



Digital Progressive Scan
Analog RGB Color Camera

CV-M71A

Operation Manual

Camera: Revision B

Manual: Version 1.0

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1 General

The CV-M71A is an analog output RGB color camera, based on a progressive scan primary mosaic Bayer CCD sensor. It provides 60 full frames/second through a 9-pin D-sub connector. There is also a Camera Link version of this camera, called the CV-M71CL.

The CV-M71A color progressive scan camera is designed for a wide range of automated imaging applications, such as factory automation, and traffic solutions. The 1/2-inch CCD sensor 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 the Camera Control Tool for CV-M71A 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 C-mount protection cap.

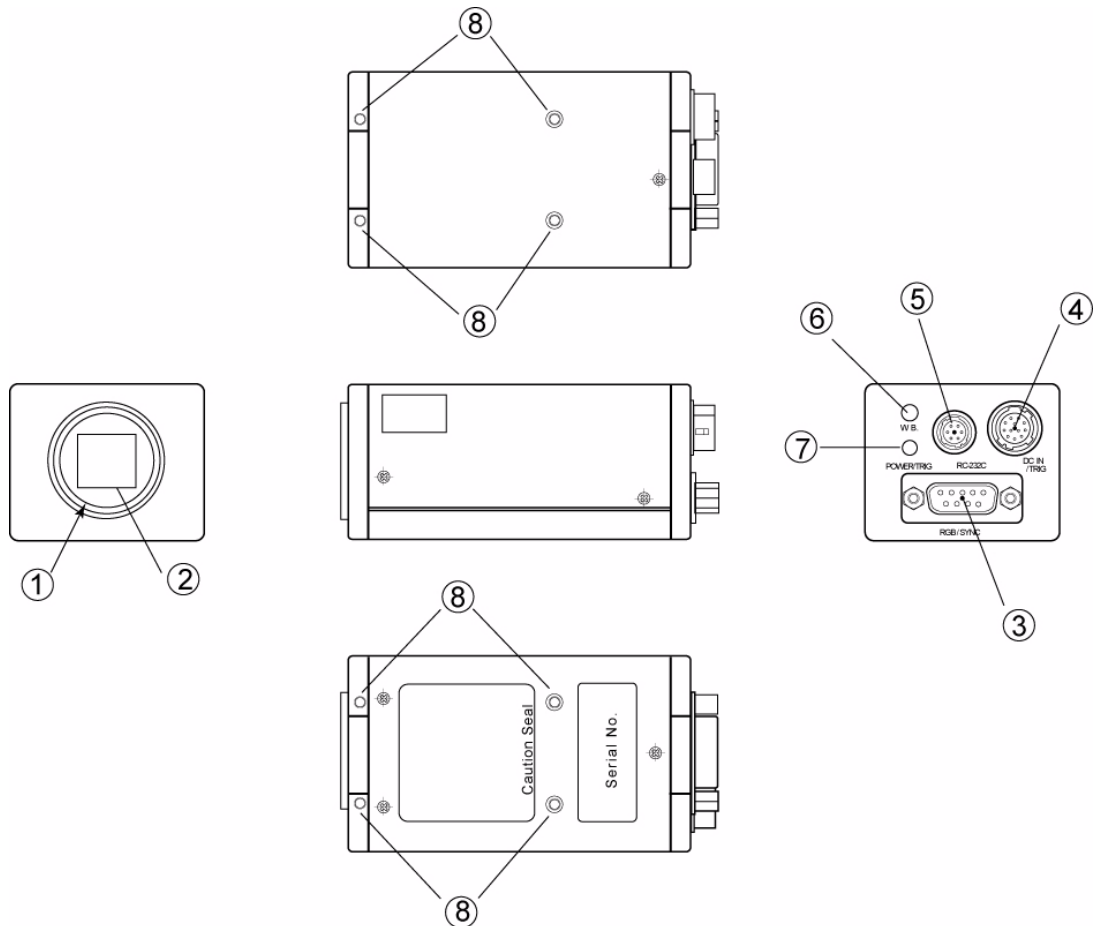
The camera is available in the following version: CV-M71A 1/2-inch progressive scan Analog RGB color camera.

3 Main Features

- Compact 1/2-inch digital progressive scan analog RGB color camera
- RGB primary color mosaic CCD (Bayer) with internal RGB interpolation
- 782 (h) x 582 (v) effective 8.3 μ m square pixels
- 60 fps with full resolution of 767 (h) x 576 (v)
- Analog RGB video output through D-sub 9 pin connector
- 8 bit internal processing and RGB interpolation
- High speed shutter from 1/60 to 1/300,000 second
- 1/2, 1/4 and 1/8-inch partial scanning are available for higher frame rate
- Edge pre-select, pulse width and sensor gate modes
- Programmable exposure, auto shutter and smearless readout
- HD 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
- Color bar generator is built in for set up.
- Setup by Windows NT/2000/XP software by means of the RS 232C connection

4 Locations and Functions

4.1 Mounting Locations



1. Lens mount of C-mount type.¹
2. Interline-transfer CCD sensor.
3. 9-pin D-sub connector for RGB video output
4. 12-pin connector for DC +12V power, RS232C and external sync signals
5. 6-pin connector for RS232C, trigger in and WEN output
6. White Balance button
7. LED for power and trigger indication

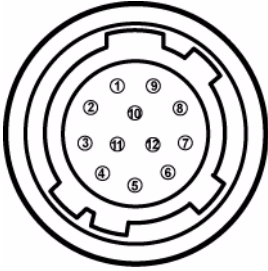
Orange, steady	Initializing after power ON
Green, steady	Operating, Continuous mode
Green, flashing	Operating and receiving external trigger
8. Mounting holes 8 x M3, depth 5mm.

FIGURE 1. Locations

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

5 Pin Assignment

5.1 12-pin Multi-connector (DC-IN/Trigger-IN/HD and VD IN)

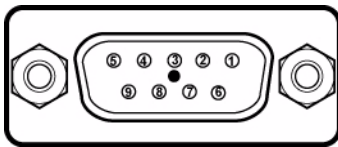


Type: HR10A-10R-12PB-01
(Hirose) male.
Seen from camera back.

Pin No.	Signal	Remarks
1	GND	
2	+12 V DC input	
3	GND	
4	Iris Video	Video signal for the auto iris lens drive
5	GND	
6	HD input	
7	VD input	
8	GND	
9	XEEN out	
10	WEN out	
11	Trigger In	
12	GND	

FIGURE 2.12-pin Hirose connector and location table

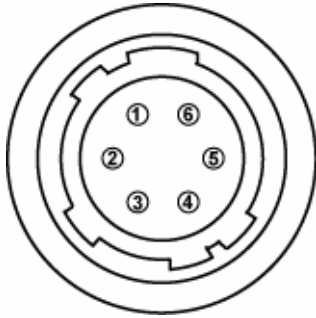
5.2 9-pin D-sub connector (Analog RGB video)



Pin no.	Signal	Remarks
1	VD IN / OUT	
2	GND	
3	R out	
4	G out /Sync on G out	Default: G out
5	B out	
6	HD IN/OUT	
7	SYNC out/WEN out	Default: SYNC out
8	GND	
9	NC	
See Section 7.1 on page 25 for more information		

FIGURE 3.9-pin Dsub connector and pin out table

5.3 6-pin Hirose Connector (RS232C / Trigger IN)



Pin no.	Signal	Remarks
1	TXD output	
2	RXD input	
3	GND	
4	NC / GND	
5	Trigger input	
6	WEN output	

FIGURE 4. 6-Pin Hirose connector and pin-outs

5.4 Input and Output Circuits

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

5.4.1 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 75Ω without termination. Do not use auto shutter (CCD iris) when auto iris lens is used.

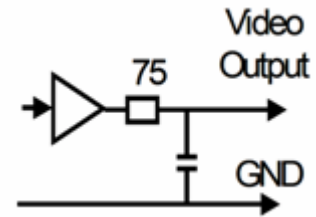


FIGURE 5.Video output.

5.4.1 (a) HD and VD input/RXD TXD

Pin #6 and #7 on the 12-pin connector; and pin #6 and #1 on the 9-pin D-sub connector are used for HD/VD input. Pin #1 and #2 on the 6-pin connector are used for the RS232C interface, TXD OUT and RXD IN.

- SW301.3: ON for HD 75Ω termination.
- OFF for TTL.
- SW301.4: ON for VD 75Ω termination.
- OFF for TTL.
- SW302.1: Hirose 12-pin and D-sub 9-pin
- Select for HD IN
- SW303.1: Hirose 12-pin and D-sub 9-pin
- Select for HD IN

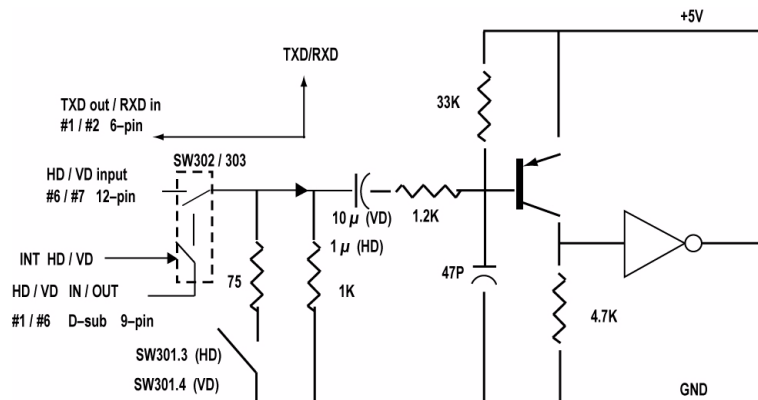


FIGURE 6.HD/VD input, RS-232C

5.4.1 (b) Trigger input

- The trigger input is available from either pin #11 on the 12 pin connector or pin #5 on the 6 pin connector.
- These inputs are internally connected, do not use simultaneously.
- The input is AC coupled. To allow a long pulse duration, the input circuit is a flip-flop. When it is toggled the negative or positive differentiated spikes are caused by the falling or rising trigger edges.
- The trigger polarity can be changed by TP=1.
- Trigger input level is 4 V $\pm$ 2 V. It can be terminated by SW301.1: ON for 75 Ω . OFF for TTL.

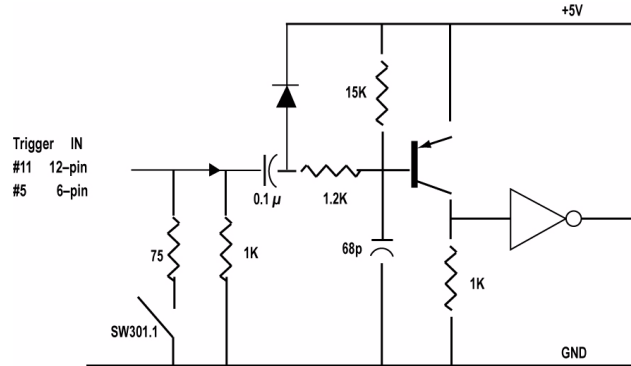


FIGURE 7. Trigger input.

