap 2 | **GJUT2**=[Param.]<CR><LF><br>GJUT2?<CR><LF> | -891～1000<br>(Data+8192)/ 8192<br>±1dB | for pixel Gain 1R |
| 4 | Fine Gain for Tap 3 | **GJUT3**=[Param.]<CR><LF><br>GJUT3?<CR><LF> | -891～1000<br>(Data+8192)/ 8192<br>±1dB | for pixel Gain 2L |
| 5 | Fine Gain for Tap 4 | **GJUT4**=[Param.]<CR><LF><br>GJUT4?<CR><LF> | -891～1000<br>(Data+8192)/ 8192<br>±1dB | for pixel Gain 2R |
| 6 | PixelGain RED Tap2 | **PGR2=[Param.]<CR><LF>**<br>PGR2?<CR><LF> | -891～1000<br>(Data+8192)/ 8192<br>±1dB | (Only AB-800CL)<br>Pixel Gain for Tap2 |
| 7 | Pixel Gain Blue Tap2 | **PGB2=[Param.]<CR><LF>**<br>PGB2?<CR><LF> | -891～1000<br>(Data+8192)/ 8192 | (Only AB-800CL)<br>Pixel Gain for Tap2 |

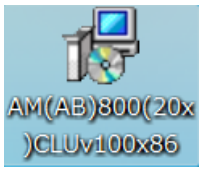
| | Command Name | Format | Parameter | Remarks |
|---|---|---|---|---|
| | | | ±1dB | |
| 8 | Pixel Gain RED Tap3 | **PGR3=[Param.]<CR><LF>**<br>PGR3?<CR><LF> | -891～1000<br>(Data+8192)/ 8192<br>±1dB | (Only AB-800CL)<br>Pixel Gain for Tap3 |
| 9 | Pixel Gain Blue Tap3 | **PGB3=[Param.]<CR><LF>**<br>PGB3?<CR><LF> | -891～1000<br>(Data+8192)/ 8192<br>±1dB | (Only AB-800CL)<br>Pixel Gain for Tap3 |
| 10 | Pixel Gain RED Tap4 | **PGR4=[Param.]<CR><LF>**<br>PGR4?<CR><LF> | -891～1000<br>(Data+8192)/ 8192<br>±1dB | (Only AB-800CL)<br>Pixel Gain for Tap4 |
| 11 | Pixel Gain Blue Tap4 | **PGB4=[Param.]<CR><LF>**<br>PGB4?<CR><LF> | -891～1000<br>(Data+8192)/ 8192<br>±1dB | (Only AB-800CL)<br>Pixel Gain for Tap4 |
| 12 | Black level auto Tap balance | **ABA=[Param.]<CR><LF>** | 0=OFF<br>1=Once (Run)<br>2=Continuous | |
| 13 | Request the Result of Black level auto Tap balance | BBRS?<CR><LF> | 0=Complete.<br>1=Too Bright.<br>2=Too dark.<br>3=Timeout Error.<br>4=Busy.<br>5=Limit.<br>6= Trig is not set as Normal. | |
| 14 | Fine Black for tap 2 | **BL2**=[Param.]<CR><LF><br>**BL2**?<CR><LF> | -512 to 511 | Tap2 Black Fine For User |
| 15 | Fine Black for tap 3 | **BL3**=[Param.]<CR><LF><br>**BL3**?<CR><LF> | -512 to 511 | Tap3 Black Fine For User |
| 16 | Fine Black for tap 4 | **BL4**=[Param.]<CR><LF><br>**BL4**?<CR><LF> | -512 to 511 | Tap4 Black Fine For User |
| 17 | BayerPixel FineBlack for tap 1L-R | **BLR1**=[Param.]<CR><LF><br>BLR1?<CR><LF> | -512 to 511 | Tap1 Black Fine For User |
| 18 | BayerPixel FineBlack for tap 1L-B | **BLB1**=[Param.]<CR><LF><br>BLB1?<CR><LF> | -512 to 511 | Tap1 Black Fine For User |
| 19 | BayerPixel FineBlack for tap 1R-R | **BLR2**=[Param.]<CR><LF><br>BLR2?<CR><LF> | -512 to 511 | Tap2 Black Fine For User |
| 20 | BayerPixel FineBlack for tap 1R-B | **BLB2**=[Param.]<CR><LF><br>BLB2?<CR><LF> | -512 to 511 | Tap2 Black Fine For User |
| 21 | BayerPixel | **BLR3**=[Param.]<CR><LF> | -512 to 511 | Tap3 Black Fine For |

