Digital 3CCD Progressive Scan
RGB Color Camera

CV-M 9CL

Operation Manual

Camera: Revision A
Manual: Version 1.4

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1. General

The CV-M9CL is a digital 3 CCD progressive scanned RGB color camera. It provides an upgraded path from the CV-M90, adding higher resolution and Camera Link output.

It is based on a 1/3" image format, making it optically compatible with CV-M90 and CV-M91. The compact 3 CCD C-mount prism unit is designed for high color quality, and combined with a color shading correction, it allows use of a wide range of C-mount lenses.

30 full RGB frames can be read out as 3 x 8 bit via a base Camera Link connection, or 3 X 10 bit in a medium Camera Link configuration. Functions like partial scanning and vertical binning allows higher frame rates.

The latest version of this manual can be downloaded from: www.jai.com
The latest version of Camera Control Tool for CV-M9CL 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 .

The camera is available in the following version:
CV-M9CL. 3 CCD progressive scan color camera.

3. Main Features

- 3 x 1/3" CCD Progressive Scan RGB Color Camera for vision applications
- 3 x 1034(h) x 779 (v) 4.65 μm effective square pixels
- Compact RGB prism for C-mount lenses
- Chromatic shading reduction makes lens choice wider
- 30 frames per second with 1024 (h) x 768 (v) pixels
- 87 fps with 1024 (h) x 96 (v) pixels In 1/8 partial scan
- Vertical binning for higher sensitivity and frame rate
- 8 bit RGB output via single port Camera Link. 10 bit via dual port
- Edge pre-select, pulse width and sensor gate trigger modes
- Reset Continuous Trigger mode and smearless mode
- Programmable exposure individual for RGB
- Manual, Continuous or One Push white balance
- Color bar test image for set-up
- Customized shading correction
- Knee point and slope settings for higher dynamic range
- Analogue iris video output for lens iris control
- Setup by Windows 98/NT/2000/XP software via RS 232C

4. Locations and Functions
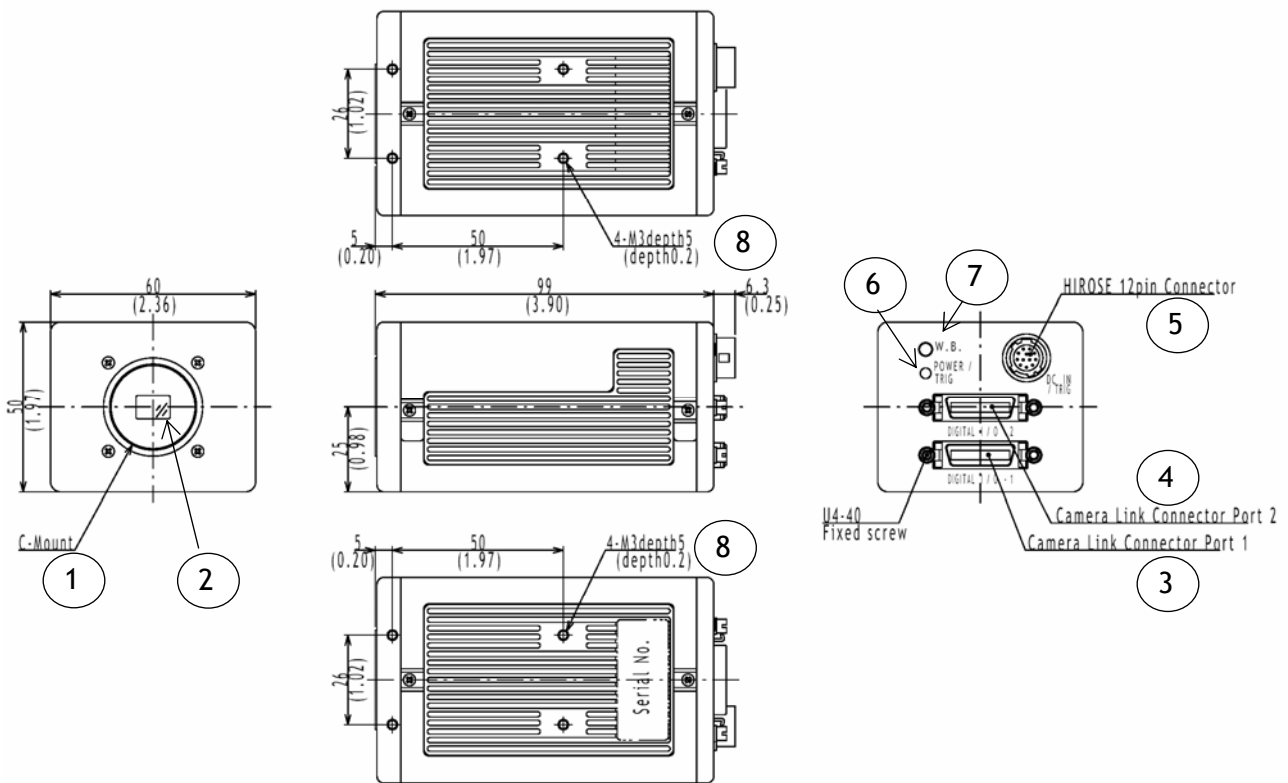
1　　　　Lens mount of C-mount type. *1)
2　　　　RGB Prism with 3 x 1/3" CCD sensors
3　　　　Camera Link base connector 1
4　　　　Camera Link medium connector 2
5　　　　12 pin connector for DC +12V power external sync signals
6　　　　LED for power and trigger indication
7　　　　Switch for 1 push white balance
8　　　　Mounting holes 8 x M3deept5.

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

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.
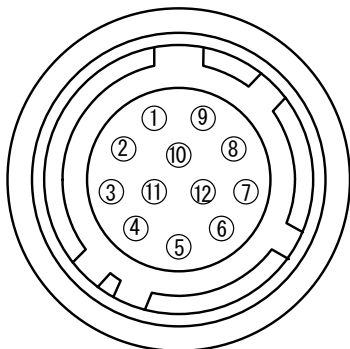
Pin no.	Signal	Remarks
1	GND	
2	+12 V DC input	
3	GND	
4	Iris video	Only Contin. and RCT mode. TR=0, TR=4
5	GND	
6	RXD in	RXD in HR, or *CL*. SW301.1 *off for CL* *1)
7	TXD out	TXD in HR, or *CL*. SW301.1 *off for CL* *1)
8	GND	
9	XEEN out	Low during exposure
10	Trigger in	TI=1 or *in CL* (TI=0). SW301.2 on for 75Ω
11	+12 V DC	
12	GND	

Notes: *1) See "7. Configuring the Camera" for more information.
SW301.1 Off for CL. ON for 12 p HR. (SW301.2 is for trig 75Ω).
Factory settings are shown in *Bold Italic*

5.2. Digital Output Connector for Camera Link
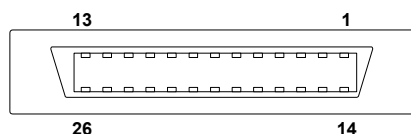
Type: 26 pin MRD connector
3M 10226-1A10JL

Fig. 3. Camera Link connector

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

The following signals are found on the Digital Output Connector:

SerTC	*RXD serial data to camera*	(*SW301.1. Off for CL*. On for HR)
SerTFG	*TXD serial data to frame grabber*	(*SW301.1. Off for CL*. On for HR)
CC1	*Trigger input*	(*TI=0 for CL*. TI=1 for 12 pin HR)
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	3 x 8 bit RGB video data out.
LVAL	Line VALid. Video line data is valid. High for valid line.
FVAL	Frame VALid. Video frame data is valid. High for valid frame.
DVAL	Data VALid. Effective video pixel data is valid. High for valid data.
EEN	Exposure ENable. High during exposure.

The polarity is positive and TRIG in negative as factory setting.
For Camera Link interface principle diagram please check Fig. 7.

5.3. Input and output circuits

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

5.3.1. Iris video output

This signal can be used for lens iris control
In Continuous and Reset Continuous Trigger
Mode. The signal is taken from the CCD sensor output
before the gain circuit.
The iris video output is 0.7 Vpp from 75 Ω.
The signal is without sync.
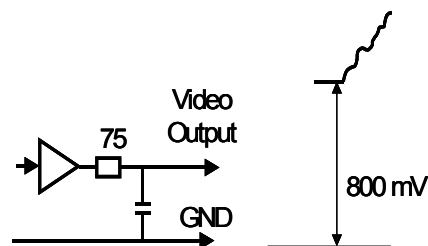
Fig. 4. Iris video output.

5.3.2. Trigger input

With TI=1, the trigger input is on pin #10 on 12
pin connector. The input is AC coupled. To allow
a long pulse width, the input circuit is a flip flop,
which is toggled by the negative or positive
differentiated spikes caused by the falling or
rising trigger edges.
The trigger polarity can be changed by TP=1.
Trigger input level 4 V ± 2 V. It can be
terminated by SW301.2: ON for 75Ω. OFF for TTL.
The trigger inputs can be changed to
Camera Link. (TI=0 for CL)
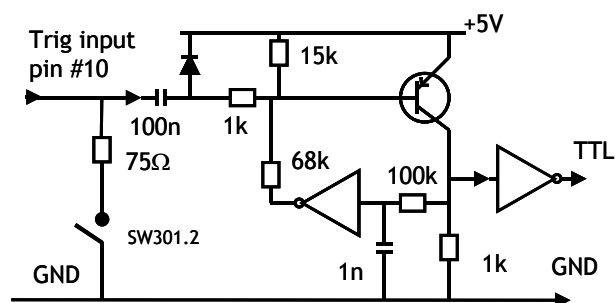
Fig. 5. Trigger input.

5.3.3. EEN output

XEEN is found on pin #9 on 12 pin HR connector.
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).
XEEN is low during exposure.
EEN is found in Camera Link. It is high during
exposure.

Fig. 6. EEN output

5.3.3. Camera Link interface

The video output is Camera Link with either 3 x 8 bit RGB video placed in a base configuration, or 3 x 10 bit RGB placed in a Camera Link medium configuration. The digital output signals follow the Camera Link standardized multiplexed signal output interface. The Camera Link output driver is NS type DS90CR285MTD.

The data bits from the digital video, FVAL, LVAL, DVAL and EEN are multiplexed into the twisted pairs, which are a part of the Camera Link. Trigger signals and the serial camera control are 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 HR). Factory setting is *CL*.

The serial camera control can be switches between the 12 pin connector or CL by the internal switch SW301.1. Factory setting is *CL*.

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	Pin No.
Port A0	R D0	Tx0
Port A1	R D1	Tx1
Port A2	R D2	Tx2
Port A3	R D3	Tx3
Port A4	R D4	Tx4
Port A5	R D5	Tx6
Port A6	R D6	Tx27
Port A7	R D7	Tx5
Port B0	G D0	Tx7
Port B1	G D1	Tx8
Port B2	G D2	Tx9
Port B3	G D3	Tx12
Port B4	G D4	Tx13
Port B5	G D5	Tx14
Port B6	G D6	Tx10
Port B7	G D7	Tx11
Port C0	B D0	Tx15
Port C1	B D1	Tx18
Port C2	B D2	Tx19
Port C3	B D3	Tx20
Port C4	B D4	Tx21
Port C5	B D5	Tx22
Port C6	B D6	Tx16
Port C7	B D7	Tx17
LVAL		Tx24
FVAL		Tx25
DVAL		Tx26
EEN		Tx23

Camera Link bit allocation
D0 = LSB. D7 = MSB
Base configuration

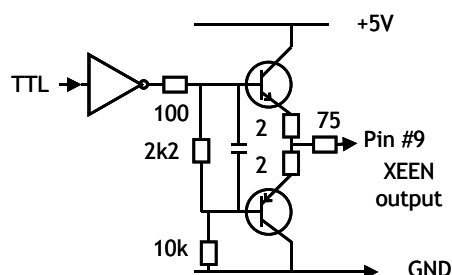Fig. 7. Principle diagram for 3 x 8 bit RGB in Camera Link base configuration

5.3.5. Bit allocation in Camera Link connectors

The CV-M9CL camera has outputs for the RGB signals in Camera Link. The RBG output can be allocated as 3 x 8 bit in Camera Link base configuration. Connector 1 is then used.
For 3 x 10 bit RGB output in Camera Link, 2 connectors are used in medium configuration.

The below 2 tables shows the bit allocations in the Camera Link connectors.

CL base configuration Connector 1		
Camera signals 8 bit	Camera Link Port	CL Pin No.
R D0	Port A0	Tx0
R D1	Port A1	Tx1
R D2	Port A2	Tx2
R D3	Port A3	Tx3
R D4	Port A4	Tx4
R D5	Port A5	Tx6
R D6	Port A6	Tx27
R D7	Port A7	Tx5
G D0	Port B0	Tx7
G D1	Port B1	Tx8
G D2	Port B2	Tx9
G D3	Port B3	Tx12
G D4	Port B4	Tx13
G D5	Port B5	Tx14
G D6	Port B6	Tx10
G D7	Port B7	Tx11
B D0	Port C0	Tx15
B D1	Port C1	Tx18
B D2	Port C2	Tx19
B D3	Port C3	Tx20
B D4	Port C4	Tx21
B D5	Port C5	Tx22
B D6	Port C6	Tx16
B D7	Port C7	Tx17
LVAL		Tx24
FVAL		Tx25
DVAL		Tx26
EEN		Tx23
TXD out	Ser TFG	
RXD in	Ser TC	
Trig in	CC1	
NC	CC2	
NC	CC3	
NC	CC4	

CL medium configuration					
Connector 1			Connector 2		
Camera signals 10 bit	Camera Link Port	CL Pin No.	Camera signals 10 bit	Camera Link Port	CL Pin No.
R D0	Port A0	Tx0	NC	Port D0	Tx0
R D1	Port A1	Tx1	NC	Port D1	Tx1
R D2	Port A2	Tx2	NC	Port D2	Tx2
R D3	Port A3	Tx3	NC	Port D3	Tx3
R D4	Port A4	Tx4	NC	Port D4	Tx4
R D5	Port A5	Tx6	NC	Port D5	Tx6
R D6	Port A6	Tx27	NC	Port D6	Tx27
R D7	Port A7	Tx5	NC	Port D7	Tx5
R D8	Port B0	Tx7	G D0	Port E0	Tx7
R D9	Port B1	Tx8	G D1	Port E1	Tx8
NC	Port B2	Tx9	G D2	Port E2	Tx9
NC	Port B3	Tx12	G D3	Port E3	Tx12
B D8	Port B4	Tx13	G D4	Port E4	Tx13
B D9	Port B5	Tx14	G D5	Port E5	Tx14
NC	Port B6	Tx10	G D6	Port E6	Tx10
NC	Port B7	Tx11	G D7	Port E7	Tx11
B D0	Port C0	Tx15	G D8	Port F0	Tx15
B D1	Port C1	Tx18	G D9	Port F1	Tx18
B D2	Port C2	Tx19	NC	Port F2	Tx19
B D3	Port C3	Tx20	NC	Port F3	Tx20
B D4	Port C4	Tx21	NC	Port F4	Tx21
B D5	Port C5	Tx22	NC	Port F5	Tx22
B D6	Port C6	Tx16	NC	Port F6	Tx16
B D7	Port C7	Tx17	NC	Port F7	Tx17
LVAL		Tx24	LVAL		Tx24
FVAL		Tx25	FVAL		Tx25
DVAL		Tx26	DVAL		Tx26
EEN		Tx23	NC		Tx23
TXD out	Ser TFG				
RXD in	Ser TC				
Trig in	CC1				
NC	CC2				
NC	CC3				
NC	CC4				