5.4.1 (c) XEEN output

- XEEN is located on pin #9 of the 12-pin connector. This signal is active during the accumulation (exposure) period of the camera.
- The output circuit is 75 Ω complementary emitter followers. It will deliver a full 5 volt signal.
- Output level $\geq$ 4 V from 75 Ω . (No termination).

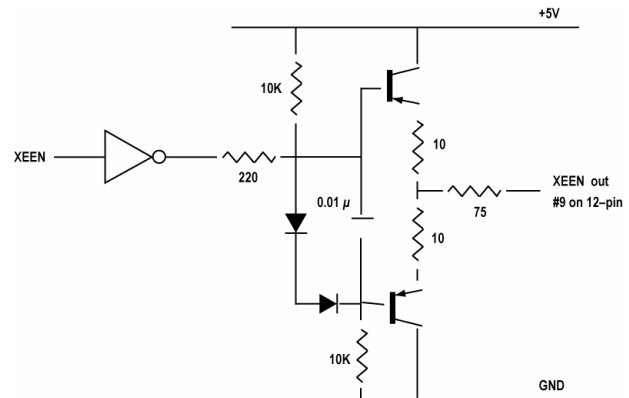


FIGURE 8. XEEN output

6 Functions and Operations

6.1 Basic functions

The CV-M71A camera is a progressive scan camera with a primary color mosaic CCD (Bayer). An internal DSP performs the color-interpolation, outputting separate analog R, G and B signals through the 9-pin D-sub connector.

An analog iris video signal can be used for lens iris control.

There are four modes; continuous, edge pre-select (EPS), pulse width control (PWC) and sensor gate control. The accumulation can be HD synchronous or HD asynchronous. For trigger modes using fast shutter times, smearless read out is possible.

6.1.1 Sensor Gate Control

This function is for applications where a strobe flash is the only illumination, and where the exact time to fire the strobe is unknown. This allows the strobe to fire in a time window that can include up to several frames. The resulting video readout can also be delayed by this function. This makes the synchronization of the frame grabber more flexible.

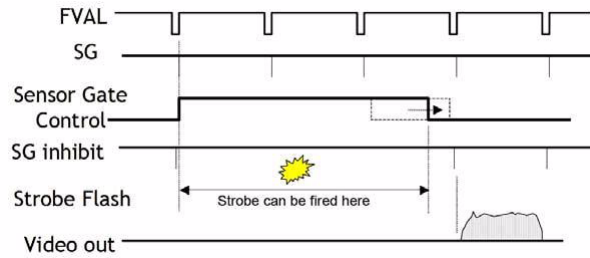


FIGURE 9. Sensor Gate Control

The Sensor Gate Control signal inhibits the internal SG signal so 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 VD (or SG), following the falling edge of Sensor Gate Control signal.

6.1.2 CV-M71A Test pattern

The CV-M71A camera has a built-in color bar generator. When it is activated, the output image is a test pattern as shown in the figure. The RGB values shown are for an 8-bit output.

The test pattern displays when the output select command is OS=3.

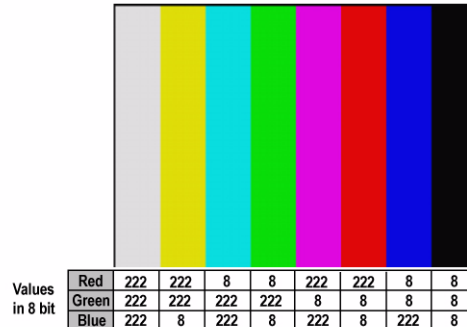


FIGURE 10. CV-M71A Test Pattern

6.2 Sensor Layout and timing

6.2.1 CCD Sensor Layout

The CCD sensor layout below shows the pixels and lines used in the timing and video full frame readout.

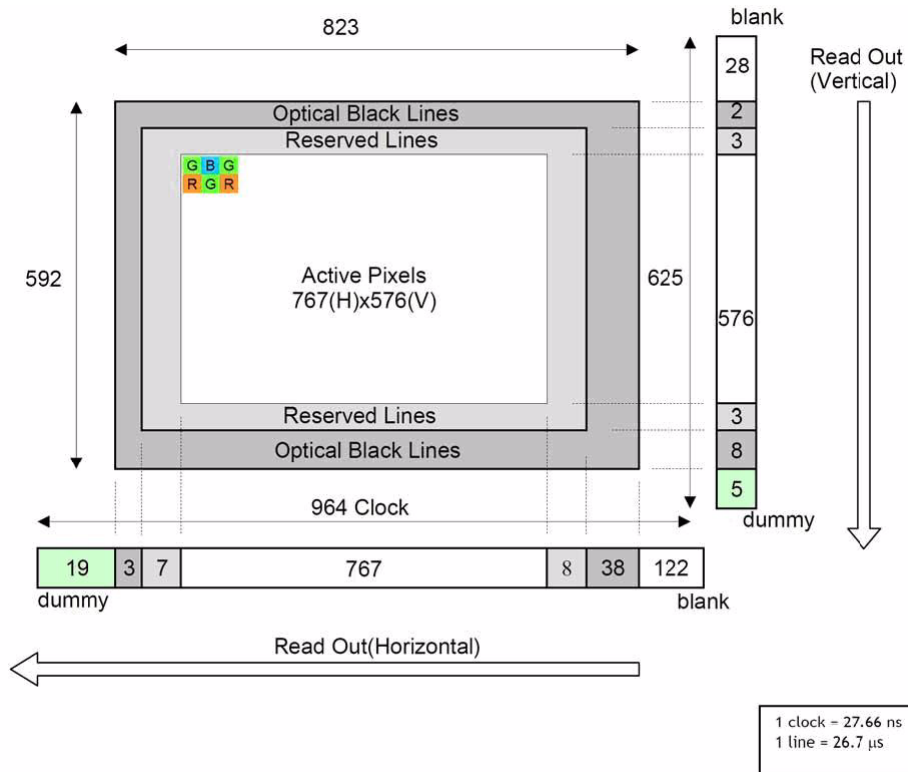


FIGURE 11.CCD sensor layout

6.2.2 Horizontal timing

- The HD period is shown for continuous mode.
- The timing signal definition
- EEN: Exposure enable (EEN) is defined HIGH for the exposure period.
- XEEN: Inverted polarity of EEN

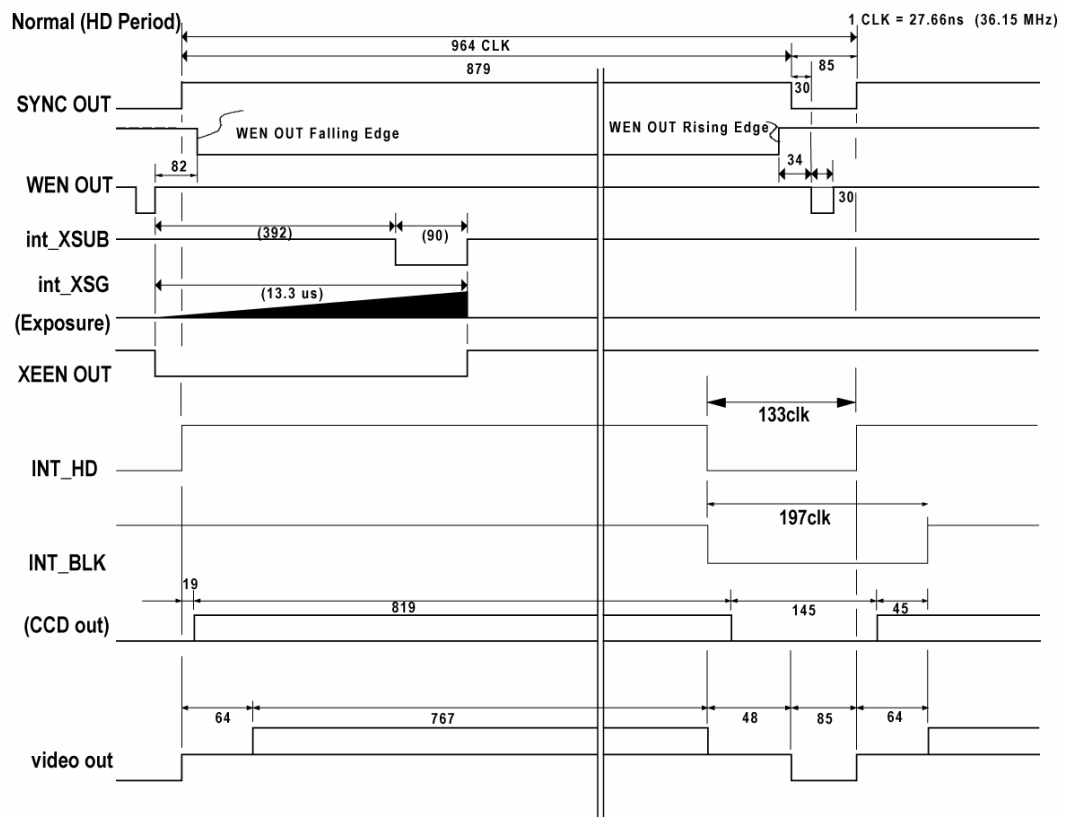


FIGURE 12.Horizontal timing

6.2.3 Vertical timing

The VD period for continuous mode full scan is shown:

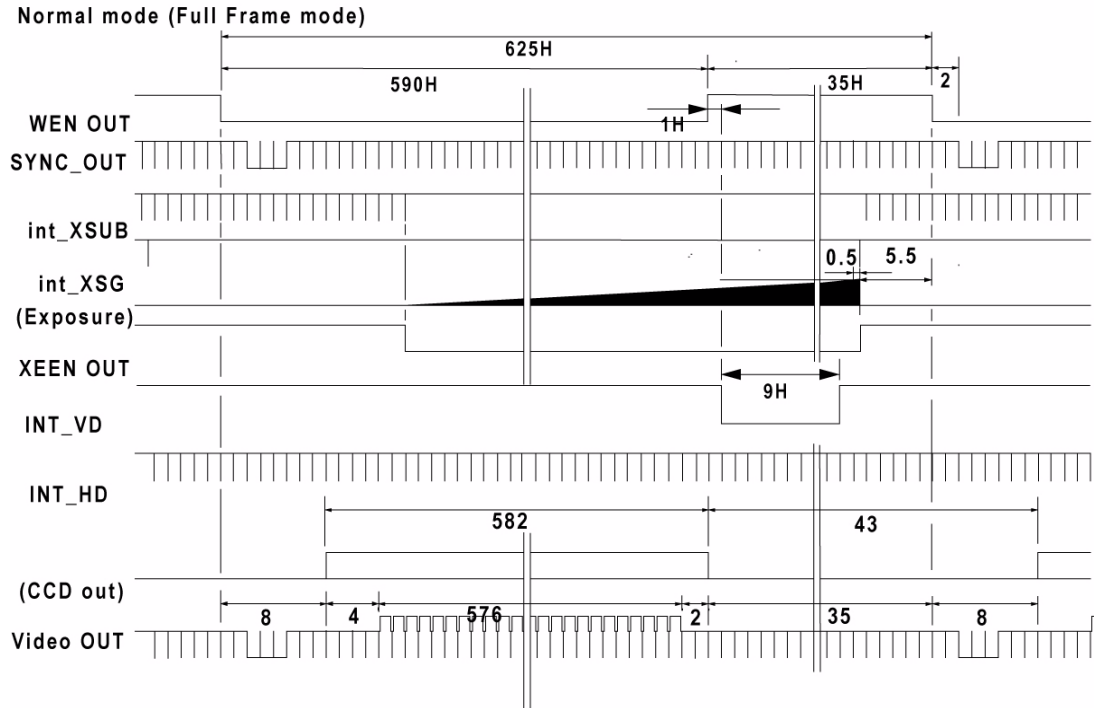


FIGURE 13.Vertical Timing

6.2.4 Partial Scanning

CV-M71A has a partial scanning function. Utilizing the CCD high-speed read-out function, CV-M71A is able to provide faster frame rates than with a full scan through 1/2, 1/4 and 1/8 scanning of vertical height.

