Digital Monochrome and Color
2 Megapixel Progressive Scan Camera

CV-M2CL
CV-M8CL

Operation Manual

Camera: Revision D
Manual: Version 2.2

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1. General

The CV-M2CL and CV-M8CL are digital 2 megapixel monochrome and color cameras designed for automated imaging and ITS (Intelligent Traffic Systems) applications, featuring high resolution and high speed within a uniform and compact housing.
The color version CV-M8CL is based on a CCD sensor with primary Bayer color mosaic filter. The color reconstruction should be done in the host PC.
The high-speed shutter function, asynchronous random trigger mode and partial scan mode allows the camera to capture high quality images of fast moving objects with a high frame rate. Functions like burst trigger, reset continuous trigger mode, analog iris video output, knee and gamma function for single channel makes the camera suitable for intelligent traffic systems.
The CV-M2CL/M8CL features the Camera Link standardized multiplexed signal output interface.

The CV-M2CL revision B starting with sn. E520301 is updated with a new CCD sensor. The sensor gate control mode (SG) is removed. Some minor bugs in the firmware are solved.
The CV-M2CL revision C includes the color version **CV-M8CL revision C**, and has new updated boards. For CV-M2CL a vertical binning function has been added.
Revision D is without binning, and some boards are updated.

The latest version of this manual can be downloaded from: www.jai.com
The latest version of Camera Control Tool for CV-M2/M8 can be downloaded from: www.jai.com
For camera revision history, please contact your local JAI distributor.

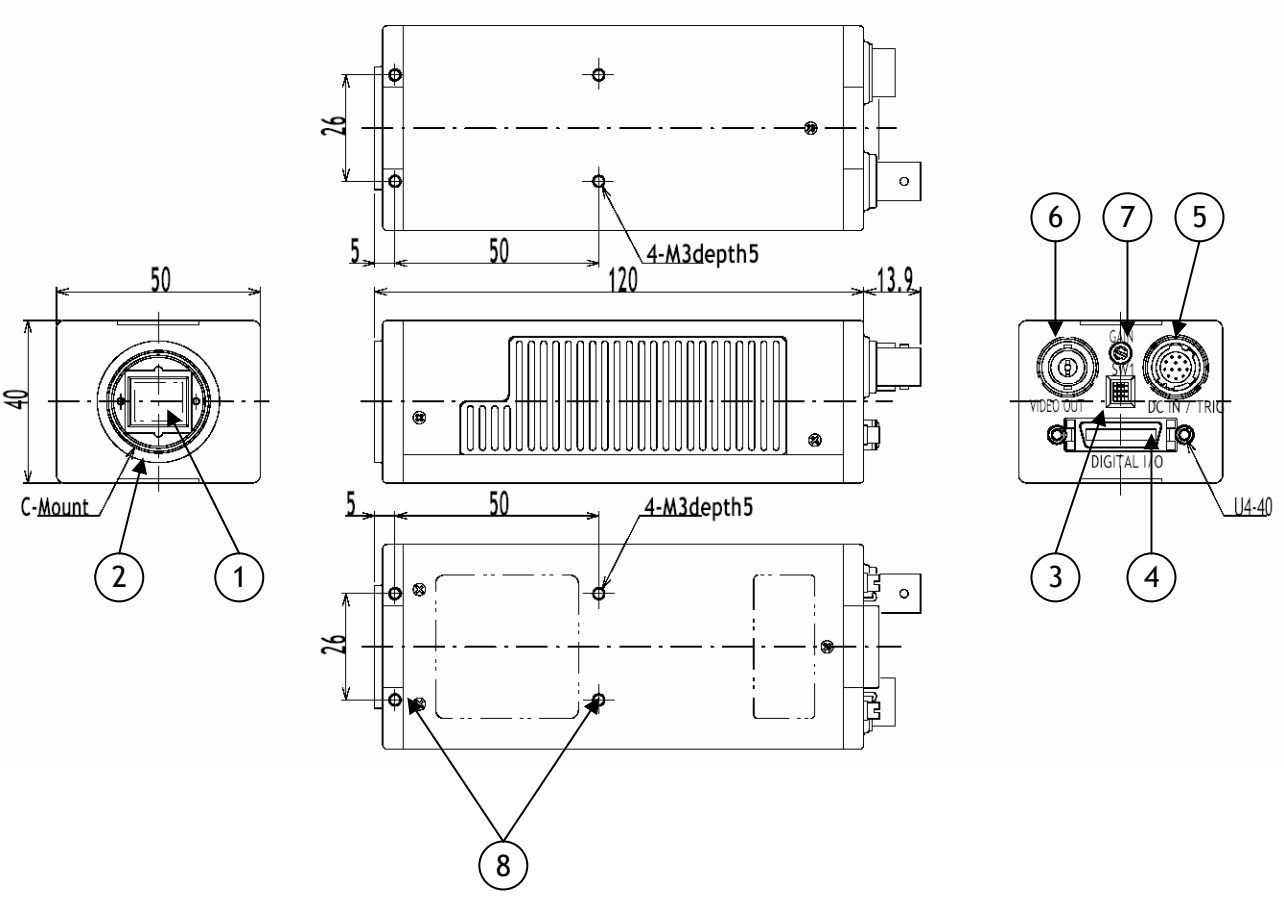
2. Standard Composition

The standard camera composition consists of the camera main body and tripod mount plate.
The camera is available in the following versions:
CV-M2CL. Digital Monochrome 2 Megapixel Progressive Scan Camera.
CV-M8CL. Digital Color 2 Megapixel Progressive Scan Camera.

3. Main Features

- Digital 1” monochrome and color 2 megapixel progressive scan CCD camera
- Color version with Bayer RGB color mosaic for host PC color reconstruction
- 1600 (h) x 1200 (v) effective 7.4 µm square pixels
- 10 or 8 bit video output as Camera Link
- 17 full frames/second for single channel video readout
- 30 frames/second with dual channel video readout
- One push black level and gain calibrations for dual channel readout
- Higher frame rates with 1/2, 1/4 and 1/8 partial scanning
- Programable partial scanning with 1 line interval for start position and width 50 – 1200 lines.
- CV-M2CL has vertical binning for higher sensitivy and frame rate.
- Edge pre-select and pulse width controlled external trigger modes
- Shutter speed 1/17 (off) to 1/14,000 second in 10 steps
- Programable exposure by edge pre-select shutter 1.5H to 1216.5H with 1 H interval
- Burst trigger for 5 different edge pre-selected exposures in sequence
- Analog video output for lens automatic iris control
- Reset continuous trigger mode (RCT) makes it ideal for traffic control (ITS)
- Analog composite monochrome video output for CCIR/EIA monitor
- PIV mode (Particle Image Velocimetry) for 2 short exposures with very short interval
- Short ASCII commands for fast mode setup via serial port
- Setup by Windows NT/Win2000/XP via RS-232C or Camera Link

4. Locations and Functions



1. CCD sensor
2. Lens mount (C-mount) *)
3. Rear panel with SW1
4. Digital output connector (Camera Link)
5. DC in/Trigger in/RS-232C connector
6. BNC connector for monitor video output
7. Gain potentiometer
8. Mounting holes M3. (8x)

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

Fig. 1. Locations

5. Pin Assignment

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

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

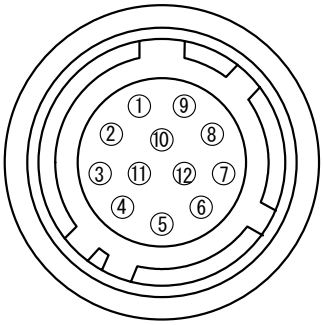


Fig. 2. 12-pin connector.

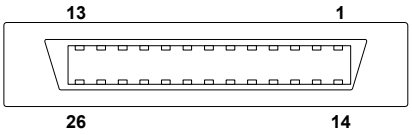
Pin no.	Signal	Remarks
1	GND	
2	+12 V DC input	
3	GND	
4	Iris Video output	Analog video for lens iris control in continuous mode and RCT mode. *)
5	GND	
6	RXD in	RS 232C on 12 pin. Or via Camera Link. Int. switch SW700 HR/CL (Refer to 7.2)
7	TXD out	
8	GND	
9	EEN out	Or via Camera Link
10	Trigger input	TI=1. (Or via Camera Link if TI=0)
11	Factory use	For factory test
12	GND	

*) Refer to 5.4.2. for iris video output.

5.2. BNC connector for analog monitor video output

On the BNC connector a monochrome composite video signal (CCIR or EIA) for monitoring is found, if OS=2. The signal can be viewed on a standard monitor as 50 FPS/15.734 kHz 290 lines if MN=1, or 60 FPS/15.734 kHz 240 lines if MN=0. It is non-interlaced and for single channel only. The image covers the full format, but the resolution is lower than the digital video output. For M8CL the image is monochrome and with RGB pixels as the are from the CCD sensor.

5.3. Digital Output Connector for Camera Link



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

Fig. 3. Camera Link connector

The digital output signals follow the Camera Link standardized multiplexed signal output interface. The output driver is NS type DS90CR285, and the receiver is NS type DS90CR286.

The following signals are found on the Digital Output Connector:

SerTC	RXD serial data to camera	(Int. switch SW 700. Refer to 7.2)
SerTFG	TXD serial data to frame grabber	(Int. switch SW 700. Refer to 7.2)
CC1	Trigger input	(TI=0 for CL.)
CC2	Factory use	
X0 to X3	Camera Link multiplexed data out	
Xclk	Camera Link clock. Used as pixel clock.	

In the Channel Link X0 to X3 multiplexed signals the following signals are encoded.

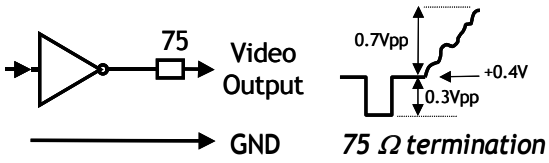
D0 – D9	2 x 10 bit video data out for right and left channel.
LVAL	Line VALid. Video line data is valid.
FVAL	Frame VALid. Video frame data is valid.
DVAL	Data VALid. Effective video pixel data is valid
EEN	Exposure ENable. (Not specified by Camera Link).

LVAL, FVAL, DVAL polarity is positive. EEN is negative. TRIG is negative as factory setting. TRIG polarity can be changed by TP. For Camera Link interface principle diagram please check Fig. 7.

5.4. Input and Output Circuits

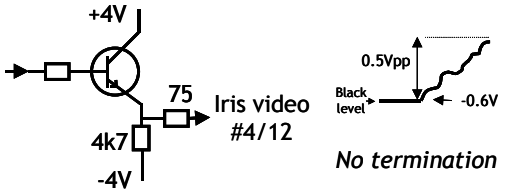
5.4.1. Monitor video output

On the BNC connector an analog video signal with sync is found if OS=2. The signal can be used for focus and field of view adjustments.
CCIR if MN=1. (50 fps, 17.734 kHz, 290 active lines.)
EIA if MN=0. (60 fps, 17.734 kHz, 240 active lines.)
It is for single channel normal (TR=0) operation only.
Shutter speed <262 LVAL (CCIR). <262 LVAL (EIA).
Video is monochrome composite 1Vpp with 75 Ω termination.
For M8 the signal level is affected by the Bayer filter.
The signal is shown is also on CL. (Not for trigger modes.)



5.4.2. Iris video output

The analog video output without composite sync on pin #4 12 pin Hirose connector is a 75 Ω DC coupled circuit. It can be used for iris control if the camera is in normal continuous mode or Reset Continuous Trigger mode. Iris video is added from both channels.
Black level is –0.6 volt without termination.



Important note on using this signal for iris control.
The signal for iris video output is taken from the video signal after the gain control. If it is used for auto iris control, output video level can only be adjusted on the lens level adjust.

Fig. 4. Video output.

5.4.3. Trigger input

The trigger inputs on pin #10 12 pin Hirose connector is AC coupled. To allow a long pulse width, the input circuit is a flip flop, which is toggled by the negative or positive differentiated spikes caused by the falling or rising trigger edges.
The trigger polarity can be changed.
Trigger input level 4 V ±2 V.
The trigger-input impedance is 1 kΩ.
The trigger inputs can be changed to Camera Link input.

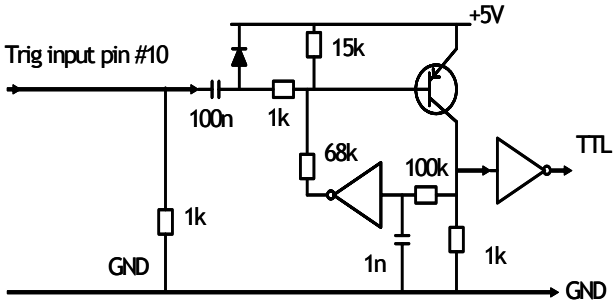


Fig. 5. Trigger input.

5.4.4. EEN output

On pin #9 on 12 pin Hirose connector EEN is found.
The output circuit is 75 Ω complementary emitter followers. It will deliver a full 5 volt signal.
Output level ≥4 V from 75Ω. (No termination).
EEN output is also on Camera Link.

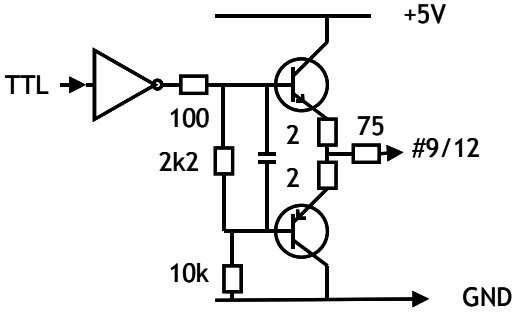
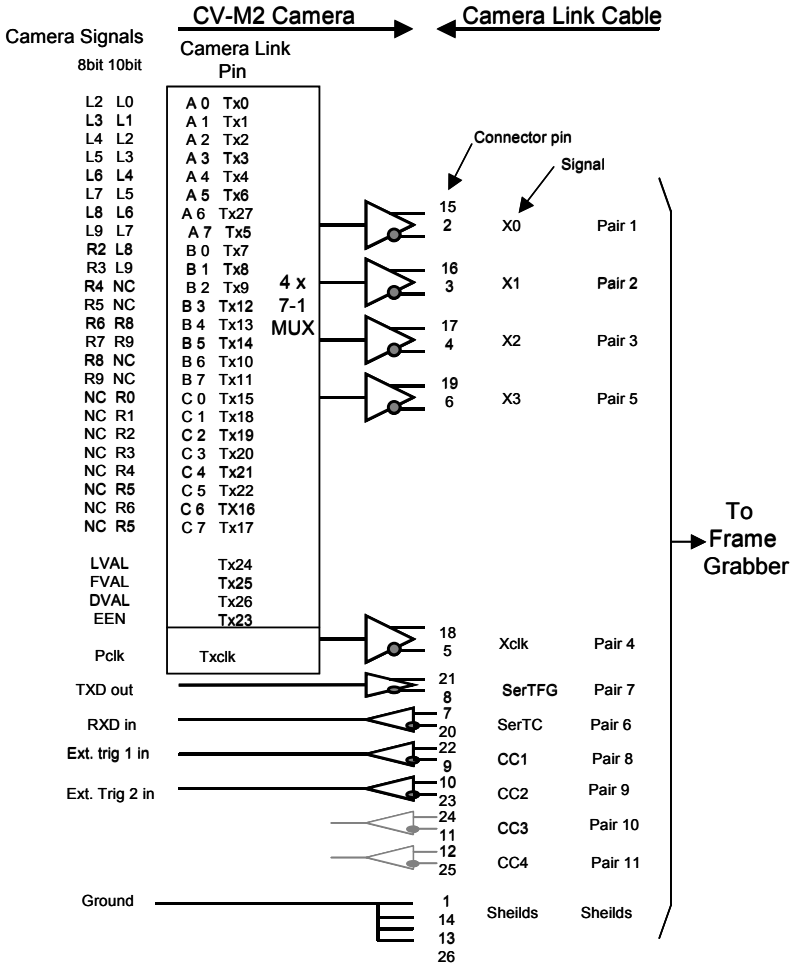


Fig. 6. EEN output

5.4.5. Camera Link interface

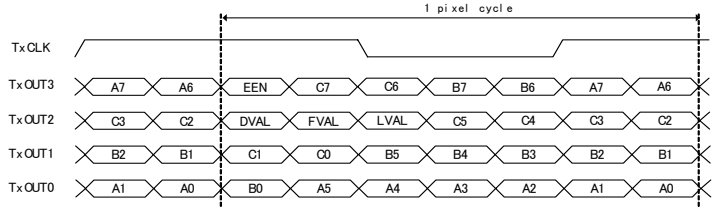
The video output is Camera Link, where the 2 channels with 10 or 8 bit video are placed in a base configuration. The digital output signals follow the Camera Link standardized multiplexed signal output interface. The output driver is NS type DS90CR285, and the receiver is NS type DS90CR286.
The data bits from the digital video, FVAL, LVAL, DVAL and EEN are multiplexed into the twisted pairs, which are a part of the Camera Link. Trigger signals and the serial camera control are feed directly through its own pairs. The trigger input can also be TTL on the 12 pin connector. (TI=0 for CL. TI=1 for 12 pin). The serial camera control can be switches between the 12 pin connector or CL by an internal switch SW 700 (HR/CL). Refer to 7.2
The 26 pin MDR connector pin assignment follows the Camera Link base configuration.