| | Command Name | Format | Parameter | Remarks |
|---|---|---|---|---|
| | FineBlack for tap 2L-R | BLR3?<CR><LF> | | User |
| 22 | BayerPixel FineBlack for tap 2L-B | **BLB3**=[Param.]<CR><LF><br>BLB3?<CR><LF> | -512 to 511 | Tap3 Black Fine For User |
| 23 | BayerPixel FineBlack for tap 2R-R | **BLR4**=[Param.]<CR><LF><br>BLR4?<CR><LF> | -512 to 511 | Tap4 Black Fine For User |
| 24 | BayerPixel FineBlack for tap 2R-B | **BLB4**=[Param.]<CR><LF><br>BLB4?<CR><LF> | -512 to 511 | Tap4 Black Fine For User |
| **K - Blemish** | | | | |
| 1 | Blemish Reduction | **BLM=[Param.]<CR><LF>**<br>BLM?<CR><LF> | 0=off, 1=Black, 2=White, 3=Both | |
| 2 | ReCalibrate Blemish | **BMRC**=[Param.]<CR><LF> | Param :<br>2=White | |
| 3 | Blemish Threshold White | **BMTHW**=[Param.]<CR><LF><br>BMTHW?<CR><LF> | 0 to 16383 | |
| 4 | BLMP White H | **BMWH=[Param1],[Param2]<CR><LF>**<br>BMH?[Param1]<CR><LF> | Param1 : Blemish No. 1 to 256<br>Param2 : H position | |
| 5 | BLMP White V | **BMWV=[Param1],[Param2]<CR><LF>**<br>BMV?[Param1]<CR><LF> | Param1 : Blemish No. 1 to 256<br>Param2 : V position | |
| **L – ALC control** | | | | |
| 1 | Auto Iris Lens Control Signal output | **AIC=[Param.]<CR><LF>**<br>AIC?<CR><LF> | 0=off, 1=on | |
| 2 | Iris Reverse Gain | **IRRG=[Param.]<CR><LF>** | 0=ON<br>1=OFF | |
| 3 | Iris State Control | **IRSC=[Param.]<CR><LF>** | 0=Video 1=Close<br>2=Open | |
| 4 | Iris Sync Level | **IRSL=[Param.]<CR><LF>** | 0 to 255 | |
| 5 | Channel area | **CHA=[Param.]<CR><LF>**<br>CHA?<CR><LF> | 0=AllArea<br>1=Low Right;<br>2=Low Center;<br>3=Low Left;<br>4=Middle Right;<br>5=Middle Center;<br>6=Middle Left;<br>7=High Right;<br>8=High Center; | |

| | Command Name | Format | Parameter | Remarks |
|---|---|---|---|---|
| | | | 9=High Left; | |
| **M – Flat field correction** | | | | |
| 1 | Flat Field Correction Control | **SDM**=[Param.]<CR><LF><br>SDM?<CR><LF> | 0=Off, 1=Factory, 2=User | |
| 2 | Recalibrate FFC | **RS**=[Param1]<CR><LF> | 0 Only | Save User Area |
| 3 | Request the Result of FFC | SDRS?<CR><LF> | 0=Complete.<br>1=Too Bright.<br>2=Too dark.<br>3=Timeout Error.<br>4=Busy.<br>5=Limit.<br>6= Trig is not set as Normal. | |
| **N - Others** | | | | |
| 1 | Temperature | TMP0?<CR><LF> | 0 to 0xFFF8 (/ 128 → ℃) | |
| 2 | Noise Reject SW | **NR=[Param.]<CR><LF>**<br>NR?<CR><LF> | 0=off, 1=on | |
| **O – Sequence exposure control operation** | | | | |
| 1 | Exposure Sequence | **EXSQ=[Param.]<CR><LF>**<br>**EXSQ?<CR><LF>** | 0=OFF<br>1=ON | Available when EM=1,2 |
| 2 | Exposure Sequence No N (1 ～ 16) | **PES(N)=[Param.]<CR><LF>**<br>**PES(N)?<CR><LF>** | 0 ～ 15 | |
| 3 | Exposure Repeat Time N (1 ～ 16) | **PER(N)=[Param.]<CR><LF>**<br>**PER(N)?<CR><LF>** | 0 ～ 15 | |
| 4 | Exposure Sequence Reset | **EXSR=[Param.]<CR><LF>**<br>**EXSR?<CR><LF>** | 0=OFF<br>1=ON | Effective when EXSQ=1. Only command 1 is used. In the firmware, 1 is immediately turned to 0. |
| 5 | Exposure Sequence End Point | **EXSEP=[Param.]<CR><LF>**<br>**EXSEP?<CR><LF>** | 0 ～ 15 | Effective when EXSQ=1. When EXSR =1, set 0. |
| 6 | Exposure time 1 | **PE1=[Param.]<CR><LF>**<br>PE1?<CR><LF> | 10μs ～ 2000000μs | Available when EXSQ=1 |
| 7 | Exposure time 2 | **PE2=[Param.]<CR><LF>**<br>PE2?<CR><LF> | 10μs ～ 2000000μs | Available when EXSQ=1 |
| 8 | Exposure time 3 | **PE3=[Param.]<CR><LF>**<br>PE3?<CR><LF> | 10μs ～ 2000000μs | Available when EXSQ=1 |