Fig. 8. Connector 1 base configuration and connector 1 and 2 medium configuration

6. Functions and Operations

6.1. Basic functions

A 16-bit processor controls all functions in the CV-M9CL camera. The CCD sensor output is normalized in preamplifiers. The signals are then digitized to 12 bits. Digital gain control and look-up tables can do signal processing in 12 bits before it is truncated to a 10 or 8 bit camera link signal.
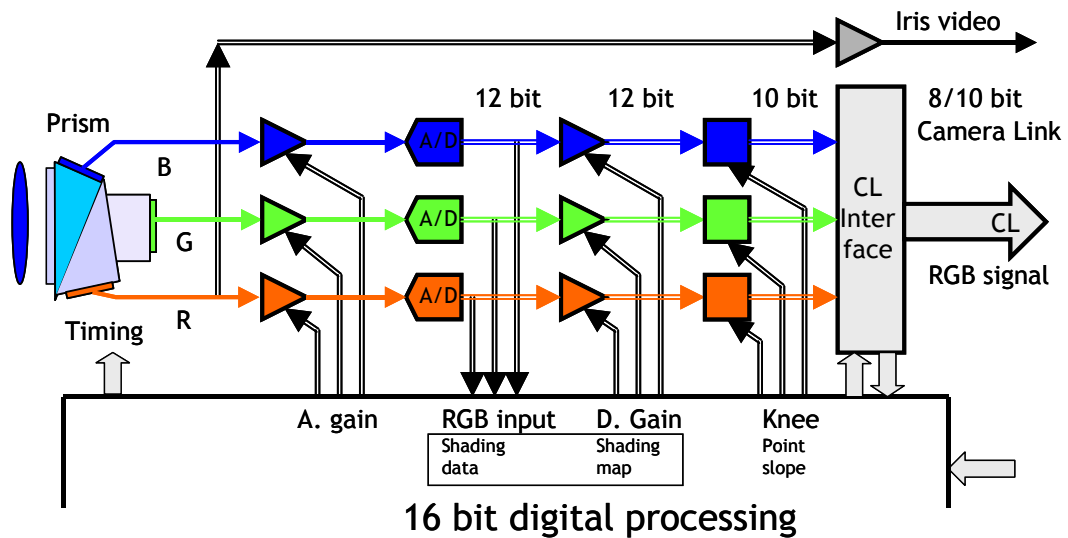
Fig. 9. Principle diagram for signal processing

6.1.1. Dynamic shading correction

The CV-M9CL camera has a digital shading correction circuit, which can compensate for prism chromatic shading, for lens vignetting and for CCD shading. It makes the choice of lenses wider. The camera with a given lens and a given f-number is looking on a homogeneous white scene. A horizontal profile of the shading in 128 points is made for the 3 colors.

A vertical profile of the shading in 96 points is made for the 3 colors.

The result is stored as gain difference from the image centre.

Data from this h and v profile is used to adjust the R, B and G gain depending of the H and V position. The resulting image is then compensated for shading caused by the lens, prism and CCD.

The lens used is a Fujinon 15mm F2.2.

The iris is set to F5.6.

With the camera control tool it is possible to customize the correction for a given set-up, and store the corrections in a file. Refer to chapter 6.5.1.
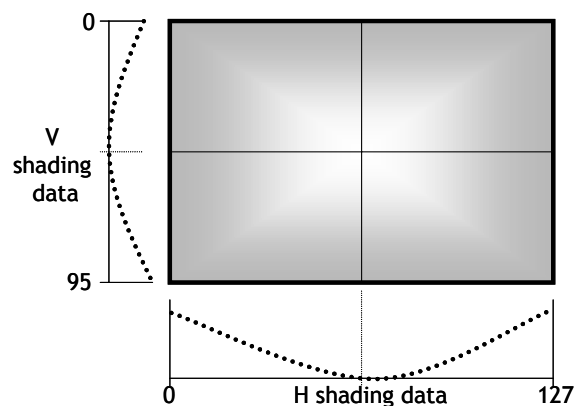
Fig. 10. Shading correction.

Note: Lens requirements.

To obtain the best possible image, it is recommended to use lenses designed for 1/3" 3 CCD cameras. The shading depends of the focal length and the iris setting. Avoid wide-angle lenses, and do not use an iris setting fully open.

6.1.2. Knee function

The internal video signal is 12 bit, and only 8 or 10 bit is output. By help of the look-up table function it is possible to compress or expand the video signal to change the dynamic range. It can be done individually for R, G and B with the knee function.

The Knee function is given by 2 sets of parameters. Knee point and slope. These 2 sets of data determine how the output would be with reference to the input data. This conversion is done by the hardware (FPGA) doing calculations using the knee data.

The normal transfer function is with a slope 1:1. From a given point and up, the slope can be changed. This point is the knee point parameter, and its range is from 0 to 1023 referring to the video output. Factory setting is 890.

The new slope can be set from 1:0 to 1:2. A slope 1:0 is a clipper function, which will limit the output signal. A slope 1:2 will function as a 2 times contrast expanding function.

The slope parameter range is from 0 to 4095.

0 is slope 1:0.

2048 is slope 1:1.

4095 is slope 1:2.

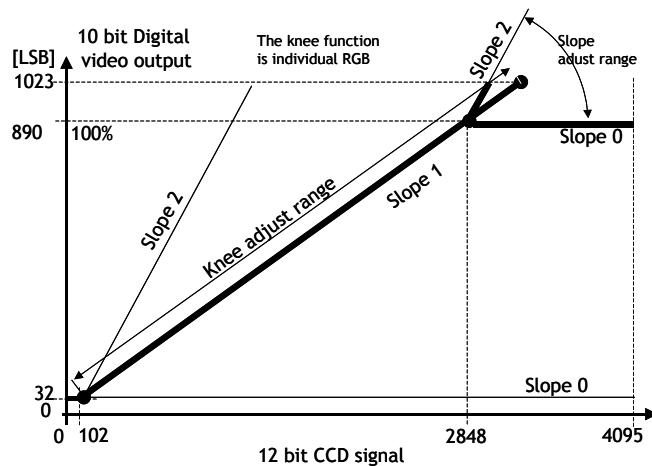Factory setting is 800. The slope is then 800/2048 =1: 0.39.

Fig. 11. Knee function.

6.1.3. Color bar for test

The CV-M9CL camera has a build in color bar generator. When it is activated, the output image will be as shown below. The RGB values are shown for both 8 and 10 bit output.
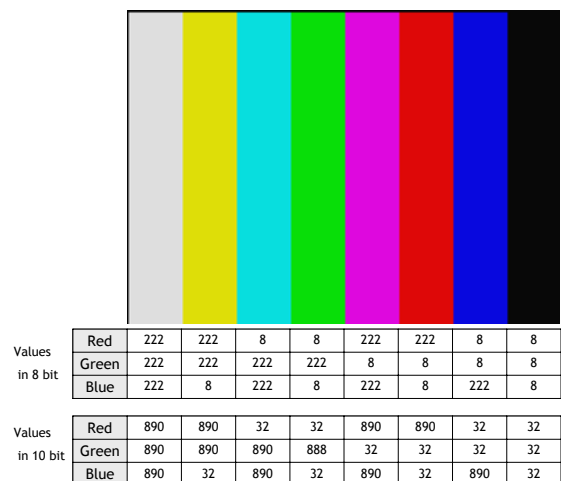

Values in 8 bit									
	Red	222	222	8	8	222	222	8	8
	Green	222	222	222	222	8	8	8	8
	Blue	222	8	222	8	222	8	222	8

Values in 10 bit									
	Red	890	890	32	32	890	890	32	32
	Green	890	890	890	888	32	32	32	32
	Blue	890	32	890	32	890	32	890	32

Fig. 12. Color bar RGB values

6.2. Sensor Layout and timing
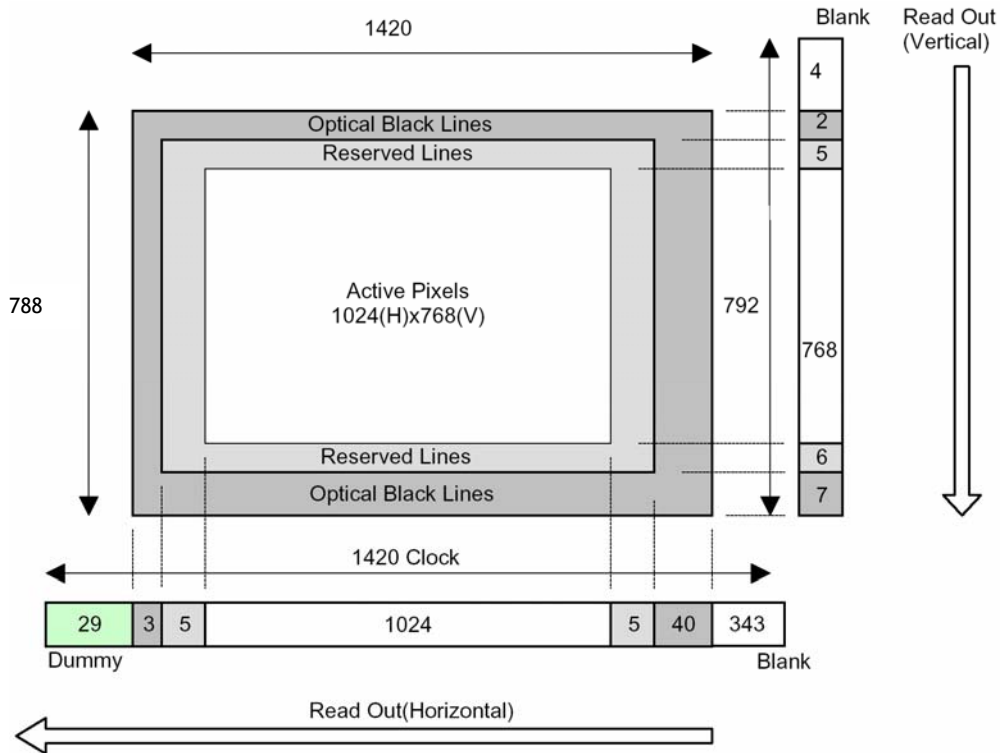
6.2.1. CCD Sensor Layout

Fig. 13. CCD sensor layout

Table for scanning.
The below table shows the start line, the stop line and the number of active lines in the vertical centred scanned area on the CCD sensor. The front and back lines are the lines used for the fast dump readout used in partial scanning.

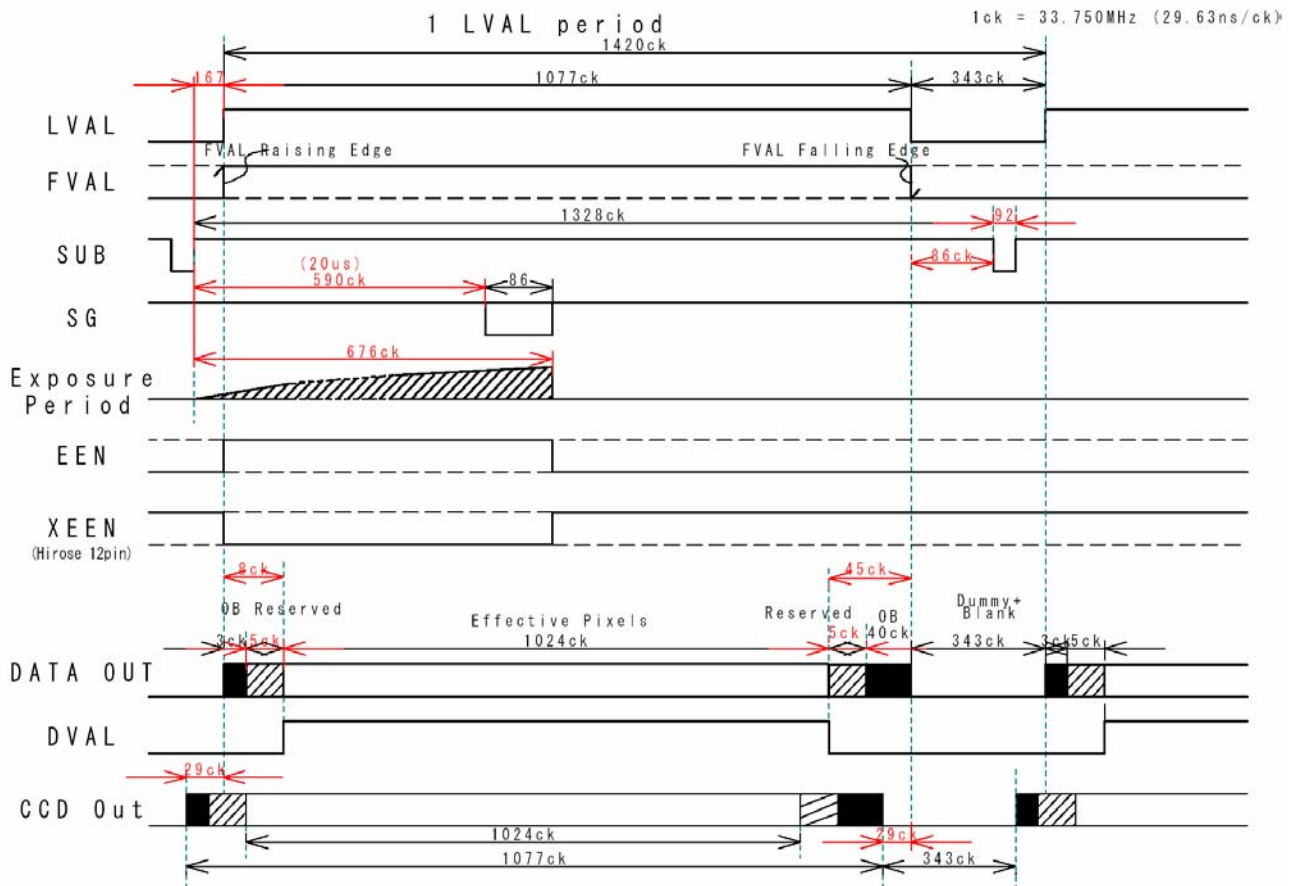|	Scanning	Start line #	End line #	Active lines	Front lines	Back lines	Blank lines	Remarks
SC=0	Full	1	768	768	12	8	4	*Refer to fig. 15.*
SC=1	1/2	192	576	384	54	50	4	*Refer to fig. 16.*
SC=2	1/4	288	480	192	78	74	4	*Refer to fig. 17.*
SC=3	1/8	336	432	96	90	86	4	*Refer to fig. 18.*