For a detailed description of Camera Link specifications, please refer to the Camera Link standard specifications found on www.jai.com



Port/Signal	8bit	10bit	Pin No.
Port A0	L2	L0	Tx0
Port A1	L3	L1	Tx1
Port A2	L4	L2	Tx2
Port A3	L5	L3	Tx3
Port A4	L6	L4	Tx4
Port A5	L7	L5	Tx6
Port A6	L8	L6	Tx27
Port A7	L9	L7	Tx5
Port B0	R2	L8	Tx7
Port B1	R3	L9	Tx8
Port B2	R4	NC	Tx9
Port B3	R5	NC	Tx12
Port B4	R6	R8	Tx13
Port B5	R7	R9	Tx14
Port B6	R8	NC	Tx10
Port B7	R9	NC	Tx11
Port C0	NC	R0	Tx15
Port C1	NC	R1	Tx18
Port C2	NC	R2	Tx19
Port C3	NC	R3	Tx20
Port C4	NC	R4	Tx21
Port C5	NC	R5	Tx22
Port C6	NC	R6	Tx16
Port C7	NC	R7	Tx17
LVAL			Tx24
FVAL			Tx25
DVAL			Tx26
EEN			Tx23

Camera Link bit allocation



Time slots in Camera Link

Fig. 7. Principle diagram for Camera Link base configuration interface

6. Functions and Operations

In the following the format and the abbreviations shown in "7.5. CV-M2/M8 command list" are used for function commands and parameters.

6.1. Basic functions

The M2/M8 cameras are a progressive scan camera with 10 or 8 bit video output in single or dual channel Camera Link. On a BNC connector on M2, a standard composite video output (CCIR or EIA) for monitor use is found. The image covers the full format, but the resolution is much lower than the digital video output. For M8 it is not a correct monochrome image because the Bayer pattern.
An iris video signal can be used for lens iris control if the camera is in continuous mode or Reset Continuous Trigger mode.
For M2 a knee function (and gamma for single channel) makes it possible to cover high contrast scenes.
The CV-M2/M8 camera has 1/2, 1/4 or 1/8 partial scanning. Programmable partial scan, where the start line and the number of lines can be selected in 1line increments is also available.
There are 5 trigger modes. Normal continuous, reset continuous trigger, edge pre-select, pulse width control, edge pre-select burst trigger and PIV trigger. (PIV, Particle Image Velocimetry).
The accumulation can be LVAL synchronous or LVAL a-synchronous.
In the following some of the functions are shown in details.

6.1.1. Dual video output

The video read out through Camera Link can be via a single or via double channels. (OS=0 for single channel, OS=1 for dual channel.) If dual video outputs are used, the frame grabber PC should reconstruct the image frame from the 2 half images.

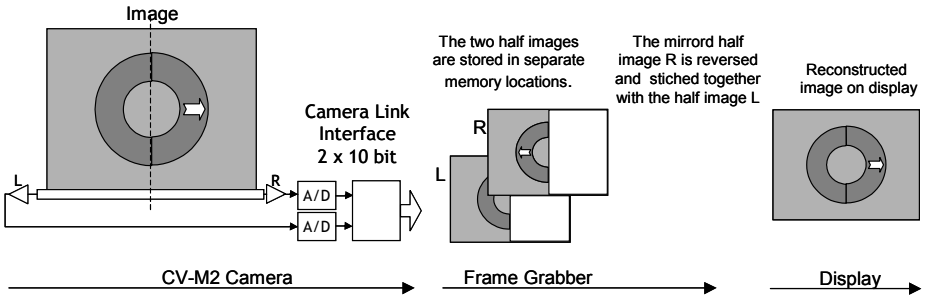


Fig. 8. Dual channel read out

6.1.2. Burst trigger

With the burst trigger function TR=4, five previous set edge pre-selected programmable exposures can be done with a single trigger pulse. The five shutter times can be set with BSH1 through BSH5. (1H through 1216H.)

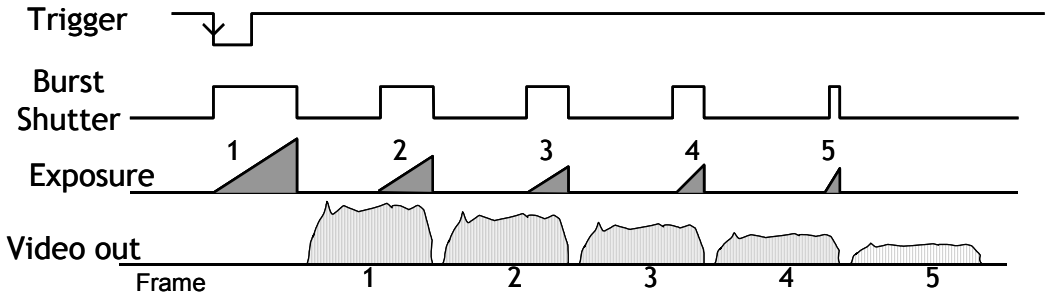


Fig. 9. Burst trigger

6.1.3. Reset continuous trigger mode

The RCT mode makes it possible to use a lens with video controlled iris for intelligent traffic surveillance applications. TR=2. The camera is running continuously, and the iris is controlled from the iris video output. When a trigger pulse is applied, the scanning is reset and restarted, the previous signal is dumped with a fast dump read out, and the new triggered exposure is started. This fast dump read out has the same effect as "smearless read out". Smear over highlighted areas are reduced for the triggered frame.

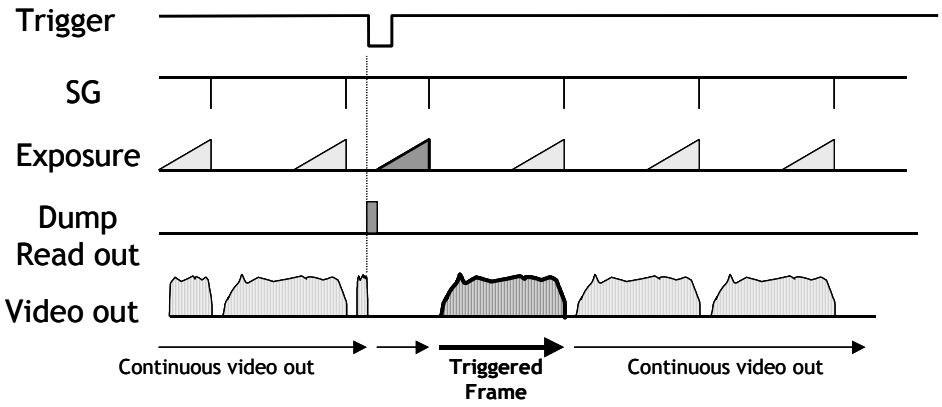


Fig. 10. Reset continuous trigger mode

6.1.4. PIV mode

The Particle Image Velocimetry (PIV) mode (TR=5) 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 or lasers as the only illumination. The first accumulation time is 4 μsec. The second is as long as the time for a full frame.

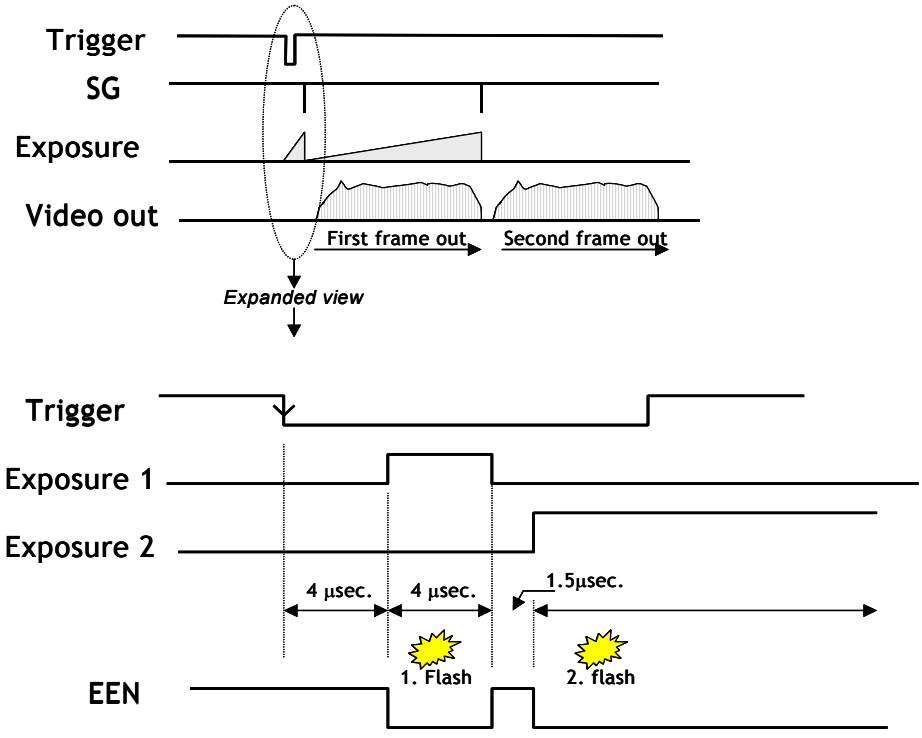


Fig. 11. PIV mode

6.1.5. Digital video out allocation

The set-up and the relations between the analog and digital video are shown below.

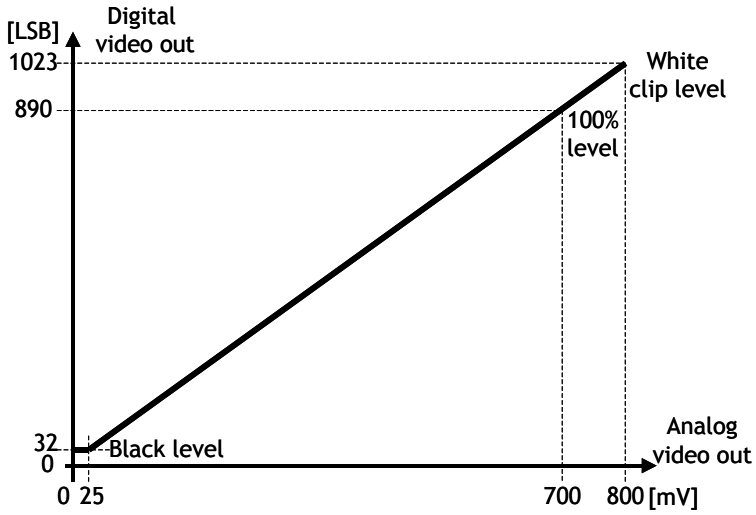


Fig. 12. Digital video bit allocation

6.1.6. Knee function

Only in M2CL.

The knee functions can compress the signals in the highlighted areas. The slope over the knee point is only 20%. The Knee point can be adjusted from 712 to 1023. Knee point at max (1023) is the same as knee function off. With the knee at 890, the camera can reproduce scene highlight up to 175%. The image contrast is reduced to 20% for scene luminance higher than the knee point.

This function can be used in applications where the scene brightness is divided in an area in shadow, and another in bright sunshine.

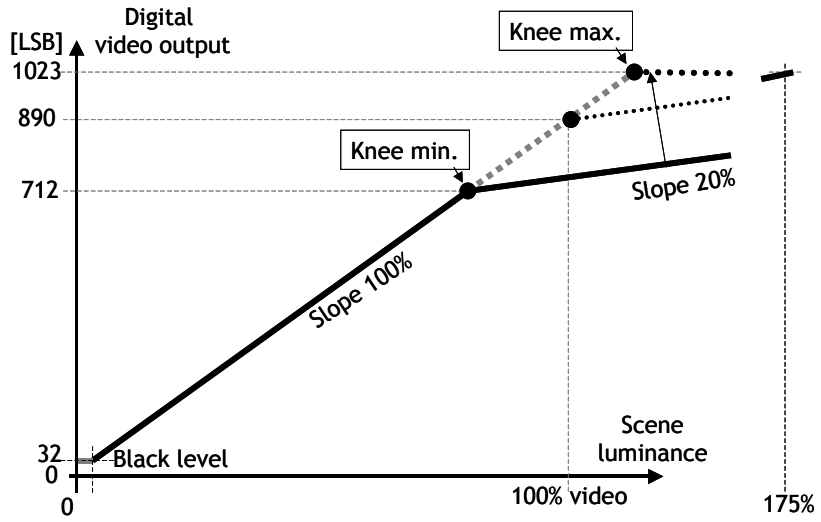


Fig. 13. Knee function

6.2. Sensor layout and timing

6.2.1. CCD sensor layout

The CCD sensor layout with respect to pixels and lines as it is used in the timing and video read out is shown below. For CV-M8CL the effective full frame Bayer sequence starts with GRG.
For partial scan it is GRG for odd lines and BGB for even lines.

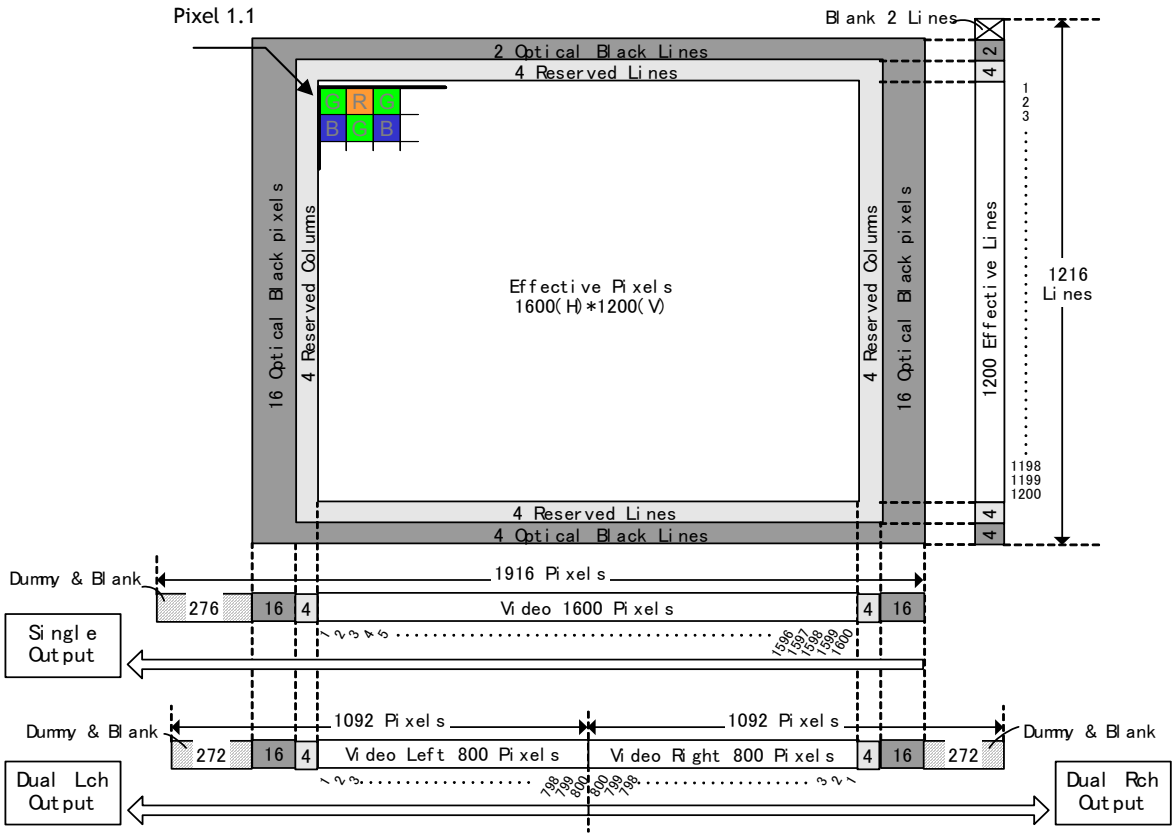


Fig. 14. CCD sensor layout

6.2.2. Vertical timing

Normal mode, full frame, single and dual channel. 1LVAL = 47.9 μsec (single). 27.3 μsec (dual)