| | Command Name | Format | Parameter | Remarks |
|---|---|---|---|---|
| 9 | Exposure time 4 | **PE4=[Param.]<CR><LF>**<br>PE4?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| 10 | Exposure time 5 | **PE5=[Param.]<CR><LF>**<br>PE5?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| 11 | Exposure time 6 | **PE6=[Param.]<CR><LF>**<br>PE6?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| 12 | Exposure time 7 | **PE7=[Param.]<CR><LF>**<br>PE7?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| 13 | Exposure time 8 | **PE8=[Param.]<CR><LF>**<br>PE8?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| 14 | Exposure time 9 | **PE9=[Param.]<CR><LF>**<br>PE9?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| 15 | Exposure time 10 | **PE10=[Param.]<CR><LF>**<br>PE10?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| 16 | Exposure time 11 | **PE11=[Param.]<CR><LF>**<br>PE11?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| 17 | Exposure time 12 | **PE12=[Param.]<CR><LF>**<br>PE12?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| 18 | Exposure time 13 | **PE13=[Param.]<CR><LF>**<br>PE13?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| 19 | Exposure time 14 | **PE14=[Param.]<CR><LF>**<br>PE14?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| 20 | Exposure time 15 | **PE15**=[Param.]<CR><LF><br>PE14?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| 21 | Exposure time 16 | **PE15**=[Param.]<CR><LF><br>PE14?<CR><LF> | 10μs ~ 2000000μs | Available when EXSQ=1 |
| **P - Saving and loading data in EEPROM** | | | | |
| 1 | Load Setttings (from Camera EEPROM) | **LD**=[Param.]<CR><LF> | 0=Factory area<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>Note : parameter 0 is not allowed | |
| 3 | EEPROM Current Area No Request. | **EA**?<CR><LF> | 0=Factory area<br>1=User 1 area<br>2=User 2 area<br>3=User 3 area | The camera return the latest used DATA AREA. |

# 10. Camera control tool




The AM-800CL and AB-800CL camera Control Tool can be downloaded from JAI Web site www.jai.com. This control software is available for Windows2000/XP/Vista/7. In this control tool, the developers guide is included in order for customers to create their own programs.

## 10.1. Control tool windows

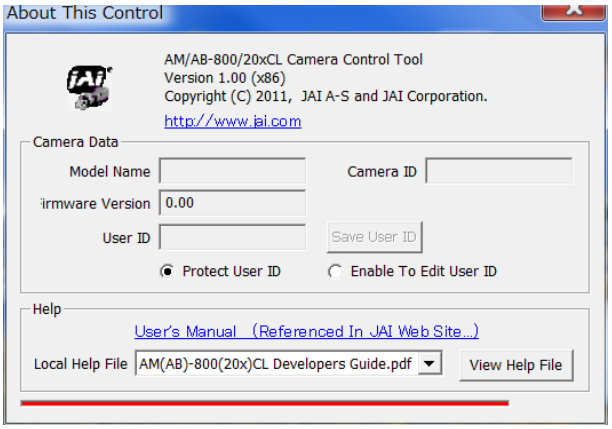
Here is some practical information about the Camera Control Tool:

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'

## 10.2. Camera Control Tool interface


The Camera Control software consists of the main tool bar and associated tool windows. When each icon in the main tool bar is clicked, the associated window will open. The program is refreshed after reboot.
The Camera control tool includes an About Window, Communication Window and Camera Control Window.

### 10.2.1 About Window




The About Window contains a picture of the camera and information about the version of the program, Internet connection to JAI A/S and access to the help documents.
The List box that contains the help documents will list all files, which have the extension .pdf and that are found in the program (default) folder
It is possible to download updated operation manuals from the jai website:

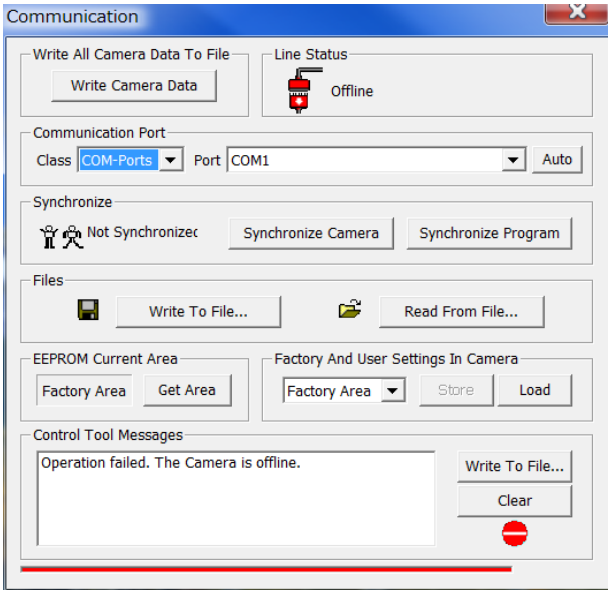
http://www.jai.com

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 (all windows but the Communication Window is a colored bar. The bar is red when the Camera Control Tool is not connected to a camera or when the camera is turned off. The bar is green when the Camera Control

Tool is connected to a camera and the camera is turned on.

### 10.2.2 Communication Window




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

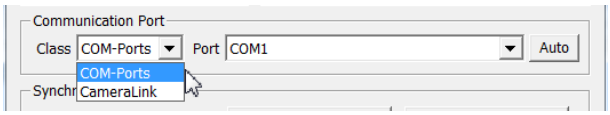
**RS-232C**

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-232C 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 now.