6.2.2. Horizontal timing

Fig. 14. Horizontal timing

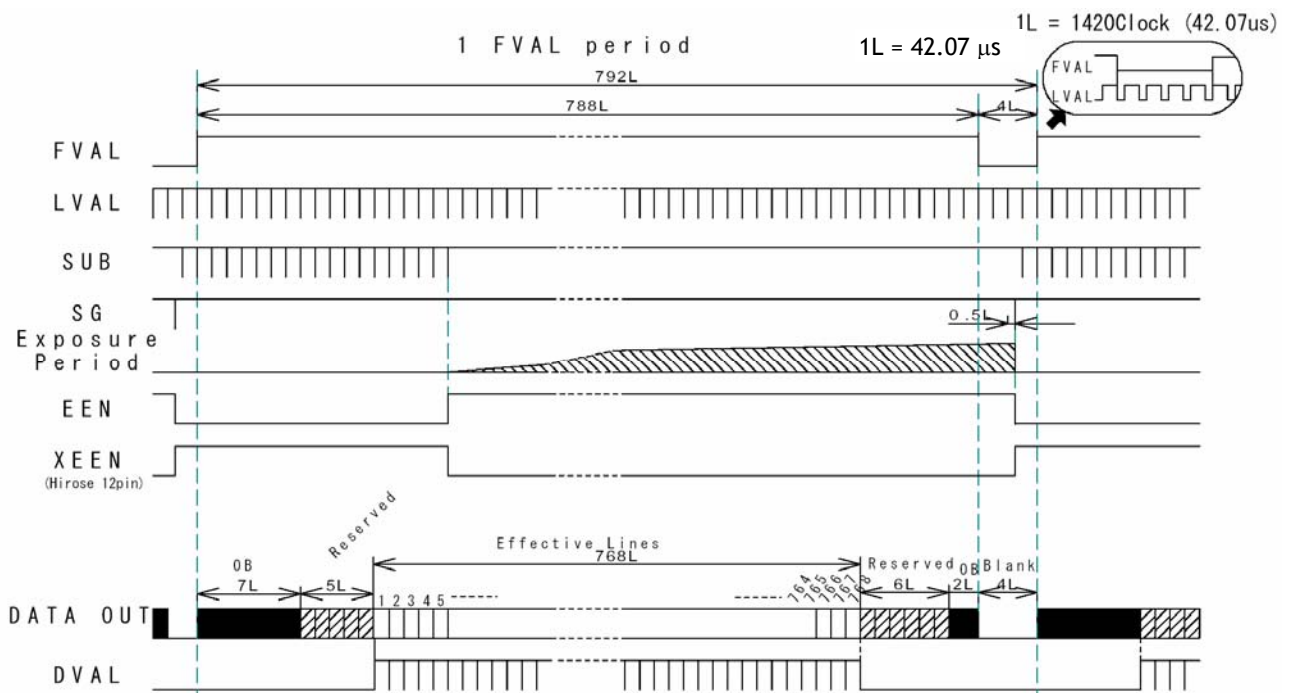### 6.2.3. Vertical timing

Fig. 15. Vertical timing for full scan
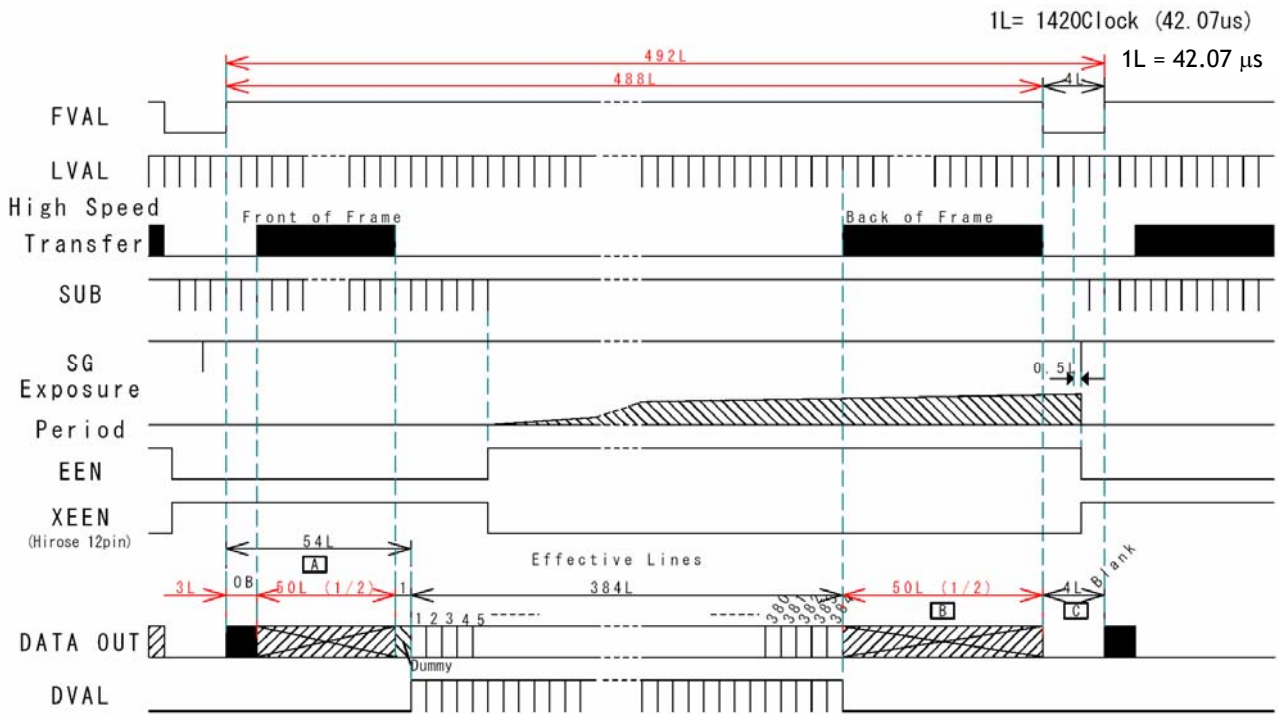
6.2.4. Partial Scanning
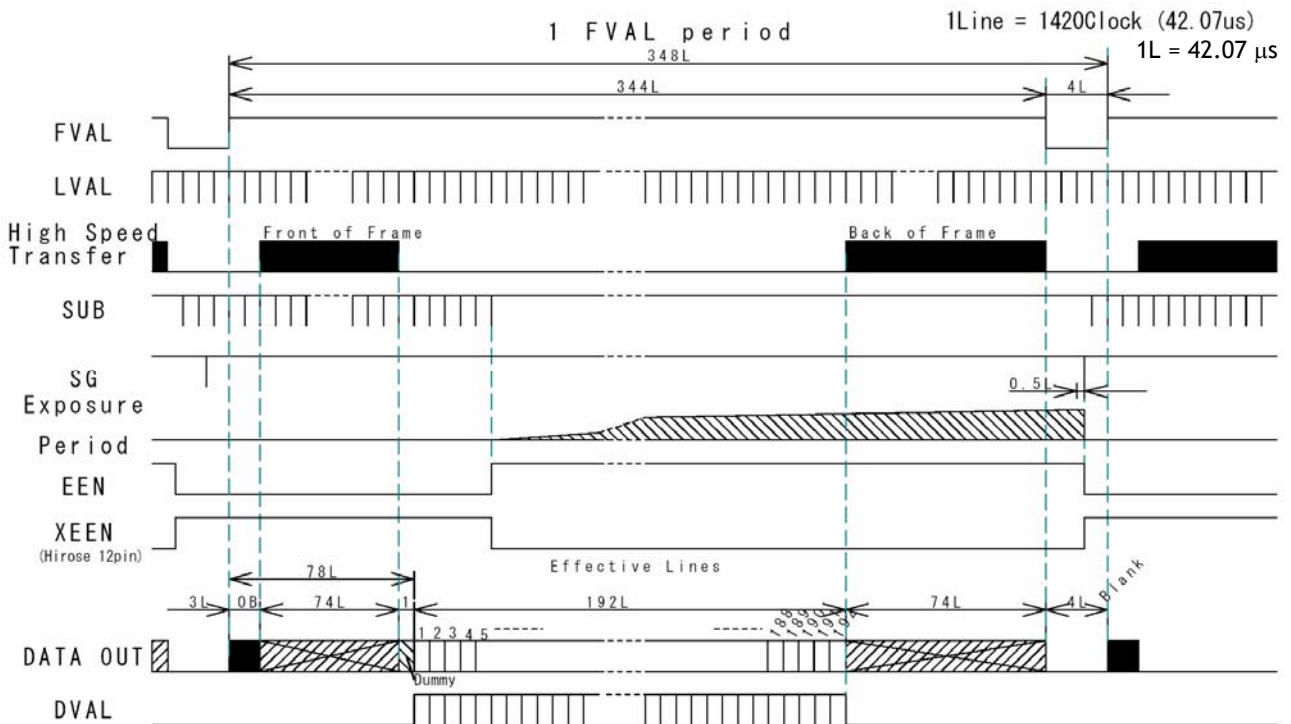

Fig. 16 Vertical timing for 1/2 partial scan

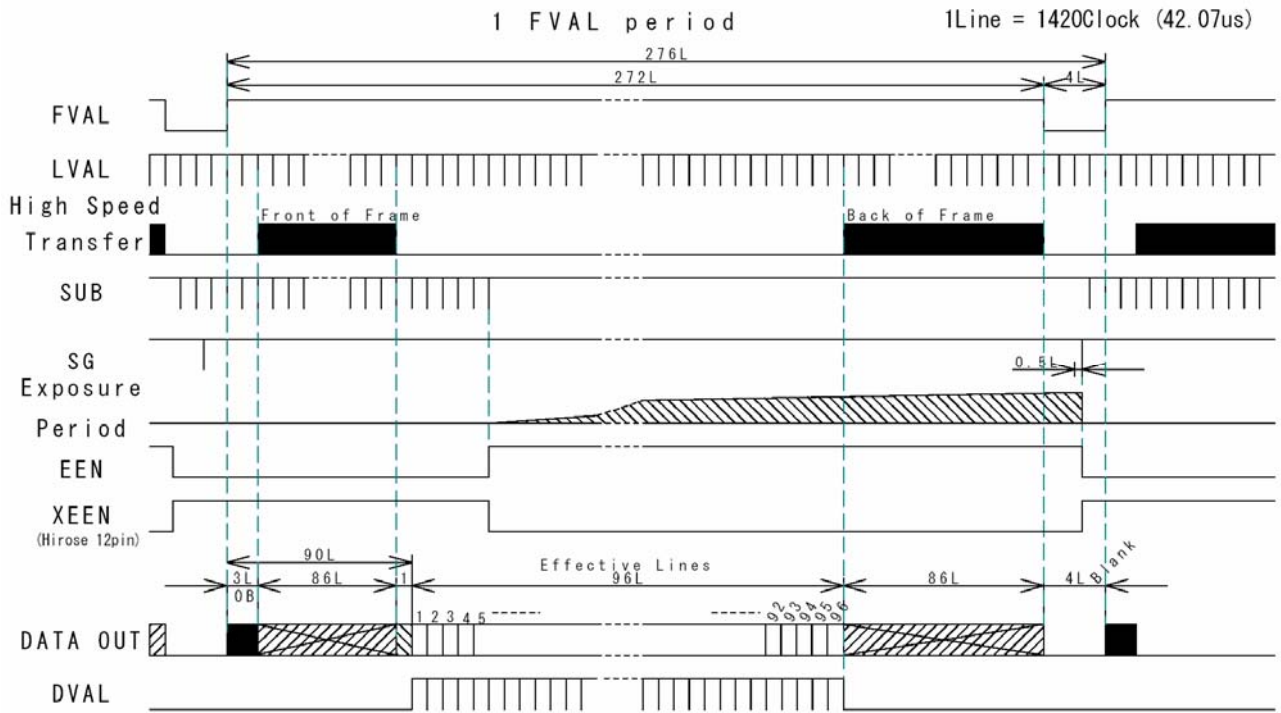Fig. 17 Vertical timing for 1/4 partial scan

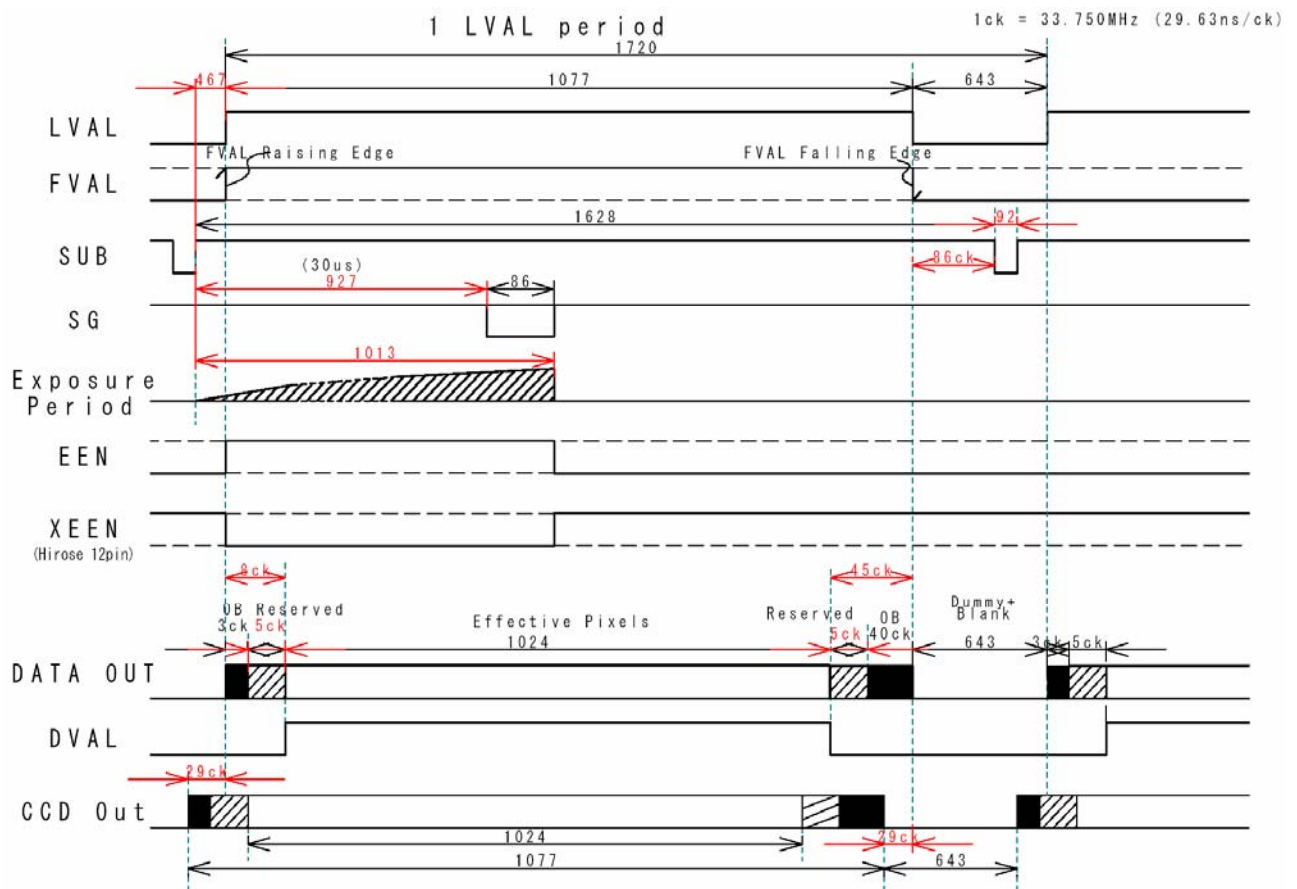Fig. 18 Vertical timing for 1/8 partial scan