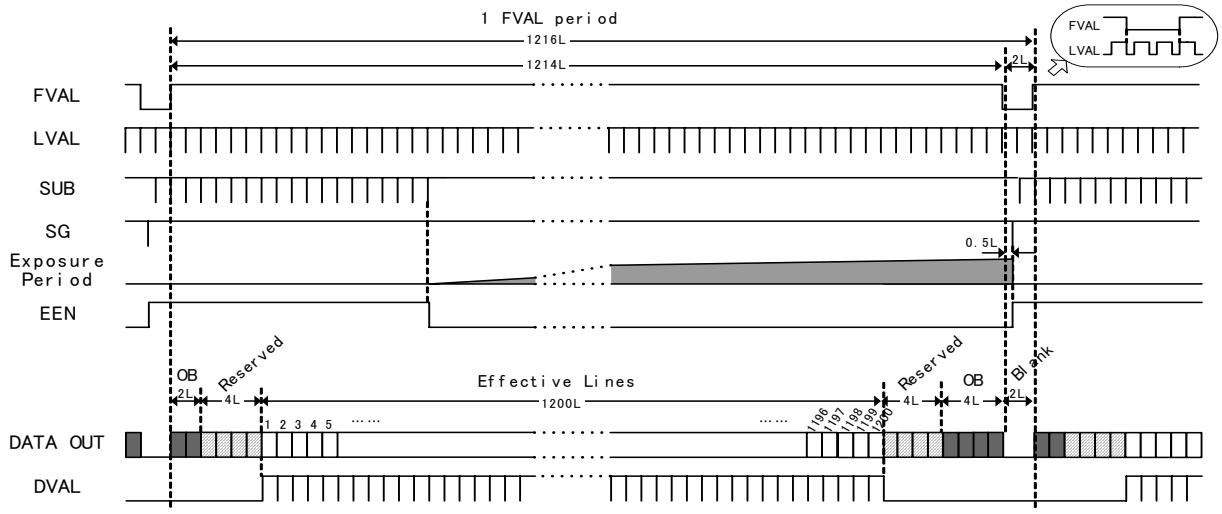


Fig. 15. Vertical timing

6.2.3. Horizontal timing single channel

OS=0. Normal mode, full frame. 1ck = 25 nsec

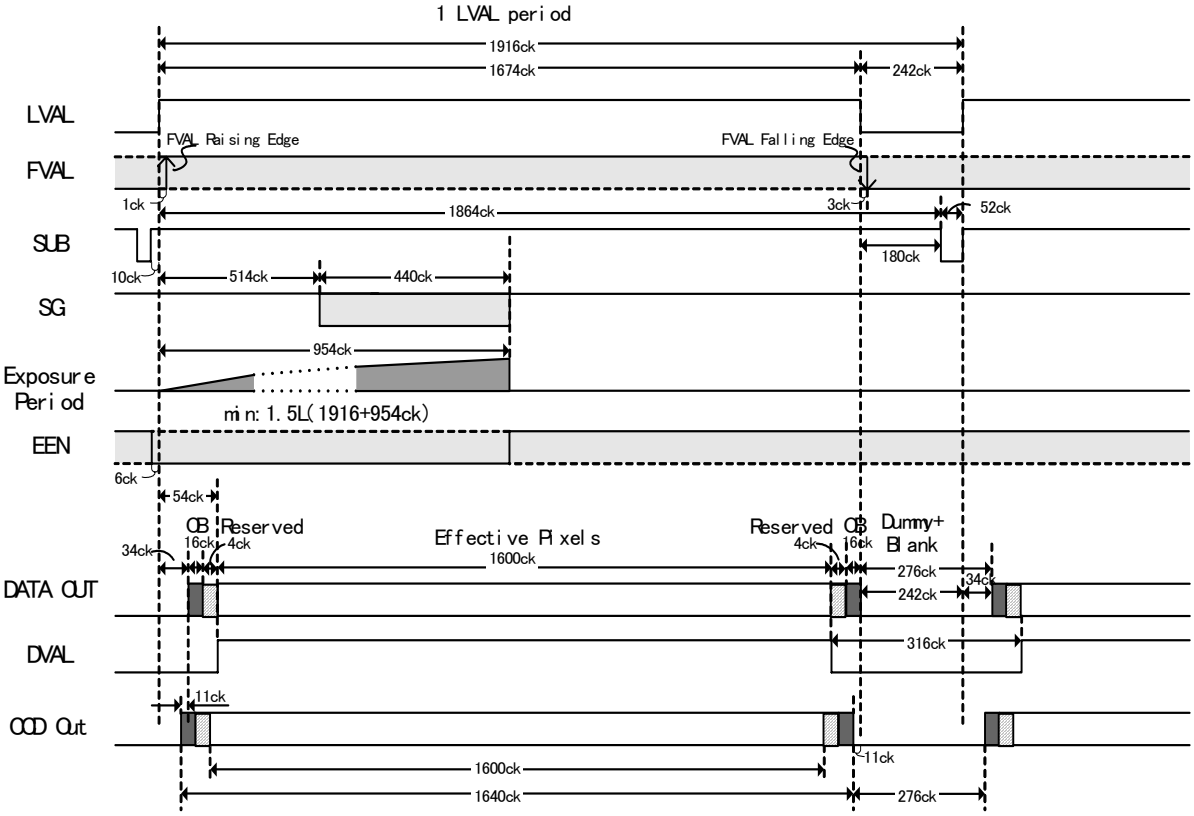


Fig. 16. Horizontal timing single channel

6.2.4. Horizontal timing details single channel

OS=0. For all modes, full frame. 1ck = 25 nsec

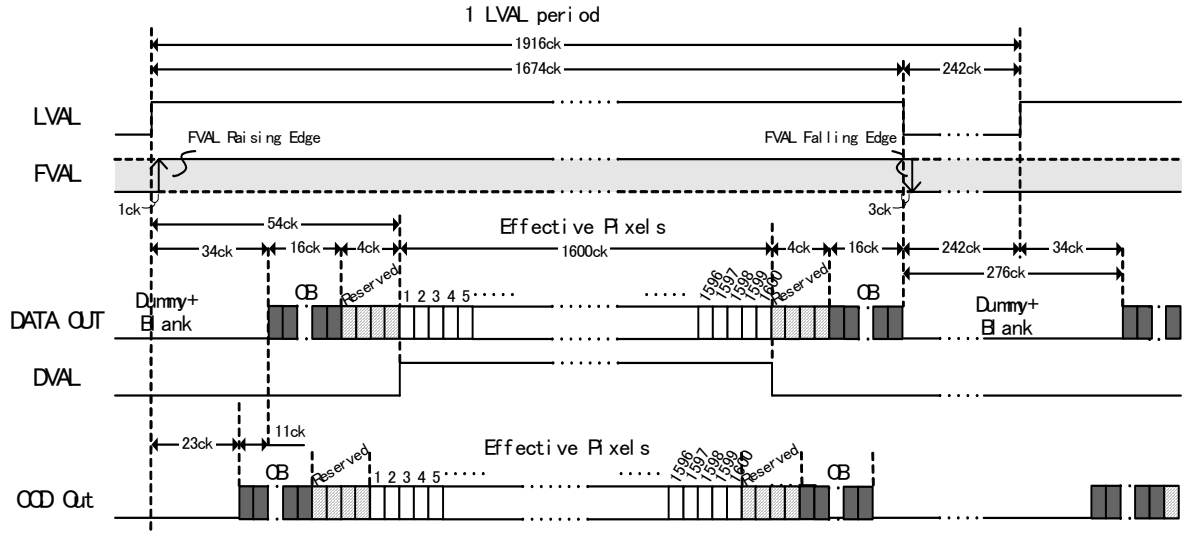


Fig. 17. Horizontal timing details single channel

6.2.5. Horizontal timing dual channel

OS=1. Normal mode, full frame. 1ck = 25 nsec

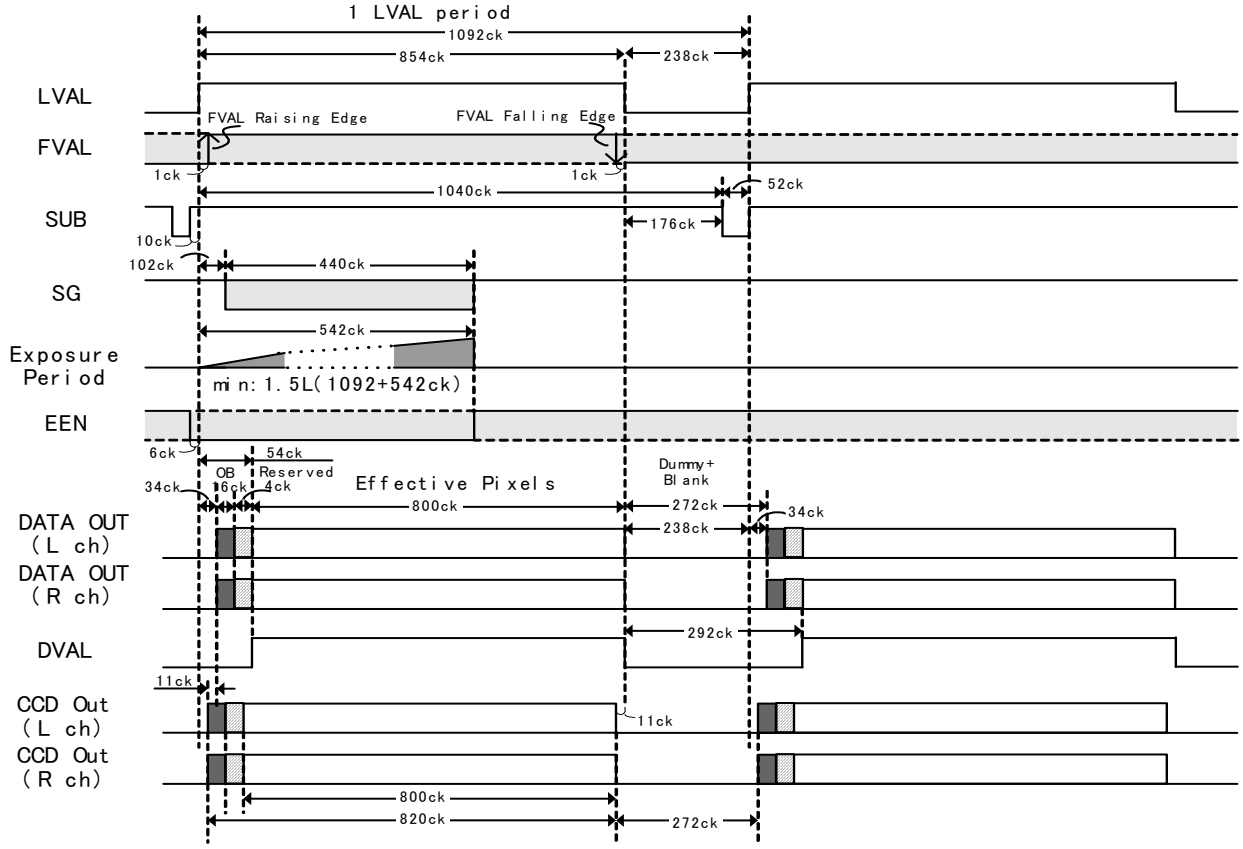


Fig. 18. Horizontal timing dual channel

6.2.6. Horizontal timing details dual channel

OS=1. For all modes, full frame. 1ck = 25 nsec

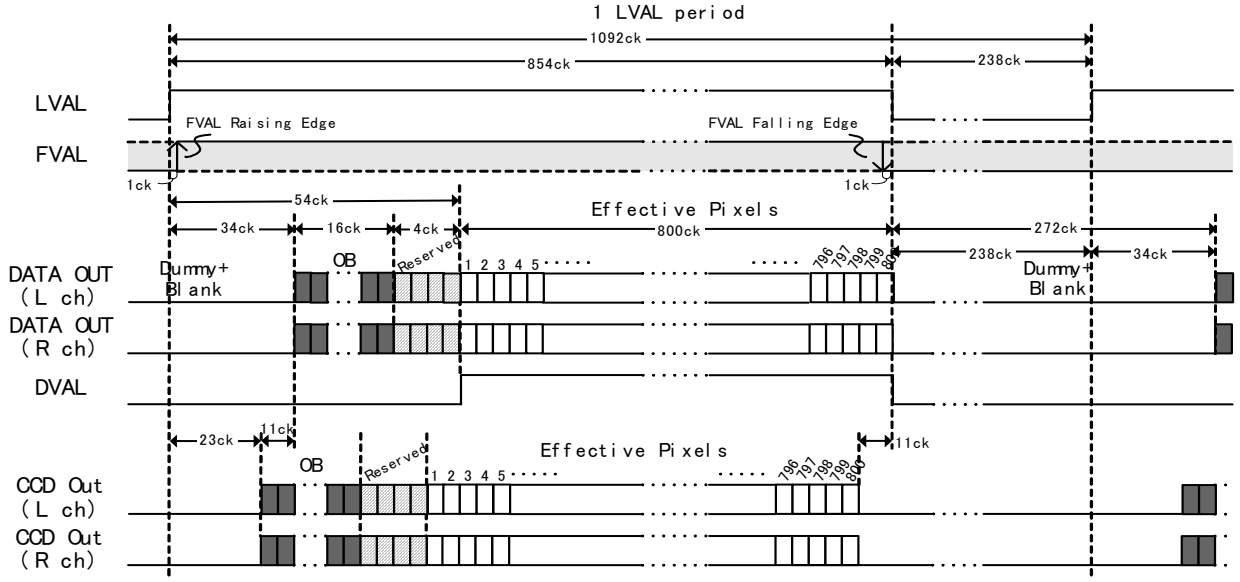


Fig. 19. Horizontal timing details dual channel

6.2.7. LVAL synchronous accumulation

With LS=0, the accumulation will start synchronously with LVAL. The trigger pulse should be longer than 2 LVAL intervals, and the accumulation will then start at the first LVAL after the trigger leading edge. The exposure start delay will be up to 1 line. (Single channel 47.9 μsec. Dual 27.3 μsec).
In EPS mode the exposure stops 0.5 L after the selected shutter time, (in number of LVAL).
In PWC mode the exposure stops 0.5 L after the first LVAL after the trigger trailing edge. It results in up to 1 LVAL jitter.
In LVAL synchronous accumulation mode a new trigger can start a new exposure during the previous frame read out, but the exposure may not be finished before the frame is read out. It makes it possible to have a trigger rate close to the frame rate. (1 FVAL + 3 LVAL).

Important notes on using this mode.

In LVAL synchronous PWC mode exposure jitter up to 1 LVAL can be the result, if the trigger trailing edge is not synchronized to LVAL.

