JAI®

Digital Progressive Scan
RGB Color Camera

CV-M71 CL

Operation Manual

Camera: Revision A
Manual: Version 1.0

Table of Contents

1. General

The CV-M71CL is a RGB color camera based on a CCD sensor with primary RGB Bayer mosaic filter. The camera is from the CV-A70CL family, but here the RGB video output is done internally by interpolation in a DSP. The progressive scanned CV-M71CL has a RGB digital video output as 3 x 8 bit in Camera Link base configuration. For external host based color coding, the output can also be the raw Bayer signal as 8 or10 bit video in Camera Link. The frame rate for full frame is 60 fps. Functions like partial scanning allows frame rates up to 250 fps.

CV-M71CL is a compact color progressive scan camera designed for automated imaging applications. The 1/2" CCD with square pixels offers a superb image quality. The high-speed shutter function and asynchronous random trigger mode allows the camera to capture high quality images of fast moving objects.

The latest version of this manual can be downloaded from: www.jai.com
The latest version of Camera Control Tool for CV-M71CL 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 version:
CV-M71CL. Progressive scan RGB color camera.

3. Main Features

- Compact 1/2" digital progressive scan RGB color camera
- RGB primary color mosaic CCD (Bayer) with internal RGB coding
- 782 (h) x 582 (v) effective 8.3 µm square pixels
- 60 fps 767 (h) x 576 (v) by single channel progressive readout
- 250 fps 767 (h) x 71 (v) with 1/8 partial scan
- RGB output as 3 x 8 bit via Camera Link
- 8 or 10 bit raw output via Camera Link for host based RGB decoding
- High speed shutter from 1/60 to 1/300,000 second
- Internal, external VD/VD or random trigger synchronization
- Edge pre-select, pulse width and sensor gate modes
- Programmable exposure, auto shutter and smear less readout
- LVAL synchronous or asynchronous accumulation
- Fixed, manual or one push white balance
- Auto iris lens video output, auto shutter and AGC allow a wider light range
- Setup by Windows NT/2000/XP software via RS 232C or Camera Link

4. Locations and Functions
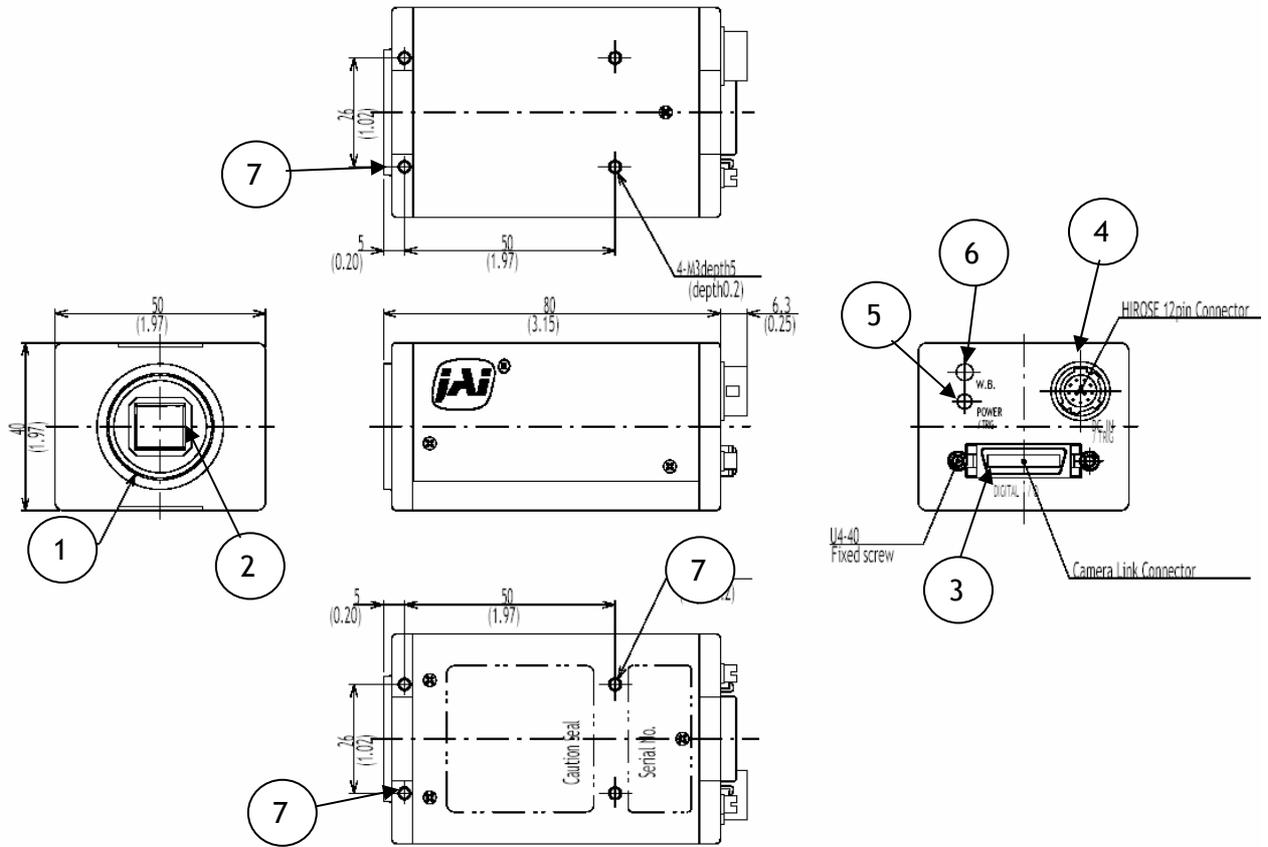
1   Lens mount of C-mount type. *1)
2   Interline-transfer CCD sensor.
3   Camera Link connector
4   12 pin connector for DC +12V power, RS232C and external sync signals
5   LED for power and trigger indication
6   White Balance button
7   Mounting holes 8 x M3deept4.

*1) **Note**:   *Rear protrusion on C-mount lens must be less than 9.0mm.*

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.)
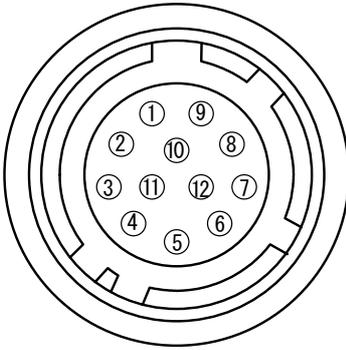
| Pin no.	Signal	Remarks
1	GND	
2	+12 V DC input	
3	GND	
4	Iris video	Only for Continuous mode. TR=0
5	GND	
6	HD input/ *RxD in*	SW301.2 ON for HD in. *OFF for RxD*. *1)
7	VD input/*TxD out*	SW301.3 ON for VD in. *OFF for TxD*. *1) *2)
8	GND	
9	XEEN out	Low during exposure
10	Trigger in	TI=1. Or Camera Link (TI=0). *1)
11	Reserved	
12	GND	

Notes: *1) See "7.1. Switch Settings" for more information.*
2) Do not input ext. VD in trigger modes.
Factory settings in *bold italic*.

Fig. 2. 12-pin connector.

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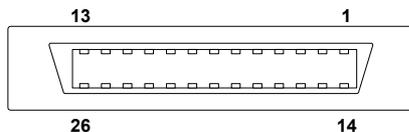
Type: 26 pin MRD connector
3M 10226-1A10JL

Fig. 3. Camera Link connector

The digital output signals follow the Camera Link standardized multiplexed signal output interface. Camera Link base configuration is used. 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 12 pin HR)
SerTFG	TxD serial data to frame grabber	(SW301.1. *Off for CL*. On 12 pin 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	8/10 bit 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. 8.

5.3. Input and output circuits

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

5.3.1. Iris video output

This signal can be used for lens iris control
in Continuous mode.
The signal is taken from the CCD sensor output
before the gain circuit. The video output is without
sync. The signal is 0.7 Vpp from 75 Ω without termination.
Do not use auto shutter (CCD iris) when auto iris lens is used.
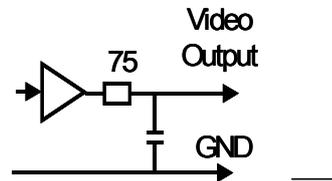
Fig. 4. Video output.

5.3.2. HD and VD input/RXD TXD

Pin #6 and #7 on the 12 pin connector is used for
HD/VD input or for the RS232C interface.
If the camera control is done via Camera Link,
the pins can be used for input of external HD and VD.
SW301.2: ON for ext. HD in. *OFF for RS232C RxD*.
SW301.3: ON for ext. VD in. *OFF for RS232C TxD*.
SW302.3: ON for HD 75Ω termination. *OFF forTTL*.
SW302.4: ON for VD 75Ω termination. *OFF forTTL*.
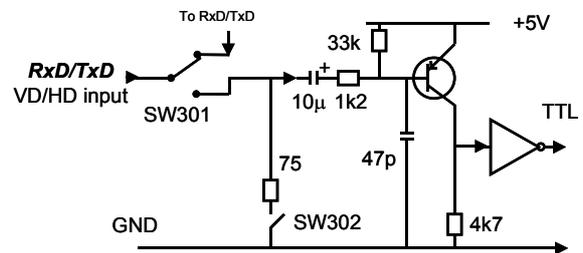
Fig. 5. HD/VD input, RS-232C

5.3.3. Trigger input

With TI=1, the trigger input is on pin #10 12 pin
connector. The input is AC coupled. To allow a long
width, the input circuit is a flip flop, which is toggled
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
SW302.1: ON for 75Ω. *OFF for TTL*.
The trigger inputs can be changed to
Camera Link. (TI=0 for CL)
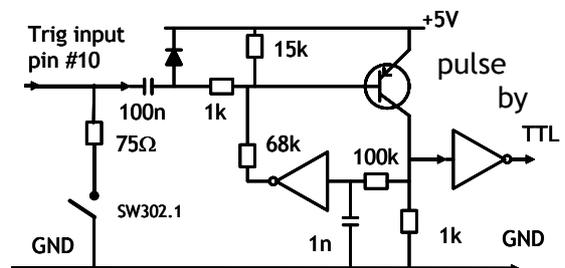
Fig. 6. Trigger input.

5.3.4. XEEN output

XEEN is 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).
EEN is also found in Camera Link.
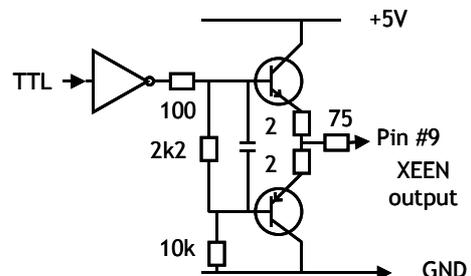
Fig. 7. XEEN output

5.3.5. Camera Link interface

The video output is Camera Link with 3 x 8 bit RGB video (or 10/8 bit raw video) placed in a base 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). The serial camera control can be switches between the 12 pin connector or CL by the internal switch SW301.1.
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	RGB 24 bit	Bayer 8 bit	Bayer 10 bit	Pin No.
Port A0	RD0	D2	D0	Tx0
Port A1	RD1	D3	D1	Tx1
Port A2	RD2	D4	D2	Tx2
Port A3	RD3	D5	D3	Tx3
Port A4	RD4	D6	D4	Tx4
Port A5	RD5	D7	D5	Tx6
Port A6	RD6	D8	D6	Tx27
Port A7	RD7	D9	D7	Tx5
Port B0	GD0	NC	D8	Tx7
Port B1	GD1	NC	D9	Tx8
Port B2	GD2	NC	NC	Tx9
Port B3	GD3	NC	NC	Tx12
Port B4	GD4	NC	NC	Tx13
Port B5	GD5	NC	NC	Tx14
Port B6	GD6	NC	NC	Tx10
Port B7	GD7	NC	NC	Tx11
Port C0	BD0	NC	NC	Tx15
Port C1	BD1	NC	NC	Tx18
Port C2	BD2	NC	NC	Tx19
Port C3	BD3	NC	NC	Tx20
Port C4	BD4	NC	NC	Tx21
Port C5	BD5	NC	NC	Tx22
Port C6	BD6	NC	NC	Tx16
Port C7	BD7	NC	NC	Tx17
LVAL				Tx24
FVAL				Tx25
DVAL				Tx26
EEN				Tx23

Camera Link bit allocation
D0 = LSB. D9 = MSB

Fig. 8. Principle diagram for Camera Link base configuration interface

6. Functions and Operations

6.1. Basic functions

The CV-M71CL camera is a progressive scan camera with a primary color mosaic CCD (Bayer). An internal DSP make the color-coding so a 3 x 8 bit RGB signal can be output in Camera Link. For external host PC color-coding, the raw video signal can be output as 8 or 10 bit in Camera Link. An analogue iris video signal can be used for lens iris control. The camera has 1/2, 1/4 or 1/8 partial scanning for faster frame rates.