6.2.5. Vertical binning

Fig. 19. Horizontal timing for V binning.
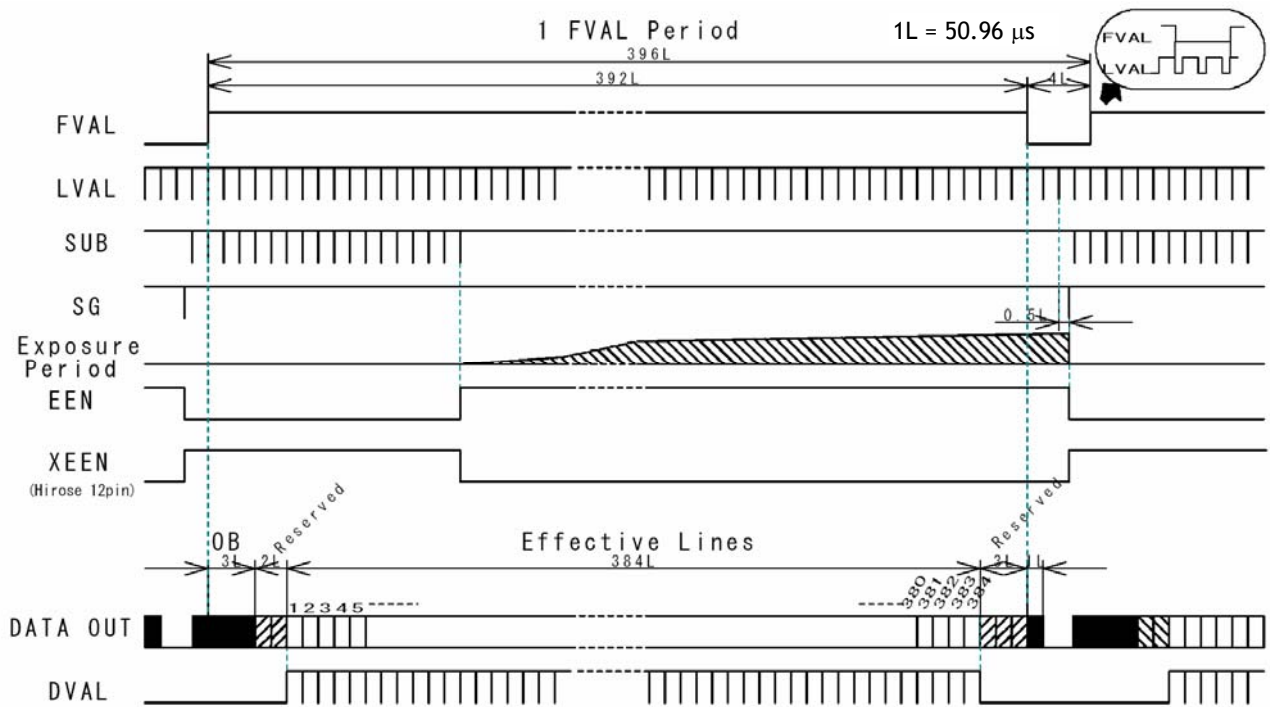
Fig. 20. Vertical timing for V binning.

6.3. Input/Output of Timing Signals

For settings, please refer to chapter "7. Configuring the Camera"

6.3.1. Input of external trigger

Input of external trigger signal can be via Camera Link (*TI=0*). Factory setting. Or as TTL on the 12 pin connector pin 10. (TI=1). Here it should be 4.0 Vp-p ±2.0 V from a 75 Ω source. The trigger input signal can be 75 Ω terminated. Factory setting is TTL. For 75 Ω termination SW301.2 should be ON.

6.3.2. Output of EEN (XEEN)

The Exposure Enable signal EEN indicate that the accumulation is ongoing. It can be used for controlling a strobe flash. The XEEN signal is found on the 12 pin connector pin 9. It is 4.0 Vp-p from a 75 Ω source. The EEN signal is also found in Camera Link.

6.4. Operation Modes

This camera can operate in 5 primary modes.

1.	*TR=0*	*Con*	***Normal continuous Mode***	Pre-selected exposure.
2.	*TR=1*	*EPS*	***Edge Pre-select Mode***	Pre-selected exposure.
3.	*TR=2*	*PWC*	***Pulse Width Control Mode***	Pulse width controlled exposure.
4.	*TR=3*	*SG*	***Sensor Gate Control***	Strobe illum. exp. with delayed read out
5.	*TR=4*	*RCT*	***Reset Continuous Trigger***	Pre-selected exposure.

The triggered accumulation in EPS, PWC and RTC mode can be LVAL synchronous or LVAL a-synchronous.

In **LVAL synchronous accumulation**, a new exposure can be started while the previous frame is read out. The new exposure should not be finished before the frame is read out. FVAL shall be low for >2 LVAL. The maximum frame rate in trigger modes can then be close to the frame rate in continuous mode.
The minimum trigger interval should be longer than (1 FVAL+2 LVAL).
To avoid <1L time jitter in LVAL synchronous mode, it is recommended to synchronize the trigger to LVAL.

In **LVAL a-synchronous accumulation**, 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 (exposure time + 1 FVAL+3 LVAL).

Refer to chapter 6.4.1. and 6.4.2. for accumulation details.

Refer to chapter "7. Configuring the Camera" for details in mode settings.

Mode and function matrix.
The following table shows which functions will work in the different modes.

	Func.	Shutter SM=		Part. sc SC= 0 to 3	Binning BI=1	Smearl SL=1	Accum LS=		Iris video out	
Mode	TR=	0	1				0	1		Remarks
Cont.	0	√	√	√	√	-	-	-	√	
EPS	1	√	√	√	√	√	√	√	-	
PWC	2	-	-	√	√	√	√	√	-	
SG	3	-	-	-	-	-	-	-	-	
RCT	4	√	√	√	√	√	√	√	√	

√ = ok, - = no function
Partial scanning has priority over Binning.

6.4.1. 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. (42.07 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 trigger modes with LVAL synchronous accumulation, a new exposure can be started while the previous frame is read out. The new exposure should not finish before the frame is read out. FVAL shall be low for >2 LVAL. The maximum frame rate in trigger modes can then be close to the frame rate in continuous mode.

Minimum trigger interval ≥ (1 FVAL + 2 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.
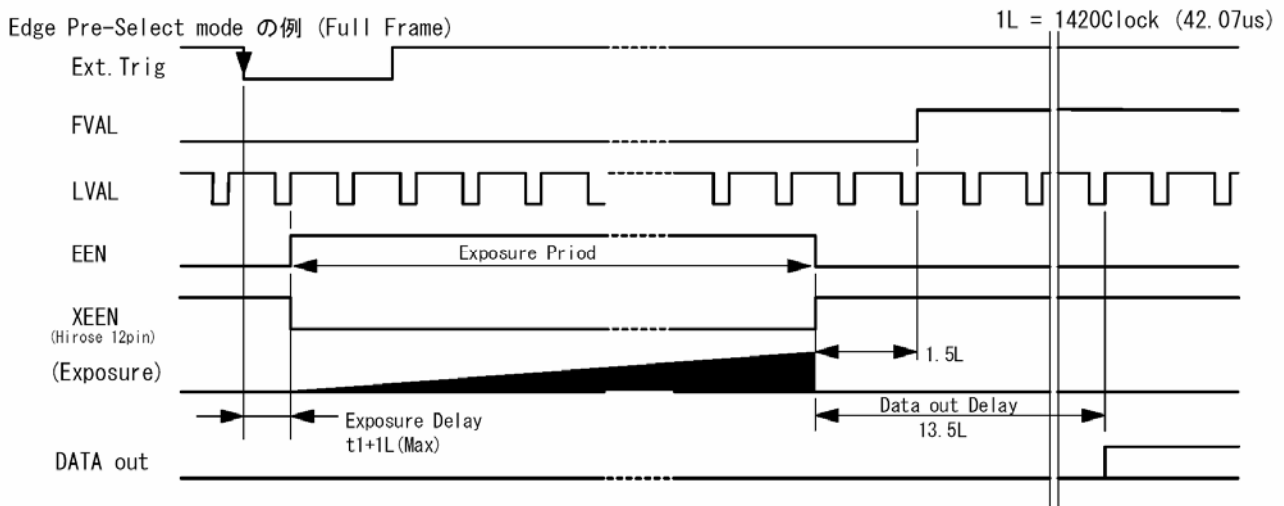
Fig. 21. LVAL synchronous accumulation in EPS mode
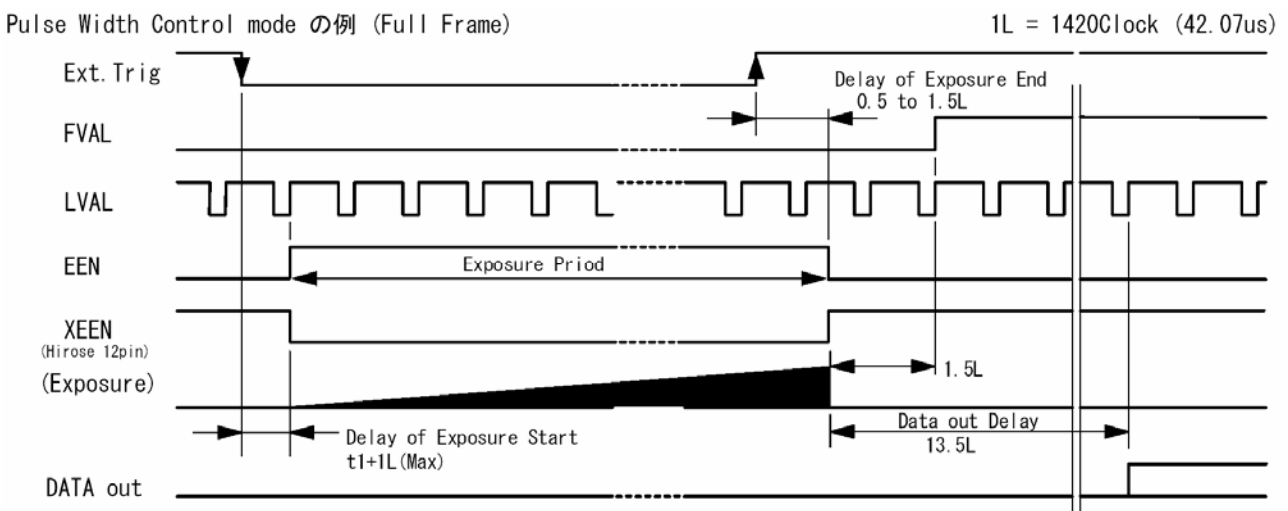
Fig. 22. LVAL synchronous accumulation in PWC mode

6.4.2. LVAL a-synchronous accumulation

With LS=1, the accumulation will start immediately after the trigger leading edge.
The exposure start delay is 9.7 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).

Minimum trigger interval ≥ (exposure time + 1 FVAL + 3 LVAL).