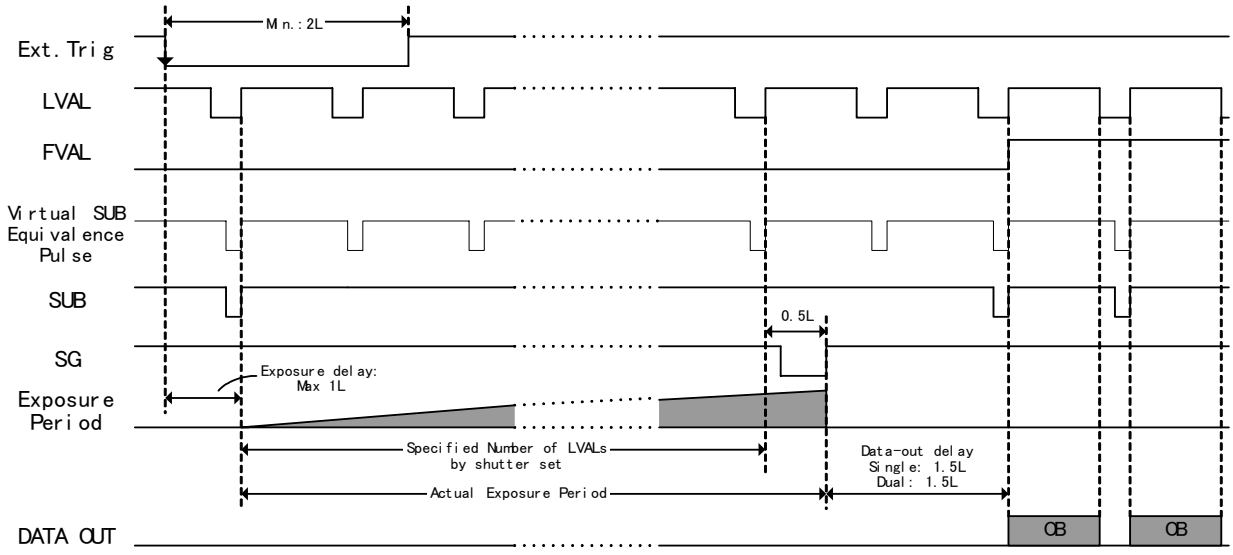


Fig. 20. LVAL synchronous accumulation in EPS mode

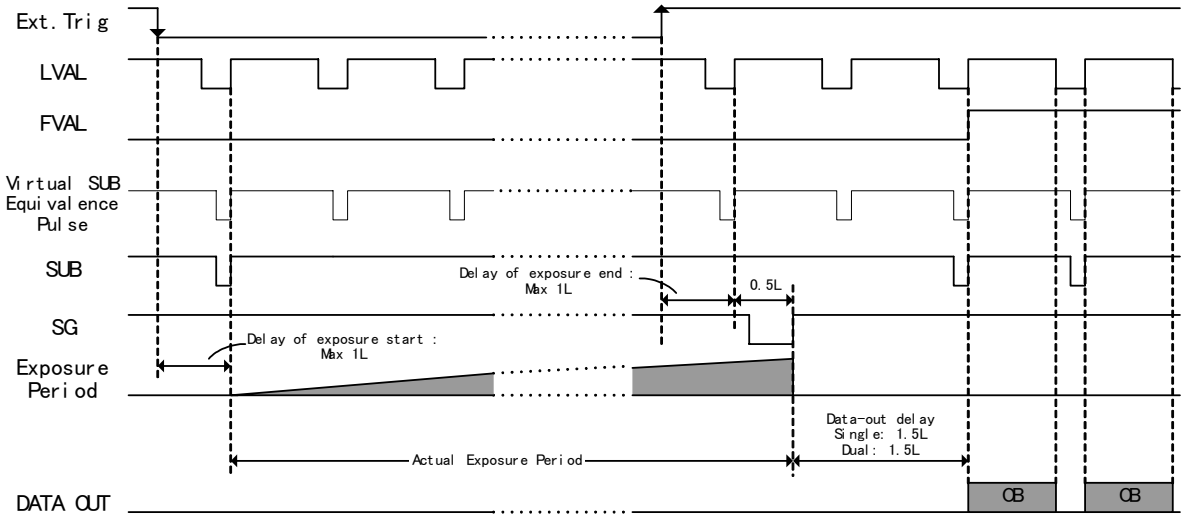


Fig. 21. LVAL synchronous accumulation in PWC mode

6.2.8. LVAL a-synchronous accumulation

With LS=1, the accumulation will start after the trigger leading edge.
The exposure start delay will be 151 clk. pulses after the trigger. It is 3.76 μsec.
In EPS mode the exposure stops 0.5 L after the selected shutter time, (in number of LVAL).
In PWC mode the exposure stops 0.5 L after the trigger trailing edge.
A new trigger must not be applied before the previous frame is read out. (FVAL is low).
The minimum trigger interval should be longer than the exposure time + 1 FVAL+3 LVAL.

Important notes on using this mode.
In LVAL a-synchronous PWC mode there is no exposure jitter.

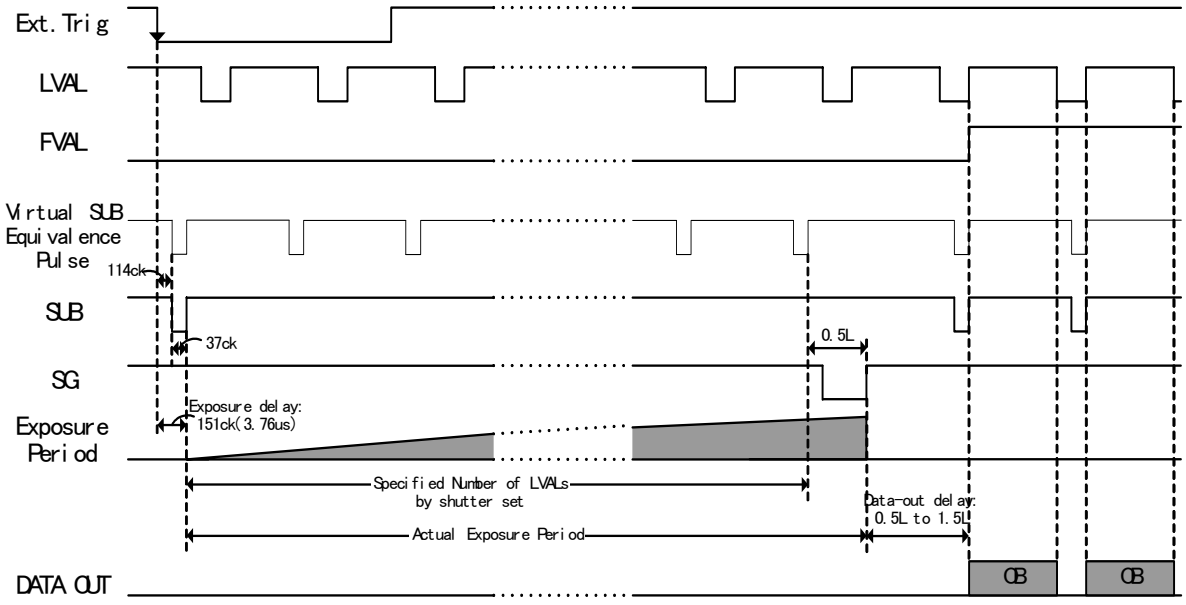


Fig. 22. LVAL a-synchronous accumulation in EPS mode

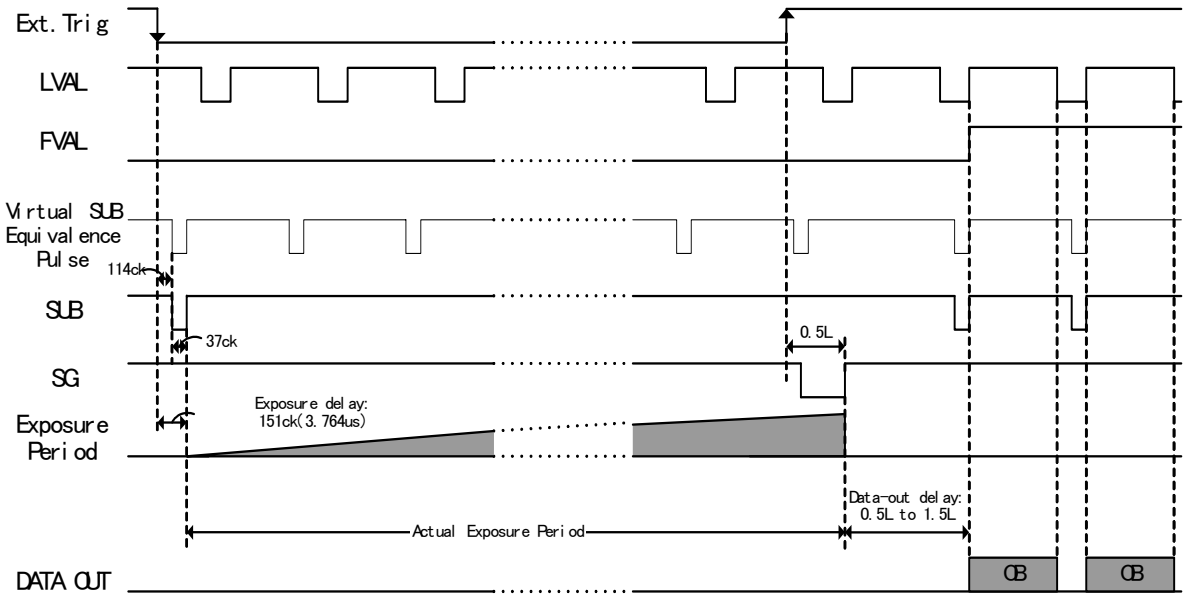
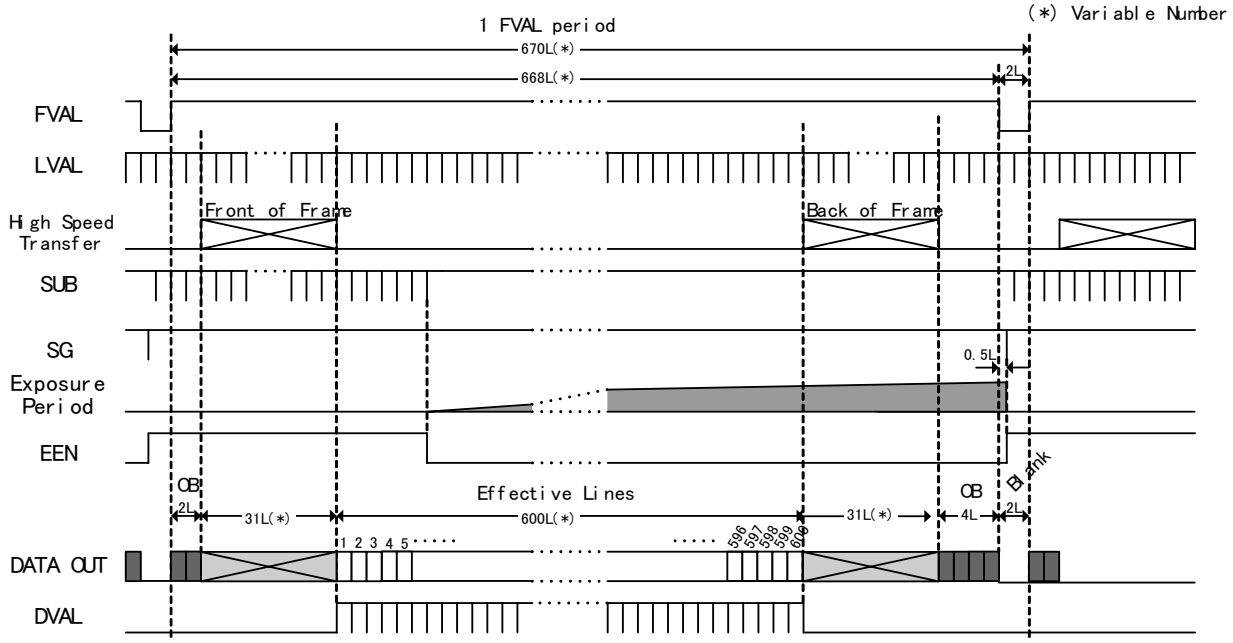


Fig. 23. LVAL a-synchronous accumulation in PWC mode

6.2.9. Partial scanning vertical timing

Partial scanning has 3 pre-selected vertical centred areas 1/2, 1/4 and 1/8. SC=1 through SC=3. With SC=4, the start and the height of the partial scanned area can be programmed with 1 line interval. The start line can be programmed with PS=1 through 1151. The scanned height can be programmed with PC=50 though 1200. Partial scanning will operate with single or dual channel output. Partial scan is done by a high-speed dump read out of the areas over and under the area of interest. This partial scanned area is read out with normal speed. The high-speed dump read out (Front of Frame and in Back of Frame) is done with a speed 18 times faster for single channel, and 10 times faster for dual channel.
The figures on the timing diagram below are for 1/2 partial scanning and dual output.



All figures marked with (*) will change with other partial settings. See table below. 1LVAL = 47.9 μsec (single). 27.3 μsec (dual).

Fig. 24. Partial scanning vertical timing

The following table shows the figures for partial scanning.
The maximum frame rate (FPS) for single and dual channel readout is shown for normal mode. (TR=0.) For triggered modes it will be lower, because the accumulation time is added to the read out time. 1LVAL = 47.9 μsec (single). 27.3 μsec (dual).

Table showing values for the vertical timing.

Single channel output				Frame Start		Effect.	Frame End		Frame	
Mode	Scanning	Start line	Stop line	OB [LVAL]	HS [LVAL]	video [LVAL]	HS [LVAL]	OB [LVAL]	rate [FPS]	Remarks
SC=0	Full	1	1200	6	0	1200	0	10	17.17	Full scan
SC=1	1/2 partial	301	900	2	17	600	17	6	32.52	Vertical centred
SC=2	1/4 partial	451	750	2	26	300	26	6	57.99	Vertical centred
SC=3	1/8 partial	526	675	2	30	150	30	6	95.77	Vertical centred
SC=4	Programmable	1-1151	50-1200	2	-	50-1200	-	6	-	Start & height program.

Dual channel output				Frame Start		Effect.	Frame End		Frame	
Mode	Scanning	Start line	Stop line	OB [LVAL]	HS [LVAL]	video [LVAL]	HS [LVAL]	OB [LVAL]	rate [FPS]	Remarks
SC=0	Full	1	1200	6	0	1200	0	10	30.12	Full scan
SC=1	1/2 partial	301	900	2	31	600	31	6	54.67	Vertical centred
SC=2	1/4 partial	451	750	2	46	300	46	6	91.58	Vertical centred
SC=3	1/8 partial	526	675	2	53	150	53	6	138.75	Vertical centred
SC=4	Programmable	1-1151	50-1200	2	-	50-1200	-	6	-	Start & height program.

OB = Optical Black. **HS** = High-Speed dump read out.
The Bayer color sequence in odd lines starts with GRG, and in even lines with BGB. Refer to fig 14.

6.2.10. Vertical binning

Note! Vertical binning is not supported from revision D!

Vertical binning is a function on CV-M2CL only. It will add the pixel value from 2 adjacent lines, and read it out as a single line. The sensitivity is then doubled, but the vertical resolution is reduced to ½.
The vertical binning is done by reading the charge from 2 vertical ccd cells into 1 horizontal ccd cell. It is only done only for lines during the DVAL high period. It will not change the Horizontal timing.
Binning is available for CV-M2CL in Normal mode (TR=0), EPS mode (TR=1) and PWC mode (TR=2).
Binning will not work together with partial scanning. If both are set at the same time, binning has the highest priority.

The below shown vertical timing is for normal mode (TR=0).

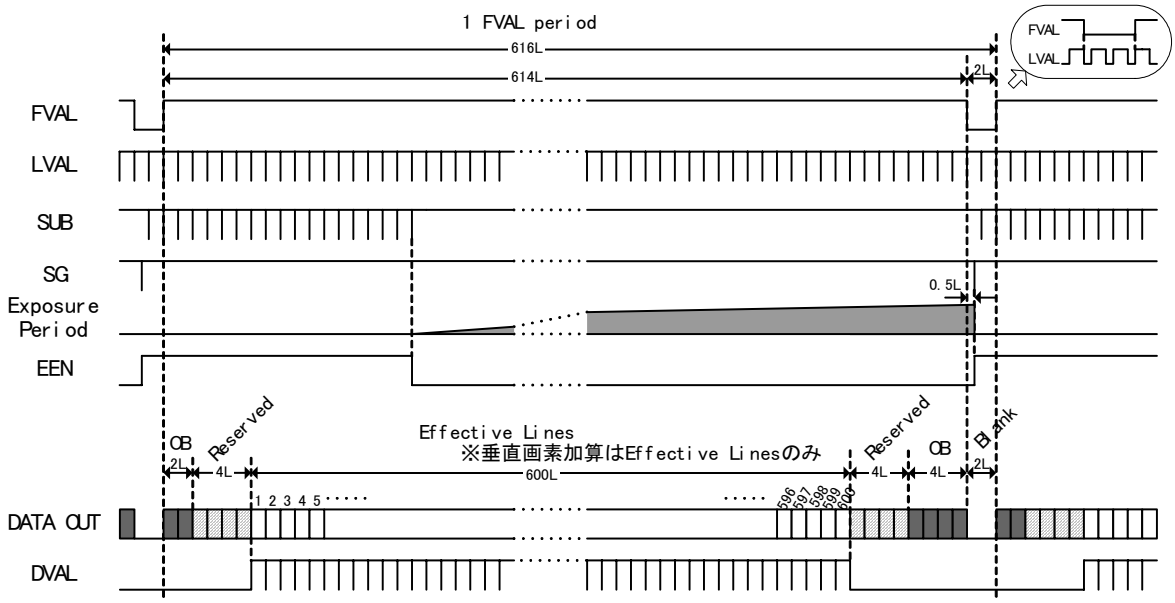


Fig. 25. Vertical binning, vertical timing

6.3. Input/Output of Timing Signals

6.3.1. Input of Timing Signals

It is not possible to synchronize the camera from an external sync source except by an extern trigger pulse. The camera will always run with its internal X-tal controlled timing.