There are 4 trigger modes. Normal continuous, edge pre-select, pulse width control and sensor gate control. The accumulation can be LVAL synchronous or LVAL a-synchronous. For trigger modes using fast shutter times, smear less read out is possible.

In the following some of the functions are shown in details.

Fig. 9. *Omitted.*

6.1.1. Sensor Gate Control

This function is for applications where a strobe flash is the only illumination, and where the exact time for the strobe firing is not known. The time window for the strobe firing can be up to several frames. The resulting video readout can also be delayed by this function. It makes the synchronization of the frame grabber more flexible.

The Sensor Gate Control signal will inhibit the internal SG signal so the accumulation can continue. The SG signal is an internal signal, which is low when the accumulated charge on the photo diode array is transferred to the vertical ccd registers for readout. When the Sensor Gate Control input is high, the internal SG pulse is inhibited, and the signal accumulation on the photo diode array can take place. After the strobe flash is fired, the Sensor Gate Control signal can be low. The resulting video is then read out after the first FVAL (or SG), following the falling edge of Sensor Gate Control signal.
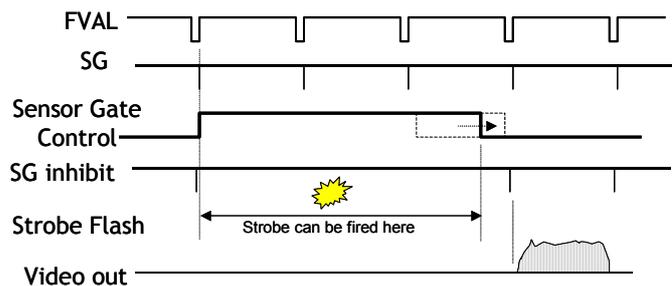
Fig. 10. Sensor Gate Control

6.1.2. CV-M71 CL Test pattern

The CV-M71CL 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 8 bit output.
The test pattern are output when the output select command OS=3.

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
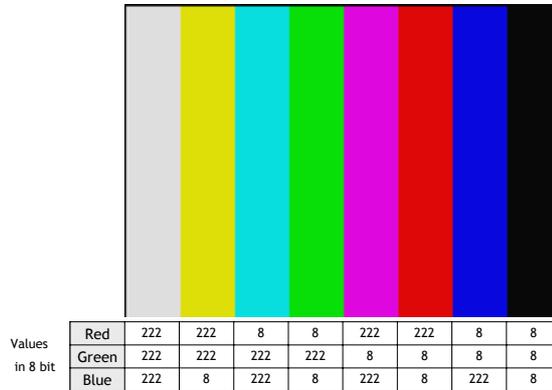
Fig. 11. CV-M71CL Test Pattern

6.1.3. CV-M71 CL. Bayer filter

CV-M71 CL is a color camera based on a CCD sensor with a Bayer RGB color mosaic. The internal DSP makes the RGB color–coding. RGB output if OS=0.
The color image reconstruction can then be done in the host PC frame grabber.
The Color sequence in the video signal differ from full scanning to partial scanning. The right hand drawing shows the color sequence at the image start.
The start line # is shown from LVAL.
The start pixel is # 11 from LVAL. It is when DVAL rise.
Even lines starts with GBG.
Odd lines starts with RGR
The raw video as 8/10 bit output if OS=1 or OS=2.
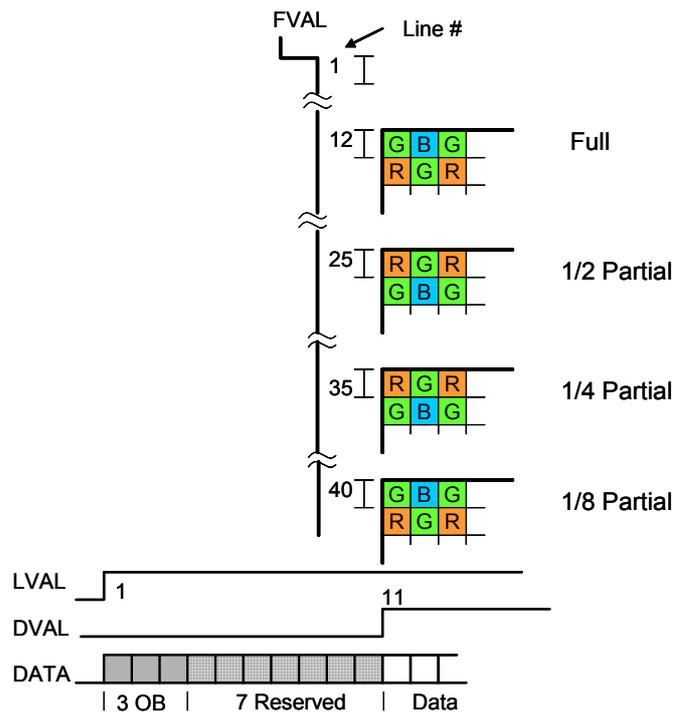
Fig. 12. CV-M71 CL Bayer RGB color sequence.

DSP color-coding

Pattern 1	1 R	2 Gr	3 R	R(5) = (R(1)+R(3)+R(7)+R(9)) / 4 G(5) = (G(2)+G(4)+G(6)+G(8)) / 4 B(5) = B(5)
	4 Gb	5 B	6 Gb	
	7 R	8 Gr	9 R	
Pattern 2	1 Gr	2 R	3 Gr	R(5) = (R(2)+R(8)) / 2 G(5) = G(5) B(5) = (B(4)+B(6)) / 2
	4 B	5 Gb	6 B	
	7 Gr	8 R	9 Gr	
Pattern 3	1 Gb	2 B	3 Gb	R(5) = (R(4)+R(6)) / 2 G(5) = G(5) B(5) = (B(2)+B(8)) / 2
	4 R	5 Gr	6 R	
	7 Gb	8 B	9 Gb	
Pattern 4	1 B	2 Gb	3 B	R(5) = R(5) G(5) = (G(2)+G(4)+G(6)+G(8)) / 4 B(5) = (B(1)+B(3)+B(7)+B(9)) / 4
	4 Gr	5 R	6 Gr	
	7 B	8 Gb	9 B	

The principle of Bayer RGB mosaic color interpolation.

1. Red and blue interpolation in Gr
2. Blue and green interpolation in R
3. Red and blue interpolation in Gb
4. Green and red interpolation in B
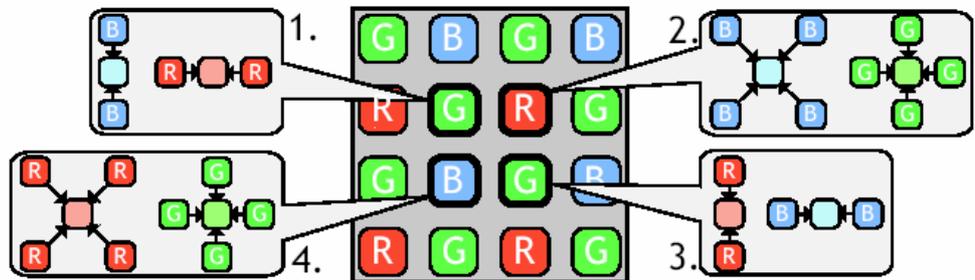
Fig. 13. Principle for DSP color-coding

6.2. Sensor Layout and timing

6.2.1. CCD Sensor Layout

The CCD sensor layout with respect to pixels and lines used in the timing and video full frame read out is shown below.

For Bayer color sequence, refer to chapter 6.1.3.
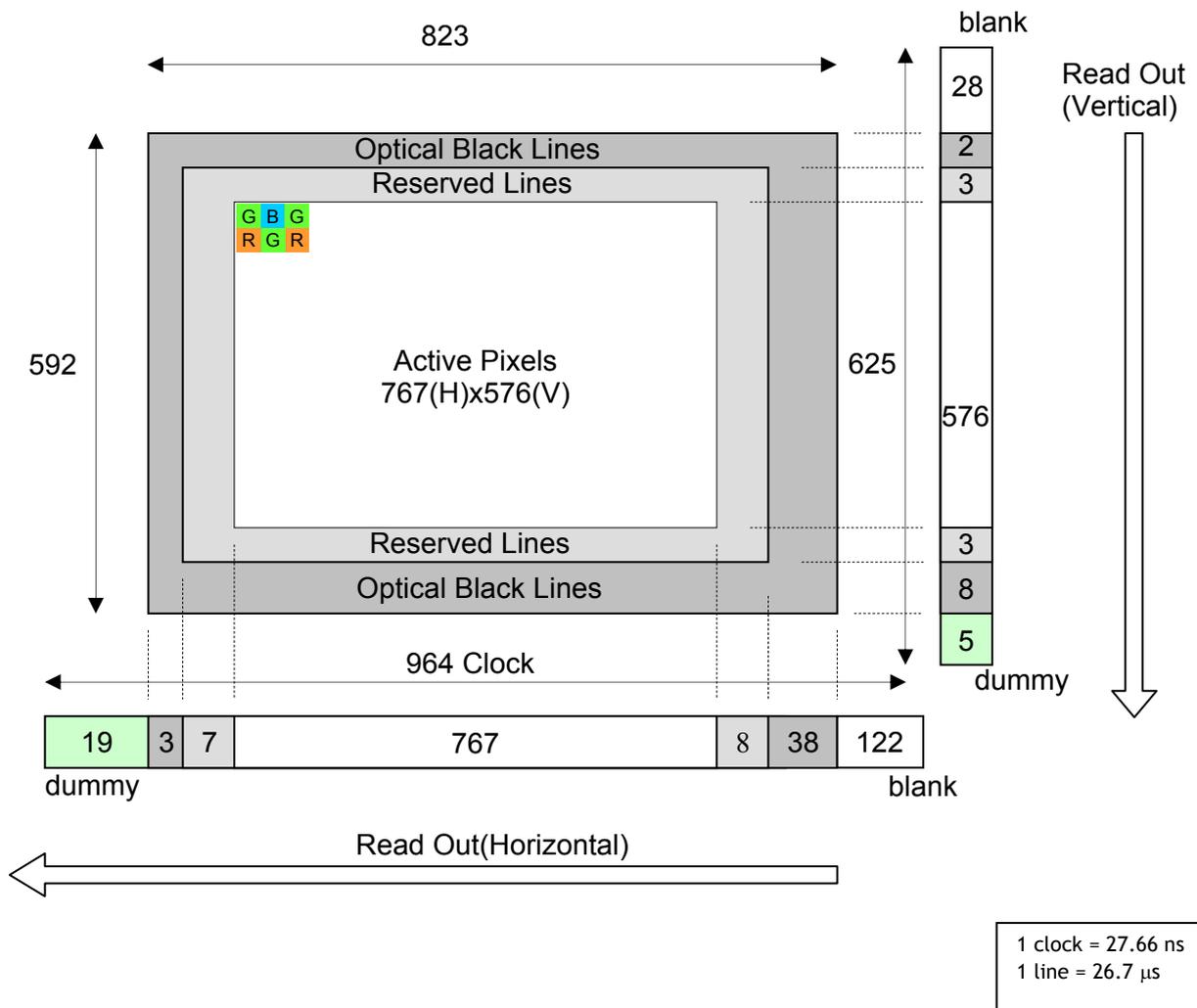
Fig. 14. CCD sensor layout

6.2.2. Horizontal timing

The LVAL period is shown for normal continuous mode.