Important notes on using this mode.
In LVAL a-synchronous PWC mode there is no exposure jitter.
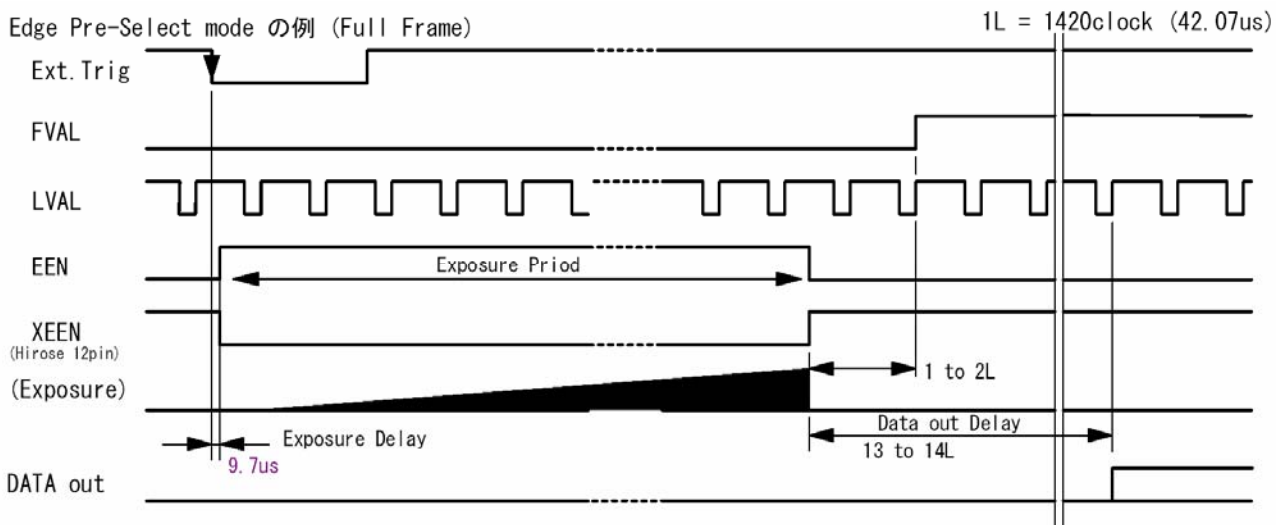
Fig. 23. LVAL a-synchronous accumulation in EPS mode
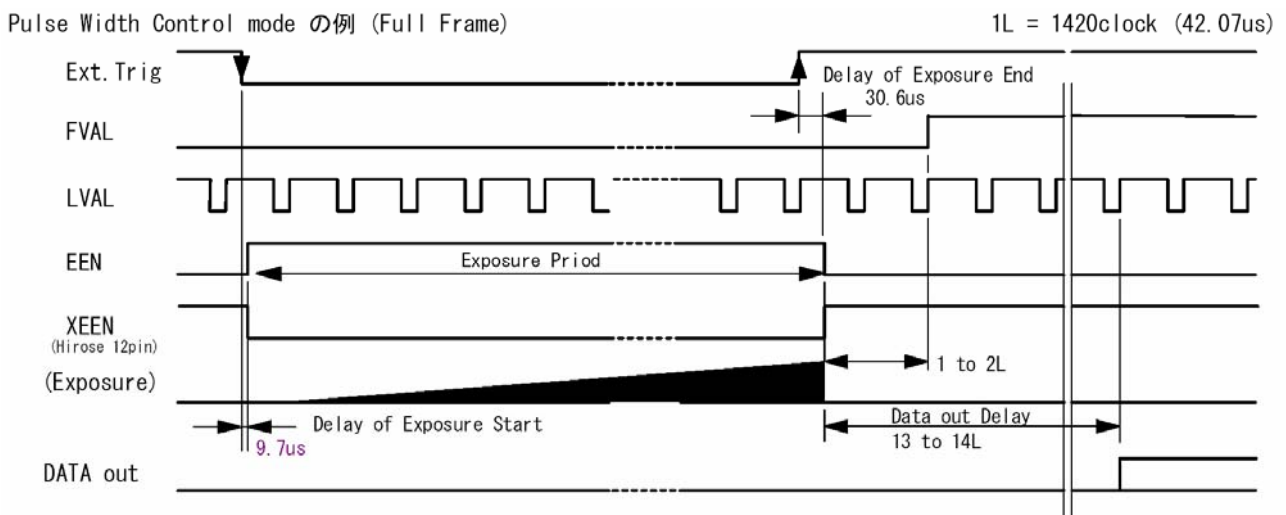
Fig. 24. LVAL a-synchronous accumulation in PWC mode

6.4.3. Continuous operation

For applications not requiring asynchronous external trigger, but should run in continuous operation, this mode is used.
In this mode it possible to use a lens with video controlled iris.
For timing details, refer to fig. 13. through fig. 20.

To use this mode:
Set function: Trigger mode to "Continuous"   TR=0
                                 Scanning   SC=0 through 3
                                 Vertical binning   BI=0, BI=1
                                 Shutter mode normal, programmable   SM=0 through 2
                                 Shutter speed   SH=0 through 11
                                 Programmable exp.   PE=0 through 791
                                 Other functions and settings
Input:

Important notes on using this mode

For timing details, refer to fig. 13. through fig. 20.

6.4.4. Edge Pre-select Trigger Mode

An external trigger pulse initiates the capture, and the exposure time (accumulation time) is the fixed shutter speed set by SH or PE. The accumulation can be LVAL synchronous or LVAL a-synchronous.
The resulting video signal will start to be read out after the selected shutter time.

For timing details, refer to fig. 13. through fig. 20. and fig. 25.

To use this mode:

Set function:	Trigger mode to "Edge pre-select"	TR=1
	Scanning	SC=0 through 3
	Vertical binning	BI=0, BI=1
	Shutter mode to normal or programmable	SM=0 through 2
	Shutter speed	SH=0 through 11
	Programmable exp.	PE=0 through 791
	Accumulation LVAL synch. or a-synch.	LS=0, LS=1
	Other functions and settings	
Input:	Ext. trigger. Camera Link or 12 HiRose	TI=0, TI=1

Important notes on using this mode

Trigger pulse >2 LVAL to <1 FVAL
To avoid $\leq$ 1 LVAL jitter in synch. accum, synchronize the trigger to LVAL.
Minimum trigger interval in synch. accum. $\geq$ (1 FVAL + 2 LVAL).
Minimum trigger interval in a-synch. accum. $\geq$ (exposure time + 1 FVAL + 3 LVAL).

Fig. 25. Edge pre-select. LVAL synchronized.

6.4.5. Pulse Width Control Trigger Mode

In this mode the accumulation time is equal the trigger pulse width. Here it is possible to have long time exposure. The maximum recommended time is <2 seconds.
The accumulation can be LVAL synchronous or LVAL a-synchronous.
The resulting video signal will start to be read out after the trigger rising edge.
For timing details, refer to fig. 13. through fig. 20. and fig. 26.

To use this mode:

Set function:	Trigger mode to "Pulse width control".	TR=2
	Scanning	SC=0 through 3
	Vertical binning	BI=0, BI=1
	Accumulation LVAL synch. or a-synch.	LS=0, LS=1
	Other functions and settings	
Input:	Ext. trigger. Camera Link or 12 HiRose	TI=0, TI=1

Important notes on using this mode

Trigger pulse width >2 LVAL to <1 seconds.
To avoid $\leq$ 1 LVAL jitter in synch. accum, synchronize the trigger to LVAL.
Minimum trigger interval in synch. accum. $\geq$ (1 FVAL + 2 LVAL).
Minimum trigger interval in a-synch. accum. $\geq$ (exposure time + 1 FVAL + 3 LVAL).

Fig. 26. Pulse width control. LVAL synchronized.
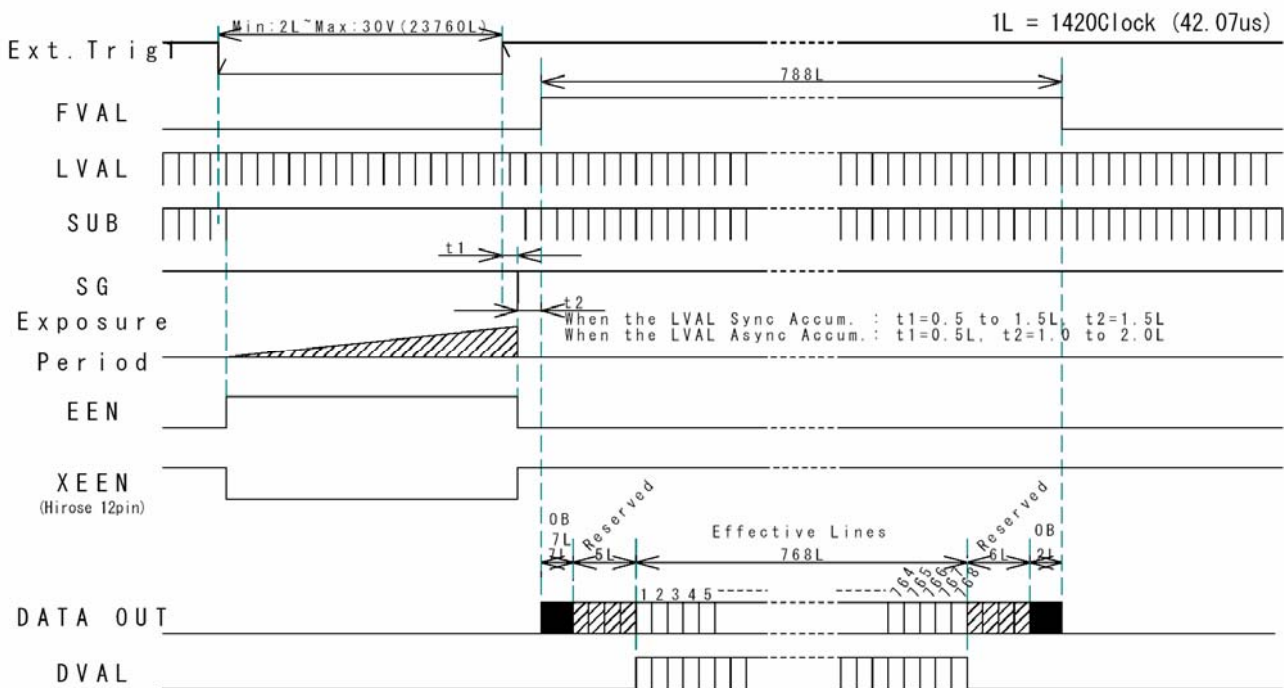
6.4.6. Reset Continuous Trigger mode

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 (198 L = 8.33ms), a new triggered exposure is started and read out as normal. The fast dump read out is performed with a speed 4 times faster as normal. 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 together with a triggered exposure.
For timing details, refer to fig. 13. through fig. 20. and fig. 27.

To use this mode:

Set function:	Trigger mode to "Reset continuous trigger".	TR=4
	Scanning	SC=0 through 3
	Vertical binning	BI=0, BI=1
	Shutter mode normal, programmable or auto	SM=0 through 2
	Shutter speed	SH=0 through 11
	Programmable exp.	PE=0 through 791
	Accumulation LVAL synch. or a-synch.	LS=0, LS=1
	Other functions and settings	
Input:	Ext. trigger. Camera Link or 12 HiRose	TI=0, TI=1

Important notes on using this mode

Trigger pulse >2 LVAL to <1 FVAL
To avoid ≤ 1 LVAL jitter in synch. accum, synchronize the trigger to LVAL.
Minimum trigger interval ≥ (exposure time + 1 FVAL + 2 LVAL + 198 LVAL).
A new trigger must not be applied before the previous triggered frame is read out.
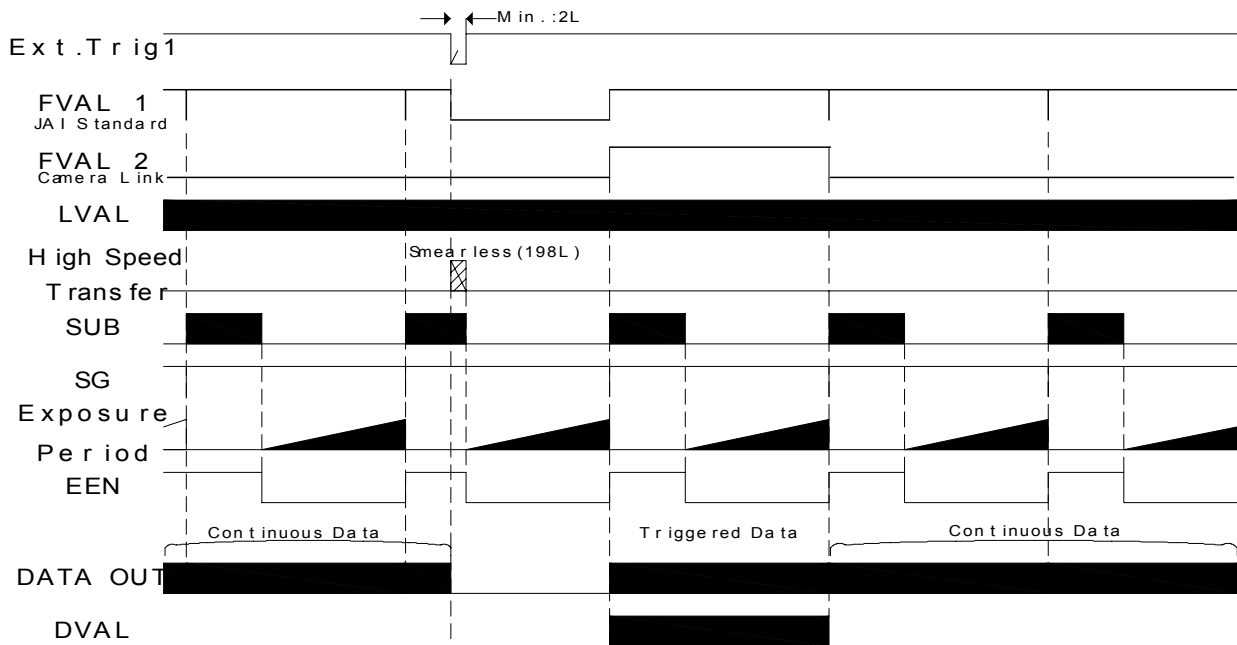
Fig. 27. Reset Continuous Trigger

6.4.7. Sensor Gate Control

This function is for applications with strobe flash illuminations or long time accumulations up to several frames. The external Sensor Gate control signal will disable the internal SG pulse so the accumulation will continue during the next frame. As long as the sensor gate control signal is low, the accumulation will continue. The resulting video is read out after the first FVAL (or SG), following the trailing edge of the Sensor Gate Control signal. Fig. 28.
To disable the internal SG pulse, the sensor gate control signal should be low 2 μs before.
Fig. 29. shows the sensor gate signal setup time and hold time. It is inside the first line after FVAL goes low.
For timing details, refer to fig. 13. through fig. 20. and fig. 28. - 29.

To use this mode:
Set function:	Trigger mode to "Sensor gate control".	TR=3
	Scanning	SC=0
	Vertical binning	BI=0
	Other functions and settings	
Input:	Ext. SG control to trigger input, CL or 12 pin HR	

Important notes on using this mode

Fig. 28. Sensor Gate Control

Minimum setup and hold time for external sensor gate control signal is shown in relation to the first LVAL after FVAL falling edge.