	Option	Start Position (Line)	End Position (Line)	Line No. (Lines)	Output Image	Front of Frame A	Back of Frame B	Back of Frame C
0	Full screen	1	576	576	Full Frame →			
1	1/2 Screen	148	434	287	Partial Scan →	23	23	2
2	1/4 screen	218	360	143		33	33	2
3	1/4 screen	253	323	71		38	38	2

TABLE 1.Partial Scanning details

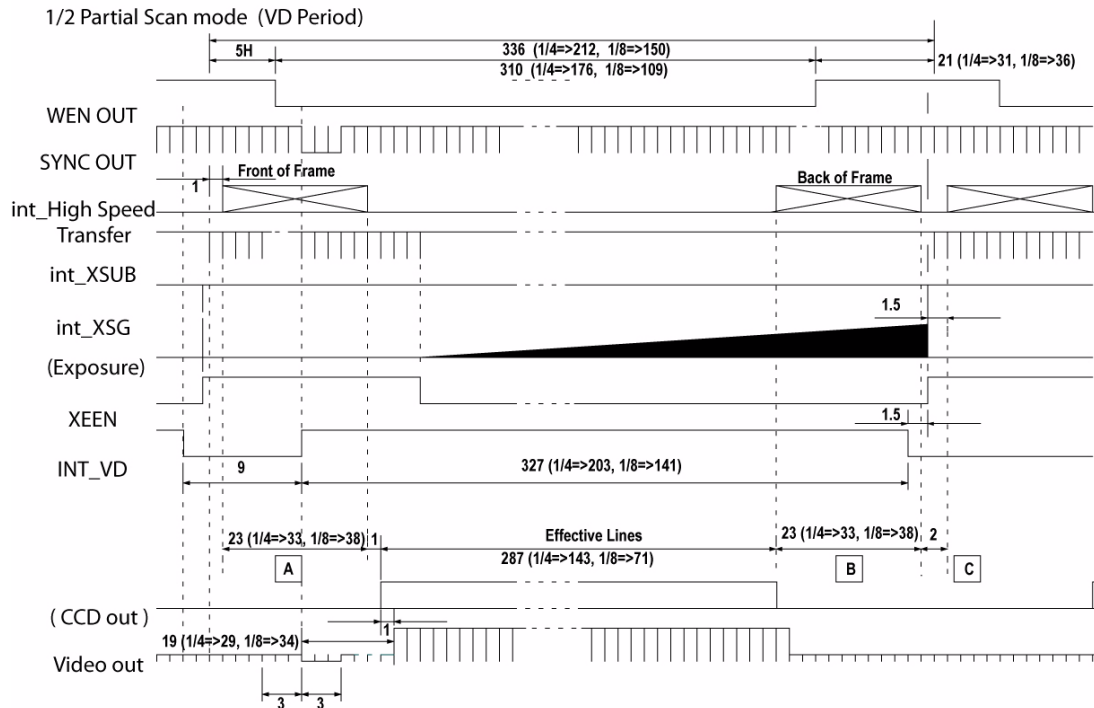


FIGURE 14. Timing chart for 1/2 partial scanning

6.3 Input/Output of Timing Signals

For switch settings, refer to chapter “7.1. Switch setting by internal switch.”

6.3.1 Input of External HD/VD signals

External synchronization is only possible in continuous mode. For trigger modes only external HD can be input.

HD and VD input pins on D-sub 9-pin connector are shared with HD/VD output (HD/VD inputs are factory default). HD/VD inputs are also available by means of the Hirose 12-pin connector. SW302.1 selects by means of the D-sub 9-pin or Hirose 12-pin for HD input. SW303.1 selects by means of the D-sub 9-pin or Hirose 12-pin for VD input. The video output is synchronized with external HD/VD signals if applied. If no external HD is connected, the camera will switch to the internal X-tal controlled HD sync. If no external 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. Factory setting is TTL. For 75 Ω termination is SW301.3 for HD input and SW301.4 for VD; input should be ON.

Figure 15. through figure 18. shows timing details for external sync operations.

To use this function:

Set function:	SW302.1 for HD input	ON: D-sub 9-pin,	OFF: Hirose 12-pin
	SW303.1 for VD input	ON: D-sub 9-pin,	OFF: Hirose 12-pin
	SW302.2	ON: HD output,	OFF: HD input
	SW303.2	ON: VD output,	OFF: VD input

Important notes on using this mode:

- External sync system should follow the camera scanning system
- The ext. HD/VD phase relations should follow the synchronization shown in Figure 15.

External Synchronization (VD Timing)

HD/VD Synchronization (Normal, SYNC Period)

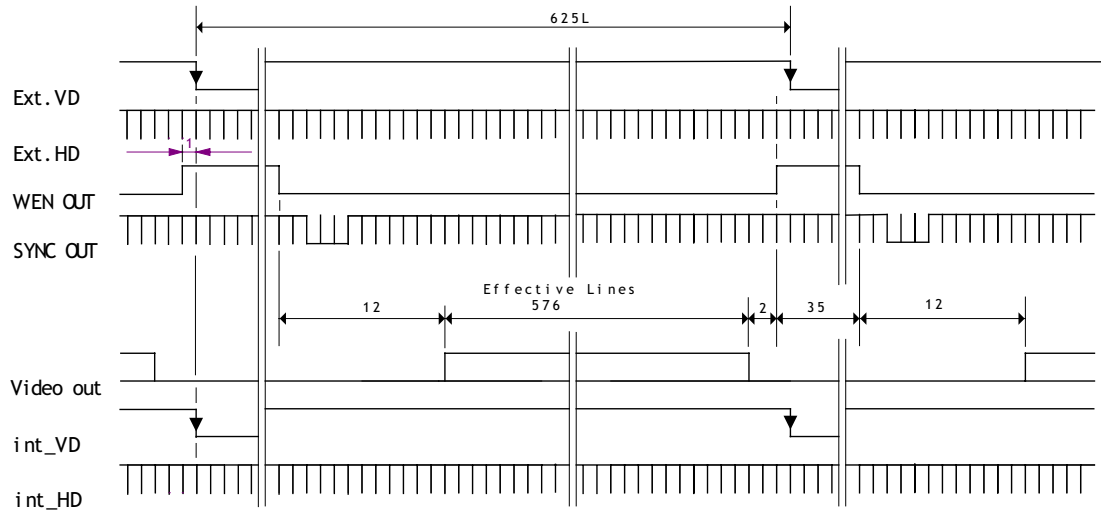


FIGURE 15.VD timing for external synchronization

6.3.1 (a) External Synchronization (VD timing Details)

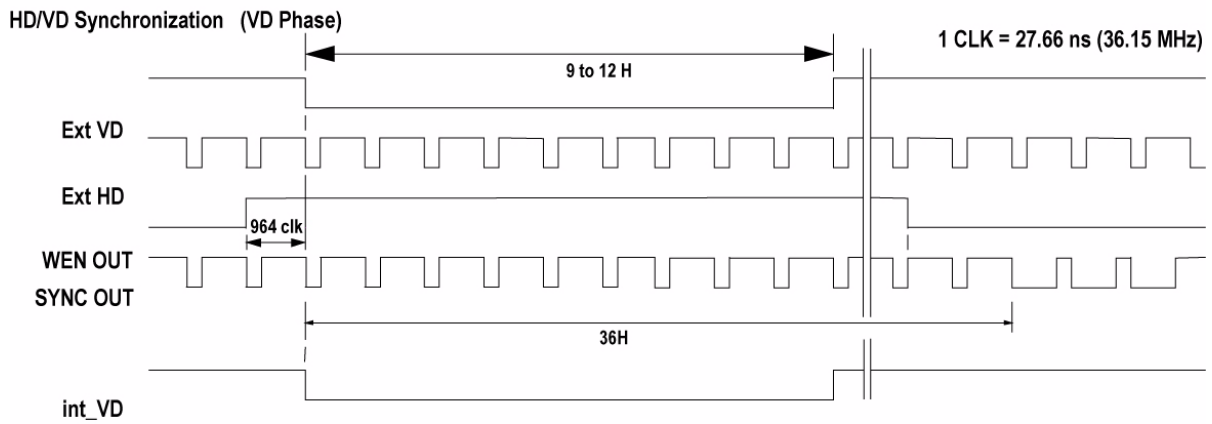


FIGURE 16.VD timing Details

Note: The internal VD is reset by the falling edge of Ext. VD but there is no field identification. The pulse width of Ext. VD requires 9H to 12 H.