Trigger input through Camera Link.	TI=0
Trigger input as TTL on pin #10 on 12 pin Hirose.	TI=1
The trigger polarity is active low.	TP=0
Trigger input can be changed to active high.	TP=1

6.3.2. Output of Timing Signals

To synchronize the video data transfer from the camera the following signals are available in a base configuration of Camera Link:

FVAL	Frame valid	High for valid Frame
LVAL	Line valid	High for valid line
PCLK	Pixel clock	Rising for data stobe
DVAL	Data valid	High for valid data
EEN	Exposure enable	Low during exposure. (Not specified by CL).

See the full connector pin assignment for Camera Link in chapter 5.3 and 5.4.5
For complete documentation on the Camera Link standard, please contact your JAI distributor.
EEN is also found as a TTL signal on pin #9 on the 12 pin Hirose. EEN is low during exposure.

6.4. Trigger Modes

This camera can operate in 6 primary modes. 1 non-triggered mode and 5 external trigger modes, which can be set by RS-232C commands.

1.	*Normal continuous Mode. TR=0*	Pre-selected exposure. (SM=0, SM=1)
2.	*Edge Pre-select Mode. TR=1*	Pre-selected exposure. (SM=0, SM=1)
3.	*Reset Continuous Trigger Mode. TR=2*	Pre-selected exposure. (SM=0, SM=1)
4.	*Pulse Width Control Mode. TR=3*	Pulse width controlled exposure.
5.	*Burst Trigger mode Mode. TR=4*	5 EPS. Read out by trailing trig. edge.
6.	*PIV Mode. TR=5*	

In normal continuous mode and edge pre-select mode the shutter time can be selected from the normal 10 fixed steps. (SM=0). Or it can be selected from the 1216 steps programmable (SM=1). Pulse width control can be used for long time exposure. The trigger pulse width can be from 2 LVAL to ∞. The exposure time is not recommended to exceed 2 seconds.
Partial scan (SC=1 through 4) can be used in all 6 modes.

Note! *The very first triggered frame after power-up can under some conditions be corrupted. It is recommended to skip the first image after the power is connected.*

Important note on changing trigger modes by RS-232C and CL.
Disconnect or stop the trigger input before changing mode by RS-232C or Camera Link. In worst case it can lead to latch-up of camera function and communication if a mode command is received at same time as a trigger pulse. The modes are trigger modes (TR) and scanning (SC). The camera latch-up can only be reset if the power is switched off and on again.

6.4.1. Continuous Operation (Non triggered)

Mode settings can be done with RS-232C. Trigger Mode Normal. TR=0. It is for applications where the camera is continuously running without external trigger. The shutter mode can be normal or programmable exposure. (SM=0, SM=1). The shutter will work in all 10 steps up to 1/14,000 second or with the programmable exposure in 1216 steps. In partial scanning, shutter times longer than the actual frame time has no meaning. The exposure will be equal the frame time. In this mode it is possible for M2 to have CCIR/EIA composite analog video output for monitor use. It is for full scan only. The video can be 50 or 60 frames per second with a line frequency at 15.734 kHz. CCIR has 290 active lines. Shutter speed <262 LVAL. EIA has 240 active lines. Shutter speed <262 LVAL.
For M8, the analog video signal is monochrome direct from the CCD without any compensation for the Bayer filter.

To use this mode:

Set function:		
	Trigger mode "Normal"	TR=0
	Shutter mode "Normal" or "Programmable"	SM=0, SM=1
	"Shutter Speed"	SH=0 through 9
	"Programmable exposure"	PE=1 through 1216
	Scanning format	SC=0 through SC=4
	Vertical binning (only M2)	VB=0, VB=1
	Output select	OS=0, OS=1, OS=2
	Polarity and other functions	

Important notes on using this mode.

- Analog video output, OS=2. Only for full, SC=0

For vertical timing refer to 6.2.2. (Fig. 15.)
For horizontal timing refer to 6.2.3 through 6.2.6. (Fig.16. through fig. 19.)

6.4.2. Edge Pre-select Mode

In EPS mode, the trigger leading edge will start an exposure at the first LVAL pulse if LS=0, (or immediately if LS=1), and it stops and the resulting image is read out after the pre-selected shutter time. It can be the 10 steps in normal or 1216 steps in programmable. SM=0 or SM=1. This mode will operate with full and partial scanning.
An EEN pulse will indicate the active accumulation time, and a FVAL pulse indicates that the resulting video is read out.

To use this mode:

Set function:	Trigger mode "Edge Pre-select"	TR=1
	LVAL synchronous accum. to "synch" or "asynch"	LS=0, LS=1
	Shutter mode "Normal" or "Programmable"	SM=0, SM=1
	"Shutter Speed"	SH=0 through 9
	"Programmable exposure"	PE=1 through 1216
	Scanning format	SC=0 through SC=4
	Vertical binning (only M2)	VB=0, VB=1
	Output select	OS=0, OS=1
	Polarity and other functions	
Input:	Ext. trigger to Camera Link or pin 10 on 12-pin connector.	

Important notes on using this mode.

- The duration of the trigger should be >2LVAL to <3FVAL.
- If LS=0 (Synchronous accumulation), the minimum trigger interval is the longest of 1 FVAL + 3 LVAL or the exposure time + 3LVAL. The new exposure should not be finish before the previous frame is read out.
- If LS=1 (Asynchronous accumulation) the minimum trigger interval is the exposure time + 1 FVAL + 3 LVAL. A new trigger must not be applied before FVAL is low.
- 1LVAL = 47.9 μsec (single). 27.3 μsec (dual).

For horizontal timing refer to 6.2.3 through 6.2.6. (Fig.16. through fig. 19.)
For LVAL sync/a-sync accumulation, refer to 6.2.7 and 6.2.8. (Fig. 20. through fig. 23.)

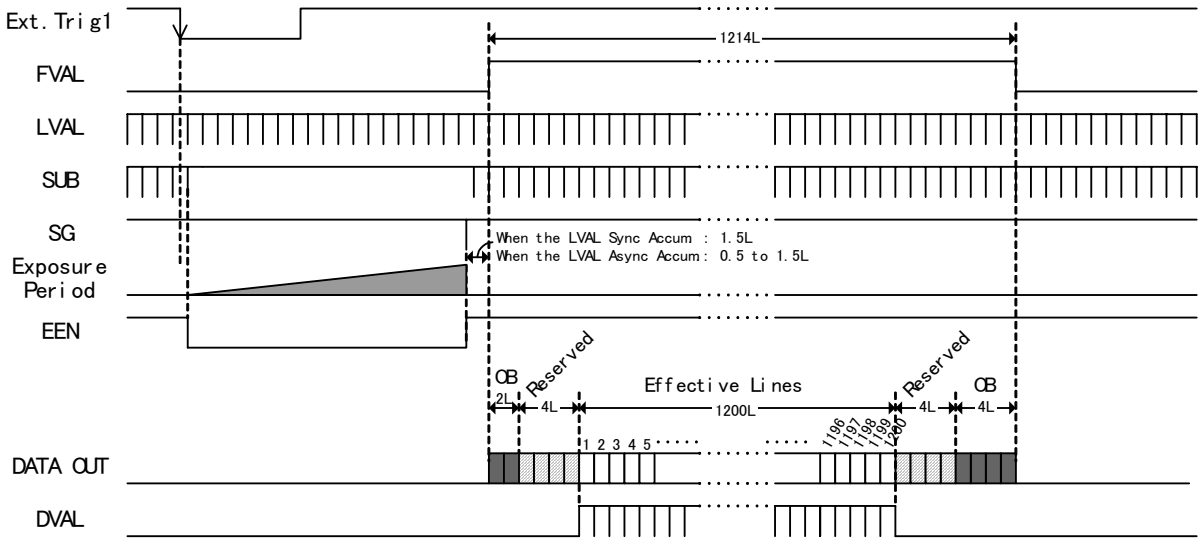


Fig. 26. Edge Pre-select mode vertical timing. (Full frame).

6.4.3. Reset Continuous Trigger mode

The RCT mode is in principle the same as normal continuous mode. The difference is that an external trigger pulse will immediately stop the video read out and reset and restart the vertical timing. After a fast dump read out, a new triggered exposure is started and read out as normal. The fast dump read out is performed with a speed 18 times faster for single output, and 10 times faster for dual output. If no further trigger pulses are applied, the camera will continue in normal mode. This fast dump read out has the same effect as "smearless read out". Smear over highlighted areas are reduced for the triggered frame.
The reset continuous trigger mode makes it possible to use a lens with video controlled iris in intelligent traffic surveillance applications.

To use this mode:

Set function:	Trigger mode "Reset continuous trigger"	TR=2
	LVAL synchronous accumulation to "synch"	LS=0
	Shutter mode "Normal" or "Programmable"	SM=0, SM=1
	"Shutter Speed"	SH=0 through 9
	"Programmable exposure"	PE=1 through 1216
	Scanning format	SC=0 through SC=4
	Output select	OS=0, OS=1
	Polarity and other functions	
Input:	Ext. trigger to Camera Link or pin 10 on 12-pin connector.	

Important notes on using this mode.

- The duration of the trigger should be >2LVAL to <3FVAL.
- A new trigger must not be applied before the triggered data is read out.
- 1LVAL = 47.9 μsec (single). 27.3 μsec (dual).
- The time for the fast dump read out (smearless) is 3.2 ms for single output. 3.3 ms for dual output.

For horizontal timing refer to 6.2.3. through 6.2.6. (Fig.16. through fig. 19.)
For LVAL sync/a-sync accumulation, refer to 6.2.7. and 6.2.8. (Fig. 20. through fig. 23.)

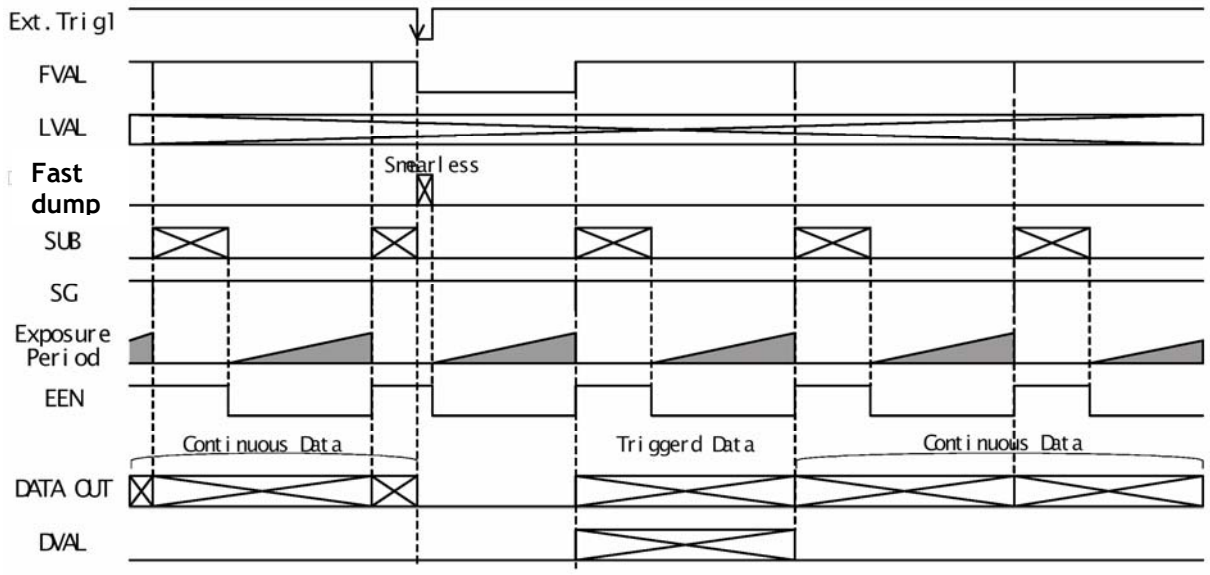


Fig. 27. Reset Continuous trigger mode

6.4.4. Pulse Width Control Mode

In PWC mode, the trigger leading edge will start an exposure at the first LVAL pulse if LS=0 (or immediately if LS=1). It stops at the trailing edge of the trigger pulse, and the resulting video is read out. This mode will operate with full and partial scanning. An EEN pulse will indicate the active accumulation time, and a FVAL pulse indicates that the resulting video is read out.
Long time exposure can be done with pulse width control mode.

To use this mode:

Set function:	Trigger mode "Pulse width control"	TR=3
	LVAL synchronous accum. to "synch" or "asynch"	LS=0, LS=1
	Scanning format	SC=0 through SC=4
	Vertical binning (only M2)	VB=0, VB=1
	Output select	OS=0, OS=1
	Polarity and other functions	
Input:	Ext. trigger to Camera Link or pin 10 on 12-pin connector.	

Important notes on using this mode.

- Minimum trigger duration is 2LVAL for sync accumulation, 1.1 LVAL for a-sync. Maximum is ∞. Thermal noise and dark current noise will increase by accumulation time, therefore the exposure time is not recommended to exceed 2 seconds.
- If LS=0 (Synchronous accumulation), the minimum trigger interval is 1 FVAL + 3 LVAL. The new exposure should not be finished before the previous frame is read out.
- If LS=1 (Asynchronous accumulation) the minimum trigger interval is the exposure time + 1FVAL + 2 LVAL. A new trigger must not be applied before FVAL is low.
- 1LVAL = 47.9 μsec (single). 27.3 μsec (dual).

For horizontal timing refer to 6.2.3. through 6.2.6. (Fig.16. through fig. 19.)
For LVAL synchronous accumulation, refer to 6.2.7 and 6.2.8. (Fig. 21. through fig. 23.)

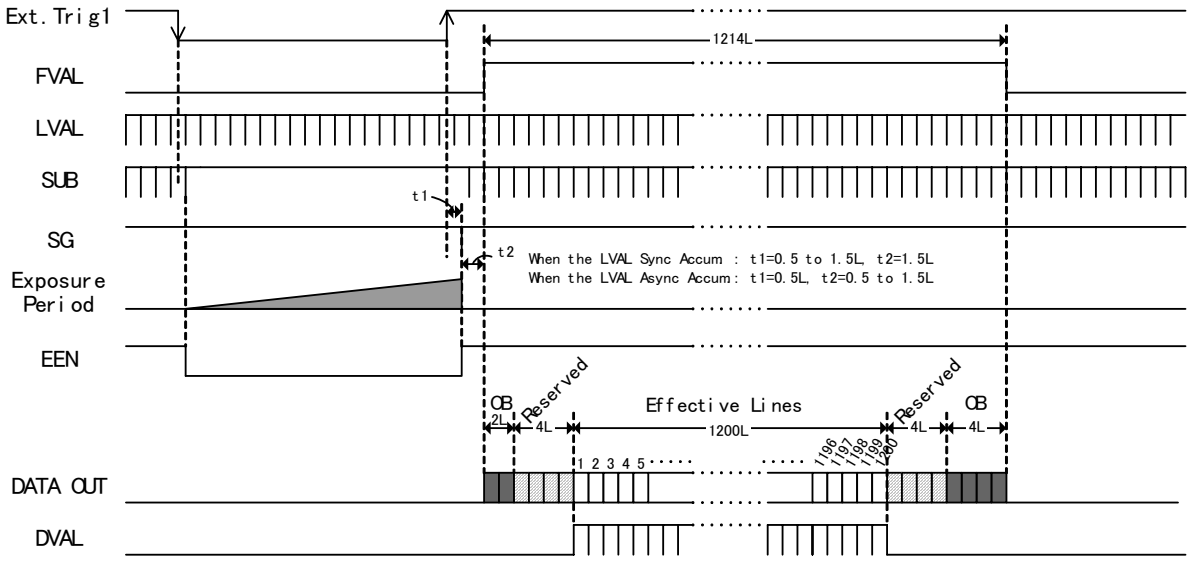


Fig. 28. Pulse Width Control mode vertical timing

6.4.5. Burst Trigger mode

With the burst trigger function, a single trigger pulse can start a sequence with five previous set pre-selected programmable exposures. The five shutter times can be set with BSH1 through BSH5. (Exposure 1H through 1216H.) The exposure is LVAL synchronous. Preset shutter (SM=0) can not be used.
The sequence will start with the first exposure at the first LVAL pulse after the trigger leading edge, and the result is read out after the selected shutter time. During the read out of the previous frame, the next exposure starts. It will continue until exposure 5 is read out.
This mode will operate with full and partial scanning.
An EEN pulse will indicate the active accumulation time, and a FVAL pulse indicates that the resulting video sequence is read out.