1 clock = 27.66 ns
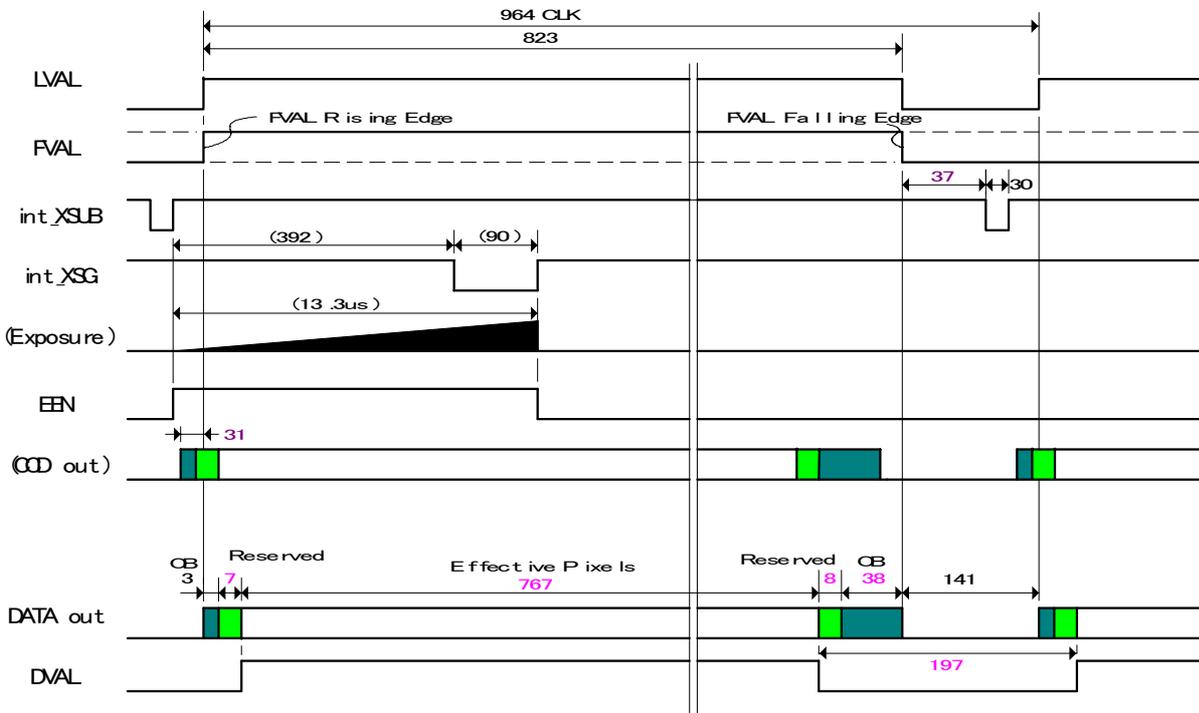
Fig. 15. Horizontal timing

6.2.3. Vertical timing

The FVAL period for normal continuous mode full scan is shown.

1 line = 26.7 μs
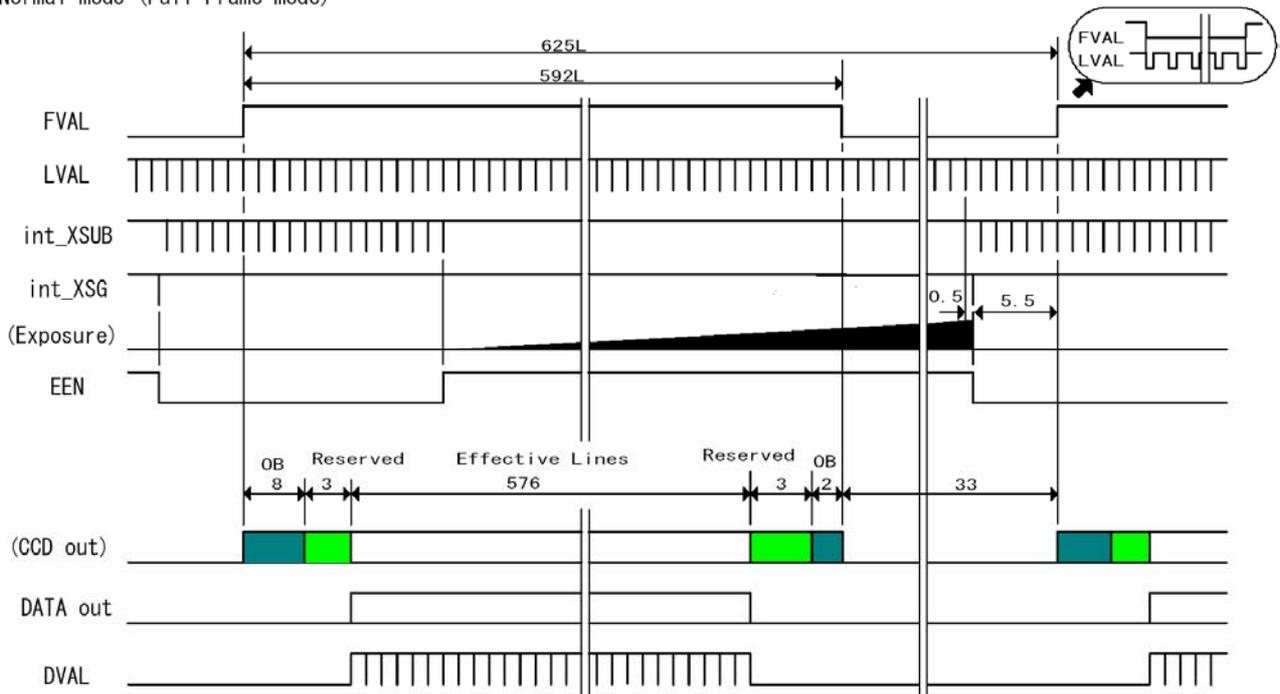
Fig. 16. Vertical timing for full scan

6.2.4. Partial Scanning

The FVAL period is shown for 1/2 partial scan in normal continuous mode.

1 line = 26.7 μs

1/2 Partial Scan mode (FVAL Period)
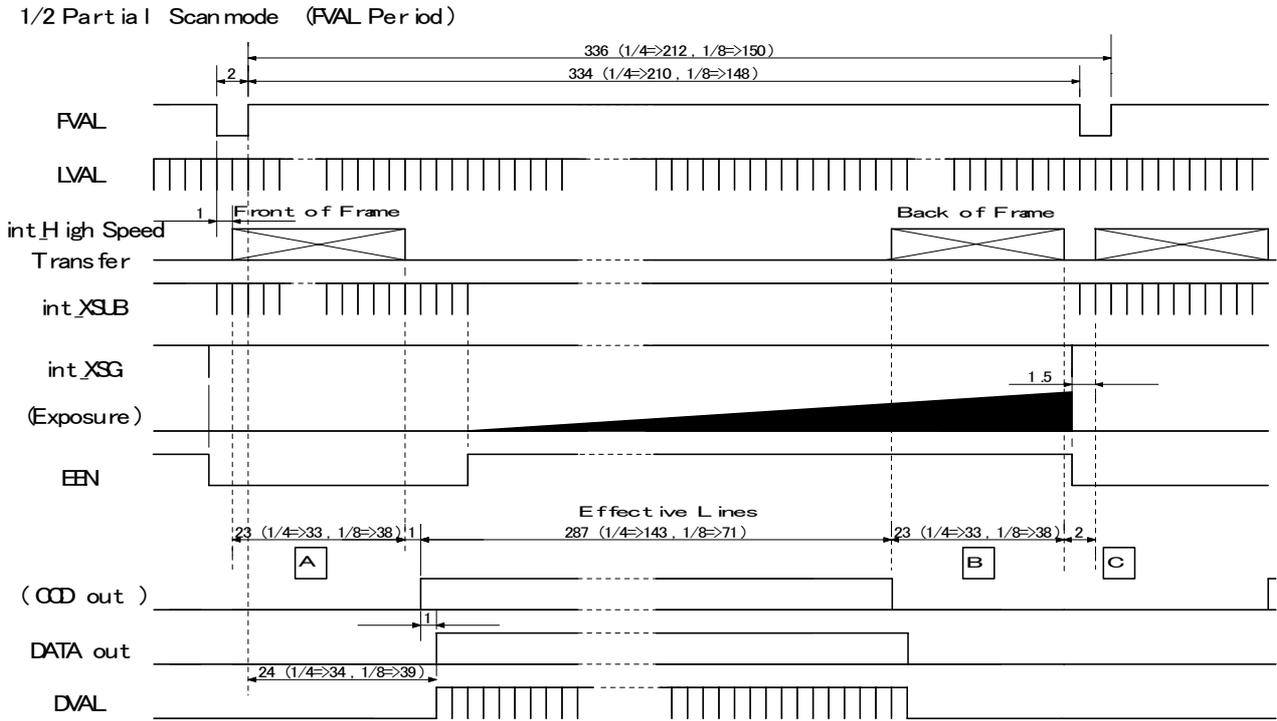
Values for vertical timing in partial scan continuous mode.

Mode	Scanning	Start line #	Stop line #	A Front [LVAL]	[LVAL]	Effect. video [LVAL]	B Back [LVAL]	C Blank [LVAL]	Lines per frame	Frame Rate [FPS]	Remarks
SC=0	Full	1	576	-	1	576	-	1	625	60	Full scan
SC=1	1/2 partial	146	432	23	1	287	23	2	336	112	Vertical centred
SC=2	1/4 partial	218	360	33	1	143	33	2	212	177	Vertical centred
SC=3	1/8 partial	254	324	38	1	71	38	2	150	250	Vertical centred

Remark! The color sequence for CV-M71 CL differ in partial scan. Refer to chapter 6.1.4.

Fig. 17. Vertical timing for partial scanning

6.3. Input/Output of Timing Signals

For switch settings, please refer to chapter "7.1. Switch setting by internal switch."

6.3.1. Input of External HD/VD signals

External synchronizing is only possible in full and partial scanning in normal mode. For trigger modes only ext. HD can be input.

HD and VD input pins are shared with the RS-232C interface, which is factory default. SW301.2 (HD/RxD) and SW301.3 (VD/TxD). The video output is synchronized with external HD/VD signals if applied. If no ext. HD is connected, the camera will switch to the internal X-tal controlled HD sync. If no ext. VD is connected, the camera will continue with its internal VD.

The tracking range for H is 37.50 KHz $\pm 1\%$

The external HD/VD signal should be 4.0 Vp-p ± 2.0 V from a 75 Ω source.

Fig. 18. through fig. 21 shows timing details for external sync operations.

To use this mode:

Set function:	SW 301.2 and 301.3 to ON for external HD/VD input..
	SW 302.3 and 302.4 to ON for 75 Ω termination of HD/VD.
	SW 302.3 and 302.4 to OFF for TTL level for HD/VD.
Input:	Ext. HD in on pin 6 on 12-pin connector.
	Ext. VD in on pin 7 on 12-pin connector.

Important notes on using this mode
> External sync system should follow the camera scanning system.
> The ext. HD/VD phase relations should follow the shown in fig. 20.
> Incorrect ext. VD interval in partial scan can result in malfunction. Use only HD.