6.3.1 (b) External Synchronization (HD timing)

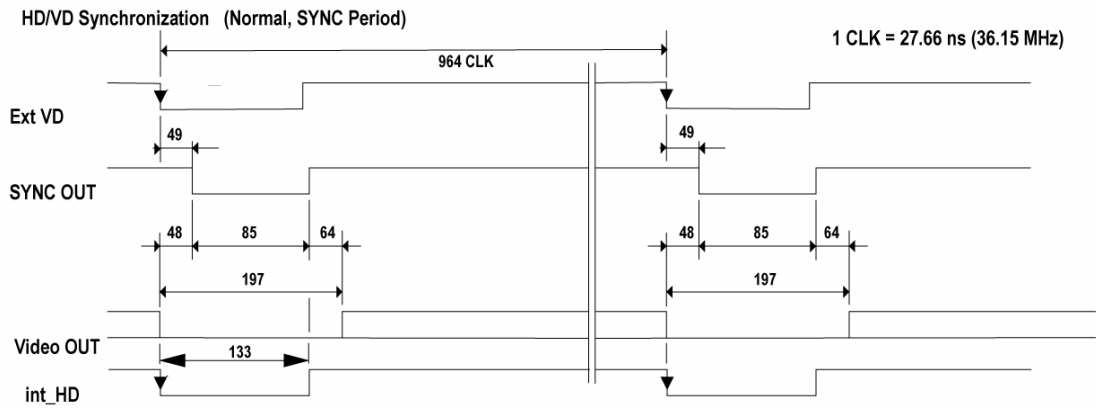


FIGURE 17.HD timing for external synchronization

6.3.1 (c) External Synchronization (HD timing details)

HD/VD Synchronization (HD Phase)

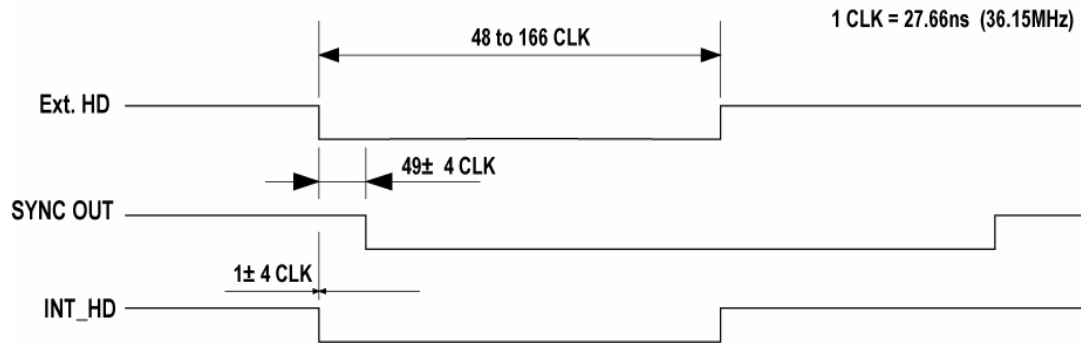


FIGURE 18.HD timing details

Note: The pulse width of Ext. HD requires between 48clk to 166clk. HD can not be reset directly.

6.3.2 Input of external trigger

The external trigger signal can be by means of pin 5 on the 6-pin connector (TI=0) or pin 11 on the 12-pin connector. (TI=1). Here it should be 4.0 Vp-p $\pm$ 2.0 V from a 75 Ω source.

The factory setting is TTL. For 75 Ω termination SW301.1 should be ON.

6.3.3 Output of XEEN

The XEEN signal is 4.0 Vp-p from a 75 Ω source.

6.3.4 Output of HD/VD signals

HD input and VD input of D-sub 9-pin can be changed to HD and VD outputs by selecting internal switches, SW302 and SW303. The output level is 4 V p-p.

6.4 Operation Modes

This camera can operate in four primary modes.

1. TR=0 *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 HD synchronous or HD asynchronous accumulation. Refer to Section 6.4.1 on page 14 and Section 6.4.2 on page 16.

To avoid <1H time jitter in HD synchronous mode, it is recommended the trigger be synchronized to the HD as shown in Figure 19. If trigger transitions are inside the limits shaded blue, the accumulation jitter is minimal.

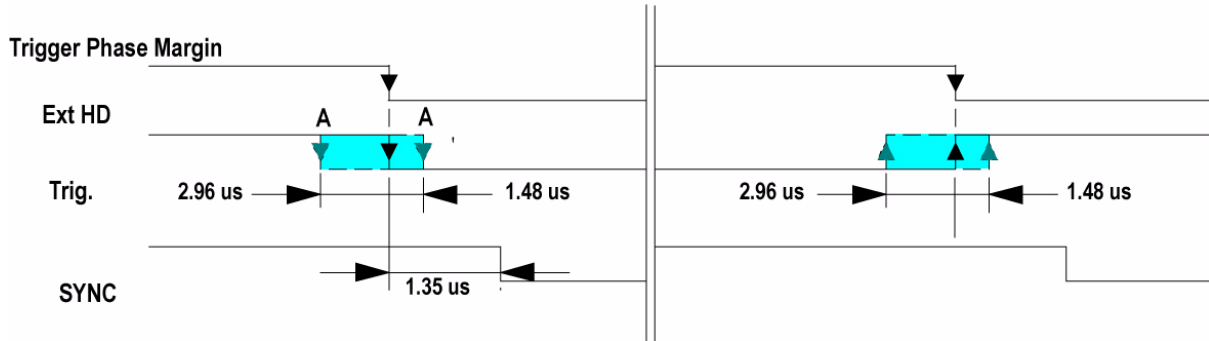


FIGURE 19. Trigger to ext. HD phase relation

In the following chapters the different operation modes and functions are covered.

6.4.1 HD synchronous accumulation

With LS=0, the accumulation will start synchronously with HD. The trigger pulse should be longer than 2 H, and the accumulation will then start at the first HD after the trigger leading edge. The exposure start delay is shown in the table below the timing drawings.

In EPS mode the exposure stops 0.5H after the selected shutter time, (in number of HD).

In PWC mode the exposure stops 4.3μs after the trigger trailing edge. It results in up to 1 H jitter.

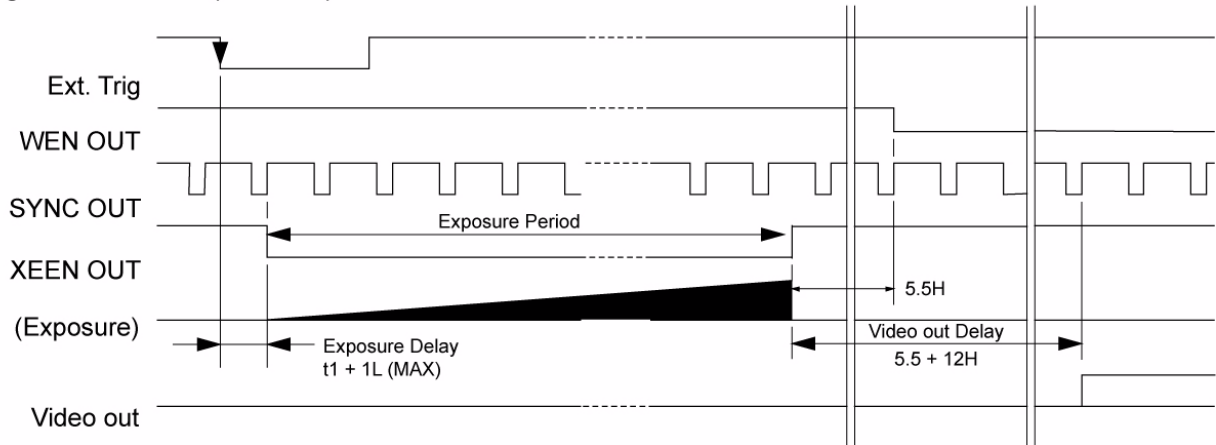
In trigger modes with HD synchronous accumulation, a new exposure can be started while the previous frame is read out. The new exposure should not finish before the frame is read out. FVAL shall be low for >2 LVAL. The maximum frame rate in trigger modes can then be close to the frame rate in continuous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

Important notes on using this mode

- In HD synchronous trigger modes, exposure jitter up to 1 H can be the result, if the trigger trailing edge is not synchronized to HD.
- The minimum trigger interval in EPS should be longer than $(1V + 2H)$, and $1V + 4H$ in PWC.

6.4.1 (a) EPS (Edge Pre select Mode)

Edge Pre-Select mode (Full Frame)

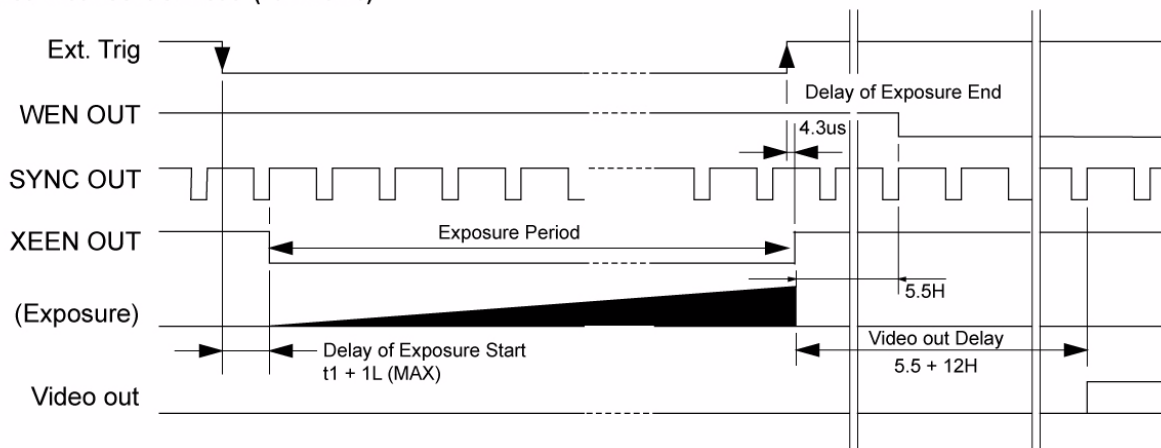


t1. Exposure start delay				
$\leq 1/25,000$	$1/75,000$	$1/100,000$	$1/150,000$	$1/300,000$
4-30 μ sec.	30-57 μ sec.	34-60 μ sec.	37-64 μ sec.	40-67 μ sec.

FIGURE 20.HD synchronous accumulation in EPS mode. Full frame.

6.4.1 (b) PWC (Pulse Width Control mode)

Pulse Width Control mode (Full Frame)



t1. Exposure start delay

4-30 μ sec.

FIGURE 21.HD synchronous accumulation in PWC mode. Full frame.

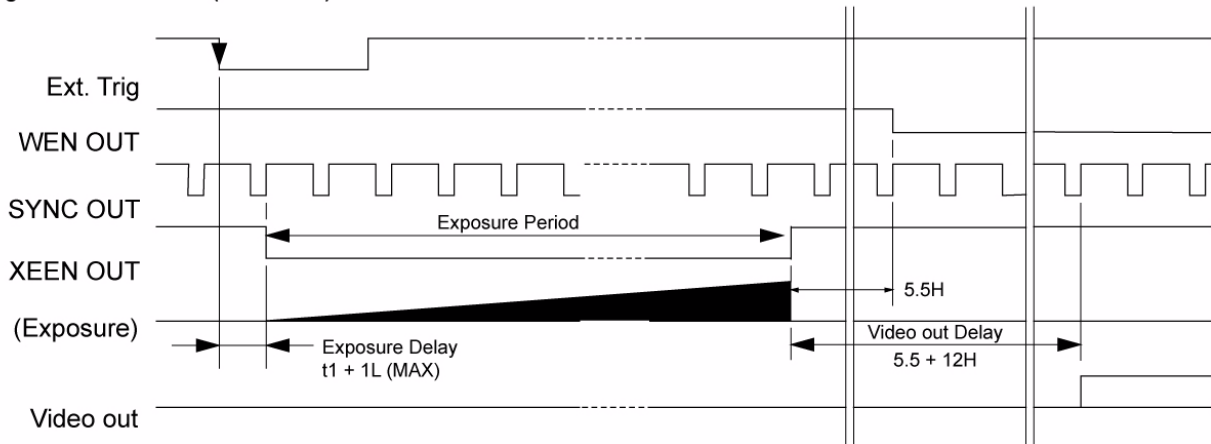
6.4.2 HD asynchronous accumulation

- With LS=1, the accumulation starts after the trigger leading edge.
- The exposure start delay is fixed. See the table included in Figure 22 for the fixed delay.
- In EPS mode the exposure stops 0.5 H after the selected shutter time, (in number of HD).
- In PWC mode the exposure stops 0.5 H after the trigger trailing edge.
- A new trigger must not be applied before the previous frame is read out (VD is low).
- The minimum trigger interval should be longer than (exposure time + 1 V + 3 H).