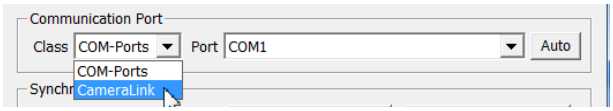
**RS-232CCommunication**




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 a 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.
Offline mode is indicated in the Communication Window, where a status field with graphic and text indicates the on/offline status.
Changing the selected communication port (from the Communication Window) changes the online/offline status. If a camera is found on the selected communication port the application runs online otherwise offline.

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 ".cam" extension. 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).

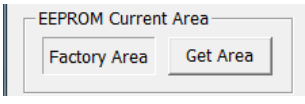
**Factory and User Settings**

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 to 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:

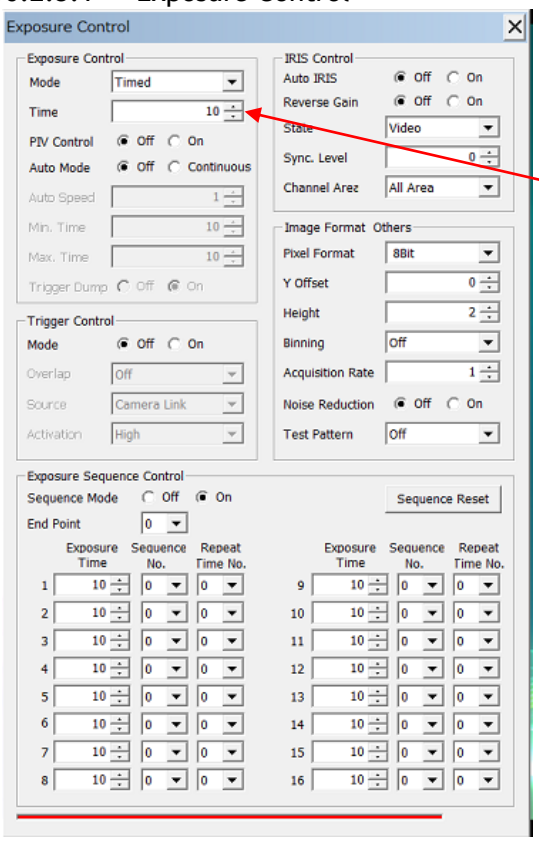
EEPROM Current Area.

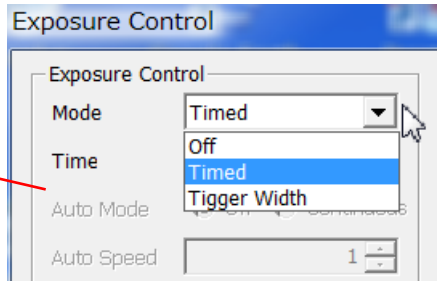



Click the 'Get Area' button to read the power up settings area number.