1 HD or LVAL period = 26.7 μs
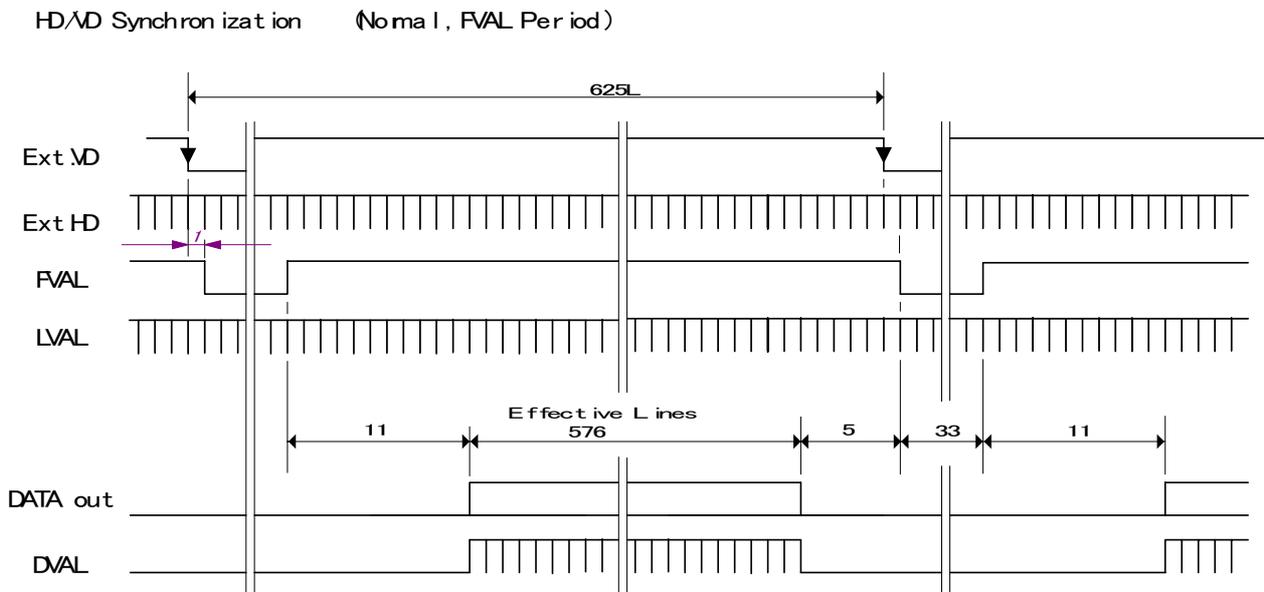
Fig. 18. VD timing for ext. synchronization

HD/VD Synchronization　(Nomal, LVAL Period）

1 clk period = 27.7 ns

1CLK = 27.66ns（36.15MHz）

964 CLK

Ext HD

189

LVAL

141

10

196

DVAL
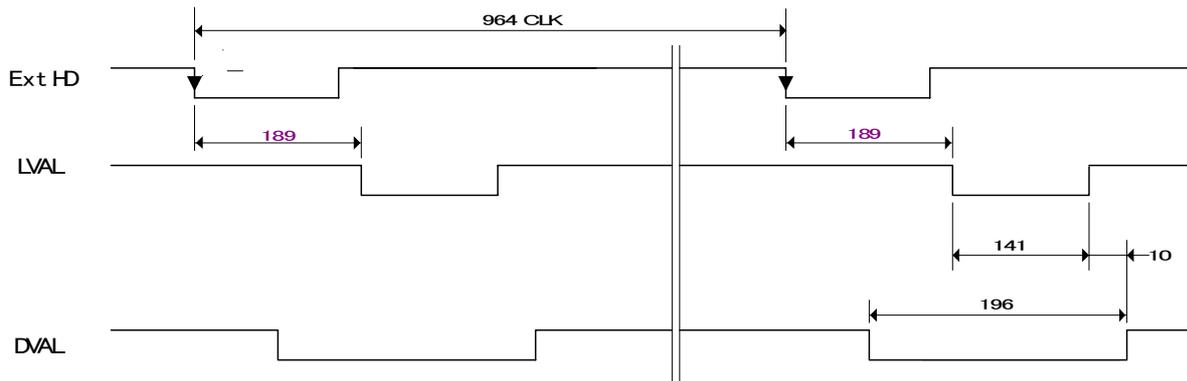
Fig. 19. HD to LVAL timing for ext. synchronization

HD/VD Synchronization　(VD Phase）

1 HD or LVAL period = 26.7 μs

1 CLK = 27.66ns（36.15MHz）

9 to 12 L

Ext VD

Ext HD

189±120 CLK

FVAL

1153clk
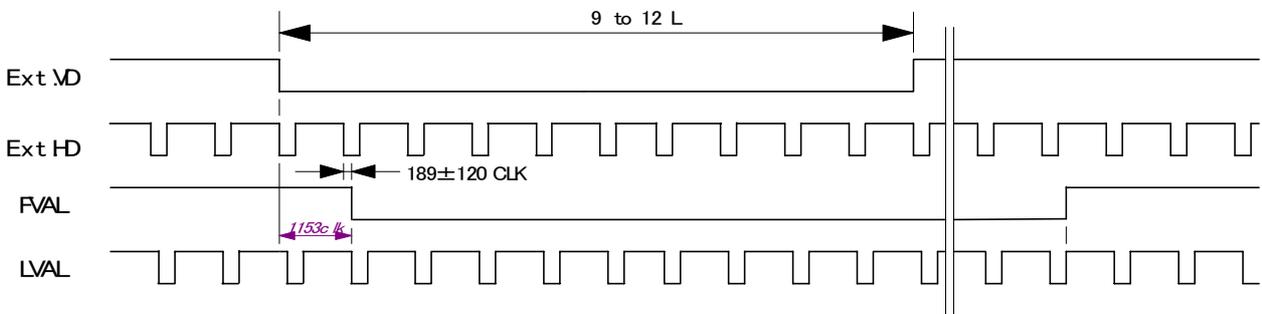
LVAL

Fig. 20. Ext. VD/HD to int. FVAL/LVAL phase relations

HD/VD Synchronization　(HD Phase）

1 clk period = 27.7 ns

1 CLK = 27.66ns（36.15MHz）

48 to 166 CLK

Ext HD

189±4 CLK
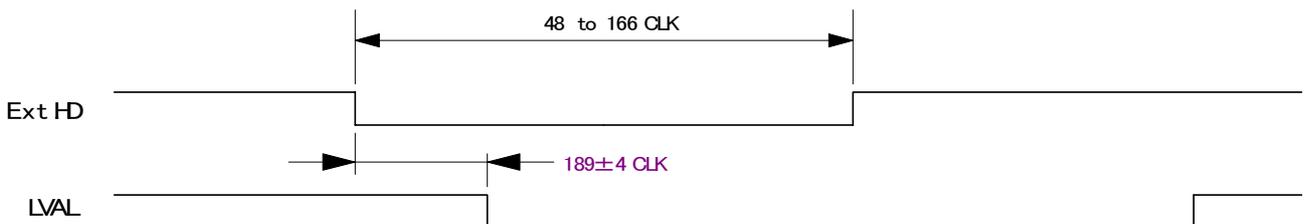
LVAL

Fig. 21. Ext. HD to int. LVAL phase relations

6.3.2. Input of external trigger

The external trigger signal can be via Camera Link (TI=0), or pin 10 on 12 pin connector. (TI=1). Here it should be 4.0 Vp-p ±2.0 V from a 75 Ω source. Factory setting TTL. For 75 Ω termination SW302.1 should be ON.

6.3.3. Output of XEEN (or EEN).

The XEEN signal 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 4 primary modes.

1. **TR=0** *Normal continuous Mode.* Pre-selected exposure.
2. **TR=1** *Edge Pre-select Mode.* Pre-selected exposure.
3. **TR=2** *Pulse Width Control Mode.* Pulse width controlled exposure.
4. **TR=3** *Sensor Gate Control* Strobe illuminated exposure with delayed read out

The triggered shutter in EPS and PWC mode can be LVAL synchronous or LVAL a-synchronous accumulation. Refer to chapter 6.4.1. and 6.4.2.
To avoid <1H time jitter in LVAL synchronous mode, it is recommended to synchronize the trigger to HD as shown I fig. 22. If trigger transitions are inside the shown limits in shaded blue, the accumulation jitter will be minimum.

Trigger Phase Margin

Ext. HD

Trig.

2.96 us ►◄ 1.48 us   2.96 us ►◄ 1.48 us
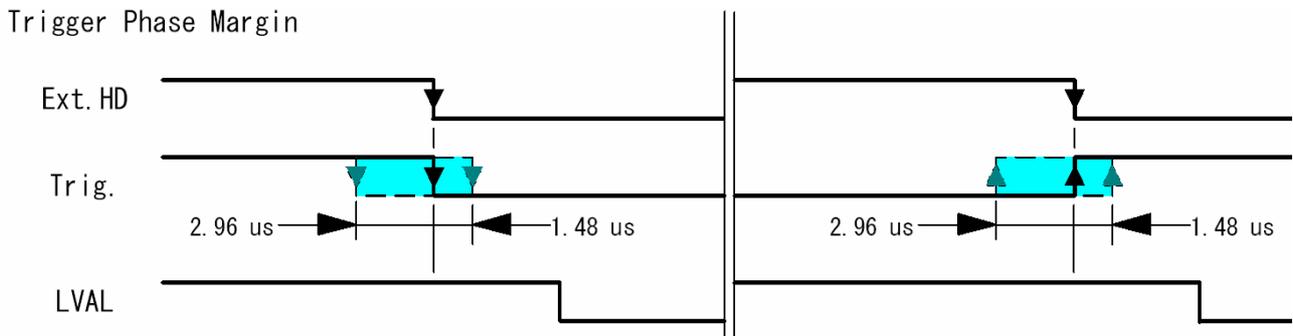
LVAL

Fig. 22. Trigger to ext. HD phase relation

In the following chapters the different operation modes and functions will be covered.

6.4.2. LVAL a-synchronous accumulation

With LS=1, the accumulation will start after the trigger leading edge.
The exposure start delay is fixed, and it is shown in the table below the timing drawings.
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 (exposure time + 1 FVAL + 3 LVAL).

Important notes on using this mode.
In LVAL a-synchronous trigger modes, there is a fixed delay but no exposure jitter.
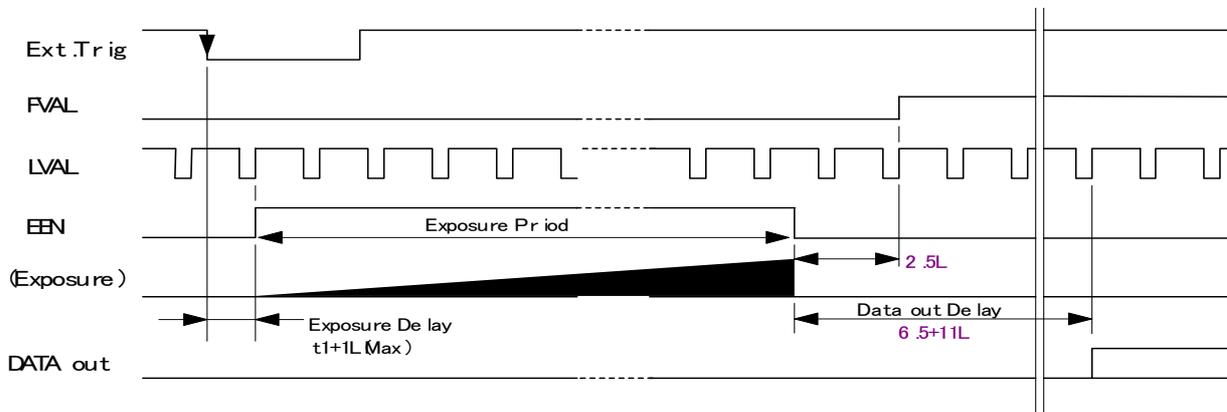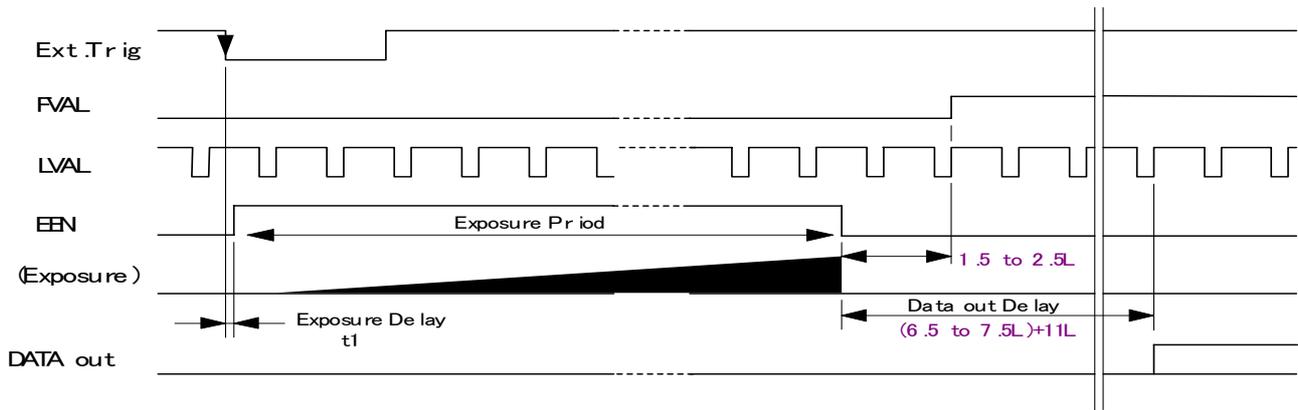
t1. Exposure start delay				
≤1/25,000	1/75,000	1/100,000	1/150,000	1/300,000
4 µsec.	4 µsec.	7 µsec.	11 µsec.	14 µsec.