Fig. 29. Sensor Gate control signal minimum specifications

6.5. Other Functions.

Scanning. SC=0 through 3.
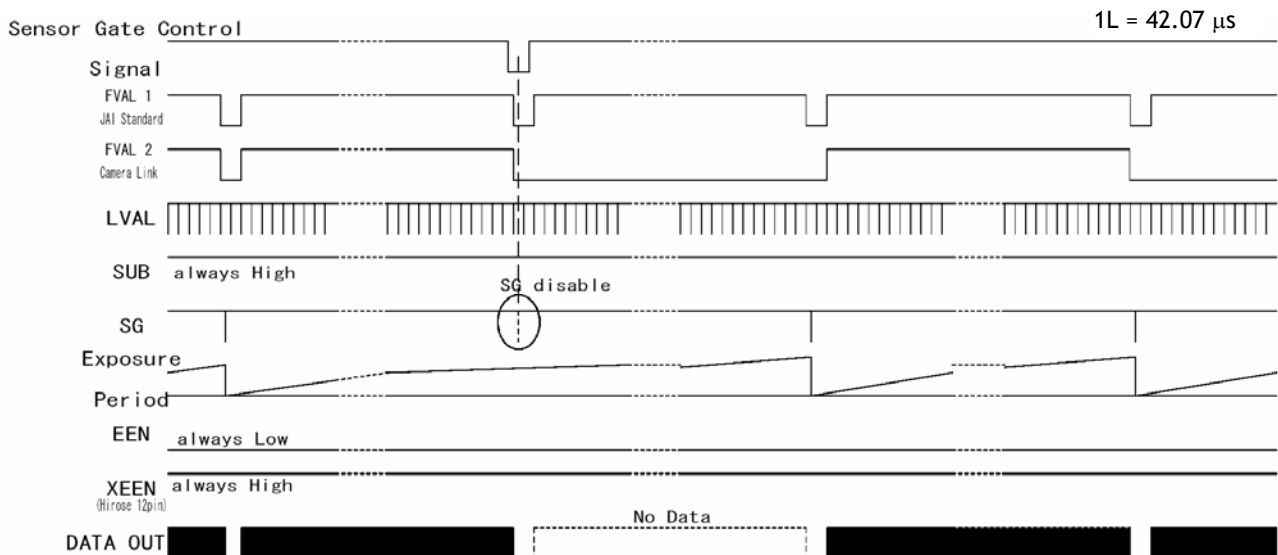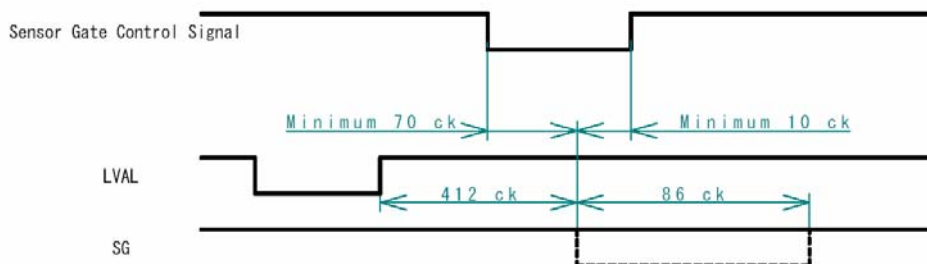The CCD scanning format can be selected between full or partial scanning. With partial scanning only the vertical central part of the CCD sensor is read out with a higher frame rate. The partial scan is done by a fast dump read out of the lines in the vertical ccd register down to the top of the partial image. The partial part of the image is read out with normal speed. The lines below the partial image is read out and dumped with a high speed. With partial scan the shutter speed is limited to be shorter than the frame read out time. There is no limitation in PWC mode.

Bit allocation. BA=0, BA=1.
The video output in Camera Link can be selected to be 10 or 8 bits (BA=0, BA=1). For 8 bits only the 8 most significant bits are output.
The relations between CCD signal output, normal analog video signal and the digital video signal are shown.

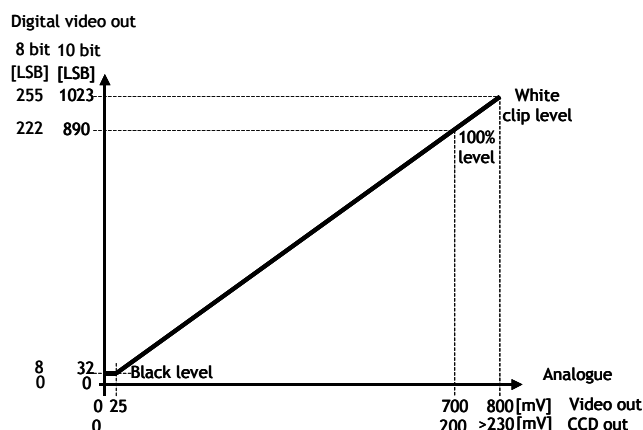| CCD out	Analog Signal	Digital Out(10bit)	Out(8bit)
Black	Setup 3.6% 25mV	32LSB	8LSB
200mV	700mV	890LSB	222LSB
>230mV	800mV	1023LSB	255LSB

Fig. 30. Bit allocation.

Binning. BI=0 through BI=1.
Binning mode is a function where the signal charge from 2 or more adjacent pixels are added together and read out as one pixel. A resulting full frame with lower spatial resolution can be read out with a higher rate, and higher sensitivity. The CV-M9CL has vertical binning 2:1.
Vertical binning is done by adding the pixel charge from adjacent lines together in the horizontal ccd register. It is done by multiple shift pulses to the vertical ccd register.
Lowest shutter speed is reduced to be shorter than the frame read out time. There are no limitations in PWC mode.

Smearless readout. SL=1.
This function will reduce the unwanted smear signal from a highlighted scene when a short exposure time is used. It works in all trigger modes, but a dummy readout is performed before the active accumulation is started. It will remove the smear above the highlighted parts in the image, but there is still smear left below highlighted areas.
The trigger leading edge will start the dummy readout. It takes 198 LVAL (8.33ms) before the exposure starts. The exposure stops and the resulting video signal is read out. This mode will operate with full and partial scanning and with all binning modes.

Color bar. CBAR=0, CBAR=1.
The command CBAR=1 insert a standard color test bar on the output image, so it can be used for calibration. For color bar specifications refer to chapter 6.1.3.

Shutter mode. SM=0, SM=1 and SM=2. SH=0 through SH=11 and PE=2 through PE=791.
With SM=0 this function selects the shutter from the 12 fixed steps (SH). With SM=1 from programmable in 789 steps (PE). SM=2 is for individual programmable exposure of red, green and blue. PER, PEG and PEB =2 through =791. It allows a wide range of manual color balance adjusting.

RCT FVAL type. *RF=0, RF=1.*
This command selects the FVAL type in RCT mode. Refer to chapter 6.4.6. Reset Continuous Trigger mode.

Trigger input select. *TI=0, TI=1.*
This function selects the trigger input to be through Camera Link (TI=0), or as TTL through the 12 pin Hirose connector (TI=1).

Trigger polarity. *TP=0, TP=1.*
The active trigger polarity is normal low (TP=0). It can be invert it to active high (TP=1).
Note: With TP=1 and TI=1, the first trigger pulse after power up will be ignored.

White balance. *WB=0 through, WB=4.*
By adjusting the R, G and B gain depending of the scene illumination color temperature it is possible to have correct color balance in the video output. A white scene will be shown as a white image. This white balance can be done in different ways.
WB=0 is for manual/one push white balance. In manual, the white balance can be changed by the gain settings. The one push white balance function is also active here. WB=1 is continuous white balance. WB=2, WB=3 and WB=4 are fixed values 3200K, 4600K and 5600K. Factory adjusted to 3200K.

One push white balance. *AW=0*
If the command WB=0 is received, an automatic white balance is performed once. The result of this function can be requested by the command AWRS?

*S*et Auto White Balance area*. *WA=*
This function makes it possible to set the one push white balance sensing area to the area of interest. WA=0 is the whole image, WA=1 through 9 are one of the 9 areas shown.

Full	upper left 1	upper middle 2	upper right 3
	middle left 4	middle 5	middle right 6
0	lower left 7	lower middle 8	lower right 9
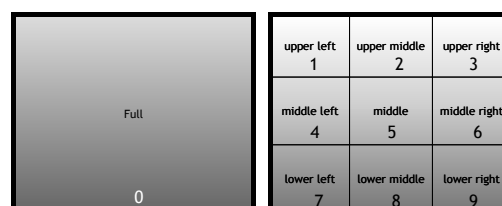
Fig. 31. Auto white balance areas.

Request result of one push white balance. *AWRS?*
If the request AWRS? is received, the camera will answer with the result of the one push white balance operation. "0" = complete, "1" scene is too bright, "2" scene too dark, "3" is timeout error, "4" is busy, "5" limit and "6" balance can't be done because camera is in trigger mode.

Master gain level. *GA=-132 through, GA=+429*
Sets the gain level for RGB. The range is –4dB to +13dB. GA=0 is 0dB.

Gain level red. *GAR=-231 through GAR=+231.*
The gain range for red is –7dB to +7 dB. GAR=0 is 0dB.

Gain level blue. *GAB=-231 through GAB=+231.*
The gain range for blue is –7dB to +7 dB. GAB=0 is 0 dB.

Black level green. *BLG=0 through BLG=1023.*
Set up level for green. Factory setting is 460.

Black level red. *BLR=0 through BLR=1023*
Set up level for red. Factory setting is 460.

Black level blue. *BLB=0 through BLB=1023.*
Set up level for blue. Factory setting is 460.

Knee function. KN=0, KN=1.
If KN=1 is received the knee function is enabled.
With the knee functions is possible to change the relation between CCD signal and the resulting output video signal. With the function disabled, the transfer slope is 1:1.
The level where the slope should be changed is set with the knee point settings. Its range is from 0 to 1023 related to the video output. Factory setting is 890. (100%).
From the knee point and up, the slope can be changed from the normal 1:1. The slope parameter range is from 0 to 4095, where 0 is slope 1:0, 2048 is slope 1:1, and 4095 is slope 1:2.
The slope range is from 0 to 2, where 0 is completely limitation (or clipping) and 2 is contrast expanding. Factory setting is 800. The slope is then 800/2048 or 0.39
For details refer to 6.1.2. Knee function.

Knee point red. KPR=0 through KPR=1023

Knee point green. KPG=0 through KPG=1023

Knee point blue. KPB=0 through KPB=1023

Knee slope red. KSR=0 through KSR=4095

Knee slope green. KSG=0 through KSG=4095

Knee slope blue. KSB=0 through KSB=4095

Shading Mode. SDM=0, SDM=1.
If the command SDM=1 is received, the shading corrector is enabled. This corrector will compensate for the color shading caused by the prism, for the circular shading caused by the lens vignetting and for CCD sensor shading.
The parameters for shading corrections are factory loaded with a given lens and f-number.
For details refer to 6.1.1. Dynamic shading correction.

For customoized shading correction, please refer to chapter 6.5.1. Customized shading correction.

LED for power and trigger.
On the camera rear a Light Emitter Diode is found. The light will be green when power is connected. For trigger pulse input an amber flash will be seen.

Iris video output.
On pin 4 on the 12 pin Hirose connector an analog video signal is found. It can be used for iris regulation if the camera is in continuous or RCT mode.
The curve shows the relation between the CCD signal output and the iris video output.
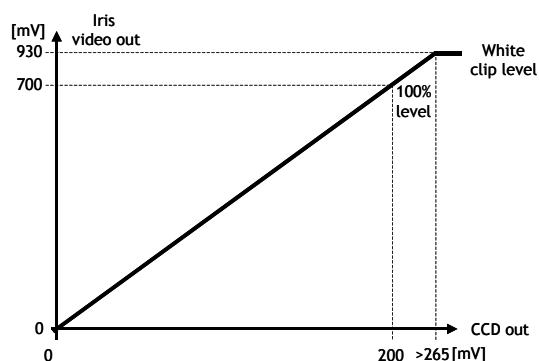100% video is 700 mV. The iris video output is without sync.

Fig. 32. Iris video output.

6.5.1. Customized shading correction.

From factory, the CV-M9CL camera is delivered with a shading correction adjusted to work with homogeny lightening coming from a DC regulated halogen lamp at 3200K and a certain Fujinon lens. This shading data stored in the factory area is also used for the 3 user areas. For other fixed illumination and for another fixed lens in a specific setup, it makes sense to make a temporary customized shading calibration.

When such calibration is done, it will be used in the camera until next power up. Here the old factory shading data will be called and used.

With the *Camera Control Tool* it is possible to store the customized shading corrections in a file. This file can then be loaded into the camera after next power up.

To make a customized shading calibration it is most important to avoid flickering of the lightening like AC powered light and also reflections should be avoided – such effects will interfere with the calibration. Apart from that the light temperature and the light density over the area of interest should be exactly as for the real setup.

The camera setting has to be as follows:
- Master gain 0dB
- Individual gain 0dB
- Shutter off
- Trigger modes off - use Normal mode
- Binning and Partial scan off
- Use 10 bit output mode
- Shading corrector off

Continue with the following:
- Set up the illumination, as it should be in the real application.
- Place a perfectly flat white object (piece of paper) at the actual scene. No reflections must be visible.
- Adjust the lens iris and focus to the level, which should be used in the real application.
- Make sure that the signal level at scene centre equals around 800LSB.
- When the above is okay then perform an Auto White Balance [command: *WB=1*].
- Be sure that no part of the image is saturated.
- Now the camera is ready to perform an Auto Shading Correction: [Command: *ATSH=0*].
- If the shading correction is successful, the camera will respond COMPLETE.
- Turn the shading on and off some times to verify the effect of the shading correction. [Command: *SDM=1* and *SDM=0*].
- *The new customized shading corrections data will be used for all user areas until factory area is called, or until next power up, where the factory shading corrections are called.*
- *With the camera control tool (version 1.2 or later), the customized shading data can be stored in a file. For later use, this file can then be loaded into the camera.*

6.6. Request Functions.

The following commands are for identification and help.
Fig. 33. 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 7.2. RS-232C control, and chapter 7.3. CV-M9CL 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. 33. left.

Help. *HP.*
If received, the camera will send back a help list for all functions. Refer to fig. 33. right.

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

PLD version. *PLD.*
If received, the camera will send back the PLD version number as a 4 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.

Change RS232C Baud Rate. *BDRT=0*   .
It is possible to change the communication speed from the normal 9600 Baud to a higher value.
BDRT=0 is 9600, BDRT=1 is 19200 and BDRT=2 is 38400 bps. The new speed will be effective after next power up. It is *not* possible to request for the baud rate. *(BDRT?)*

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. 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 is used as default settings at power up.

Save Settings. *SA.*
This command will store the actual camera settings to 1 of 3 user areas in the camera EEPROM. Factory settings can not be changed.