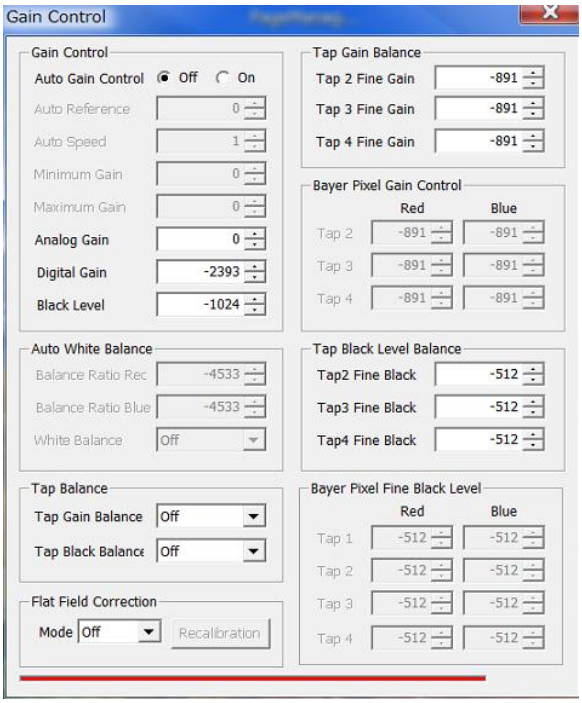
### 10.2.3 Camera Control Window

#### 10.2.3.1 Exposure Control

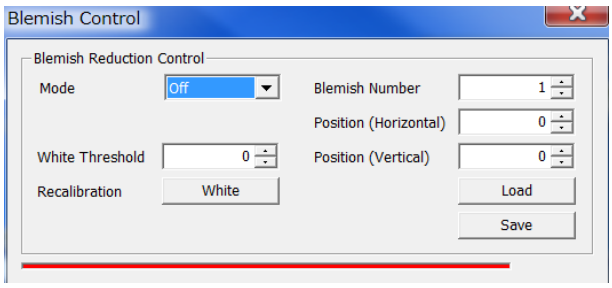


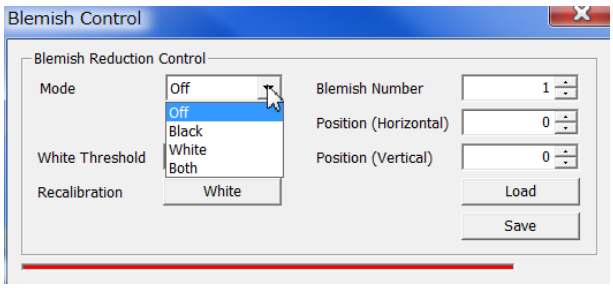




#### 10.2.3.2 Gain Control

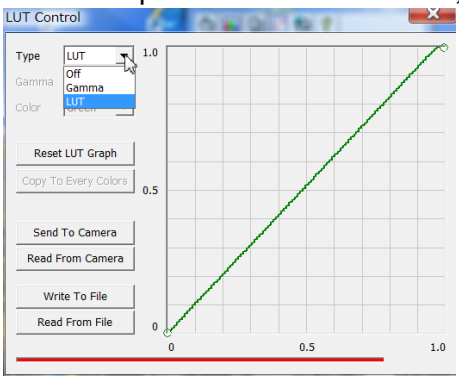


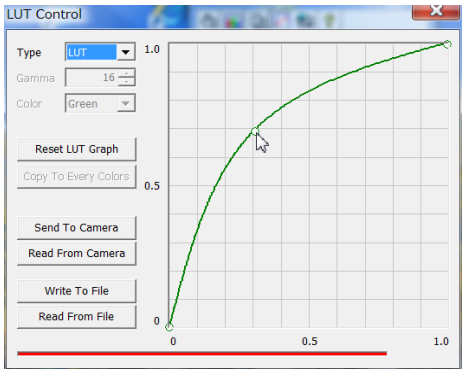
### 10.2.3.3 Blemish Control




When “Open LUT table” is clicked, the left side window will open, for example for blue channel.



# 11. External appearance and dimensions

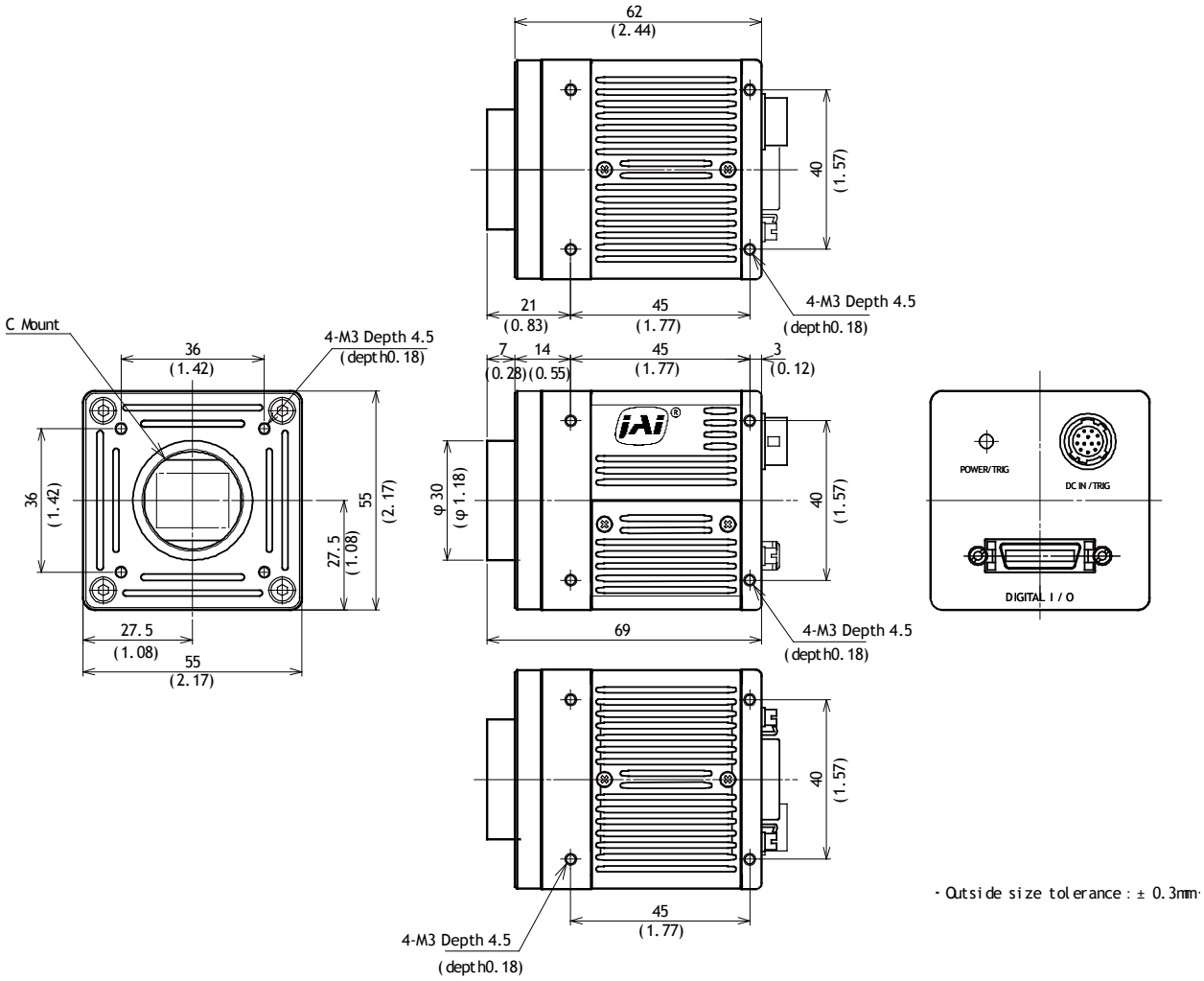



Fig. 47 Outside dimensions (C mount)