Fig. 25. LVAL a-synchronous accumulation in EPS mode. Full frame.
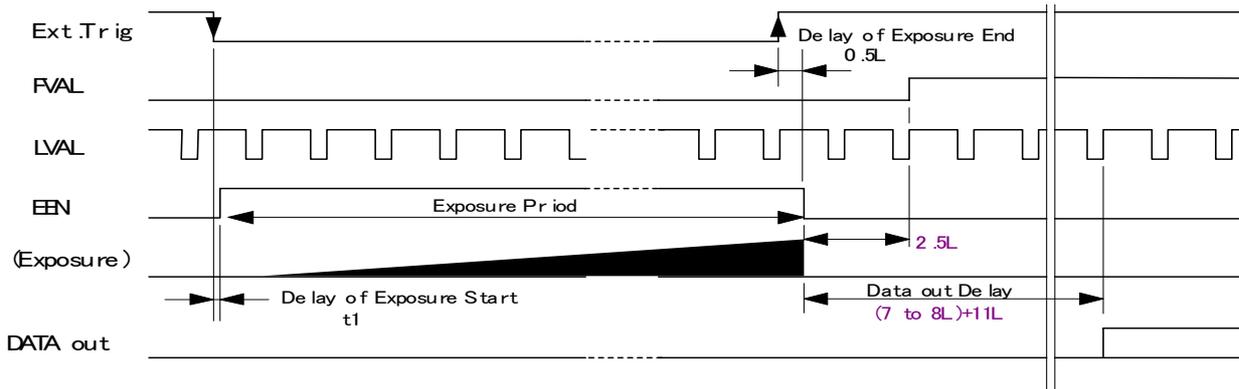
t1. Exposure start delay 4 µsec.

Fig. 26. LVAL a-synchronous accumulation in PWC mode. Full frame.

6.4.3. Continuous operation

For applications not requiring asynchronous external trigger, but should run in continuous operation, this mode is used.
For timing details, refer to fig. 14. through fig. 17.

To use this mode:
Set function:	Trigger mode to "Continuous".	TR=0
	Scanning	SC=0 through 3
	Shutter mode normal, programmable or auto	SM=0 through 2
	Shutter speed	SH=0 through14
	Programmable exp.	PE= through 628
	Other functions and settings	
Input:	Ext. HD in on pin 6 on 12-pin connector.	(If used).
	Ext. VD in on pin 7 on 12-pin connector.	(If used).

Important notes on using this mode

External sync system should follow the camera scanning system.
The ext. HD/VD phase relations should follow the shown in fig. 20.

For timing details, refer to fig. 14. through fig. 17.

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 exposure start delay is shown in the table below the timing drawing.
The resulting video signal will start to be read out after the selected shutter time.
To avoid up to 1LVAL time jitter in LVAL synchronous accumulation it is recommended to synchronize the trigger to HD. (See fig. 22.).
Use LVAL synchronous accumulation (LS=0) for highest trigger rate. A new exposure can be started while the previous is read out. The shutter time should end >2 LVAL after FVAL goes low.
For timing details, refer to fig. 14. through fig. 17. and fig. 27.

To use this mode:

Set function:	Trigger mode to "Edge pre-select".	TR=1
	Scanning	SC=0 through 3
	Shutter mode to normal or programmable	SM=0, SM=1
	Shutter speed	SH=0 through14
	Programmable exp.	PE= through 628
	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
	Ext. HD in on pin 6 on 12-pin connector.	(If used).

Important notes on using this mode

External sync system should follow the camera scanning system.
To avoid ≤ 1 LVAL jitter if LS=1, ext. HD/Trigger phase relations as shown in fig. 22.
Trigger pulse with >1 LVAL to < 1 Frame
If LS=0, the minimum trigger interval >(1 FVAL + 2 LVAL).
If LS=1, the minimum trigger interval >(exposure time + 1 FVAL + 3 LVAL).
EPS together with Smearless can only work in LVAL sync. accumulation.(LS=0).
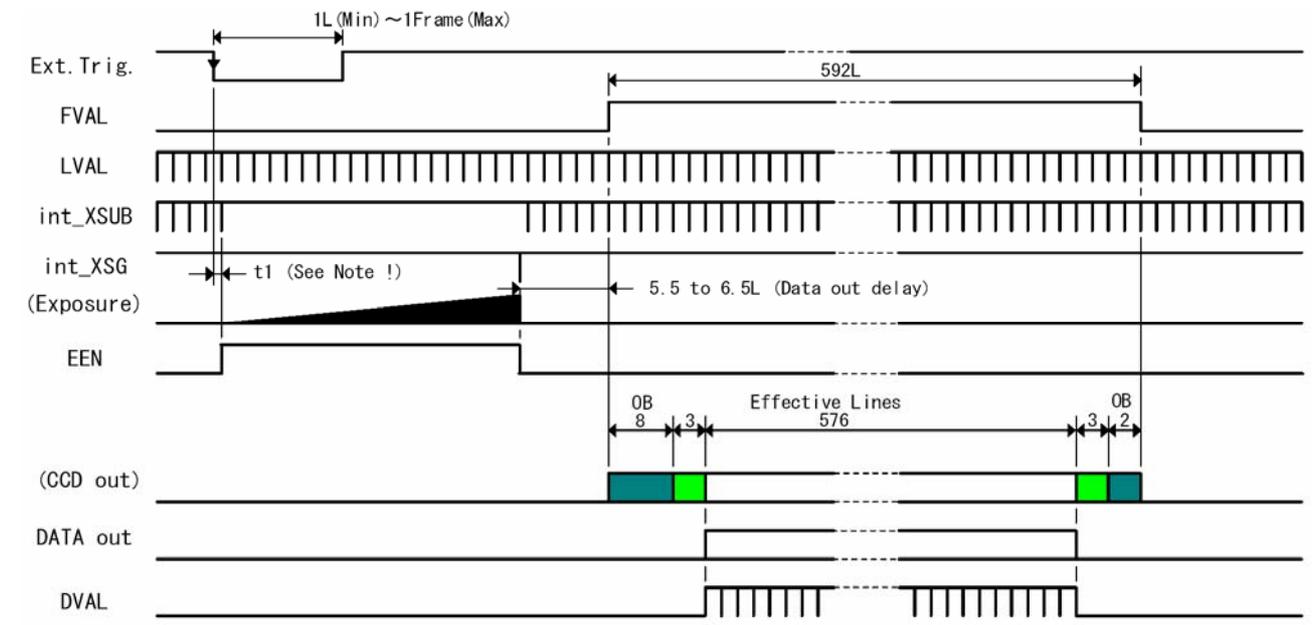
T1. Exposure start delay					
	≤1/25,000s	1/75,000	1/100,000	1/150,000	1/300,000
Sync. accum.	4-30 µs	30-57 µs	34-60 µs	37-64 µs	40-67 µs
a-sync. accum	4 µs	4 µs	7 µs	11 µs	14 µs

Fig. 27. 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 <120 frames.
The accumulation can be LVAL synchronous or LVAL a-synchronous. The exposure start delay is shown below the timing drawing.
To avoid up to 1LVAL time jitter in LVAL synchronous accumulation it is recommended to synchronize the trigger to HD. (See fig. 22.).
Use LVAL synchronous accumulation (LS=0) for highest trigger rate. Here a new exposure can be started while the previous is read out. The trigger pulse should end >2 LVAL after FVAL goes low. The resulting video signal will start to be read out after the trigger rising edge.
For timing details, refer to fig. 14. through fig. 17. and fig. 28.

To use this mode:

Set function:	Trigger mode to "Pulse width control".	TR=2
	Scanning	SC=0 through 3
	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
	Ext. HD in on pin 6 on 12-pin connector.	(If used).

Important notes on using this mode

External sync system should follow the camera scanning system.
To avoid ≤ 1 LVAL jitter if LS=1, ext. HD/Trigger phase relations as shown in fig. 22.
Trigger pulse width: >2 LVAL to <120 frames in LVAL sync. accumulation.
Trigger pulse width: >2 LVAL to <3 frames in LVAL a-sync. accumulation.
If LS=0, the minimum trigger interval >(1 FVAL + 4 LVAL).
If LS=1, the minimum trigger interval >(trigger width + 1 FVAL + 3 LVAL).
PWC together with Smearless can only work in LVAL sync. accumulation.(LS=0).
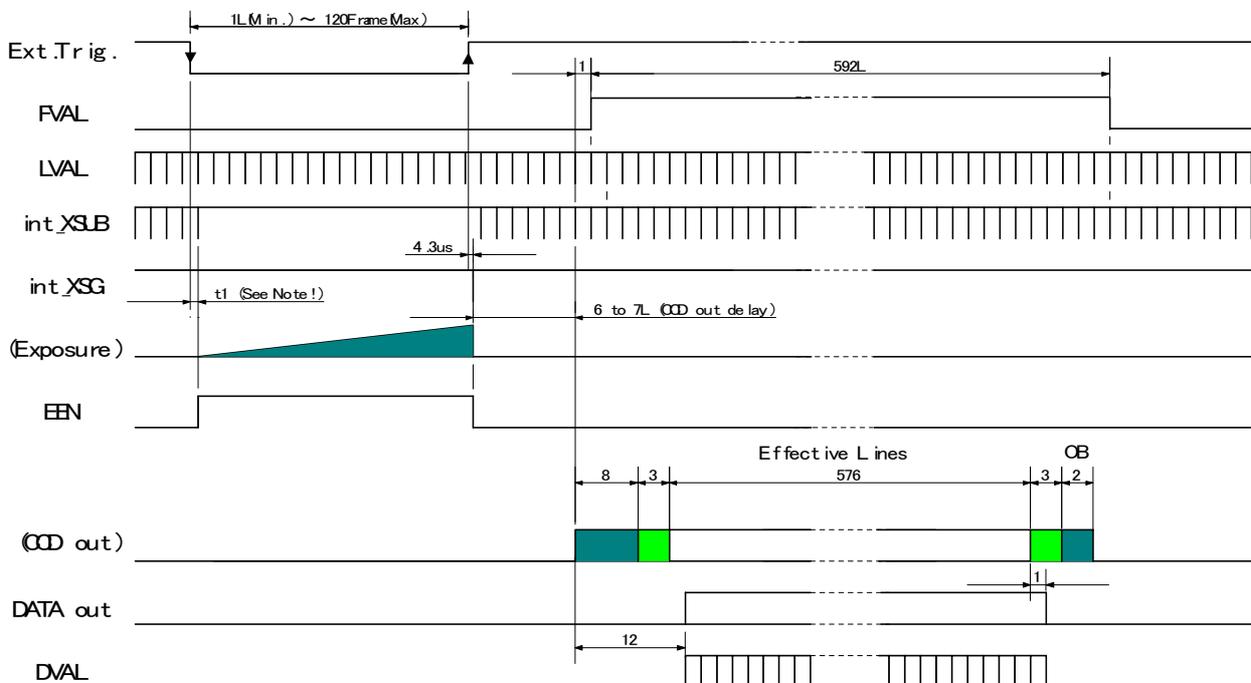
T1: Exposure start delay	
Sync. Accum	4-30 µs
a-sync. accum	4 µs

Fig. 28. Pulse width control. LVAL synchronized.