Note: In HD asynchronous trigger modes, there is a fixed delay but no exposure jitter.

EPS (Edge Pre Select Mode)

Edge Pre-Select mode (Full Frame)



t1. Exposure start delay				
< or =1/25,000	1/75,000	1/100,000	1/150,000	1/300,000
4-30μsec.	30-57μsec.	34-60μsec.	37-64μsec.	40-67μsec.

FIGURE 22.HD asynchronous accumulation in EPS mode. Full frame.

PWC (Pulse Width Control Mode)

Pulse Width Control mode (Full Frame)

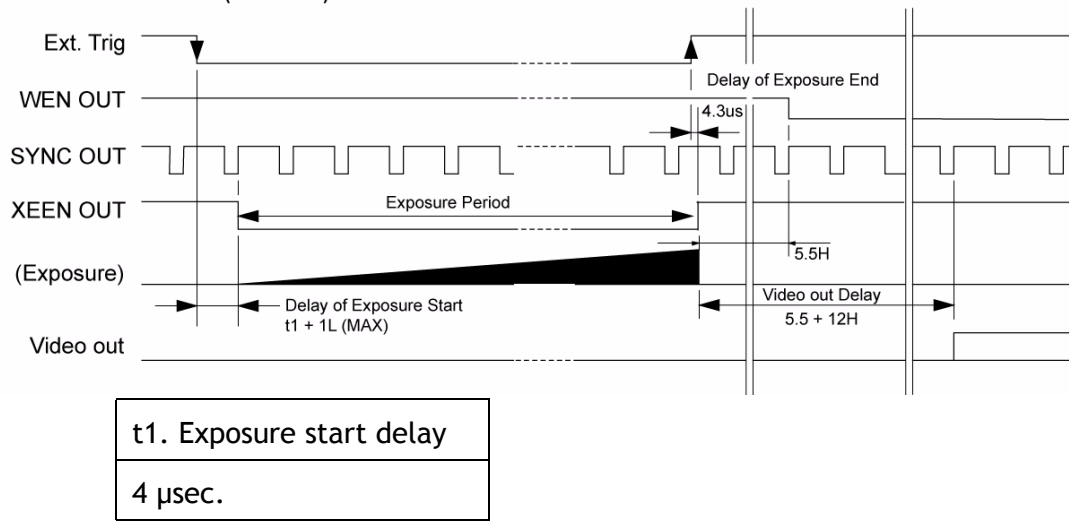


FIGURE 23. HD asynchronous accumulation in PWC mode. Full frame.

6.4.3 Continuous operation

This mode is used for continuously running applications not requiring an asynchronous external trigger. For timing details, refer to fig. 14. through fig. 17.

To use this mode:

Set function:	Trigger mode to <i>Continuous</i>	TR=0
	Shutter mode normal, programmable or auto	SM=0 through 2
	Shutter speed	SH=0 through 14
	Programmable exp.	PE= through 628
Other functions and settings		
Input	Ext. HD in pin 6 on 12-pin or pin 6 of D-sub 9-pin (If used).	
	Ext. VD in pin 7 on 12-pin or pin 1 of D-sub 9-pin (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 synchronization shown in Figure 15 on page 11.
- For timing details, refer to Figure 12 on page 8 and Figure 13 on page 9

6.4.4 Edge Pre-select Trigger Mode

An external trigger pulse initiates the capture. The exposure time (accumulation time) is the fixed shutter speed set by SH or PE. The accumulation can be HD synchronous or HD asynchronous. 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 HD synchronous accumulation, it is recommended to synchronize the trigger to HD (see Figure 19 on page 14).

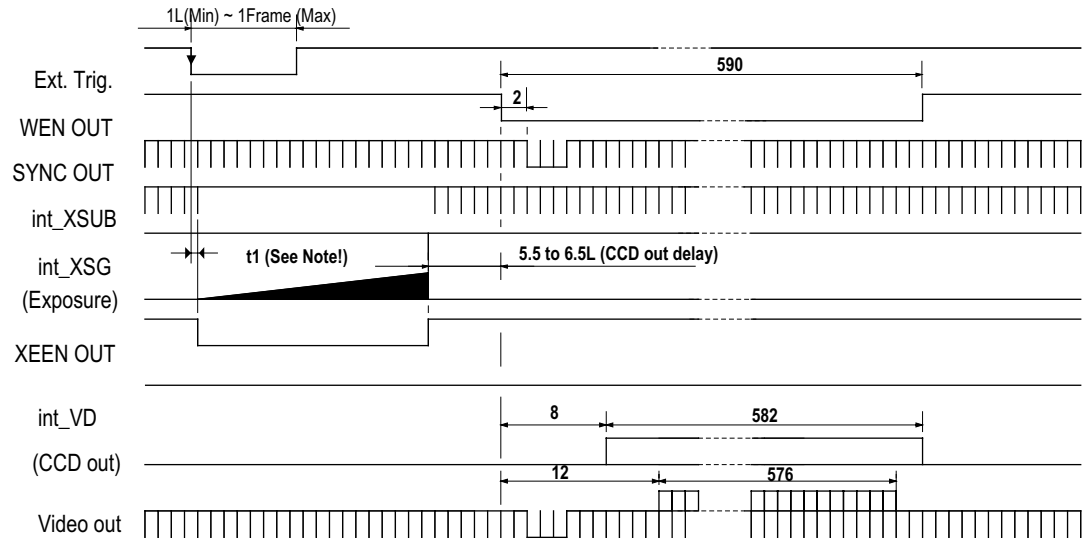
Use HD synchronous accumulation (LS=0) for the highest trigger rate. A new exposure can be started while the previous is read out. The shutter time should end >2 LVAL after FVAL goes low. For timing details, refer to Figure 12 on page 8, Figure 13 on page 9 and Figure 24 on page 19.

To use this mode:

Set function:	Trigger mode to <i>Edge pre-select</i>	TR=1
	Shutter mode normal, programmable or auto	SM=0, SM=1
	Shutter speed	SH=0 through 14
	Programmable exp.	PE= through 628
	Accumulation HD synch. or asynch.	LS=0, LS=1
Other functions and settings		
Input	Ext. trigger 6-pin Hirose or 12-pin Hirose	
	Ext. HD in D-sub p-pin or 12-pin connector	SW302.1 (If used)

Important notes on using this mode:

- External sync system should follow the camera scanning system.
- To avoid ≤ 1 LVAL jitter if LS=0, ext. HD/Trigger phase relations as shown in Figure 19 on page 14.
- Trigger pulse with >1 LVAL to < 1 Frame
- If LS=0, the minimum trigger interval >(1 VD + 2 H).
- If LS=1, the minimum trigger interval >(exposure time + 1 VD + 3 H).
- EPS together with Smearless can only work in HD sync. accumulation.(LS=0)

Edge Pre-Select mode (int_VD Period, Asynchronous mode)

t1. Exposure start delay					
Exposure Time	< or =1/25,000	1/75,000	1/100,000	1/150,000	1/300,000
Sync. accum.	4-30μsec.	30-57μsec.	34-60μsec.	37-64μsec.	40-67μsec.
Async. accum	4 μsec.	4 μsec.	7 μsec.	11 μsec.	14 μsec.

FIGURE 24.Edge pre-select. HD async. accumulation.**6.4.5 Pulse Width Control Trigger Mode**

In this mode the accumulation time is equal to the trigger pulse width. Here it is possible to have long time exposure. The maximum recommended time is <120 frames.

The accumulation can be HD synchronous or HD asynchronous. The exposure start delay is shown below the timing drawing. To avoid up to 1LVAL time jitter in HD synchronous accumulation, it is recommended to synchronize the trigger to HD. (See fig. 18.).

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. 12. through fig. 13. and fig. 24.

To use this mode:

Set function:	Trigger mode to <i>Pulse width control</i>	TR=2
	Shutter mode to normal or programmable	SM=0, SM=1
	Accumulation HD synch. or asynch.	LS=0, LS=1

Other functions and settings

Input

Ext. trigger 6-pin Hirose or 12-pin Hirose

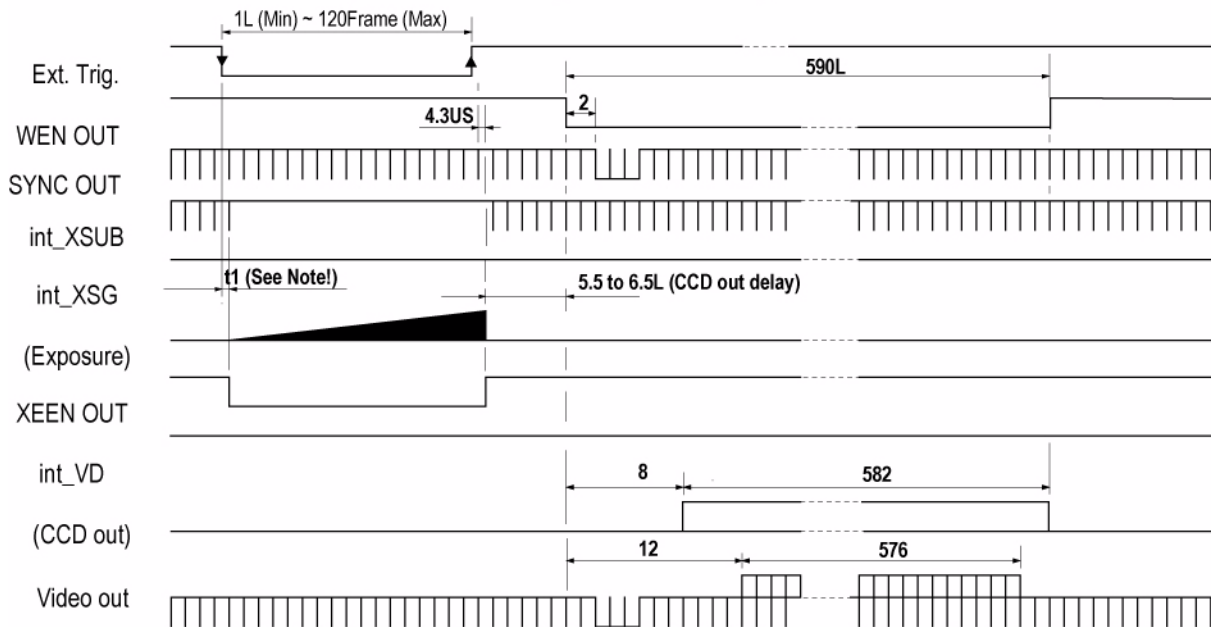
Ext. HD in D-sub p-pin or 12-pin connector

SW302.1 (If used)

Important notes on using this mode

- External sync system should follow the camera scanning system.
- To avoid ≤ 1 LVAL jitter if LS=0, ext. HD/Trigger phase relations as shown in Figure 19 on page 14.
- Trigger pulse width: >2 LVAL to <120 frames in HD sync. accumulation.
- Trigger pulse width: >2 LVAL to <3 frames in HD a-sync. accumulation.
- If LS=0, the minimum trigger interval $>(1 \text{ VD} + 4 \text{ H})$.
- If LS=1, the minimum trigger interval $>(\text{exposure time} + 1 \text{ VD} + 3 \text{ H})$.
- PWC together with Smearless can only work in HD sync. accumulation (LS=0).