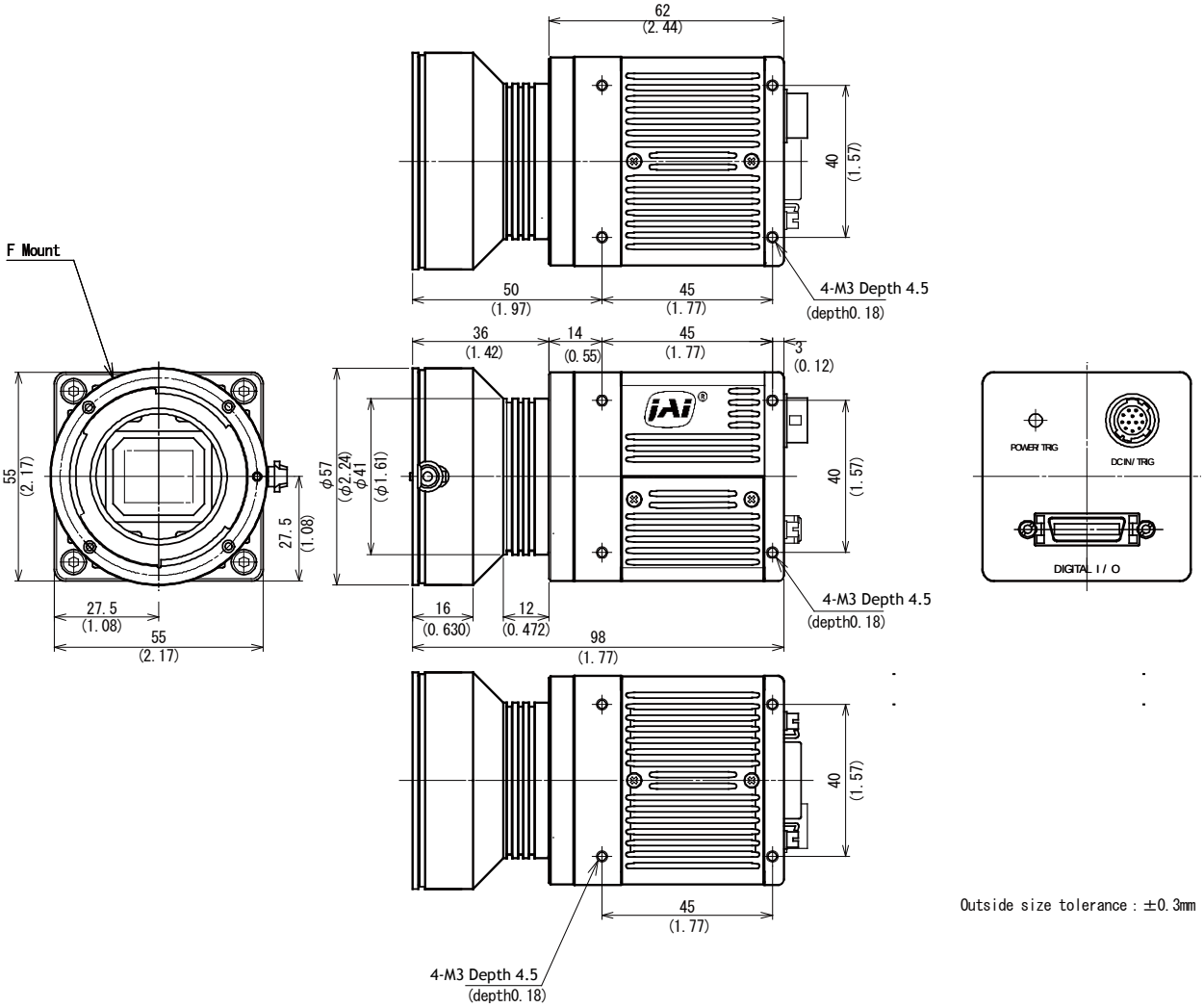



Fig.48 Outside dimensions (F mount)

# 12. Specifications

## 12.1 Spectral response

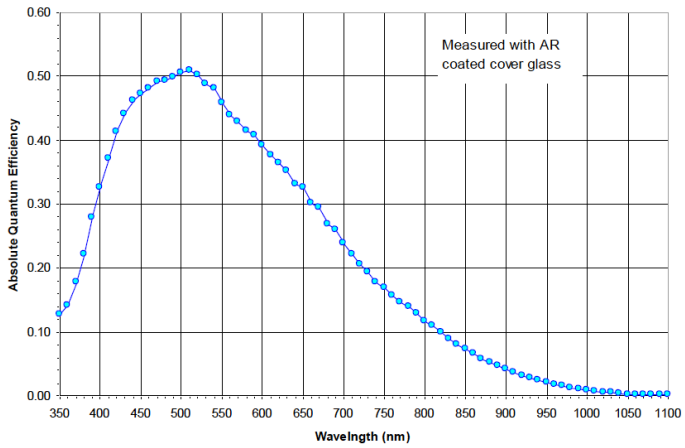



Fig. 49 Spectral response (AM-800CL)