To use this mode:

Set function:	Trigger mode "Burst EPS"	TR=4
	LVAL synchronous accumulation to "synch"	LS=0
	Burst Shutter 1	BSH1=1 through 1216
	Burst Shutter 2	BSH2=1 through 1216
	Burst Shutter 3	BSH3=1 through 1216
	Burst Shutter 4	BSH4=1 through 1216
	Burst Shutter 5	BSH5=1 through 1216
	Scanning format	SC=0 through SC=4
	Output select	OS=0, OS=1
	Polarity and other functions	
Input:	Ext. trigger to Camera Link or pin 10 on 12-pin connector.	

Important notes on using this mode.

- The duration of the trigger should be >2LVAL to <3FVAL.
- Min. trigger interval is first exposure + 5 FVAL + 3 LVAL.
- A new trigger must not be applied before FVAL is low after frame 5.
- 1LVAL = 47.9 μsec (single). 27.3 μsec (dual).

For horizontal timing refer to 6.2.3 through 6.2.6. (Fig.16. through fig. 19.)
For LVAL sync/a-sync accumulation, refer to 6.2.7. (Fig. 20. through fig. 23.)

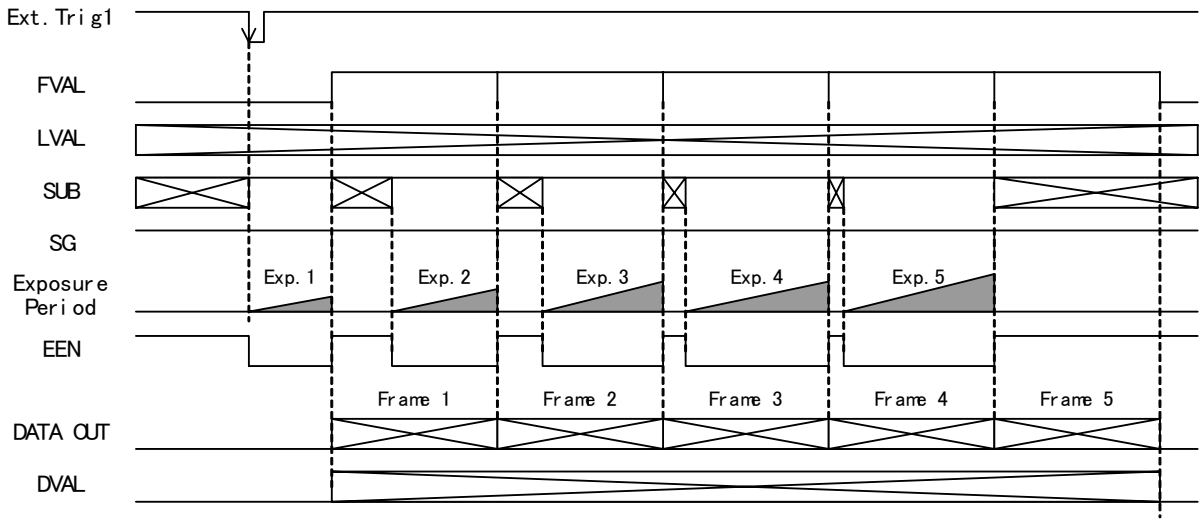


Fig. 29. Burst Trigger mode

6.4.6. PIV mode

PIV mode (Particle Image Velocimetry) 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 the only illumination. The first accumulation time is fixed at 4.68 μsec. After a delay >1.5 μsec. the second exposure period starts. It is as long as the time for a full frame. The accumulation is LVAL a-synchronous. The first exposure period starts at the trigger leading edge. The first strobe flash should be fired within the first exposure period, and the second strobe flash during the first frame read out period. The result will then be 2 frames exposed with the flash interval.

To use this mode:

Set function:	Trigger mode "PIV"	TR=5
	LVAL synchronous accumulation to "asynch"	LS=1
	Scanning format	SC=0 through SC=4
	Output select	OS=0, OS=1
	Polarity and other functions	
Input:	Ext. trigger to Camera Link or pin 10 on 12-pin connector.	
	2 strobe flash.	

Important notes on using this mode.

- The duration of the trigger should be >2LVAL to <3FVAL.
- Minimum trigger interval is 2 FVAL + 2 LVAL
- A new trigger must not be applied before FVAL is low after second frame readout.
- 1LVAL = 47.9 μsec (single). 27.3 μsec (dual).
- For minimum trigger delay and jitter, it is recommended to use CL trigger input.

For horizontal timing refer to 6.2.3. through 6.2.6. (Fig.16. through fig. 19.)
For LVAL a-synchronous accumulation refer to 6.2.8. (fig. 22 and 23.)

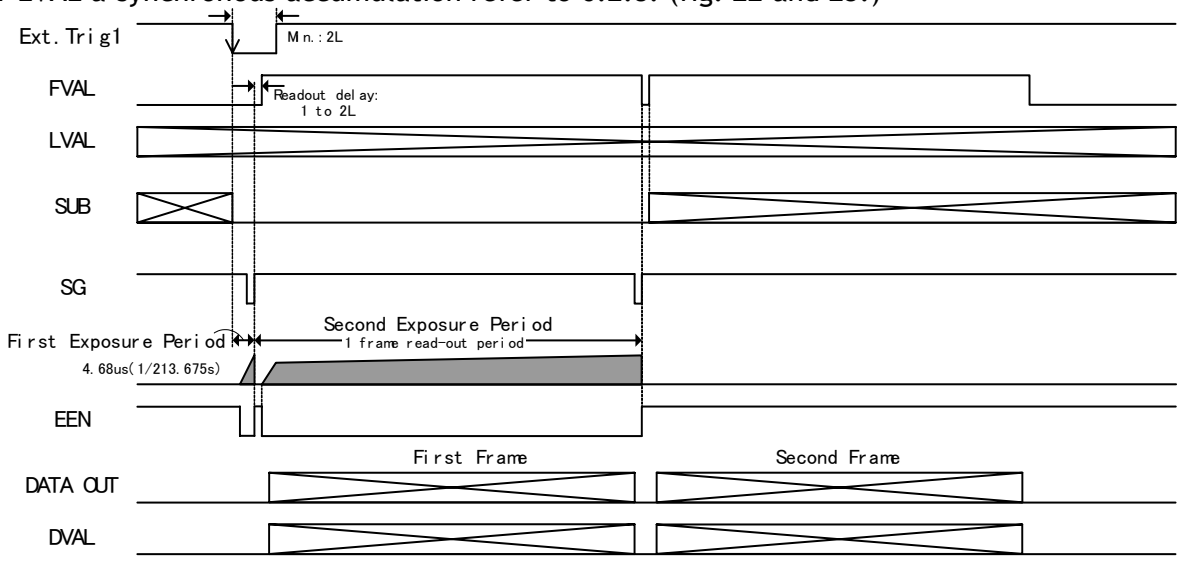


Fig. 30. PIV mode

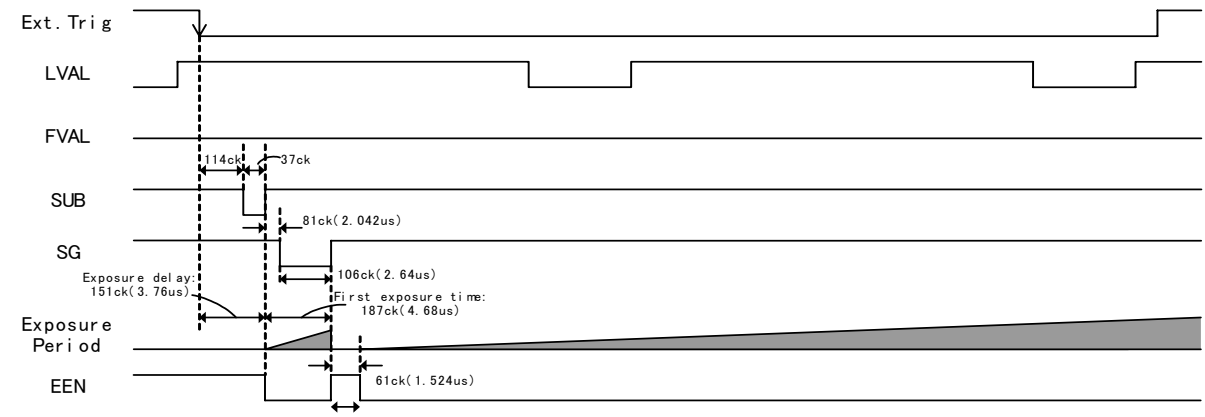


Fig. 31. PIV mode details

6.5. Other Functions

The following functions are described under their short ASCII command name.

***BA**: Output bit allocation*
With this function the number of bits in the Camera Link video output can be selected to 10 or 8. If 8 bit is selected it is the 8 most significant bits. For the bit allocation in Camera Link output, please refer to "5.4.5. Camera Link interface" and to "6.1.5. Digital video out allocation."

***MN**: Monitor mode*
In normal mode (TR=0) and full frame (SC=0) the output command (OS=2) selects the composite analog monitor video system. MN=1 for CCIR (50 FPS, 290 active lines). MN=0 for EIA (60 FPS, 240 active lines). The line frequency is 15.734 kHz. The video can be seen on a standard monitor with the command OS=2. SW1.1 can also be used. SW1.1 has highest priority.
This analog monochrome video output has a reduced resolution, and for M8 it is affected by the Bayer color filter. It is for adjust and set up only.

***TI**: Trigger input select*
To select the trigger input via Camera Link (TI=0), or pin #10 on Hirose connector (TI=1) as a TTL signal. The trigger input can also be selected by the internal switch, which has highest priority.

***TP**: Trigger polarity*
This command can change the trigger polarity.

***GS**: Gamma select*. (M2CL only)
To select gamma 1 or 0.45. Gamma 1 gives linear relation between scene luminance and video output. 0.45 will expand the contrast in dark and compress the contrast in light parts of the scene. Gamma 0.45 is only available for single output.

***RP**: Rear pot enable disable*
Select master gain from the potentiometer (RP=1) or RS-232C (RP=0).
Sw 1.4 in position potm. (ON) has highest priority.

***AU**: Auto dual adjust*
This function is used for automatic calibration of the 2 channels to have same black level and luminance. The calibration is done based on the average of the luminance signal in a 600 lines area on each side of the image centre.
(AU=1), ABA (Automatic Black Adjust) is a one-push function to align the black level for the 2 channels. It is done with the lens capped, so no light will pass through to the CCD sensor.
(AU=2). AWA (Automatic White Adjust) is a one-push function to align the white level for the 2 channels. It is done with the camera looking on a white surface, which should result in 100% video.

Due to temperature change, the luminance level of L and R channels can change. It can be manual adjusted with black level and gain. It can also be done with the ABA and AWA one push functions. It is done by comparing the average level of the 2 shown detecting areas. If there is a difference, a fine adjustment of R ch is done based on L ch values as reference. Allow 30 minutes warm up before adjustment.

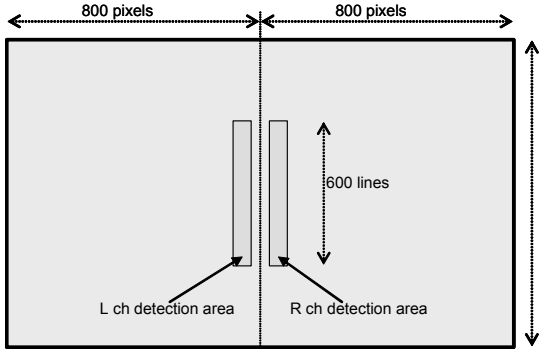


Fig. 32. Detection area for Auto dual adjust

***BL**: Black level master*
BLF: Black level fine. Right
BL is for manual adjusting the black level for both channels, and BLF to fine adjust the R channel.
It can also be done automatically by the one push function ABA.

***GA**: Gain level master*
GLR: gain level fine. Right
GA is for manual adjusting the gain for both channels, and GLR to fine adjust the R channel.
It can also be done automatically by the one push function AWA.

***KL**: Knee point master*. (M2CL only)
KLF: Knee point fine. Right. (M2CL only)
To adjust the Knee point for both channels and to fine adjust the R channel.
Refer to "6.1.6. Knee function."

Important notes on using this functions.
Adjusting the gain and black level settings should only be done when the camera is on its operation temperature. >30 minutes after power on.

6.5.1. Mode and function matrix

The following table shows which functions will work in the different modes.

Func. / Mode	TR=	Shutter SM= 0	Shutter SM= 1	Partial scan *2	V Bin *1	Accumulation sync	Accumulation a-sync	Iris video out	Output OS= 0	Output OS= 1	Output OS= 2	Remarks
Cont.	**0**	√	√	√	√			√	√	√	√	
EPS	**1**	√	√	√	√	√	√	-	√	√	-	
RCT	**2**	√	√	√	-	√	√	√	√	√	-	
PWC	**3**	-	-	√	√	√	√	-	√	√	-	
Burst	**4**	-	√	√	-	√	-	-	√	√	-	
PIV	**5**	-	-	√	-	√	-	-	√	√	-	

√ = ok

*1. V binning for CV-M2CL only
*2. If partial scan and V binning is set, binning has highest priority.

Fig. 33. Matrix for mode and functions.

6.6. Request Functions

The following commands are for identification and help.
Fig. 29. shows some printout examples from a PC running terminal emulator software. (Hyper terminal). Status, version, camera ID, model name, user ID and the help list are shown.

Please refer to chapter 7.4. RS-232C control, and chapter 7.5. CV-M2/M8 Command List.

***Echo Back**. EB=1.*
If on, the camera will echo back the RS-232C transmission.

***Status**. ST.*
If received, the camera will send back its current setting for all functions. Refer to fig. 34. left.

***Help**. HP.*
If received, the camera will send back a help list for all functions. Refer to fig. 34. right.

***Version Number**. VN.*
If received, the camera will send back its firmware version number as a 3 digits number.

***Camera ID**. ID.*
If received, the camera will send back its ID, which is a manufacturing code.

***Model Name**. MD.*
If received, the camera will send back its model name.

***User ID**. UD.*
With this command, the user can program and store up to 16 characters for identification.

6.7. Save and Load Functions.

The following commands are for store and load camera settings in the camera EEPROM.

***Load settings**. LD.*
This command will load previous stored settings to the camera. 1 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 the user areas in the camera EEPROM. Factory settings can't be changed.

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

The below lists shows printout of camera status and help list from a hyper terminal.

```
st?
SM=2
SH=0
PE=365
PER=791
PEG=791
PEB=400
TR=0
SL=0
LS=1
RF=1
TI=1
TP=0
SC=0
BI=0
BA=0
CBAR=0
WB=0
GA=255
GAR=0
GAB=0
BLG=460
BLR=460
BLB=460
KN=0
KSR=512
KSG=512
KSB=512
KPR=890
KPG=890
KPB=890
vn?
VN=11
id?
ID=
md?
MD=
ud?
UD=1234567
```

```
HP?
*** CV-M2 Help List ********************************
EB(echo back): 0=off, 1=on
ST(status request): return the all settings
VN(firmware version): return the version no. of firmware
ID(camera ID): return the camera ID (10 characters)
MD(model name): return the model name (max 10 characters)
UD(user ID): free text for user (max 16 characters)
OS(output select: 0=single ch.(17FPS), 1=dual ch.(30FPS), 2=Monitor(Analog)
BA(bit allocation: 0=10bit, 1=8bit
MN(monitor mode): 0=60FPS, 1=50FPS
SC(scanning format): 0=full frame, 1=1/2 partial, 2=1/4, 3=1/8, 4=programmab.
PS(programmable partial - start line No.): 1 - 1151
PC(programmable partial - line count): 50 - 1200
TR(trigger mode): 0=normal, 1=Edge, 2=RCT, 3=PWC, 4=Burst, 5=PIV
SM(shutter mode): 0=rom shutter, 1=programmable exposure
SH(rom shutter): 0=OFF, 1=1/60, 2=1/120, 3=1/250, 4=1/500, 5=1/1000
            6=1/2000, 7=1/4000, 8=1/8000, 9=1/14000
PE(programmable exposure): 1 - 1216
BSH1(burst shutter1): 1 - 1216
BSH2(burst shutter1): 1 - 1216
BSH3(burst shutter1): 1 - 1216
BSH4(burst shutter1): 1 - 1216
BSH5(burst shutter1): 1 - 1216
LS(lval synchronous accumulation): 0=sync., 1=async.
TI(tirgger input): 0=camera-link, 1=hirose 12pin-10p
TP(tirgger polarity): 0=active low, 1=active high
SG(sensor gate control): 0=off, 1=on
BL(black level master): 0 - 1023
BLF(black level fine): -512 - +511
GA(gain level master): 0 - 4095
GAF(gain level fine): -2048 - +2047
KN(knee select): 0=off, 1=on
KL(knee level master): 0 - 1023
KLF(knee level fine): -512 - +511
GS(gamma select): 0=1.0(off), 1=0.45
RP(Rear Potentiometer): 0=off, 1=on
AU(Auto dual ch adjustment): 0=off, 1=ABA, 2=AWA
LD(Load settings from EEPROM): 0=factory, 1=user
SA(Save settings into EEPROM): 1=user
*** Firmware Version 1.14 ***** Copyright(c) 2003 JAI Corporation *****
```

Fig. 34. Terminal printout of status, ID and help.