6.4.6. Sensor Gate Control

This mode is for applications with strobe flash illuminations or long time accumulations up to several frames. In this mode the camera is running continuously. The external Sensor Gate control signal will disable the internal XSG pulse so the accumulation will continue during the next frame. The resulting video is read out after the first FVAL (or SG), following the trailing edge of the Sensor Gate Control signal.

To inhibit the internal XSG pulse and continue the accumulation, the external sensor gate control signal should be low during line 27, where the internal XSG is placed. Fig. 31.

The sensor gate control signal can be synchronized by the FVAL signal. Fig. 30. and fig. 31.

For video out timing details, refer to fig. 14. through fig. 16. and fig. 30.

To use this mode:

Set function:	Trigger mode to "Sensor gate control".	TR=3
	Scanning: (Only full scanning.)	SC=0
	Other functions and settings	
Input:	Ext. SG control to trigger input, CL or 12 pin HR	
	Ext. HD in on pin 6 on 12-pin connector.	(If used).
	Ext. VD in on pin 7 on 12-pin connector.	(If used).

Important notes on using this mode

External sync system should follow the camera scanning system.
The ext. HD/VD phase relations should follow the shown in fig. 22.
After power up the camera, apply more than 1 SG pulse before operation.
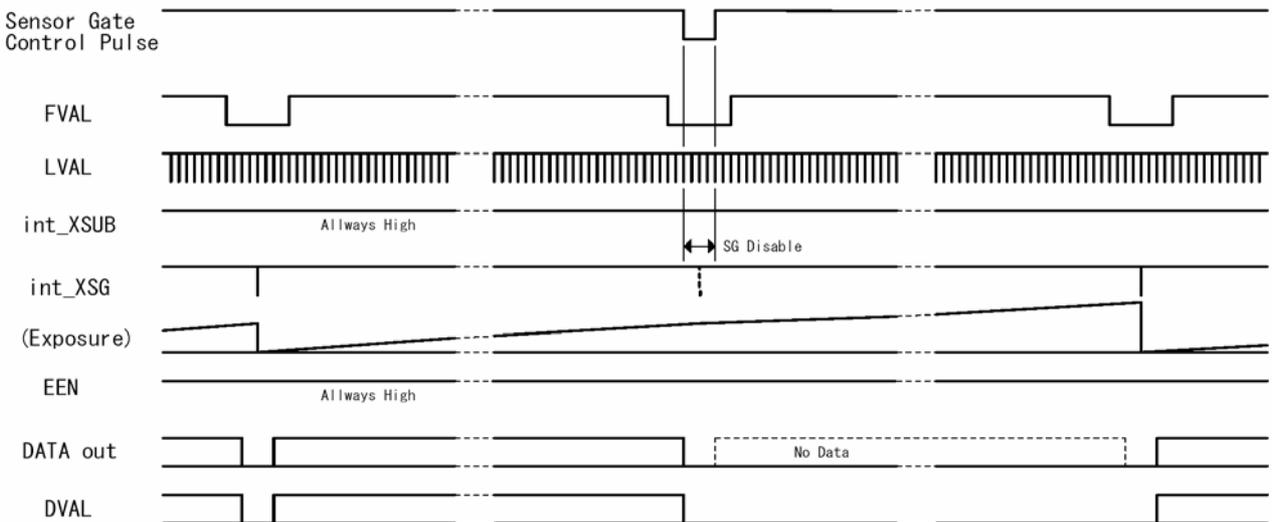
Fig. 30. Vertical timing for Sensor Gate Control
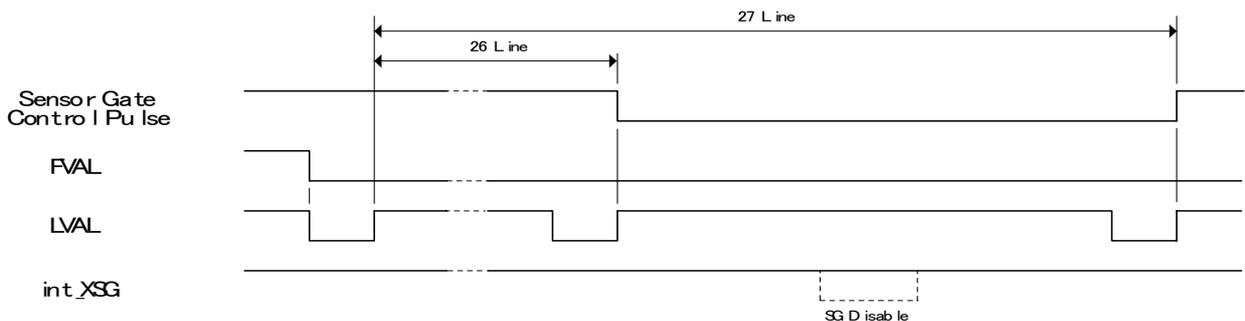
Fig. 31. Sensor Gate position in line number 27

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. This central 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.
Note: The color sequence for CV-M71 CL differ in partial scan modes. Refer to chapter 6.1.4.

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 86 lines before the exposure starts. The exposure stops and the resulting video signal is read out. This mode will operate with full and partial scanning. Smearless readout will only work with LVAL synchronous accumulation.

Shutter mode. SM=0, SM=1 and SM=2. SH=0 through SH=14 and PE=0 through PE=628.
With SM=0 this function selects the shutter from the 15 fixed steps (SH).
With SM=1 from programmable in 628 steps (PE).
SM=2 is auto shutter. The auto shutter range is from OFF to 1/25,000. The reference setting for auto shutter is done with the command AG=, which is common with the AGC. Together with the AGC function it will keep the video output constant over a wide range of illumination. Auto shutter will work in continuous mode. *(TR=0).*
Do not use auto iris lens together with the auto shutter function. The camera may be unstable.

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).

Gamma.
For CV-M71CL, gamma set to 1.0, which is linear.

Gain settings. AS=0, AS=1.
The video gain can be selected between manual gain (AS=0), or AGC (AS=1). Manual gain is set by the master gain level command GA=. The reference level for the AGC is set by the AGC reference level AG=1 through AG=255. In AGC mode the video level is kept constant by the automatic gain control circuit within a 12 dB range. Together with the auto shutter function it will keep the video output constant over a wide range of illumination. For continuous mode only.

Master gain level. GA=-50 through +150.
This gain setting works on all 3 colors. GA=0 is 0dB gain, which is normal working point. The range is from -3 dB to +12 dB.

Red gain level. GAR=-1024 through +2047.
Blue gain leve.: GAB=-1024 through +2047.
Red and blue gain level is used for manual white balance of the RGB output signal. Range -6dB to +6dB.

Master black level. BL=0 through BL=255.
Black level (or set-up level) will set the video level for black on all 3 colors.
Factory setting is 32 LSB for 10bit or 8 LSB for 8bit.

Red black level. BLR=-128 through +127.
Blue black level. BLB=-128 through +127.
This settings are used to fine adjust the black level for red and blue.

White Balance. WB=0 through WB=3.
Here the white balance mode is selected. There are 3 fixed values, 3200K, 4600K and 5600K.
The manual range is from 2800K to 7000K. One-push 2800K to 6500K. Manual/one-push WB=0
makes it possible to use red and blue gain level for manual adjusting the white balance. The
one-push white balance function AW=0 and the button on the camera rear is active here.

One-push auto white balance. AW=0.
When this command is received, an automatic white balance is performed. Range 2800K to
6500K. The result can be seen when the command inquire result of WB is sent. AWRS?

Inquire result of WB. AWRS?
After a one-push white balance is done, the result can be called with this command. Returned
error code 0 is busy, 1 is succeed, 2 is green too bright, 3 is green too dark, 4 is time-out error.

Output select. OS=0 through OS=3.
The video output is 3 x 8 bits RGB in Camera Link. The raw Bayer video can be 8 or 10 bit.
With OS=3 the test pattern are output. (Refer to 6.1.2.)

The below figures shows the bit allocations for Gamma 1.0.
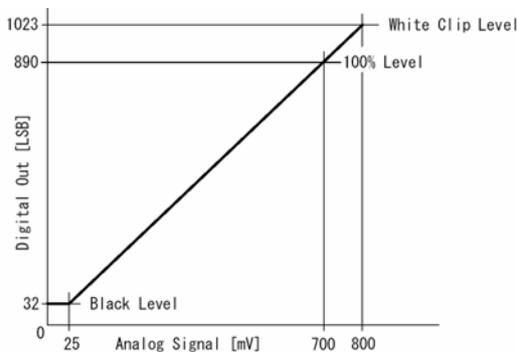
CCD out	Analog Signal	Digital Out(10bit)	Digital Out(8bit)
Black	Setup 3.6% 25mV	32LSB	8LSB
200mV	700mV	890LSB	222LSB
230mV	800mV	1023LSB	255LSB

Fig. 32. Bit allocation for Gamma 1.0.

Iris video output.
The iris video output in pin #4 on 12 pin HR is 700 mv for 100%
video out in Camera Link. The iris video signal is taken before the
gain circuit. It is without sync.
The iris video signal can be used for auto iris lens drive in
continuous mode.
*Do not use the auto shutter (CCD iris) function together with an
auto iris lens. It may result in an unstable regulation.*
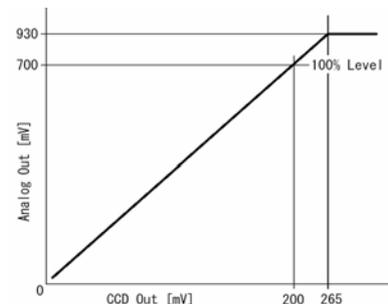
Fig. 33. Iris video output.

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

One Push White Balance button.
On the camera rear a button is placed. It is used for manual one push white balance.

Mode and function matrix.
The following table shows which functions will work in the different modes for CV-M71 CL.

Func. Mode TR=	Shutter SM= 0	1	2	Part. s SC=	Smearl SL=	Accum LS=	Ext sync VD	HD	Iris video out	Remarks
Cont. 0	√	√	√	√ *1	-	-	√	√	√	
EPS 1	√	√	-	√	√	√ *2	-	√	-	
PWC 2	-	-	-	√	√	√ *2 *3	-	√	-	
SG 3	-	-	-	-	-	-	√	√	-	

√ = ok, - = no function.
*1 With partial scan, auto iris lens can be used, but CCD iris is not useable.
*2 With smearless, only LVAL sync. accumulation can be used.
*3 Long time exposure >3 frames is not possible with LVAL a-sync accumulation.

Fig. 34. Mode and function matrix.

6.6. Request Functions.
The following commands are for identification and help.
Fig. 35. 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-M71 CL 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.

Help. HP.
If received, the camera will send back a help list for all functions.

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.

RS232C Baud Rate.
The communication speed is 9600 Baud. It is not possible to request for the Baud rate.

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 the 3 user area in the camera EEPROM.