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

Printout of status and help list from the camera.
The below lists shows printout from a hyperterminal.

```
Fpga Init. NG
COMPLETE


ST?
SM=2
SH=2
PE=791
PER=250
PEG=250
PEB=250
TR=0
SL=0
LS=1
RF=1
TI=0
TP=0
SC=0
BI=0
BA=1
CBAR=0
WB=0
GA=0
GAR=0
GAB=0
BLG=0
BLR=0
BLB=0
KN=1
KSR=2048
KSG=2048
KSB=2048
KPR=890
KPG=890
KPB=890
WA=0
SDM=1

VN?
VN=100
PV?
PV=37
ID?
ID=A100016683
MD?
MD=
UD?
UD=
```

```
hp?
*** CV-M9 Camera Control Help List *******************************
EB(echo back): 0=off, 1=on
ST(status request): return the all settings
VN(firmware version request): return the version no. of firmware
UD(user ID request): return 16 letters of user ID
SM(Shutter Mode): 0=preset shutter (RGB common set), 1=programmable exposure
              (RGB common set), 2=programmable exposure(RGB individual set)
SH(Shutter Speed): 0=off, 1=1/60, 2=1/100, 3=1/120, 4=1/250, 5=1/500
              6=1/1000, 7=1/2000, 8=1/4000, 9=1/10000, 10=1/16000, 11=1/50000
PE(programmable exposure)(RGB common set): 0-791
PE(programmable exposure)(RGB common set): 0-791
PER(programmable exposure for Red): 0-791
PEG(programmable exposure for Green): 0-791
PEB(programmable exposure for Blue): 0-791
TR(trigger mode): 0=normal, 1=edge pre-select, 2=pulse width control
              3=sensor gate control, 4=reset continuous
SL(smearless mode): 0=off, 1=on
LS(lval synchronous accumulation): 0=sync., 1=async.
RF(rct fval type): 0=cameralink, 1=JAI standard
TI(trigger input): 0=camera-link, 1=hirose 12pin
TP(trigger polarity): 0=active low, 1=active high
SC(scanning format): 0=full frame, 1=1/2 partial, 1=1/4 partial, 1=1/8 partial
BI(binning): 0=binning off, 1=v binning
BA(output bit allocation): 0=10bit, 1=8bit
CBAR(color bar): 0=off, 1=on
WB(white balance): 0=manual/one push, 1=continuous, 2=3200K, 3=4600K, 4=5600K
GA(master gain level): -132-429
GAR(red gain level): -231-231
GAB(blue gain level): -231-231
AW(one push white balance): 0=one push
BLG(green black level): 0-1023
BLR(red black level): 0-1023
BLB(blue black level): 0-1023
KN(knee on/off): 0=on, 1=off
KSR(knee slope for red): 1-4095
KSG(knee slope for green): 1-4095
KSB(knee slope for black): 1-4095
KSR(knee point for red): 0-1023
KSG(knee point for green): 0-1023
KSB(knee point for black): 0-1023
SDM(shading mode): 0=on, 1=off
LD(Load settings from Flash memory): 0=factory, 1=user1, 2=user2, 3=user3
SA(Save settings in Flash memory): 1=user1, 2=user2, 3=user3
WA(Set auto white sampling Area): 0=full, 1=upper left, 2=upper middle,
              3=upper right, 4=middle left, 5=middle, 6=middle right,
              7=lower left, 8=lower middle, 9=lower right,
AWRS(Request one push W.Bal. result): 0=complete, 1=too bright, 2=too dark,
              3=timeout, 4=busy, 5=limit,
*** Firmware Version 1.00 ***** Copyright(c) 2003-2004 JAI Corporation *****
```

Fig. 33. Terminal printout of status, ID and Help.

7. Configuring the Camera

7.1. Setting by internal Switch SW301

SW 301 is used for communication port select and trigger termination. The switch is placed on the rear board behind the LED and WB button.

To access the switch:

        Remove the top cover frame. 6 screws.
        Remove the bottom cover frame. 6 screws.
        Remove left side cover. (Seen from rear). 5 screws.
        SW 301 is seen on the rear board behind the LED and WB button.

No	Functions	OFF	ON
1	Communication port switch	*LVDS (Camera Link)*	RS232C (HIROSE 12pin)
2	Trigger In Termination switch	*TTL*	75Ω

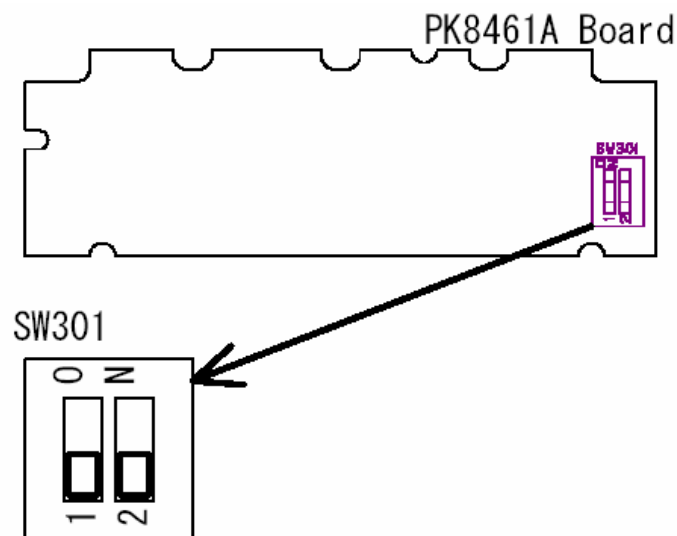Factory settings are shown in **Bold Italic**.

Fig. 34. Switch position
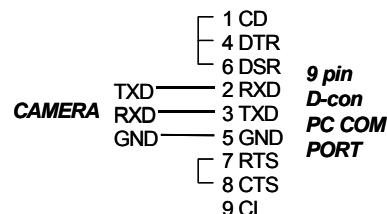
7.2. RS-232C control

All configuration of the CV-M9CL camera is done via the RS-232C port on the 12 pin HR connector or via Camera Link. (Internal switch SW301.1 off for HR). 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

```
                                      ┌ 1 CD
                                      ├ 4 DTR
                                      └ 6 DSR    9 pin
                            TXD ───── 2 RXD     D-con
                    CAMERA  RXD ───── 3 TXD     PC COM
                            GND ───── 5 GND     PORT
                                      ┌ 7 RTS
                                      └ 8 CTS
                                        9 CI
```

 *) Baud rates can be changed by RS232C commands. (9600bps to 38400 bps.)

Protocol.

Transmit setting to camera:
        NN=[Parameter]<CR><LF> (NN is any kind of command. Capital or small letters.)
The camera answers:
        COMPLETE<CR><LF>
Note: Some commands can only be requested.

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

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

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

7.3. CV-M9CL command list

	Command Name	Format	Parameter		Remarks
A – General settings and useful commands					
EB	Echo Back	EB=[Param.]<CR><LF>	0=echo off 1=echo on		Off at power up
ST	Camera Status request	ST?<CR><LF>			Actual setting
HP	Online Help request	HP?<CR><LF>			Command list
VN	Firmware version	VN?<CR><LF>			3 digits version
PV	PLD version request	PV?<CR><LF>			4 digits version
ID	Camera ID request	ID?<CR><LF>			10 characters
MD	Model Name request	MD?<CR><LF>			≤ 10 characters
UD	User ID (Free text)	TR=[Param.]<CR><LF>	User can save and load free text		≤ 16 characters
BDRT	Baud rate	BDRT=[Param.]<CR><LF>	0=9600 bps 1=19200 bps 2=38400 bps		At next power up
B – Video Output					
SC	Scanning format	SC=[Param.]<CR><LF>	0=full 1=1/2 partial 2=1/4 partial 3=1/8 partial		
BA	Output bit allocation	BA=[Param.]<CR><LF>	0=10 bit 1=8 bit		In Camera Link
BI	Vertical binning	BI=[Param.]<CR><LF>	0=off 1=V binning		Only when SC=0
SL	Smearless readout	SL=[Param.]<CR><LF>	0=off 1=on		
CBAR	Color Bar	CBAR=[Param.]<CR><LF>	0=off 1=on		Test image output
C – Trigger and shutter related commands					
TR	Trigger mode	TR=[Param.]<CR><LF>	0=Contin 1=EPS 2=PWC 4=RCT		
LS	LVAL accumulation	LS=[Param.]<CR><LF>	0= LVAL sync. 1= LVAL a-sync.		
SM	Shutter mode	SM=[Param.]<CR><LF>	0=RGB common EPS 1=RGB common PE 2=RGB individual PER, PEG and PEB		Only for TR=0 , TR=1 and TR=4
SH	Shutter speed	SH=[Param.]<CR><LF>	0=Off (1/30) 1=1/60 2=1/100 3=1/120 4=1/250 5=1/500 6=1/1000 7=1/2000 8=1/4000 9=1/10,000 10=1/16,000 11=1/50,00		When SM=0
PE	Programmable exp. RGB	PE=[Param.]<CR><LF>	0 to 791		RGB com. SM=1
PER	Programmable exp. Red	PER=[Param.]<CR><LF>	0 to 791		Red exp. SM=2
PEG	Programmable exp. Green	PEG=[Param.]<CR><LF>	0 to 791		Green exp. SM=2
PEB	Programmable exp. Blue	PEB=[Param.]<CR><LF>	0 to 791		Blue exp. SM=2
D- Signals and polarity					
RF	RCT FVAL type	RF=[Param.]<CR><LF>	0=CameraLink 1=JAI standard		
TI	Trigger Input	TI=[Param.]<CR><LF>	0= CamerLink 1= 12 pin Hirorose		
TP	Trigger polarity	TP=[Param.]<CR><LF>	0= active low 1= active high		
E – Gain and analogue signals setting					
WB	White Balance	WB=[Param.]<CR><LF>	0=Manual/One Push 1=Continuous AWB 2=3200K 3=4600K 4=5600K		
AW	One Push White balance	AW=[Param.]<CR><LF>	0=one push auto white balance		When WB=0
WA	Set Auto White Area	WA=[Param.]<CR><LF>	0=Full, 1=UL, 2=UM, 3=UR, 4=ML, 5=MM, 6=MR, 7=LL, 8=LM. 9=LR		Full or 1 of 9 areas
AWRS	Request Auto White result	AWRS?<CR><LF>	0=complete, 1=too bright, 2=too dark, 3=timeout, 4=busy, 5=limit, 6=trig not norm.		
GA	Master Gain level	GA=[Param.]<CR><LF>	-132 to +429		-4 to +13 dB,
GAR	Gain level Red	GA=[Param.]<CR><LF>	-231 to +231		-7 to +7 dB
GAB	Gain level Blue	GA=[Param.]<CR><LF>	-231 to +231		-7 to +7 dB
BLG	Black level Green	BLG=[Param.]<CR><LF>	0-1023 (0=low 1023=high)		Default=460
BLR	Black level Red	BLR=[Param.]<CR><LF>	0-1023 (0=low 1023=high)		Default=460
BLB	Black level Blue	BLB=[Param.]<CR><LF>	0-1023 (0=low 1023=high)		Default=460
KN	Knee On/Off	KN=[Param.]<CR><LF>	0=on 1=off		
KSR	Knee Slope for Red	KSR=[Param.]<CR><LF>	0 to 4095		Default=800
KSG	Knee Slope for Green	KSR=[Param.]<CR><LF>	0 to 4095		Default=800
KSB	Knee Slope for Blue	KSR=[Param.]<CR><LF>	0 to 4095		Default=800
KPR	Knee Point for Red	KPR=[Param.]<CR><LF>	0 to 1023		Default=890
KPG	Knee Point for Green	KPR=[Param.]<CR><LF>	0 to 1023		Default=890
KPB	Knee Point for Blue	KPB=[Param.]<CR><LF>	0 to 1023		Default=890
SDM	Shading Mode	SDM=[Param.]<CR><LF>	0=on 1=off		
ATSH	Shading Correction mask	ATSH=[Param.]<CR><LF>	0=Auto		Only 0 is allowed
F - Saving and loading data in EEPROM					
LD	Load settings from camera EEPROM	LD=[Param.]<CR><LF>	0=Factory data 1=User 1 area 2=User 2 area 3=User 3 area		Latest used data defa. at power up
SA	Save settings to camera EEPROM	SA=[Param.]<CR><LF>	1=User 1 area 2=User 2 area 3=User 3 area		Parameter = 0 is not allowed
EA	EEPROM area request	EA?<CR><LF>	0=Factory data 1=User 1 area 2=User 2 area 3=User 3 area		Return latest used area

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

8. Camera Control Tool for CV-M9CL

From www.jai.com Camera Control Tool for Windows 98/NT/2000 can be downloaded.
The control tool contains a camera control program and tools for making your own program.
For the integrator and experienced user, the Camera Control Tool is much more than a program
with a window interface. It also provides an easy and efficient ActiveX interface built for MS
Windows 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.

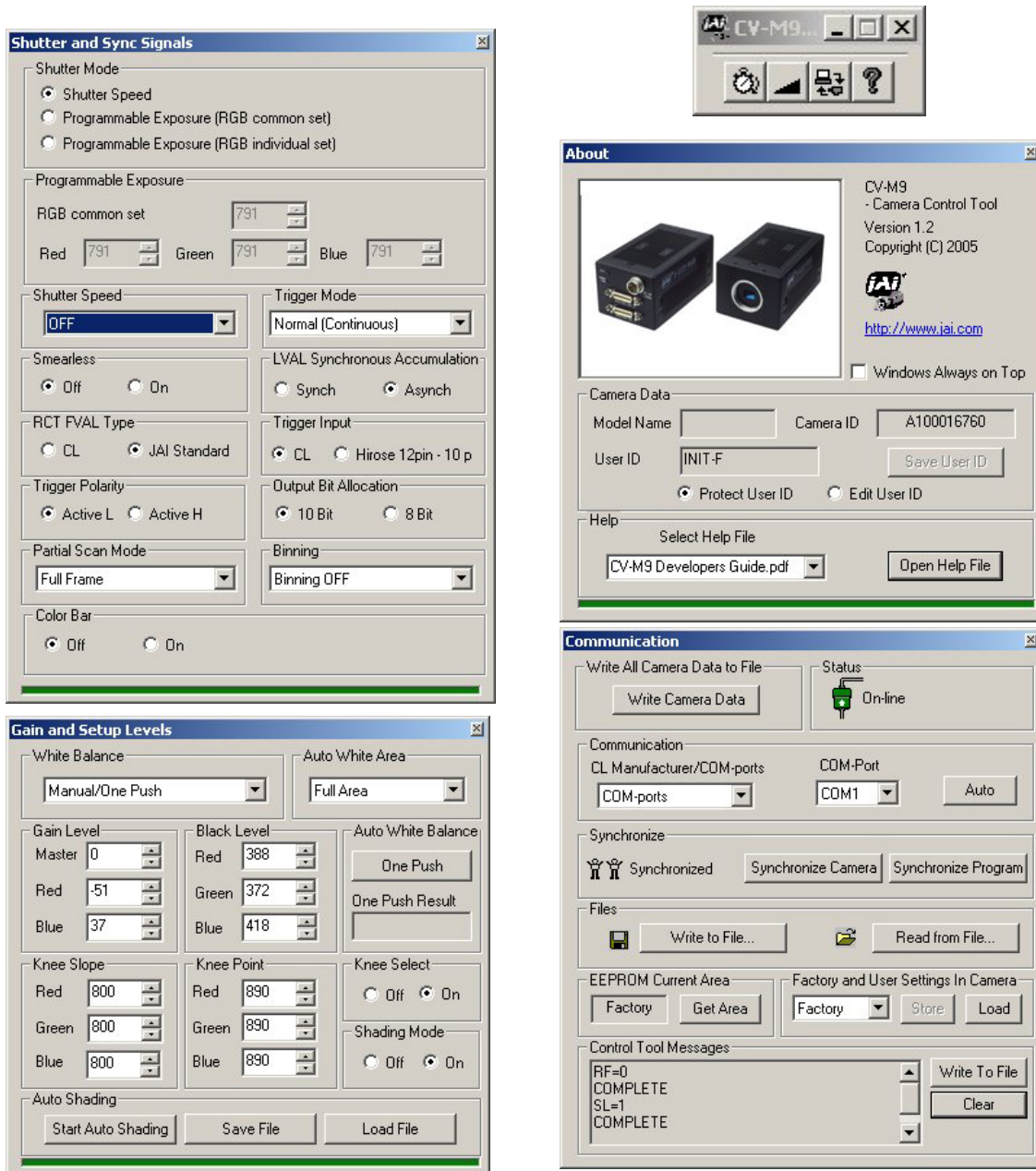## 8.1. Control Tool Windows

Fig. 35. Camera control tool windows.