Pulse Width Control mode (int_VD Period, Asynchronous mode)



T1: Exposure start delay	
Sync. Accum	4-30 μs
Async. Accum	4 μs

FIGURE 25. Pulse width control. HD async. accumulation

6.4.5 (a) 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 runs continuously. The external Sensor Gate control signal will disable the internal XSG pulse so the accumulation continues during the next frame. The resulting video is read out after the first VD (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 28, where the internal XSG is placed. Refer to Figure 27 on page 21.

The sensor gate control signal can be synchronized by the VD signal.

For video out timing details, refer to Figure 12 on page 8, Figure 13 on page 9, Figure 25 on page 20 and Figure 27 on page 21.

To use this mode:

Set function:	Trigger mode to <i>Sensor gate control</i>	TR=3
	Other functions and settings	
Input	Ext. SG control to trigger input 6-pin Hirose or 12-pin Hirose	

Important notes on using this mode:

- External sync system should follow the camera scanning system.
- The ext. HD/VD phase relations should follow the synchronization shown in Figure 17 on page 12.
- After power up the camera, apply more than 1 SG pulse before operation.

Sensor Gate Control

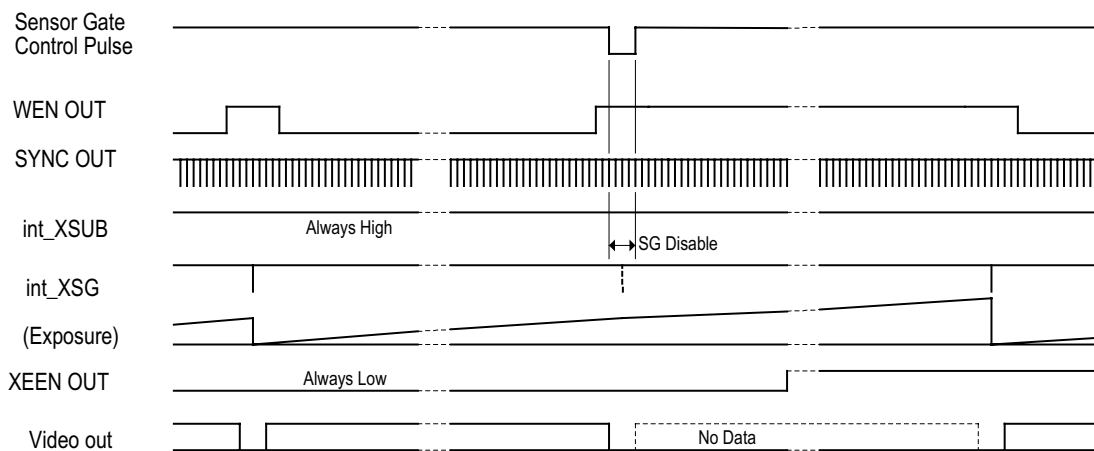


FIGURE 26. Vertical timing for Sensor Gate Control

Sensor Gate Control (Gate Position)

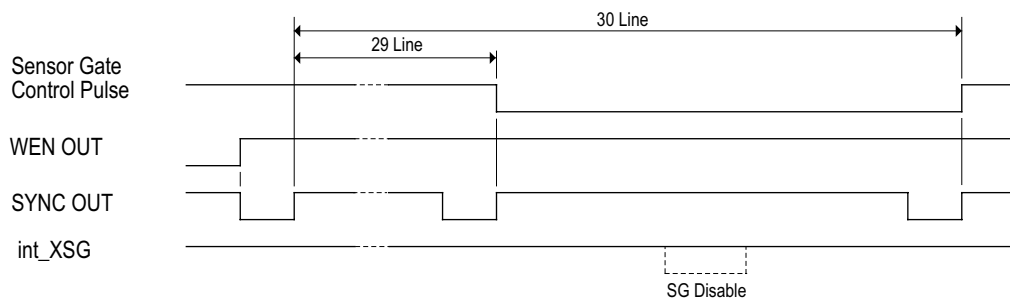


FIGURE 27. Sensor Gate position in line number 30

6.5 Other Functions.

Smearless readout. SL=1.

This function reduces the unwanted smear signal from a highlighted scene when a short exposure time is used. It works in EPS and PWC 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. Smearless readout will only work with HD synchronous accumulation.

Shutter mode. SM=0, SM=1 and SM=2. SH=0 through SH=14 and PE=0 through PE=628.

- Shutter mode is available in Continuous mode and EPS mode.
- 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 accomplished using the command AG=, which is common with the AGC. Together with the AGC function it keeps 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 with the auto shutter function. This may make the camera unstable.

Trigger polarity. TP=0, TP=1.

The default trigger polarity is active low (falling edge) (TP=0). It can be inverted to active high (TP=1).

Gamma. GS=0, GS=1

For CV-M71A, gamma is selectable between 0.45 (GS=1) and 1.0 (GS=0). Factory default is 1.0.

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 keeps 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 three colors. GA=0 is 0dB gain, which is the normal working point. The range is from -3 dB to +12 dB.

Red gain level: GAR=-1024 through +2047.

Blue gain level: 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) sets the video level for black on all three colors.

Factory setting is 32 LSB for 10-bit or 8 LSB for 8-bit.

Red black level. BLR=-128 through +127.**Blue black level. BLB=-128 through +127.**

These settings are used for fine adjustment of the black level for red and blue.

White Balance. WB=0 through WB=3.

Here the white balance mode is selected. There are three 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 to manually adjust 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 success; 2 is green is too bright; 3 is green is too dark; 4 is a time-out error.

Output select. OS=0 , OS=3

With OS=0, the video output is the analog RGB signal. With OS=3 the test pattern is output (Refer to “CV-M71A Test pattern” on page 6).

Iris video output.

The iris video output on the 4-pin of the 12-pin Hirose is 700 mv for 100% video out. 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.

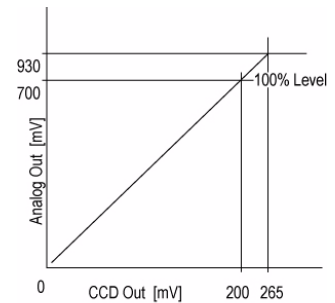


FIGURE 28. Iris video output.

One Push White Balance button.

A button located on the camera back is used for manual one push white balance.

6.6 Mode and function matrix.

The following table shows which functions work in the different modes for CV-M71A.

Function		Shutter SM=			Smearless SL	Accumulation LS=	Ext sync		Iris Video	Remarks
Mode	TR	0	1	2			VD	HD	Out	
Cont	0	✓	✓	✓	-	-	✓	✓	✓	
EPS	1	✓	✓	-	✓	✓ *1	-	✓	-	
PWC	2	-	-	-	✓	✓ *1 *2	-	✓	-	
SG	3	-	-	-	-	-	-	-	-	
✓ = ok, - = no function. *1 With smearless, only HD sync. accumulation can be used. *2 Long time exposure >3 frames is not possible with HD a-sync accumulation.										

TABLE 2.Mode and function matrix.

7 Configuring the Camera

7.1 Switch setting by internal SW301, SW302 and SW303.

- SW301 is used for 75 ohm termination for trigger and HD/VD input.
- SW302 is used for communication port select , D-sub 9-pin or Hirose 12-pin , as for HD input.
- SW303 used for communication port select , D-sub 9-pin or Hirose 12-pin , as for VD input. The switches are found inside the camera (seen from the back).

To access SW301, SW302 and SW303:
Remove camera cover.

No	Function	Setting	
		ON	OFF
1	Trigger input Termination	75Ω	TTL
2			
3	Ext. HD input Termination	75Ω	TTL
4	Ext. VD input Termination	75Ω	TTL

TABLE 3.SW 301

No	Function	Setting	
		ON	OFF
1	HD IN/OUT select on D-sub 9-pin	NC	HD in
2	HD input HIROSE 12pin or Dsub9Pin	D-sub 9 - pin	Hirose 12-pin

TABLE 4.SW 302

No	Function	Setting	
		ON	OFF
1	VD IN/OUT select on D-sub 9-pin	NC	VD in
2	VD input HIROSE 12pin or Dsub9Pin	D-sub 9-pin	Hirose 12-pin

TABLE 5.SW303

S

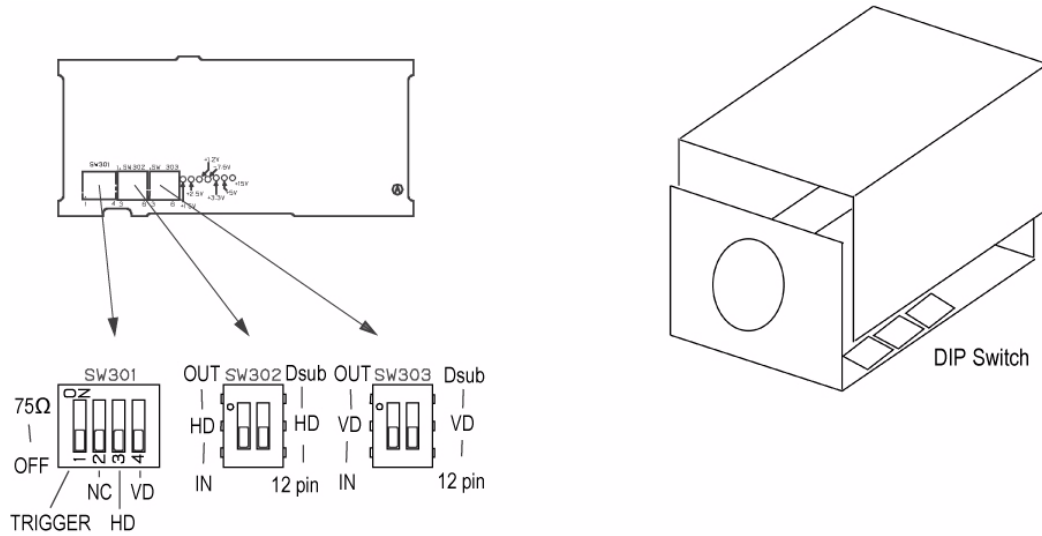


FIGURE 29. Switch 301, 302, and 303 position

7.2 RS-232C control

All configuration of the CV-M71 A camera is done by means of the RS-232C port on the 6-pin Hirose connector. 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.