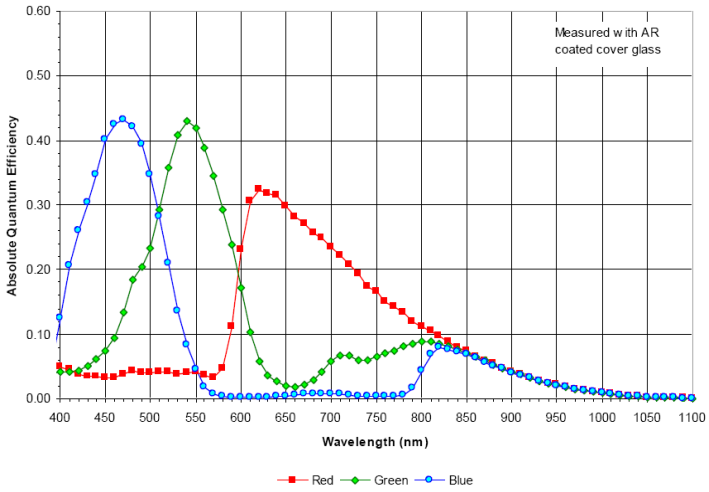



Fig.50 Spectral response (AB-800CL)

## 12.2 Specifications table

| Specifications | | AM-800CL | AB-800CL |
|---|---|---|---|
| Scanning system | | Progressive scan, 4 taps | |
| Synchronizing system | | Internal | |
| Image sensor | | 4/3 inch Monochrome interline CCD | 4/3 inch Bayer color interline CCD |
| Sensing area | | 18.13 (h) x 13.60 (v) mm 22.66 mm diagonal | |
| Cell size | | 5.5 (h) x 5.5 (v) μm | |
| Active pixels (for output) | | 3296 (h) x 2472 (v) | 3296 (h) x 2472 (v) (TBD) |
| Pixel clock(sensor) | | 40 MHz | |
| Horizontal (Camera Link) | | 21.50537 KHz (1H=46.5μs) (3720 clocks per line) (Pixel clock 80MHz) | |
| Vertical | | Total lines 2520 (Effective 2472) | |
| Frame rate (Full Resolution) | | Continuous mode 17.0263 fps (58.7ms) | Continuous mode Bayer output 17.0263fps (58.7ms) RGB output 8.5fps (117ms) |
| Image Format | Full resolution | 3296(h) x 2472(v) | Bayer 3296(h) x 2472(v) RGB 3296(h) x 2472(v) |
| | Binning (h x v) | 1 x 2 3296(h) x 1236(v) 2 x 1 1648(h) x 2472(v) 2 x 2 1648(h) x 1236(v) | - |
| | AOI | Height 1 line / step Offset Y 1 line / step | Height 2 line / step Offset Y 2 line / step |
| | | Note: number of horizontal pixels cannot be changed. | |
| Sensitivity on sensor (minimum) | | 0.04 Lux (Max. gain, Shutter OFF, 50% video,3200K, IR Cut CM500S ) | 0.06 Lux (Max. gain, Shutter OFF,50% Green, 4600K) |
| S/N ratio | | More than 57 dB (0dB gain, CCD output=300mV) | |
| Digital Video output Camera Link | Pixel format | 2 tap | |
| | Pixel clock | 80 MHz | |
| | Pixel bit depth | 8-bit, 10-bit, 12-bit | BAYER 8-bit, 10-bit, 12-bit RGB 8-bit |
| Iris video output | | Analog, 0.7 V p-p with 0.3V H.sync | |
| Sync output | | Camera Link : FVAL, LVAL, DVAL, EEN Hirose 12-pin: XEEN, 4V p-p (No termination) | |
| Acquisition frame rate | | Frame rate can be varied from 17.026Hz to 0.5Hz | |
| Exposure Control (Trigger) | OFF | | |
| | Timed | 10μs to 58.73ms(Shutter OFF), 1μs step | |
| | Trigger width | Binning OFF / 2 x 1: 93.1μs(2L) to 2 sec. Binning 1 x 2 / 2 x 2: 101.1μs to 2 sec | |
| | PIV | | |
| | Trigger- dump | | |
| Trigger Control | Source | Line 0=Camera Link CC1 or Line1=Hirose 12P 10pin | |
| | Activation | Rising edge or falling edge Level High or Level Low (If Trigger Width is selected) | |
| Gain | | Manual/Auto : -3dB to +24 dB (1 Step 0.01 dB) Fine gain (Digital gain) (1step=0.00012 times) | Manual/Auto : 0dB to +24 dB (1 Step 0.01 dB) Fine gain (Digital gain) (1step=0.00012 times) |
| White balance | | - | OFF: Manual ON: One push white balance Range: 3200K to 9000K |