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

```
ST?
SM=0
SH=0
PE=494
TR=11
SL=0
LS=0
TI=0
TP=0
SC=0
OS=0
AS=0
AG=128
GA=0
GAR=312
GAB=626
WB=0
BL=128
BLR=0
BLB=0
GS=0

vn?
VN=18

ID?
ID=A000000000

MD?
MD=CV-M71CL

UD?
UD=TESTSAMPL#03
```

```
hp?
*** CV-M71CL 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)
SM(shutter mode): 0=preset shutter, 1=programmable exposure
             2=auto shutter
SH(preset shutter): 0=off, 1=1/100, 2=1/120, 3=1/250, 4=1/500, 5=1/1000
              6=1/2000, 7=1/4000, 8=1/8000, 9=1/15000, 10=1/25000
              11=1/75000, 12=1/100000, 13=1/150000, 14=1/300000
PE(programmable exposure): 0 to 628
TR(trigger mode): 0=normal(continuous), 1=edge pre-select
             2=pulse width control, 3=sensor gate control
SL(smearless):    0=off, 1=on
LS(LVAL synchronous accumulation): 0=sync., 1=async.
TI(trigger input): 0=camera-link, 1=hirose 12pin-10p
TP(trigger polarity): 0=active low, 1=active high
SC(scanning format): 0=full frame, 1=1/2 partial, 2=1/4, 3=1/8
OS(output select): 0=normal image, 1=bayer raw 8bit, 2=bayer raw 10bit
                3=test pattern
AS(AGC select): 0=off(manual gain control), 1=on
AG(AGC/auto shutter reference): 1 to 255
GA(master gain level): -50 to 150
GAR(red gain level): -1024 to 3071
GAB(blue gain level): -1024 to 3071
WB(white balance): 0=manual/one push AWB, 1=3200K, 2=4600K, 3=5600K
AW(one push AWB): 0=initiate the one push AWB
BL(master black level): 0 to 255
BLR(red black level): -128 to 127
BLB(blue black level): -128 to 127
GS(gamma select): 0=1.0(off), 1=0.45
LD(Load settings from EEPROM): 0=factory, 1=user1, 2=user2, 3=user3
SA(Save settings into EEPROM): 1=user1, 2=user2, 3=user3
*** Firmware Version 0.18 ***** Copyright(c) 2004 JAI Corporation *****
```

Fig. 35. Terminal printout of status, ID and Help for CV-M71 CL.

7. Configuring the Camera

7.1. Switch setting by internal SW301 and SW302

SW 301 is used for communication port select and ext. HD/VD or RS232C on pin 6 and 7 (12 pin).
The switches are found inside the camera on the left hand board. (Seen from rear).
SW 302 is for 75Ω termination of trigger and HD/VD input.

To access SW301 and SW302:
        Remove camera cover.
        The switches are located on left hand board.

SW 301 is for communication

No	Functions	ON	OFF
1	Communication port switch	RS232C (HIROSE 12pin)	*LVDS (CameraLink)*
2	HIROSE 12pin No. 6 switch	External HD in	*RS232C (RxD In)*
3	HIROSE 12pin No. 7 switch	External VD in	*RS232C (TxD Out)*
4			

SW 302 is for 75Ω termination of trigger and HD/VD input.

No	Functions	ON	OFF
1	Trigger In Termination switch	75Ω	*TTL*
2	Reserved	-	-
3	External Trigger HD in Termination	75Ω	*TTL*
4	External Trigger VD in Termination	75Ω	*TTL*

Bold italic is factory setting
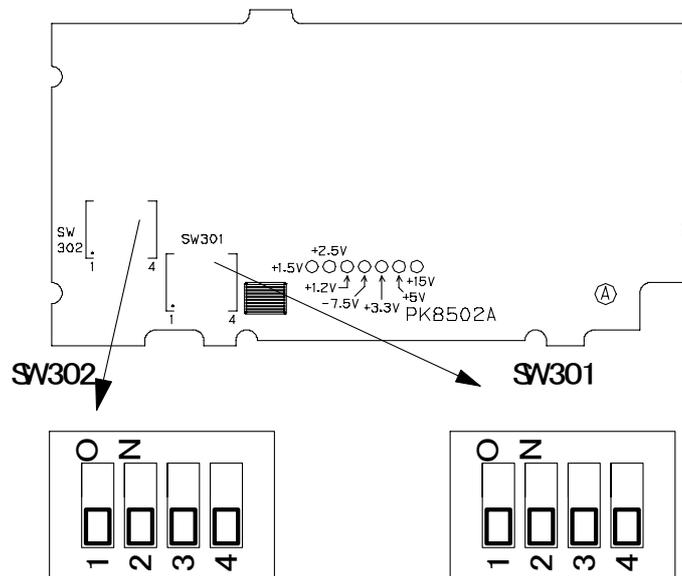
Fig. 36. Switch 301 and 302 positions on PK8502A

7.2. RS-232C control

All configuration of the CV-M71 CL camera is done via the RS-232C port on the 12 pin HR connector or via Camera Link. (Internal switch SW301-1 on 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
```
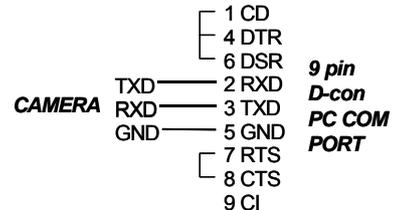
Protocol.

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 firmware number.
>   **VN?<CR><LF>**

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

7.3. CV-A10CL 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 (Free text)	TR=[Param.]<CR><LF>	User can save and load free text		≤ 16 characters
B – Video Output					
OS	Output Select	OS=[Param.]<CR><LF>	0=3x8 bit RGB 2=10 bit Bayer	1=8 bit Bayer 3=Test pattern	Raw Bayer for Host PC coding
C – Timing and shutter related commands					
SC	Scanning format	SC=[Param.]<CR><LF>	0=full 2=1/4 partial	1=1/2 partial 3=1/8 partial	
TR	Trigger mode	TR=[Param.]<CR><LF>	0=Continuous 2=Pulse width	1=Edge pre-sel 3=Sensor gate	
SL	Smearless readout	SL=[Param.]<CR><LF>	0=off	1=on	For TR=1 TR=2
SM	Shutter mode	SM=[Param.]<CR><LF>	0=Normal 2=auto shutter	1=Program. exp	Only for TR=0
SH	Preset shutter speed	SH=[Param.]<CR><LF>	0=Off (1/60) 2=1/120 4=1/500 6=1/2000 8=1/8000 10=1/25,000 12=1/100,000 14=1/300,000	1=1/100 3=1/250 5=1/1000 7=1/4000 9=1/15,000 11=1/75,000 13=1/150,000	When SM=0
PE	Programmable exposure	PE=[Param.]<CR><LF>	0 to 628 0=1/8L (3.3μs) 1=2/8L (6.7μs) 2=3/8L (10μs) 3=4/8L (13.3μs)	4=1.5L (40μs) 5=2.5L (66.7μs) .. 628=625L(16.7ms)	When SM=1 L = 26.7 μs
D– Signals and polarity					
LS	LVAL accumulation	LS=[Param.]<CR><LF>	0= LVAL sync.	1= LVAL a-sync.	
TI	Trigger Input	TI=[Param.]<CR><LF>	0= CamerLink	1= 12 pin Hiror	
TP	Trigger polarity	TP=[Param.]<CR><LF>	0= active low	1= active high	*1)
E – Gain and analogue signals setting					
AS	Gain select	AS=[Param.]<CR><LF	0=manual gain	1=AGC	
AG	AGC/auto shutter reference	AG=[Param.]<CR><LF	1 to 255		When AS =1
GA	MasterGain level	GA=[Param.]<CR><LF>	-50 to +150		-50=-3, 150=12dB
GAR	Red Gain level	GAR=[Param.]<CR><LF>	-1024 to +2047		
GAB	Blue Gain level	GAB=[Param.]<CR><LF>	-1024 to +2047		
WB	White Balance	WB=[Param.]<CR><LF>	0=man/one push 2=4600K	1=3200K 3=5600K	Man range 2800K to 7000K
AW	One-push White balance	AW=[Param.]<CR><LF>	0= init one-push white balance		2800K to 6500K
AWRS	One-push WB status	AWRS? <CR><LF>	0= not finished 2=G too bright 4=time out	1=Succeeded 3=G too dark	
BL	MasterBlack level	BL=[Param.]<CR><LF>	0-255 (0=low 255=high)		
BLR	Red Black level	BLR=[Param.]<CR><LF>	-128 to 127		
BLB	Blue Black level	BLB=[Param.]<CR><LF>	-128 to 127		
F – Saving and loading data in EEPROM					
LD	Load settings from camera EEPROM	LD=[Param.]<CR><LF>	0=Factory data 2=User 2 area	1=User 1 area 3=User 3 area	Data from latest used area default at power up
SA	Save settings to camera EEPROM	SA=[Param.]<CR><LF>	2=User 2 area	1=User 1 area 3=User 3 area	Parameter = 0 is not allowed
EA	EEPROM area request	EA?<CR><LF>			Return latest used area

*1)   If positive logic is used (TP=1), the first trigger pulse after power up will be ignored. TTL only.

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

8. Camera Control Tool for CV-M71CL

From www.jai.com Camera Control Tool for Windows 98/NT/2000 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.

8.1. Control Tool Windows
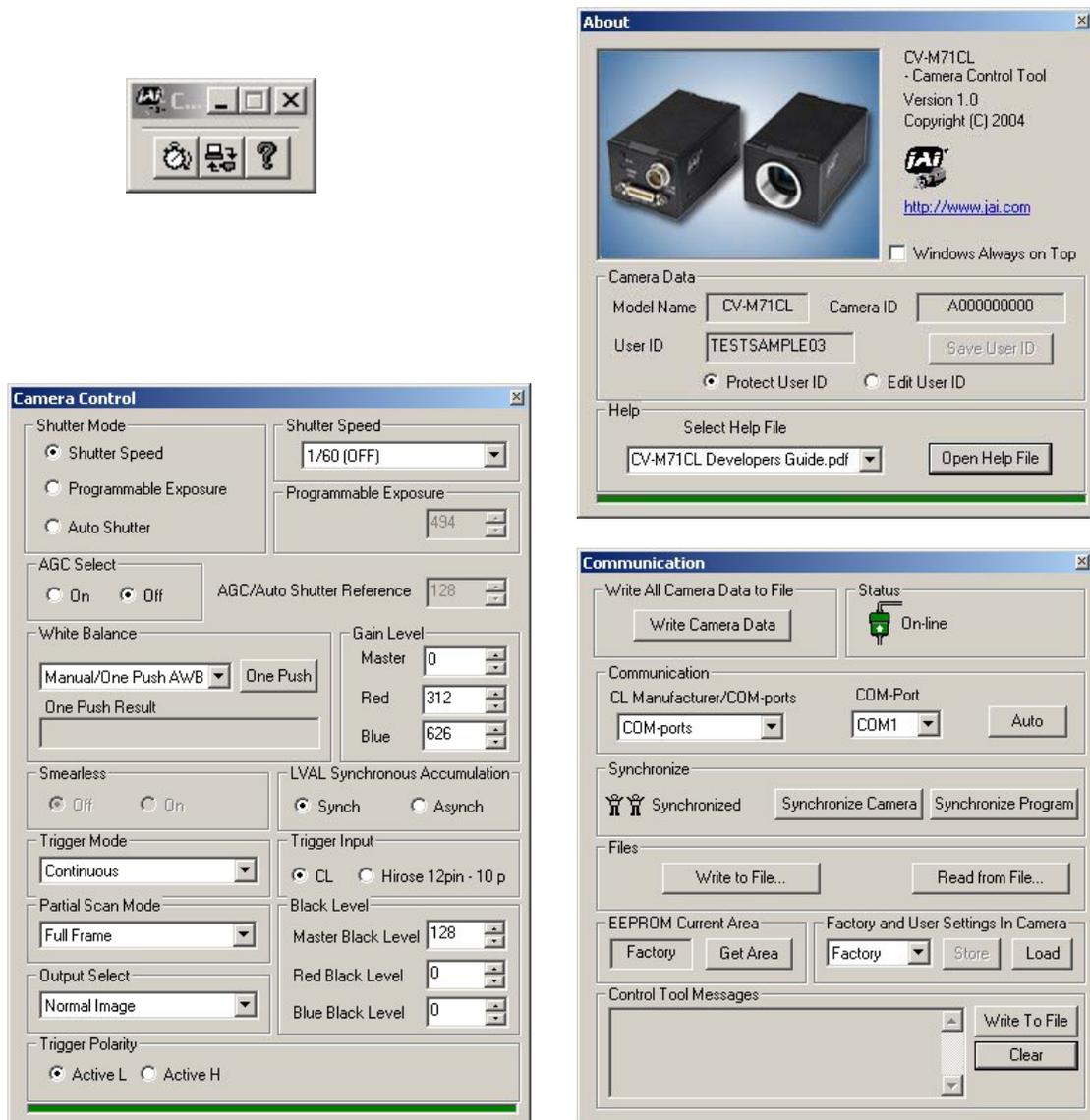
Fig. 37. CV-M71CL Camera control tool windows.

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.
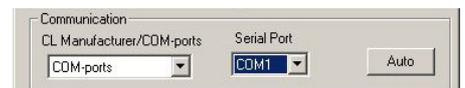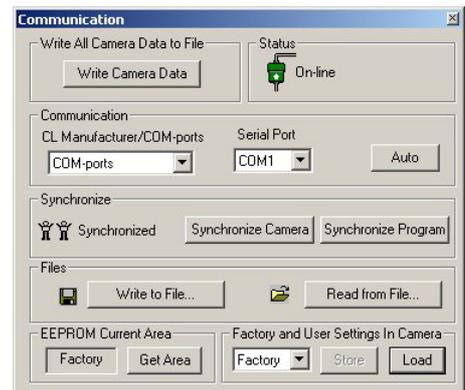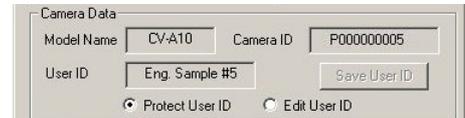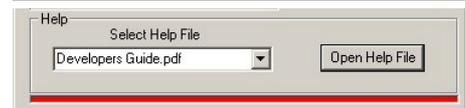
The Communication Window
The Communication Window is used to connect the Camera Control Tool with the JAI camera. Depending of camera there are 2 possible ways to communicate with a JAI camera.
RS-232:
Select the communication port, where the serial cable is connected from the list box in the 'Communication 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.
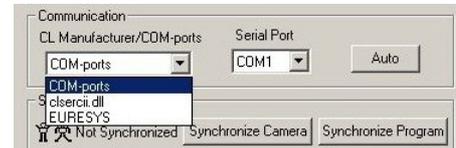
Auto search
Click the auto button to search for a camera on communication port 1 to 16. The camera control program automatically sends camera request on every communication port. The user is prompted to use a communication port if a camera answers the request.
This button is only used for RS-232 communication.

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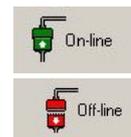
Changing the settings in the application will automatically update the camera settings when the application is online.
If the application looses connection with the camera it will automatically go to offline mode and it is indicated in the communication window.

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:


```
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.
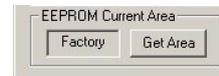
8.3. Using the Camera Control Tool

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
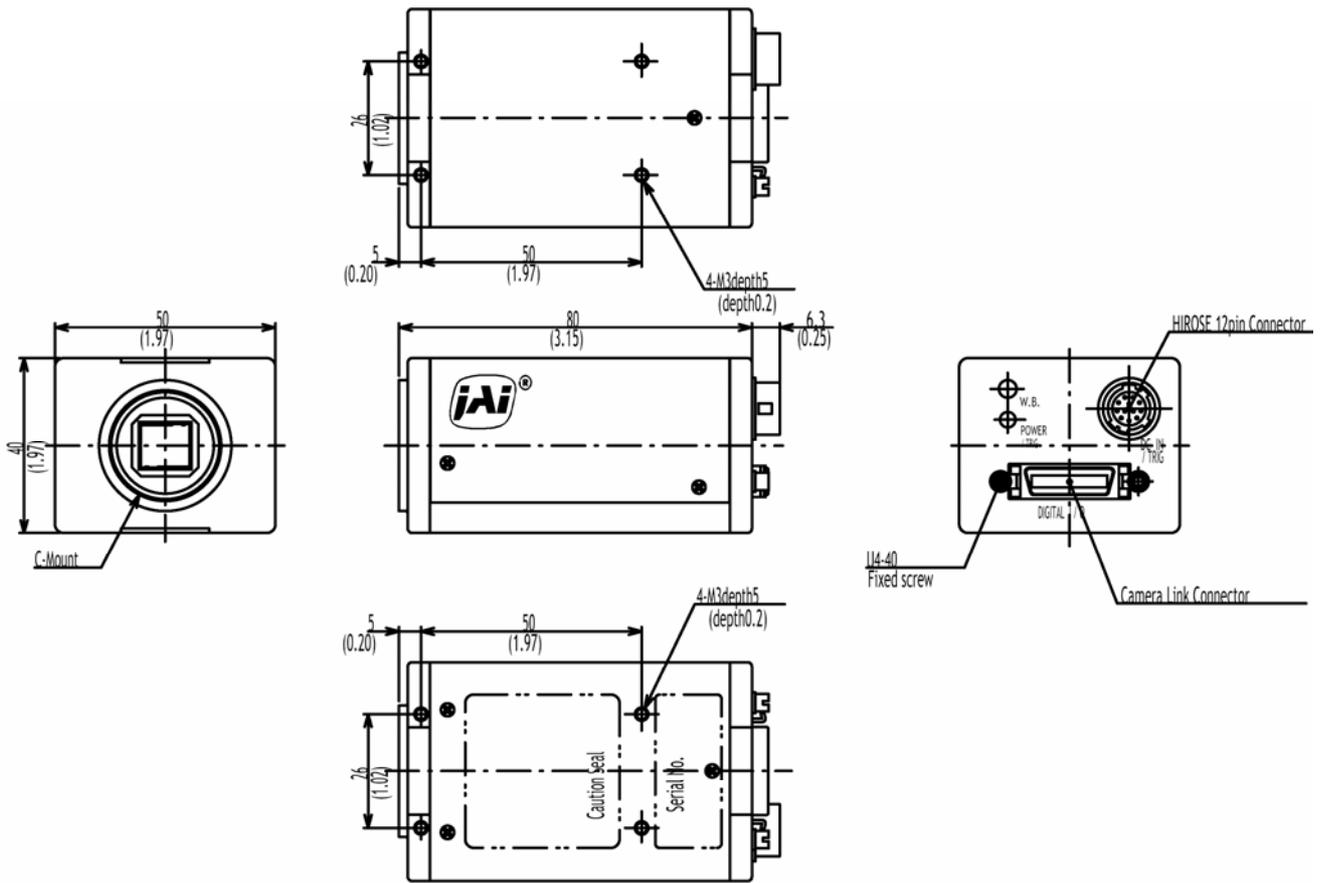
Fig. 38. Outline.

10. Specifications

10.1. Spectral sensitivity

CV-A71CL is with an IR stop and optical low-pass filter block in front of the CCD sensor.
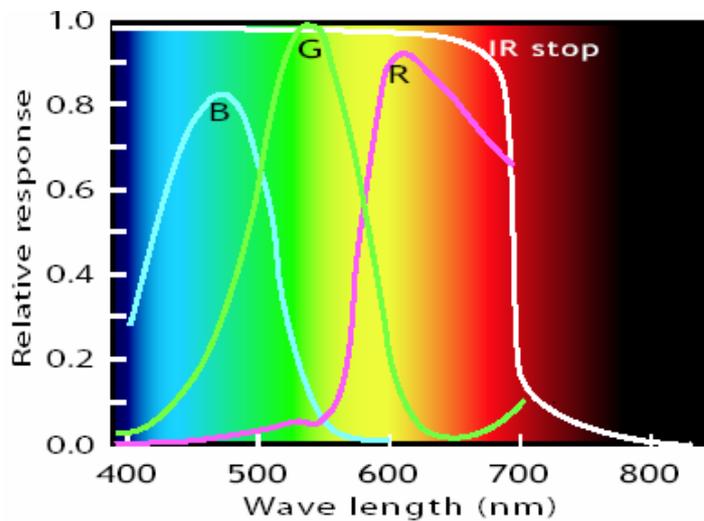
Fig. 39. Spectral sensitivity for CV-M71 CL

10.2. Specification table

Specifications	CV-M71 CL
Scanning system	Progressive scan
Frame rate full frame	60 frames/sec. Progressive (625 lines/frame)
Pixel clock	36.15 MHz
Line frequency	37.5 kHz (964 pixels clock/line)
CCD sensor	1/2". Color ICX-415AQ
Sensing area	6.4 (h) x 4.8 (v) mm
Cell size	8.3 (h) x 8.3(v) μm
Effective pixels	782 (h) x 582 (v)
Pixels in video output. Full 1/2 partial ¼ partial 1/8 partial	768 (h) x 576 (v) 60 fps. H = 37.5 kHz 768 (h) x 287(v) 112 fps. H = 37.5 kHz 768 (h) x 143 (v) 177 fps. H = 37.5 kHz 768 (h) x 71 (v) 250 fps. H = 37.5 kHz
Sensitivity on sensor	14 Lux (Min. gain, 100% video 1.7 Lux (Max. gain, 50% video)
S/N ratio	54 dB on Green
Digital Video output.	3 x 8 bit RGB in Camera Link 8 or 10 bit raw Bayer video in Camera Link
Iris video output. Analogue	0.7 Vpp
Gain Gain range	Manual – automatic (Only continuous mode) -3 to +12 dB. (-3 to +9 dB in aut.)
Gamma	1.0
Synchronization	Int. X-tal. Ext. HD/VD or random trigger
Ext HD/VD in.	4 V ±2 V. TTL or 75 Ω terminated
Tracking range for external HD	37.50 KHz ±1%
Trigger input. TTL Camera Link	4 V ±2 V. TTL or 75 Ω terminated Via Camera Link
EEN output	4 V from 75 Ω source
Trigger modes	Edge Pre-Select, Pulse Width Control, and Sensor Gate control
Accumulation	LVAL synchronous or a-synchronous
Shutter speed EPS	15 fixed steps 1/60 to 1/300,000 second
Programmable exposure EPS	Full frame: 1/60 to 1/300,000 second ½ partial scan: 1/121 to 1/300,000 ¼ partial scan: 1/249 to 1/300,000 1/8 partial scan: 1/503 to 1/300,000
Programmable exposure	1/8 line to 628 lines. (3.3 μs to 16.7 ms)
Pulse width control	LVAL sync accumulation: 2 lines to 120 frames. LVAL a-sync accumulation: 2 lines to 3 frames.
Auto shutter range	Full frame: 1/60 to 1/25,000 ½ partial scan: 1/121 to 1/25,000 ¼ partial scan: 1/249 to 1/25,000 1/8 partial scan: 1/503 to 1/25,000
Readout modes	Full, Partial scan.(½, ¼, 1/8.) Smear less
White balance Range	Manual, one-push, 3200K, 4600K and 5600K One-Push 2800K to 6500K. Manual 2800K to 7000K
Control interface	RS 232C or Camera Link
Functions controlled by RS 232C	Shutter, Trigger, Scanning, Read out, Polarity, Black level, Gain,
Operating temperature	-5°C to +45°C
Humidity	20 – 80% non-condensing
Storage temp/humidity	-25°C to +60°C/20% to 80% non-condensing
Vibration	10G (20Hz to 200Hz, XYZ)
Shock	70G
EMC	CE (EN50081-1 and EN50082-2), FCC part 15 class B
Power	12V DC ± 10%. <0.3A
Lens mount	C-mount (Flange back 17.526 mm -0.05mm) Image centre ±0.1mm from C-mount centre
Dimensions	40 x 50 x 80 mm (HxWxD)
Weight	210g

Note: Above specifications are subject to change without notice

11. Appendix

11.1. Precautions

Personnel not trained in dealing with similar electronic devices should not service this camera.
The camera contains components sensitive to electrostatic discharge. The handling of these devices should follow the requirements of electrostatic sensitive components.
Do not attempt to disassemble this camera.
Do not expose this camera to rain or moisture.
Do not face this camera towards the sun, extreme bright light or light reflecting objects.
When this camera is not in use, put the supplied lens cap on the lens mount.
Handle this camera with the maximum care.
Operate this camera only from the type of power source indicated on the camera.
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.
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 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 for CV-M71CL can be downloaded from www.jai.com
2. Datasheet for CV- can be downloaded from www.jai.com
3. Camera control software can be downloaded from www.jai.com
4. Specifications for the CCD sensor Sony ICX-415AQ can be found on www.jai.com

12. Users Record

Camera type: CV-M71 CL

Revision: (Revision A)

Serial No.   ……………..

Firmware version.   ……………..

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

Users Mode Settings.

Users Modifications.

C€

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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