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

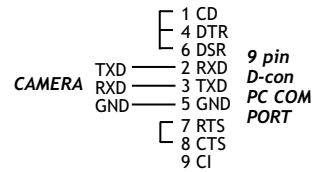


FIGURE 30. Communication setting.

Protocol

Transmit setting to camera:

NN=[Parameter]<CR><LF> (NN is any kind of command. Capital or lower case 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-M71A 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 Program Version Request	VN?<CR><LF>		3 digits, for example 100 = Version 1.00
ID	Camera ID Request	ID?<CR><LF>		max 10 characters
MD	Model Name Request	MD?<CR><LF>		max 10 characters
UD	User ID	UD=[Param.] <CR><LF> UD?<CR><LF>		User can save and load free text. (16 characters or less)
B - Shutter				

TABLE 6.CV-M71A Command List

	Command Name	Format	Parameter	Remarks
SM	Shutter mode	SM=[Param.] <CR><LF> SM?<CR><LF>	0= Preset Shutter 1= Programmable exposure 2= Auto shutter	Available when TR=0 and TR=1.
SH	Preset shutter	SH=[Param.] <CR><LF> SH?<CR><LF>	0=1/60(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=2/100000, 13=1/150000 14=1/300000	Available when SM=0
PE	Programmable exposure	PE=[Param.] <CR><LF> PE?<CR><LF>	0 to 628 (Actual exposure time when V =0 and SC=0. 1L is 26.7us.) 0=1/8L... 3.3us (1/300000s) 1=2/8L... 6.6us (1/150000s) 2=3/8L... 9.9 us (1/100000s) 3=48L... 13.3us (1/75000s) 4=1.5L... 66.7us : 627=624.5L... 16.7ms 628=625L :16.7ms (Shutter off)	Available when SM=1
C - Trigger Mode				
TR	Trigger Mode	TR=[Param.] <CR><LF> TR?<CR><LF>	0=Continuous 1=Edge pre-select 2=Pulse width control 3=Sensor Gate Control	
SL	Smearless	SL=[Param.] <CR><LF> SL?<CR><LF>	0=Off 1=On	Available when TR=1 or 2.
LS	HD Sync/Async. Accu.	LS=[Param.] <CR><LF> LS?	0=Sync 1=Async	

TABLE 6.CV-M71A Command List

	Command Name	Format	Parameter	Remarks
TP	Trigger Polarity	TP=[Param.] <CR><LF> TP?	0=Active-Low 1=Active-High	
D - Scanning format and video output				
OS	Output Select	OS=[Param.] <CR><LF> OS?<CR><LF>	0=Normal Image 1=Test Pattern	
E - Gain and analog signals setting				
AS	AGC Select	AS=[Param.] <CR><LF> AS?<CR><LF>	0=Off (Manual Gain Controlled) 1=ON	
AG	AGC/Auto Shutter Reference	AG=[Param.] <CR><LF> AG?<CR><LF>	1 - 255	Available when AS=1 or SM=2
GA	Master Gain Level	GA=[Param.] <CR><LF> GA?<CR><LF>	-50 to +150 (0 is 0dB.)	
GAR	Red Gain Level	GAR=[Param.] <CR><LF> GAR?<CR><LF>	-1024 to +2047	
GAB	Blue Gain Level	GAB=[Param.] <CR><LF> GAB?<CR><LF>	-1024 to +2047	
WB	White Balance	WB=[Param.] <CR><LF> WB?<CR><LF>	0=Manual/One push AWB 1=3200K 2=4600K 3=5600K	
AW	One-pushAuto White Balance	AW=[Param.] <CR><LF>	0=Initiates one-push AWB	
AWRS	Inquire the status after-one-push AWB	AWRS?<CR><LF>	One of the following values will be replied from the camera 0=AWB has not been finished yet. 1=Succeeded. 2=Error1. Green image was too bright. 3=Error2. Green image was too dark. 4=Error3. Timeout=error occurred.	

TABLE 6.CV-M71A Command List

	Command Name	Format	Parameter	Remarks
BL	Master Black Level	BL=[Param.] <CR><LF> BL?<CR><LF>	0 to 255	
BLR	Red Black Level	BLR=[Param.] <CR><LF> BLR?<CR><LF>	-128 to 127	
BLB	Blue Black Level	BLB=[Param.] <CR><LF> BLB?<CR><LF>	-128 to 127	
GS	Gamma Select	GS=[Param.] <CR><LF> GS?<CR><LF>	0=1 1=0.45	Default is GS=0
SW	Sync/WEN Select	SW=[Param.] <CR><LF> SW?<CR><LF>	0=Sync, 1=WEN	
SY	Sync on G	SY=[Param.] <CR><LF> SY?<CR><LF>	0=Off, 1=On	
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 AREA will become the default at the next power up.
SA	Save Settings (to Camera EEPROM)	SA=[Param.] <CR><LF>	1=User 1 area 2=User 2 area 3=User 3 area Note the parameter 0 is not allowed in this case.	
EA	EEPROM Current Area No. Request	EA=<CR><LF>		The camera returns the latest used DATA AREA
*If positive logic is used (TP=1), the first trigger pulse after power up will be ignored. TTL only. Note: Do not try to use commands not on this list.				

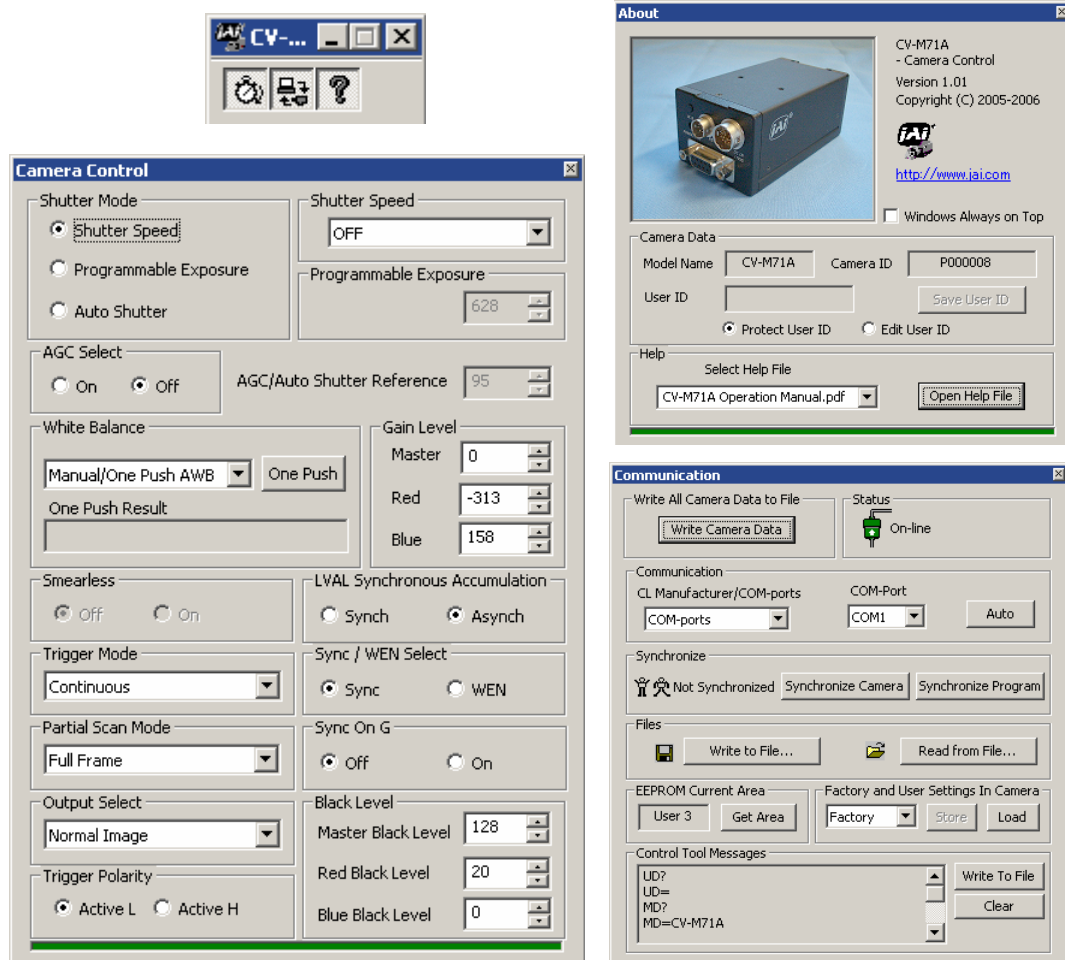
TABLE 6.CV-M71A Command List

8 Camera Control Tool for CV-M71A

The Camera Control Tool for Windows NT/2000/XP can be downloaded from www.jai.com. 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 Windows interface. It also provides an easy and efficient ActiveX interface built for MS Windows NT, 2000 and XP. The OCX interface has the ability to connect to the camera using the serial interface of the PC by reading and writing properties for the camera. This integration requires simple programming skills with Visual Basic, Visual C++ or similar languages in a Microsoft Windows environment.

8.1 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 opens a separate Tool Window when selected. 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 program version, 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>

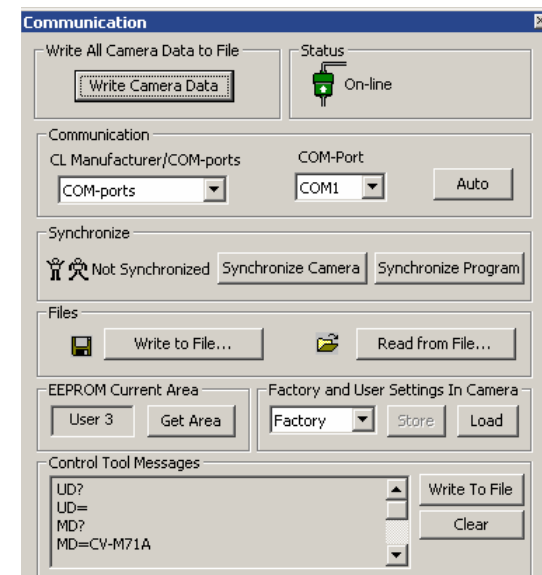
For newer camera models the *About* window also shows Model Name, Camera ID and User ID. It is possible to edit and save free text in User ID.

At the bottom of the windows (except the Communication Window) is a colored bar. The bar is green when the Camera Control Tool is connected to a camera and the camera is turned on. The bar is red when the Camera Control Tool is not connected to a camera or when the camera is turned off.

The Communication Window

The Communication Window is used to connect the Camera Control Tool with the JAI camera. Depending on the camera there are two 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 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.

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 Off-line (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 on-line/off-line status. If a camera is found on the selected communication port the application runs on-line otherwise off-line.



Changing the settings in the application will automatically update the camera settings when the application is online.

If the application loses connection with the camera it will automatically go to off-line mode. The changed status 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).