| | | | |
|---|---|---|---|
| Black level | | 32 LSB at 10-bit output,<br>-256 LSB to 255 LSB can be changed, 1 step is 0.25dB<br>(at 10-bit output) | |
| LUT | | OFF: γ=1.0, ON= 256 points can be set | |
| Gamma | | 0.45 to 1.0 can be set, Adjusting step is 0.05 | |
| Flat Field Compensation | | Compensated by 128 x 128 pixels block | |
| Blemish Compensation (Bright) | | Built in,<br>maximum 64 pixels for dark and bright compensation per 1 tap<br>(note: black compensation is only by factory preset) | |
| Color interpolation | | - | 3 x 3 interpolation matrix |
| Test pattern | | OFF/Black-white/Gray H-ramp/<br>Gray V-ramp/white(100%) | OFF/Color bar/Gray H-ramp /<br>Gray V-ramp /White(100%) |
| Temperature sensor | | -55 to +125ºC (measuring range), resolution is 0.0625ºC | |
| Serial communication | | Camera Link or Hirose 12-pin | |
| Power | | DC+12V to +24V ± 10%, 7.8W (at normal operation, DC+12V) | |
| Lens mount | | C mount or F mount<br>The rear protrusion on C mount lens must be less than 10mm.<br>The rear protrusion on F mount lens must be less than 12mm | |
| Flange back | | C mount : 17.526 mm, tolerance 0 to -0.05 mm<br>F mount : 46.5 mm, tolerance 0 to -0.05 mm | |
| Sensor alignment | | X and Y axis: ± 0.1 mm ( at center) | |
| Optical filter | | - Protection glass only | Optical low pass filter |
| Operating temperature | | -5°C to +50°C | |
| Humidity | | 20 – 80% non-condensing | |
| Storage temp/humidity | | -25°C to +60°C/20% to 80 % non-condensing | |
| Vibration | | 10G (20Hz to 200Hz, XYZ) | |
| Shock | | 70G | |
| Regulatory | | CE (EN61000-6-2 and EN61000-6-3), FCC part 15 class B, RoHS, WEEE | |
| Size | C-mount | 55 x 55 x 69 mm (W x H x D) | |
| | F-mount | 55 x 55 x 98 mm (W x H x D) | |
| Weight | C-mount | 280g | |
| | F-mount | 340g, | |

Note1): Approximately 5 minutes pre-heating is required to get the mentioned specifications.
Note2): The above specifications are subject to change without notice.

# Appendix

## 1. Precautions

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

## 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 edges may appear on the monitor.

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

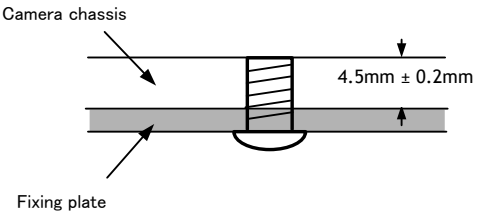
**Patterned Noise**
When the sensor captures a dark object at high temperature or is used for long time integration, fixed pattern noise may appear on the video monitor screen.

## 3. Caution when mounting a lens on the camera

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

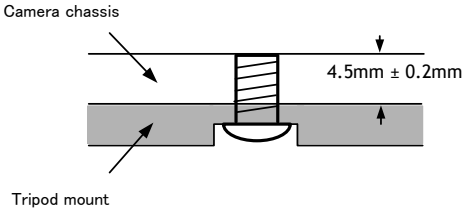
## 4. Caution when mounting the camera

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




Mounting the camera to fixing plate

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




Attaching the tripod mount

## 5. Caution for cleaning CCD and Low Pass Filter

**If you find dust on the surface of the CCD and/or Low Pass Filter, please clean using a small blower such as those used for photographic equipment. Please do not use compressed air as moisture in the compressed air will cause dust to stick to the surface of CCD and/or Low Pass Filter. After using a blower, if dust is still not removed, please consult with JAI technical support.**

## 6. Exportation

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

## 7. References

1. This manual can and datasheet for AM-800CL / AB-800CL can be downloaded from www.jai.com
2. Camera control software can be downloaded from www.jai.com

## Manual change history

| Date | Revision | Changes |
|---|---|---|
| March 2011 | Ver.1.0 | New release |
| April 2011 | Ver.1.1 | Change the drawings on 7.6.1 and 7.7.1 |
| | | Change the table on 7.6.2 and 7.7.2 |
| April 2011 | Ver.1.2 | Correct sensitivity specifications. Correct Protocol table. |
| May 2011 | Ver.1.3 | 5.4.1.2 CameraLink output drawing modified |
| | | 7.3.2 and 7.7 Trigger activation for Trigger width was corrected |
| May 2011 | Ver.1.4 | AM-800CL sensitivity is corrected from 0.07 to 0.04 lux. |
| Sept 2011 | ver.1.5 | Delete command EB since it is not implemented |
| Mar. 2012 | Ver. 1.6 | Add the description for Acquisition frame rate |
| | | Add ALC function |
| Sept. 2013 | Ver. 1.7 | Add how to clear dust on CCD or LPF |
| Oct. 2013 | Ver. 1.8 | Correct the value of exposure control for trigger width on Chapter 12.2 |

## User's Record

**Camera type:** **AM-800CL / AB-800CL**

**Revision:** **……..**

**Serial No.** **……..**

**Firmware version.** **……..**

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

**User's Mode Settings.**

**User's Modifications.**

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