7. Configuring the Camera

7.1. Mode setting SW1 on rear

Switch SW 1.1 on the camera rear can be used to select digital or analog video out. SW1.1 has higher priority than RS-232C.
SW1.2 is for termination of the trigger 1 input on pin #10 Hirose.
(SW1.3 is for termination of the factory test input on pin #11 Hirose)
SW1.4 is for master gain setting by RS-232C or rear potm. If SW1.4 is ON, it has higher priority than RS-232C gain setting. (Fine gain adjustment on R channel only by RS-232C.)

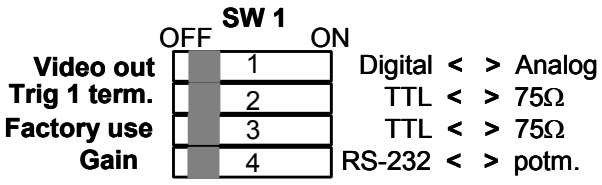


Fig. 35. SW1 on camera rear

7.2. RS-232C/Camera Link switch

The internal switch SW 700 (HR/CL) can be used to select the control input via the 12 pin Hirose as RS-232C or via Camera Link. Factory setting is Camera Link. The switch is placed inside the camera on the motherboard.

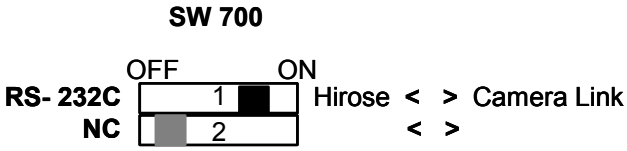


Fig. 36. Internal Switch

7.3. Internal Switch SW 700

The switch is placed inside the camera on the motherboard.

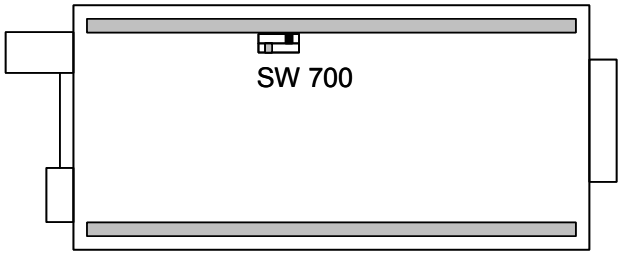


Fig. 37. Internal switch SW 700

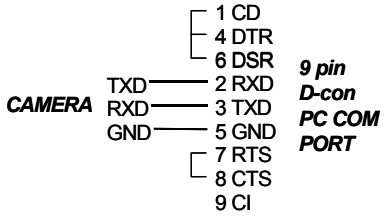
7.4. RS-232C control

All configuration of the CV-M2/M8 camera is done via the RS-232C port on the 12 pin HR connector or via Camera Link. The control mode can be selected by the internal switch RS-232C/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.

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>

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

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

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

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

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

To see the firmware number.
VN?<CR><LF>

To se the camera ID. It shows the manufacturing lot.
ID?<CR><LF>

7.5. CV-M2/M8 CL command list

	Command Name	Format	Parameter		Remarks
A – General settings and useful commands					
EB	Echo Back	EB=[Param.]<CR><LF>	0=Echo off	1=Echo on	Off at power up
ST	Camera Status request	ST?<CR><LF>			Actual setting
HP	Online Help request	HP?<CR><LF>			Command list
VN	Firmware version	VN?<CR><LF>			3 letter version
ID	Camera ID request	ID?<CR><LF>			10 Characters
MD	Model Name request	MD?<CR><LF>			≤10 Characters
UD	User ID	UD=[Param.]<CR><LF>	User text ≤16 Characters		For user ID data
B – Video Output					
OS	Output select	OS=[Param.]<CR><LF>	0=single chan. 2=monitor	1=dual chan.	1-2 Camera Link 3 Analog in BNC
BA	Output bit allocation	BA=[Param.]<CR><LF>	0=10 bit	1=8 bit	Camera Link
MN	Monitor mode	MN=[Param.]<CR><LF>	0=EIA (60FPS)	1=CCIR (50FPS)	Analog in BNC
C – Timing and shutter related commands					
SC	Scanning format	SC=[Param.]<CR><LF>	0=full frame 2=1/4 partial 4= progr. p. sc	1=1/2 partial 3=1/8 partial	*)
PS	Progr. Par. Scan start	PS=[Param.]<CR><LF>	1-1151		Start line #
PC	Progr. Par. Scan hight	PC=[Param.]<CR><LF>	50-1200		Height line#
TR	Trigger mode	TR=[Param.]<CR><LF>	0=normal 2=Restart Cont 4=Burst EPS	1=Edge pre-sel 3=Pulse width 5=PIV	*)
SM	Shutter mode	SM=[Param.]<CR><LF>	0=Normal	1=Program. Exp	
SH	Shutter speed	SH=[Param.]<CR><LF>	0=Off (frame) 2=1/120 4=1/500 6=1/2000 8=1/8000	1=1/60 3=1/250 5=1/1000 7=1/4000 9=1/14,000	All10 steps are valid in normal trigger mode, EPS and RCT mode.
PE	Programmable expos.	PE=[Param.]<CR><LF>	1-1216 (1.5H to 1216.5H. single chan) 1-1216 (1.5H to 1216.5H. dual channel)		H = 47.9μsec H = 27.3μsec
VB	Vertical Binning	PE=[Param.]<CR><LF>	0=OFF	1=ON	M2 only. Not rev. D
BSH1	EPS Burst shutter 1	BSH1=[Param.]<CR><LF>	1-1216 (As programmable shutter)		
BSH2	EPS Burst shutter 2	BSH2=[Param.]<CR><LF>			
BSH3	EPS Burst shutter 3	BSH3=[Param.]<CR><LF>			
BSH4	EPS Burst shutter 4	BSH4=[Param.]<CR><LF>			
BSH5	EPS Burst shutter 5	BSH5=[Param.]<CR><LF>			
D- Signals and polarity					
LS	LVAL synchronous accum	LS=[Param.]<CR><LF>	0= syn. accum	1=asyn. Accum	
TI	Trigger Input	TI=[Param.]<CR><LF>	0= CamerLink	1= 12 pin Hirose	
TP	Trigger polarity	TP=[Param.]<CR><LF>	0= active low	1= active high	
E – Gain and analog signals setting					
BL	Black level master	BL=[Param.]<CR><LF>	0-1023 (0=low, 1023=high)		
BLF	Black level R fine	BLF=[Param.]<CR><LF>	-512 to 511 (-512=low, 511=high)		
GA	Gain level master	GA=[Param.]<CR><LF>	0-4095 (0 = low, 4095 =high)		Range –3 to 12 dB
GAF	Gain level R fine	GAF=[Param.]<CR><LF>	-2048 to 2047 (-2048=low, 2047=high)		
KN	Knee select	KN=[Param.]<CR><LF>	0=Off	1=ON	M2 only
KL	Knee point master level	KL=[Param.]<CR><LF>	0-1023 (0=low, 1023=high)		M2 only
KLF	Knee point R fine level	KLF=[Param.]<CR><LF>	-512 to 511 (-512=low, 511=high)		M2 only
GS	Gamma select	GS=[Param.]<CR><LF>	0=Off (=1)	1=ON (=0.45)	M2 single ch. only
RP	Rear Potentiometer	RP=[Param.]<CR><LF>	0=manual gain	1=rear potm.	
AU	Auto dual adjust	AU=[Param.]<CR><LF>	0=Off 2=AWA	1=ABA	ABA w. no light AWA w. 100%
F – Saving and loading data in EEPROM					
LD	Load settings from camera EEPROM	LD=[Param.]<CR><LF>	0=Factory data	1=User 1 area	Latest used data at power up
SA	Save settings to camera EEPROM	SA=[Param.]<CR><LF>	1=User 1 area		Parameter = 0 is not allowed
EA	EEPROM area request	EA?<CR><LF>	0=Factory data	1=User 1 area	Return the latest used data area

*) Disconnect the trigger input before changing mode by RS-232C or Camera Link.

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

7.6. Camera Control Tool for CV-M2/M8 CL

From www.jai.com Camera Control Tool for Windows NT/2000/XP can be downloaded.
The control tool contents a camera control program and tools for making your own program.
For the integrator and experienced user, the Camera Control Toll is much more than a program with a window interface. It also provides an easy and efficient ActiveX interface built for MS Windows 98, ME, NT and 2000. The OCX interface has the ability to connect to the camera using the serial interface of the PC by reading and writing properties for the camera. This integration requires simple programming skills within Visual Basic, Visual C++ or similar languages in a Microsoft Windows environment.

7.6.1. Control Tool Windows

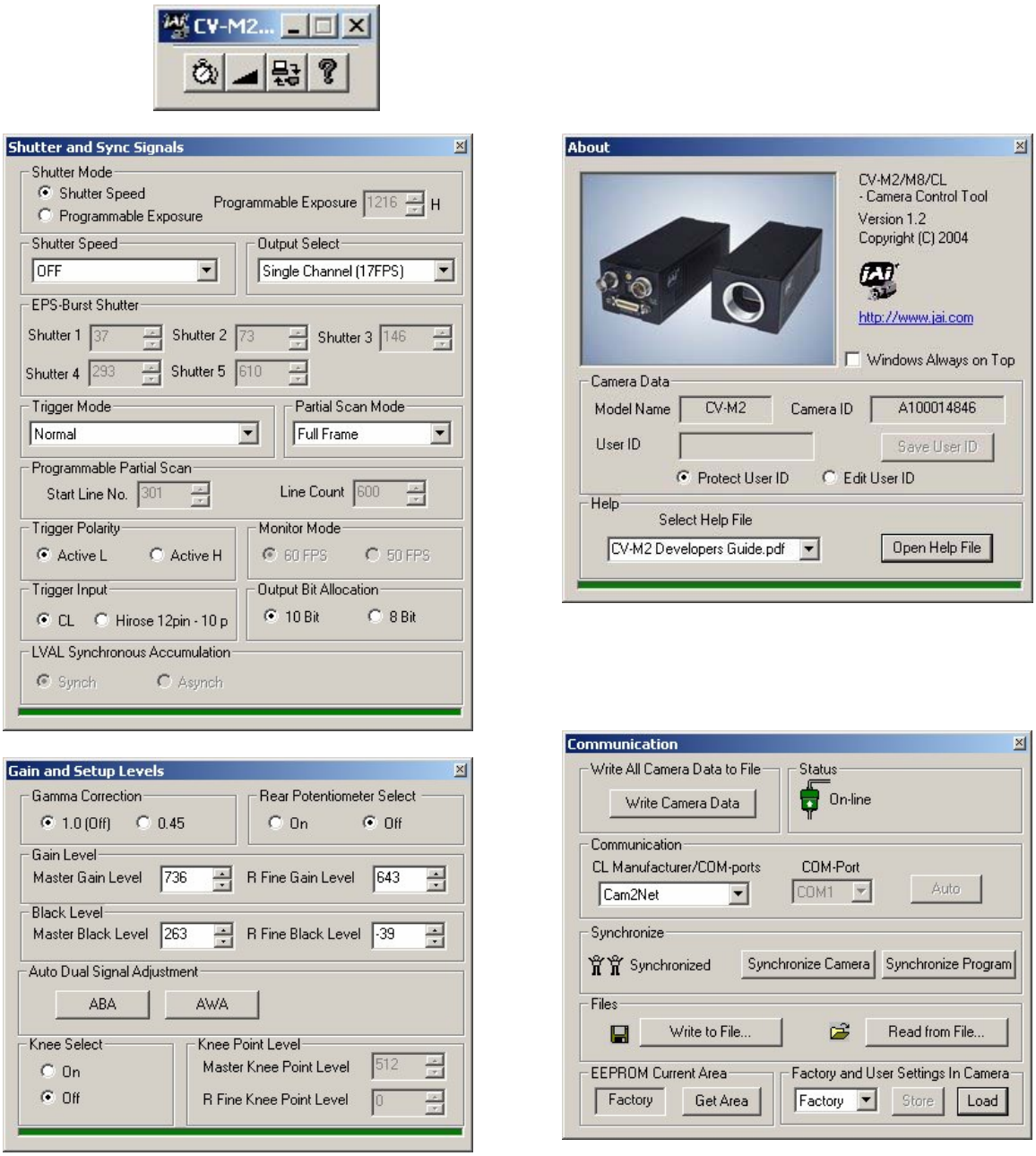


Fig. 38. Camera Control Tool windows

7.6.2. Camera Control Tool Interface

Note! *The following description is general. It is not specific for this camera.*

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

The About window

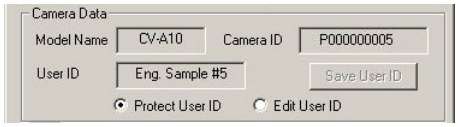
The about window contains a picture of the camera and information about the version of the program, Internet connection to JAI A/S and access to the help documents.
The List box that contains the help documents will list all files, which have the extension .pdf and that are found in the program (default) folder

C:\Program Files\JAI A-S\'Control Tool Name'

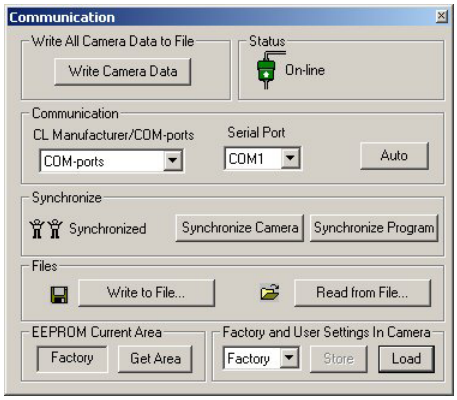
It is possible to download updated operation manuals from the jai website:

http://www.jai.com/camera/manuals.asp/sprog=uk

An updated manual can be saved in the folder address mentioned above and it will automatically be included in the list of help files.
For newer camera models the About Window also shows Model Name, camera ID and User ID. It is possible to edit and save free text in User ID.
At the bottom of the windows (all windows but the Communication Window is a coloured bar. The bar is green when the Camera Control Tool is connected to a camera and the camera is turned on.
The bar is red when the Camera Control Tool is not connected to a camera or when the camera is turned off.



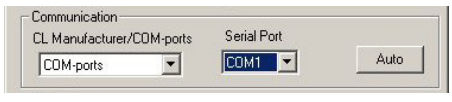
The Communication Window



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

RS-232:

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



RS-232 and Camera Link:

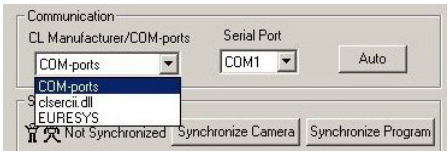
The Communication Window looks a bit different when it is possible to communicate with the camera using Camera Link and RS-232 com port. The Communication area contains 2 list boxes now.

RS-232 communication.

1. Select 'COM-ports' from the 'CL Manufacturer/COM-ports' list Box.
2. Select the communication port, where the serial cable is connected to the camera from the 'Serial Port' list box or click the 'Auto' button to search for a camera on communication port 1 to 16.

The Serial Port list box and the Auto search button are only active when COM-ports are 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. Just select the option for the frame grabber that is installed in the pc.

About Camera Link Communication.

The Camera Control Tool software loads a dll called "**clserial.dll**" (you will find it in the "**system32**" folder). "clserial.dll" loads all dlls that are called "**clser***.dll**" and which are found in the "**system32**" folder.