8.2. Camera Control Tool Interface

The Camera Control Tool Software is based on a main Tool Bar and a number of associated Tool Windows. Each button in the Tool Bar pops up a separate Tool Window when pressed. The layout of the program can be adjusted by arranging the windows the way it is preferred. The program will store this information and recreate this layout, when the program is restarted.

All Camera Control Tools have a Communication Window and an About Window. The other window(s) contains camera control commands.

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.
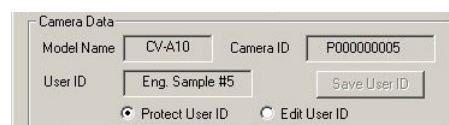
The Communication Window
The Communication Window is used to connect the Camera Control Tool with the JAI camera. Depending of camera there are 2 possible ways to communicate with a JAI camera.
RS-232:
Select the communication port, where the serial cable is connected from the list box in the 'Communication 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.
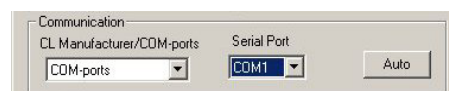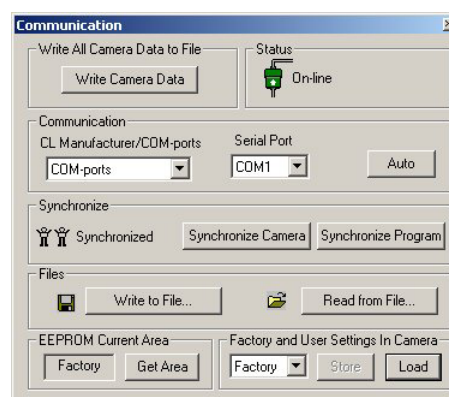
RS-232 communication:
1. Select 'COM-ports' from the 'CL Manufacturer/COM-ports' list Box.
2. Select the communication port, where the serial cable is connected to the camera from the 'Serial Port' list box or click the 'Auto' button to search for a camera on communication port 1 to 16.

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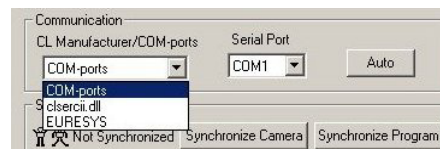
Camera Link communication:
The 'CL Manufacturer/COM-ports' list box also contains DLL file names (or frame grabber names) for all Camera Link frame grabbers that are installed in the pc. This is done by using a DLL file called "clserial.dll" to upload all frame grabber DLLs that are found in the pc.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

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

Off/On-line mode
The Camera Control Tool Application can run Offline (without a camera attached) and all functions are fully functional in offline mode.
Off line mode is indicated in The Communication Window, where a status field with graphic and text indicates the on/off-line status.
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.
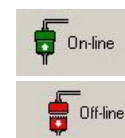
Changing the settings in the application will automatically update the camera settings when the application is online.
If the application looses connection with the camera it will automatically go to offline mode and it is indicated in the communication window.

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.
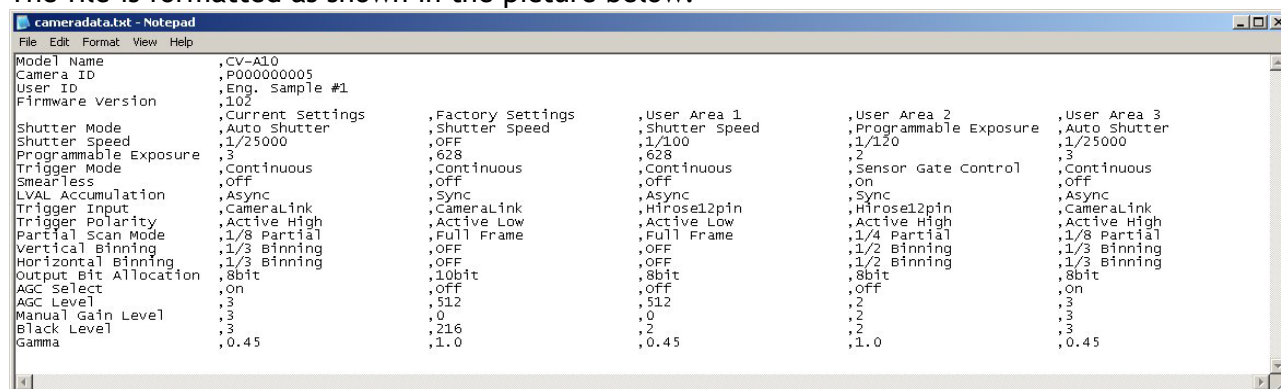Use the Load button to restore previously saved camera settings from either the Factory or the User EEPROM area.

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
```

EEPROM Current Area.
Click the 'Get Area' button to read the power up settings area number.
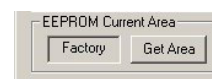
8.3. Using the Camera Control Tool

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 that are saved in the Camera Control Tool (last used settings) to the camera click "Synchronize Camera".
   c. To see which area the camera has started up in click "Get Area".

9. External Appearance and Dimensions
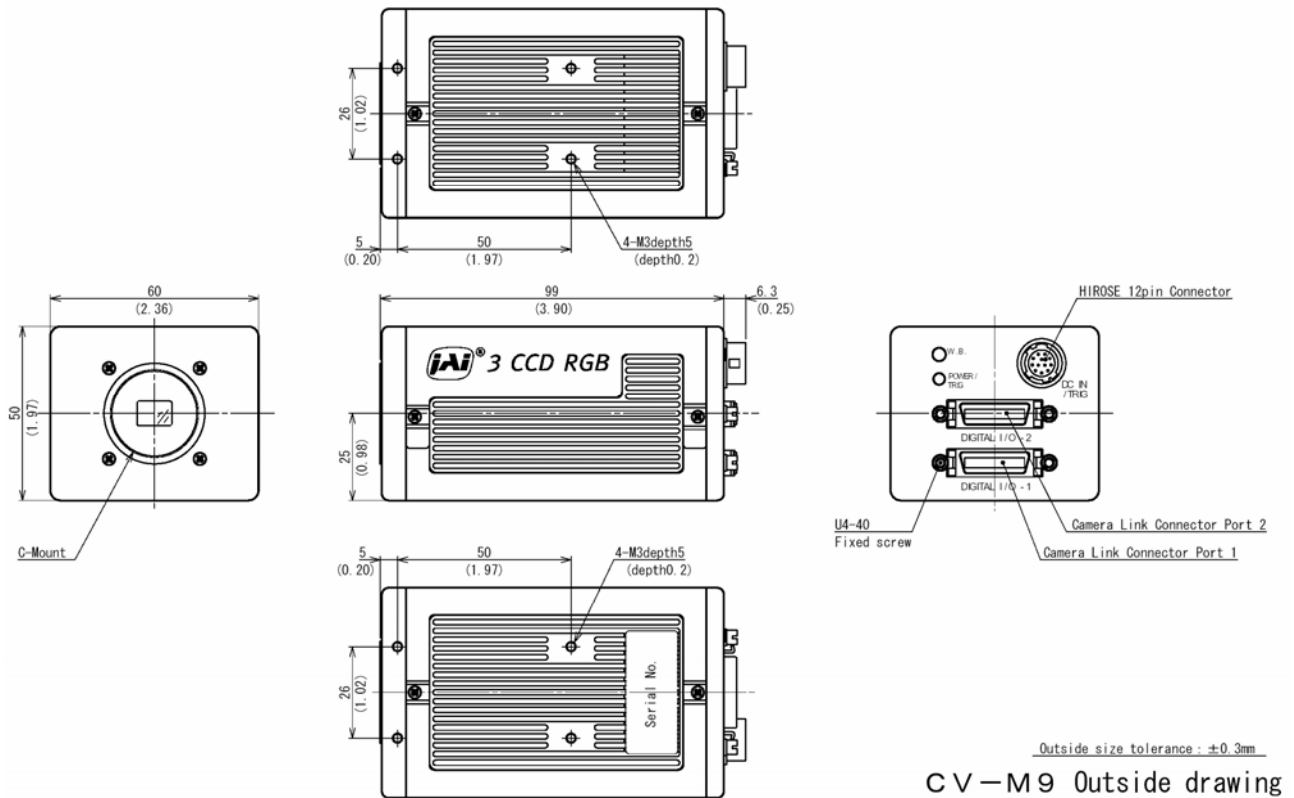
Note: *Rear protrusion on C-mount lens must be less than 4.0mm*

Fig. 37. Outline.

10. Specifications

10.1. Spectral sensitivity

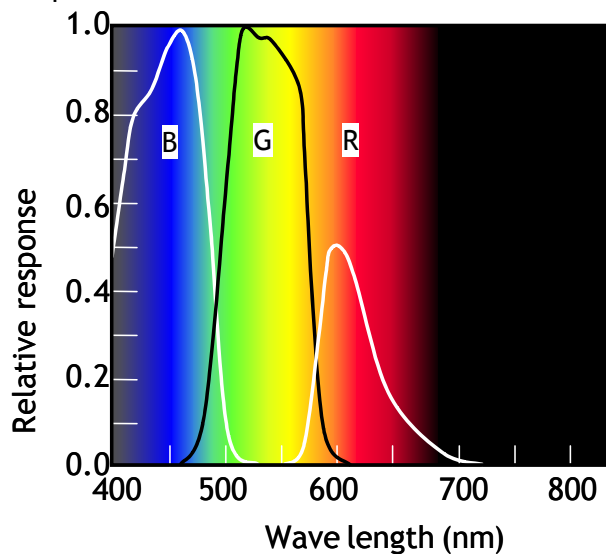The shown responses are for prism and CCD sensors combined.

Fig. 38. Spectral sensitivity for CV-M9CL

10.2. Specification table

Specifications	CV-M9CL
Scanning system	Progressive
Frame rate	30 fps (792 lines per frame)
Line frequency	23.768 kHz (1420 clk per line)
V binning	19.622 kHz (1720 clk per line)
Pixel frequency	33.75 MHz
CCD sensors	3 x 1/3" IT CCD on prism. Sony ICX204AL
Sensing area	4.8 (h) x 3.6 (v) mm
Effective pixels	1034 (h) x 779 (v)
Cell size	4.65 (h) x 4.65 (v) μm
Pixels in video output full	1024 (h) x 768 (v) 30fps. (792 lines per frame)
1/2 partial	1024 (h) x 384 (v) 48fps. (492 lines per frame)
1/4 partial	1024 (h) x 192 (v) 68fps. (384 lines per frame)
1/8 partial	1024 (h) x 96 (v) 86fps. (276 lines per frame)
V binning	1024 (h) x 384 (v) 50fps. (396 lines per frame)
Sensitivity (on sensor)	6 Lux, 0dB gain, 100% video
	2 Lux, max gain, 50% video
S/N ratio	>50 dB. (On Green)
Video outputs.	3 x 8 bit RGB via single port Camera Link base configuration
	3 x 10 bit RGB via dual port Camera Link medium configuration
Iris video output	0.7 Vpp, 75 Ω
Gamma	1.0
Gain	Manual for all 3 colors
Gain range	Master -3 to +12 dB. R and B –6 to +6 dB
White balance	Manual/one push, continuous, Fixed 3200K, 4600K, 5600K
Tracking range	-6 to +6 dB. (2800K to 6500K)
Dynamic shading correction	On/Off
Knee correction	Knee point and slope individually for RGB
Synchronization	Int. X-tal. or random trigger
Inputs TTL	Ext. trigger 4 Vpp $\pm$2 V. (TTL or 75 Ω)
Camera Link	Ext,. trigger
Outputs TTL	EEN output 4 Vpp from 75 Ω source
Camera Link	RGB 8/10 bit video output. D0 – D9
	Pixel clock, DVAL, LVAL, FVAL and EEN
Control interface	TXD and RXD via RS232C
	serTC and serTFG via Camera Link
Trigger modes	Continuous, Edge Pre-Select, Pulse Width Control,
	Reset Continuous Trigger and Sensor Gate control
Trigger function	LVAL synchronous or LVAL a-synchronous
Shutter speed (fixed).	1/30, 1/60, 1/100, 1/120, 1/120, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/10,000
	1/16,000 and 1/50,000 sec.
Programmable exposure	0L – 791L. RGB common or individual. (L=50.96μs.)
Pulse Width Control	>2L to <23760L (>84 μs to <1s)
Sensor gate control	>1Frame to <30 frames. (>1/30s to <1s)
Functions controlled by RS 232C or Camera Link	Trigger, Shutter, scanning, readout, polarity, gain, Set-up, white balance, knee point and slope
Operating temperature	-5°C to +45°C.
Humidity	20 - 80% non-condensing
Storage temp./humidity	-25°C to 60°C./20% - 90 % non-condensing
Vibration	10 G (15 Hz – 200 Hz in XYZ)
Shock	70 G
Regulations	CE (EN 50081-1, EN 50082-1) FCC part 15 class B
Power	12V DC $\pm$ 10%. 0.62A
Lens mount	C-mount. (Max 4.0 mm thread)
Flange back	17.526mm +0 –0.05mm
Optical axis	Centre $\pm$0.1mm
Dimensions	50 x 60 x 99 mm (HxWxD)
Weight	400 g

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

11. Appendix

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

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

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

Blemishes
Some pixel defects can occur, but this does not have en effect on the practical operation.

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.

11.3. References
1. This manual can and datasheet for CV-M9CL can be downloaded from www.jai.com
2. Camera control software can be downloaded from www.jai.com
3. Specifications for the CCD sensor Sony ICX-204AL can be found on www.jai.com

12. Users Record

Camera type: CV-M9CL

Revision: (Revision A)

Serial No.   ……………..

Firmware version.   ……………..

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

Users Mode Settings.

Users Modifications.

CE

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

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Supplement

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

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

重要注意事项

有毒，有害物质或元素名称及含量表

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

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

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

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。