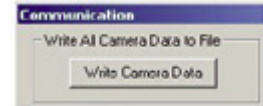
Factory and User Settings

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:



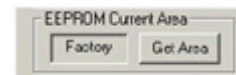
Model Name, Camera ID, User ID, Firmware Version, Current Settings, Factory Settings and the available User Areas. The file is formatted as shown:

CameraData.txt					
Model Name	CV-M71A				
Camera ID	P000008				
User ID					
Firmware Version	110				
	Current Settings	Factory Settings	User Area 1	User Area 2	User Area 3
Shutter Mode	Shutter Speed	Shutter Speed	Shutter Speed	Shutter Speed	Shutter Speed
Shutter Speed	OFF	OFF	OFF	OFF	OFF
AGC Level	95	95	95	95	95
Trigger Mode	Continuous	Continuous	Continuous	Continuous	Continuous
Smearless	Off	Off	Off	Off	Off
LVAL Accumulation	Async	Async	Async	Async	Async
Black Level Blue	-23	-23	-23	-23	-23
Trigger Polarity	Active Low	Active Low	Active Low	Active Low	Active Low
Partial Scan Mode	Full Frame	Full Frame	Full Frame	Full Frame	Full Frame
Output Select	Normal Image	Normal Image	Normal Image	Normal Image	Normal Image
AGC Select	Off	Off	Off	Off	Off
White Balance	Manual/One Push AWB	Manual/One Push AWB	Manual/One Push AWB	Manual/One Push AWB	Manual/One Push AWB
Master Gain Level	0	0	0	0	0
Progr. Exp.	628	628	628	628	628
Gain Level Red	-313	-313	-313	-313	-313
Gain Level Blue	158	158	158	158	158
Master Black Level	128	128	128	128	128
Black Level Red	20	20	20	20	20
Sync On G	Off	Off	Off	Off	Off
Sync/WEN Select	Sync	Sync	Sync	Sync	Sync

FIGURE 31. Sample camera data field

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 whether the camera is online or 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 do not 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.).
 - aTo obtain the camera settings click Synchronize Program.
 - bTo send the settings saved in the Camera Control Tool (last used settings) to the camera click Synchronize Camera.
 - cTo see which area the camera has started up in click Get.

9 External Appearance and Dimensions

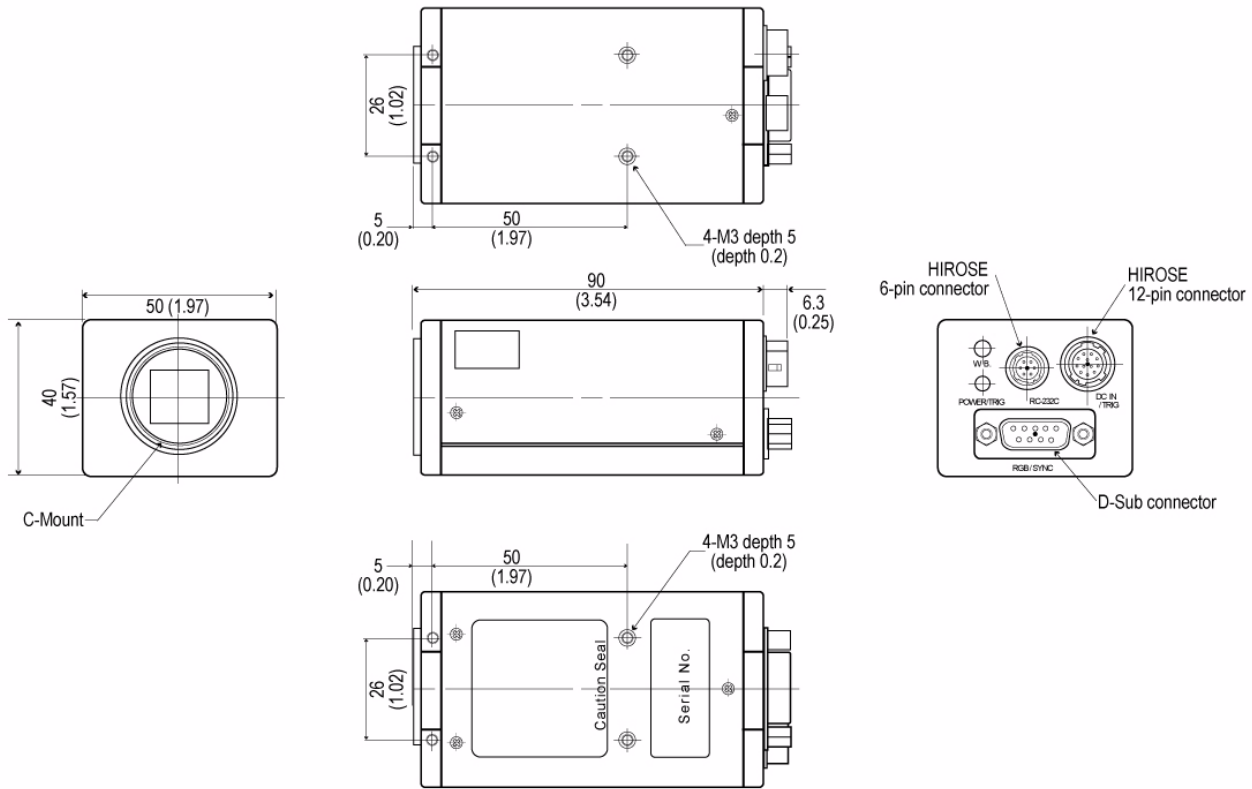


FIGURE 32. External dimensions

10 Specifications

10.1 Spectral sensitivity

CV-M71A has a built in IR-stop and optical low-pass filter block in front of the CCD sensor.

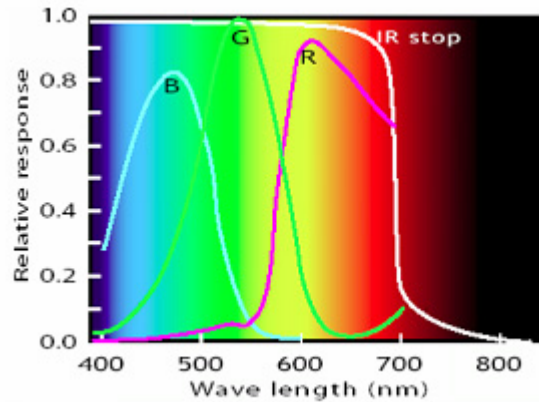


FIGURE 33. Spectral sensitivity for CV-M71 CL

10.2. Specification table

Specifications	CV-M71 A
Scanning system	Progressive scan
Frame rate	Full Frame : 60 frames/sec. Progressive (625 lines/frame) Partial Scanning : 250 fps (max.) (150 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.	767 (h) x 576 (v) 60 fps. H = 37.5 kHz
Sensitivity on sensor	9.1 Lux (Min. gain, 100% video, gamma=1) 1.2 Lux (Max. gain, 50% video ,gamma=1)
S/N ratio	54 dB on Green, gamma 1, gain 0dB

TABLE 7.CV-M71A Specifications

Video output.	Analog (D-sub 9 pin), R,G,B 0.7V p-p each, (75 ohm) Sync ON/OFF on Green channel
Iris video output. Analog	0.7 V p-p High Impedance
Gain	Manual and automatic (Only continuous mode for auto)
Gain range	-3 to +12 dB. (-3 to +9 dB in auto gain)
Gamma	0.45/1.0 (Default = 1)
Synchronization	Int. X-tal. / Ext. HD/VD
Ext HD/VD in.	4 V $\pm$ 2 V. TTL or 75 Ω terminated
Tracking range for external HD	37.50 KHz $\pm$ 1%
Trigger input.	4 V $\pm$ 2 V. TTL or 75 Ω terminated Via Hirose 12P or Hirose 6P
XEEN/WEN output	4 V p-p V from 75 Ω source
Trigger modes	Edge Pre-Select, Pulse Width Control, and Sensor Gate control
Accumulation	HD synchronous or a-synchronous
Preset 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 Partial Scanning: 1/2(1/121),1/4(1/249)1/8(1/503) to 1/300,000s
Programmable exposure PWC	1/15,000 to 2 sec
Pulse width control	HD sync accumulation: 2 lines to 120 frames. HD a-sync accumulation: 2 lines to 3 frames.
Auto shutter range	Full frame: 1/60 to 1/25,000
Readout modes	Full, Partial Scanning (1/2,1/4 ,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 (9600bps)
Functions controlled by RS 232C	Shutter, Trigger, Read out, Polarity, Black level, Gain,
Operating temperature	-5°C to +45°C
Humidity	20 to 80% non-condensing
Storage temp/humidity	-25°C to +60°C/20% to 80% non-condensing

TABLE 7.CV-M71A Specifications

Vibration	10G (20Hz to 200Hz, XYZ)
Shock	70G
EMC	CE (EN61000-6-1 and EN61000-6-3) , CC part 15 class B
Power	12V DC $\pm$ 10%. <0.35A
Lens mount	C-mount (Flange back 17.526 mm -0.05mm) Image center $\pm$ 0.1mm from C-mount center
Dimensions	40 x 50 x 90 mm (H x W x D)
Weight	240 g
<i>Note: Above specifications are subject to change without notice</i>	

TABLE 7.CV-M71A Specifications

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, a jagged image may appear on the monitor.

Blemishes

- Some pixel defects can occur, but this does not have a practical effect on the camera's operation.
- No CCD spots are visible when cameras are shipped.
- In general, photo diodes comprising a CCD sensor can be damaged by cosmic rays and as a result, spots may appear on the CCD sensor.
- Please use care not to expose the camera to cosmic rays during storage and transportation.
- We recommend sea shipment instead of air transport due to the strong influence of cosmic rays on the camera.
- Pixel defects may be exaggerated depending on ambient temperature and/or camera settings such as gain up or long term exposure, and accordingly, the camera should be used within the specifications.

Patterned Noise

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

Caution when installing the lens on the camera

When the lens is installed to the camera, floating dust may be attached to the surface of the lens or CCD of the camera. The Lens cap and the camera cap should be kept on until installation. The work should be done in a clean environment. When installing, the surface of the camera should be downward so that dust does not get into and stick to the lens. Be careful not to touch the surface of the lens.

Exportation

When exporting this product, follow the export regulations of your country.

11.3 References

1. This CV-M71A manual is available for download at www.jai.com
2. The data sheet for the CV-M71A is available for download at www.jai.com
3. Camera control software is available for download at www.jai.com
4. Specifications for the CCD sensor Sony ICX-415AQ can be found at www.jai.com

12 Users Record

Camera Type CV-M71 A

Revision: Revision B

Serial No.

Firmware Version

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

User Mode Settings:

User Modifications:



DECLARATION OF CONFORMITY

AS DEFINED BY THE COUNCIL DIRECTIVE
89/336/EEC

EMC (ELECTROMAGNETIC COMPATIBILITY)

WE HEREWITH DECLARE THAT THIS PRODUCT
COMPLIES WITH THE FOLLOWING PROVISIONS APPLYING TO IT.

EN-50081-1

EN-50082-2

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