Each frame grabber company produces a dll that is unique for its frame grabber:

[clsermtx.dll for **Matrox]**
[clsercii.dll for **Coreco]**
[clsernat.dll for **National Instruments]**
[clseremc.dll for **Euresys]**
[clserc2n.dll for **Cam2Net]**

The standard has been updated and as a result a new file is used to load the dlls (instead of clserial.dll). The new file is called "**clallserial.dll**".
Some of the frame grabber companies have updated their "clser***.dll" in order to be found and loaded by "clallserial.dll".

The new dll works in a different way:

1. You have to create a new folder "**C:\cameralink\serial**"
2. The frame grabber "clser***.dll" must be moved to the new folder
3. "clallserial.dll" loads all dlls that are called "**clser***.dll**" and which are found in the folder "**C:\cameralink\serial**"

Auto search.

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

Off/On-line mode.

The Camera Control Tool Application can run Offline (without a camera attached) and all functions are fully functional in offline mode.
Off line mode is indicated in The Communication Window, where a status field with graphic and text indicates the on/off-line status.
Changing the selected communication port (from the communication window) changes the online/off-line status. If a camera is found on the selected communication port the application runs online otherwise offline.

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

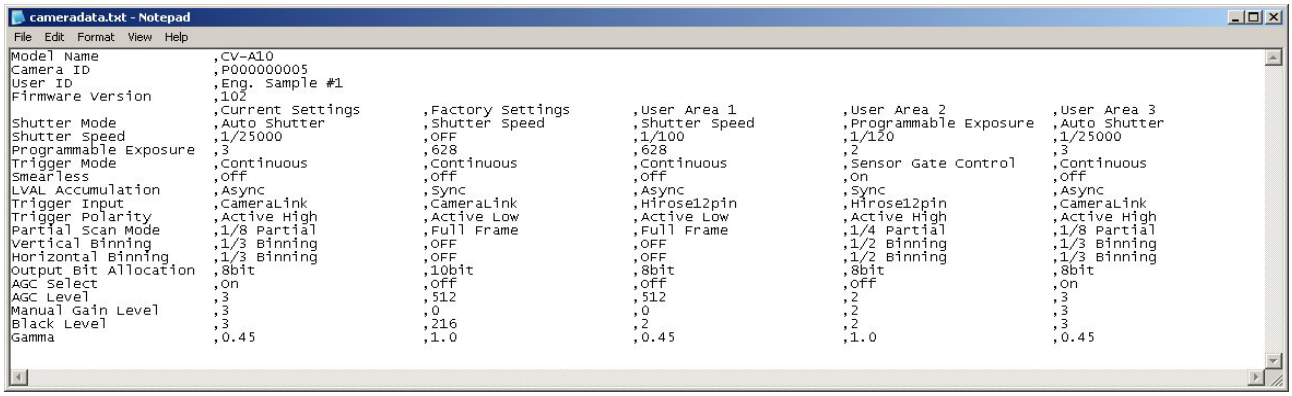
Synchronize program and camera.
The Camera Control software has the ability to synchronize either the camera or the program. Click Synchronize camera to write all settings from the program to the camera or click the Synchronize program to load all settings from the camera to the program.

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

Factory and User Settings.

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

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


cameradata.txt - Notepad

File Edit Format View Help

Model Name	,CV-A10				
Camera ID	,P000000005				
User ID	,Eng. Sample #1				
Firmware Version	,102				
	,Current Settings	,Factory Settings	,User Area 1	,User Area 2	,User Area 3
Shutter Mode	,Auto Shutter	,Shutter Speed	,Shutter Speed	,Programmable Exposure	,Auto Shutter
Shutter Speed	,1/25000	,OFF	,1/100	,1/120	,1/25000
Programmable Exposure	,3	,628	,628	,2	,3
Trigger Mode	,Continuous	,Continuous	,Continuous	,Sensor Gate Control	,Continuous
Smearless	,Off	,Off	,Off	,On	,Off
LVAL Accumulation	,Async	,Sync	,Async	,Sync	,Async
Trigger Input	,CameraLink	,CameraLink	,Hirose12pin	,Hirose12pin	,CameraLink
Trigger Polarity	,Active High	,Active Low	,Active Low	,Active High	,Active High
Partial Scan Mode	,1/8 Partial	,Full Frame	,Full Frame	,1/4 Partial	,1/8 Partial
Vertical Binning	,1/3 Binning	,OFF	,OFF	,1/2 Binning	,1/3 Binning
Horizontal Binning	,1/3 Binning	,OFF	,OFF	,1/2 Binning	,1/3 Binning
Output Bit Allocation	,8bit	,10bit	,8bit	,8bit	,8bit
AGC Select	,On	,Off	,Off	,Off	,On
AGC Level	,3	,512	,512	,2	,3
Manual Gain Level	,3	,0	,0	,2	,3
Black Level	,3	,216	,2	,2	,3
Gamma	,0.45	,1.0	,0.45	,1.0	,0.45

***Note:** The shown table is not for the actual camera!*

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

7.6.3. Using the Camera Control Tool

Here is some practical information about the Camera Control Tool:

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

8. External Appearance and Dimensions

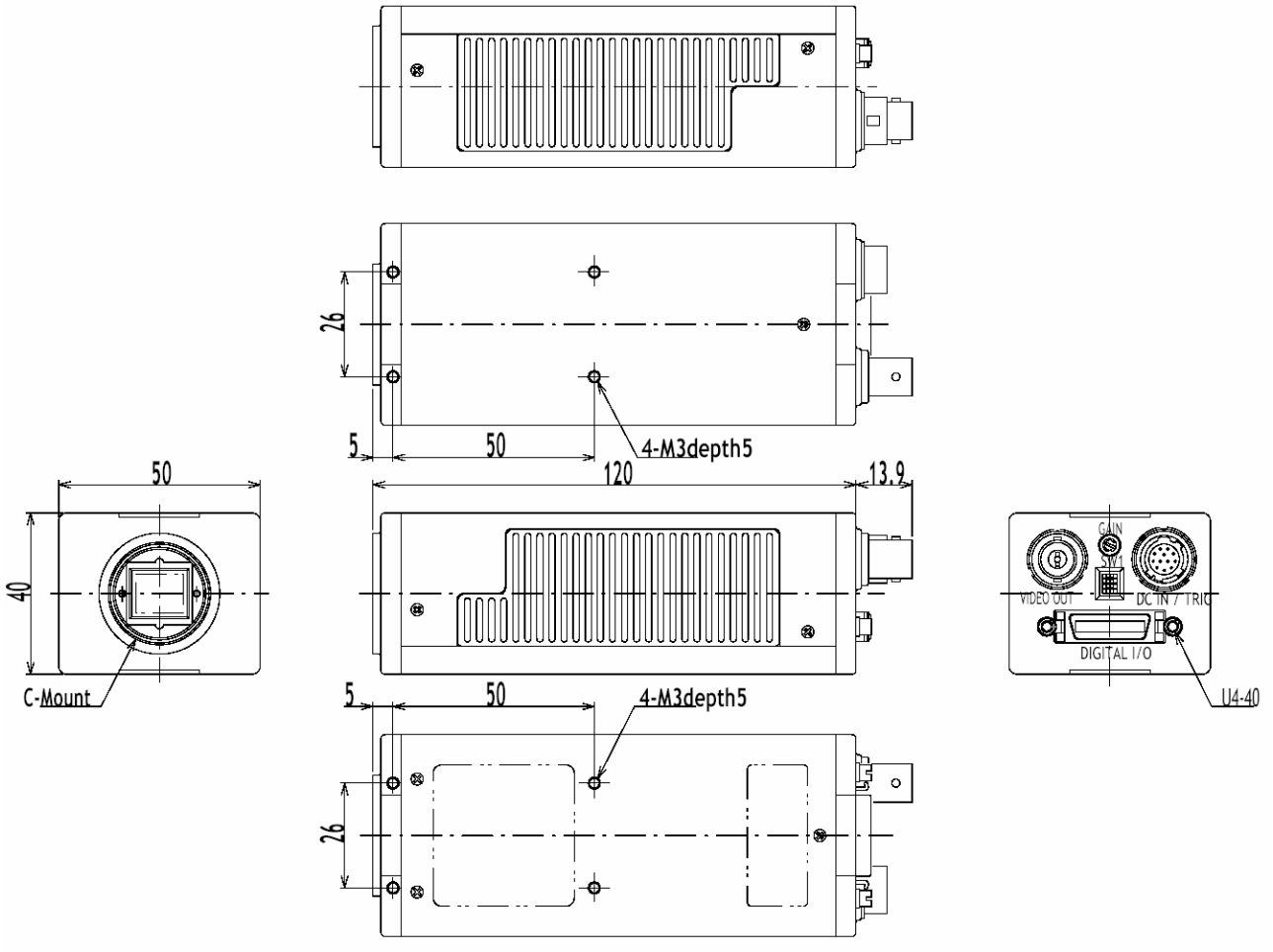


Fig. 39. Outline.

9. Specifications

9.1. Spectral sensitivity

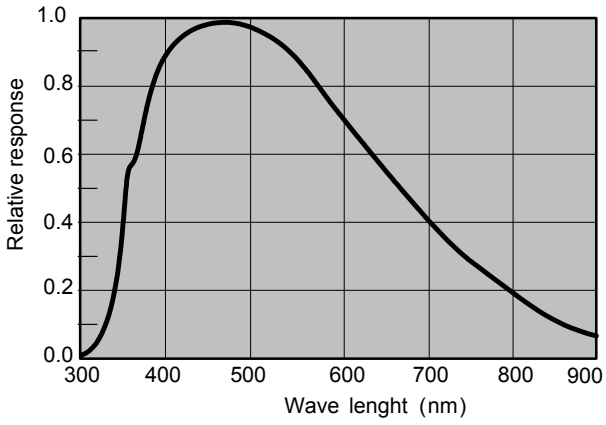


Fig. 40. Spectral sensitivity for CV-M2CL

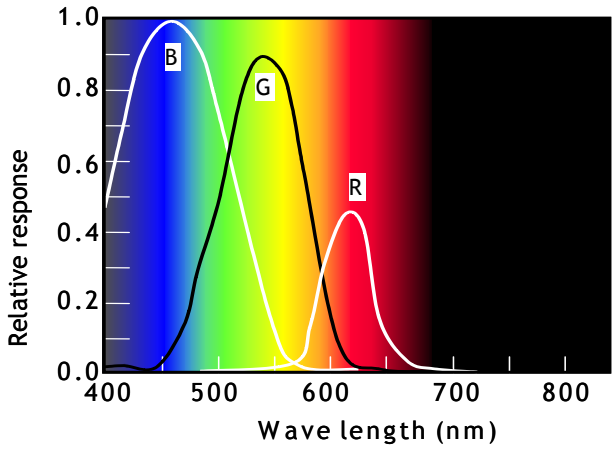


Fig. 41. Spectral sensitivity for CV-M8CL

9.2. Specification table

Specifications	CV-M2CL	CV-M8CL
Scanning system	Progressive 1216 lines 17 frames/sec.	
Pixel clock	40.00 MHz	
Line frequency, single output dual output	20.88 kHz (1916 pixel clock/line). (H = 47.9 μsec) 36.63 kHz (1092 pixel clock/line). (H = 27.3 μsec)	
Frame rate, single output dual output	17.17 frames/sec. (1216 lines/frame) 30.12 frames/sec. (1216 lines/frame)	
Frame rate V binning single output dual output	33.89 frames/sec. (616 lines/frame) 59.46 frames/sec. (616 lines/frame)	- -
CCD sensor	1" progressive scan monochrome IT Kodak KAI-2020M	1" progressive scan color IT Kodak KAI-2020CM
Sensing area	11.8 (h) x 8.9 (v) mm	
Cell size	7.4 (h) x 7.4 (v) μm	
Effective pixels	1608 (h) x 1208 (v)	
Pixels in video output Full 1/2 partial 1/4 partial 1/8 partial Variable scan Vertical Binning	1 channel 1600 (h) x 1200 (v) 17.17 FPS 1600 (h) x 600 (v) 32.52 FPS 1600 (h) x 300 (v) 57.99 FPS 1600 (h) x 150 (v) 95.77 FPS 1600 (h) x 50 (v) to 1200 (v) <167 FPS *1600 (h) x 600 (v) 33.89 FPS*	2 channel 30.12 FPS 54.67 FPS 91.58 FPS 138.75 FPS <208 FPS *59.46 FPS (Note: CV-M2CL only)*
Sensitivity on sensor	1.4 lx (100% video out. Gain 0 dB) 0.2 lx (50% video out. Gain 12 dB)	10 lx (100% video out. Gain 0 dB) 1 lx (50% video out. Gain 12 dB)
S/N ratio	>50 dB	>50 dB (On green)
Video output digital single digital dual	10 or 8 bit in Camera Link 2 x 10/8 bit in Camera Link	
Monitor video output. Analog	Monochrome composite 1.0 Vpp, 75 Ω (50 or 60 FPS. 15.734 kHz)	
Iris video output. Analog	0.7 Vpp, 75 Ω (for iris control)	
Gamma	1.0 or 0.45 (Single channel only)	1.0
Knee function	Slope 100% to 20%. Knee point adjustable	
Gain Gain range	Manual, potentiometer or remote -3 to +12 dB (0 – 4095)	
Synchronization	Int. X-tal. Ext. random trigger (LVAL synch. or asynch.)	
Inputs TTL Camera Link	Ext. trigger TTL 4 V ±2 V Ext. trigger	
Outputs TTL Camera Link	EEN output Pixel clock output D0-D9 output DVAL output LVAL output FVAL output EEN output. (Not specified by Camera Link).	
Control interface	TXD and RXD via RS 232C SerTC and SerTFG via Camera Link	
Trigger modes	Continuous, Edge pre-select, Pulse width control, Reset Continuous Trigger, PIV and EPS Burst (with 5 programmable shutter times)	
Read out modes	Single or dual digital output. Analog monochrome output. Partial scan.	
Shutter speed (fixed)	Off, 1/60, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/14,000 second	
Pulse width control	1.5 H to ∞. (>72 μsec.) <2 sec. is recommended	
Programmable exposure	1.5 H to 1216.5 H (71.9 μsec. to 58.2 msec.) Single channel 1.5 H to 1216.5 H (41 μsec. to 33.2 msec.) Dual channel	
Variable scan	50 to 1200 lines	
Functions controlled by RS 232C	Shutter, Trigger, Scanning, Readout, Trigger input, Video level, Set-up level and Gain	
Operating temperature	-5°C to +45°C	
Humidity	20 – 80% non-condensing	
Storage temp/humidity	-25°C to +60°C/20 – 90% non-condensing	
Power	12V DC ± 10%. 6.6 W. (9W with dual output).	
Lens mount	C-mount	
Dimensions	40 x 50 x 120 mm (HxWxD)	
Weight	310g	

Note! *Above specifications are subject to change without notice.*

10. Appendix

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.

Typical CCD Characteristics

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

V. Smear
Due to an excessive bright object such as electric lighting, sun or strong reflection, vertical smear may be visible on the video monitor screen. This phenomenon is related to the characteristics of the Interline Transfer System employed in the CCD.

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

Blemishes
Some pixel defects can occur, but this does not have en effect on the practical operation.
Cameras are shipped in the condition that CCD spots are not visible.
In general, it is said that photo diodes of CCD sensor might damage by influence of cosmic ray and as a result, CCD sensor will have spots.
Please pay attention so that camera might not be influenced by cosmic ray on storage and transportation.
We also recommend to use sea shipment instead of air flight due to strong influence of cosmic ray to camera.

Patterned Noise
When the CCD camera captures a dark object at high temperature or is used for long time integration, fixed pattern noise (shown as white dots) may appear on the video monitor screen.

11.3. References

1. This manual can for CV-M2CL/M8CL can be downloaded from www.jai.com
2. Datasheet for CV-M2CL and CV-M8CL can be downloaded from www.jai.com
3. Camera control software for CV-M2CL and CV-M8CL can be downloaded from www.jai.com
4. Data for the CCD sensor Kodak KAI-2020M and 2020CM can be found on www.jai.com

11. Users Record

Camera type: **CV-M2CL/M8CL**

Revision: **(Revision D)**

Serial No. **……..**

Firmware version. **……..**

Camera ID. **……..**

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

Users Mode Settings.

Users Modifications.

DECLARATION OF CONFORMITY
AS DEFINED BY THE COUNCIL DIRECTIVE
89/336/EEC
EMC (ELECTROMAGNETIC COMPABILITY)
WE HEREWITH DECLARE THAT THIS PRODUCT
COMPLIES WITH THE FOLOWING PROVISIONS APPLYING TO IT.
EN-50081-1
EN-50082-1

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