JAI®

Progressive Scan Monochrome CCD Camera

CV-A11

Operation Manual

Camera: Revision B
Manual: Version 2.1

CE

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

Table of Contents

1. General

The CV-A11 is a monochrome progressive scan 1/3" CCD cameras, designed for automated inspection application, featuring an extremely small housing and a wide range of unique functions.

The asynchronous trigger can be set to work in several modes, to allow functions such as pulse width controlled shutter, programmable shutter speed and long time integration.

All mode settings of the camera can be set up via an RS-232C interface, greatly reducing the need for mechanical switches of jumpers.

The CV-A11 outputs an analogue video signal, with composite sync.

The latest version of this manual can be downloaded from: www.jai.com
The latest version of Camera Control Tool for CV-A11 can be downloaded from: www.jai.com

2. Standard Composition

The standard camera composition consists of the camera main body.

3. Main Features

- New compact size 1/3" monochrome CCD camera
- 648 (h) x 492 (v) pixels for VGA
- Progressive scan
- Single channel video output
- High S/N ratio > 56dB
- Extended range of functions and options compared with CV-M10
- Shutter speeds from 1/30 to 1/100 000 in 15 steps
- Programmable exposure
- Partial scanning 1/2, 1/3 and 1/6 for higher frame rates
- Internal, external HD/VD or random synchronization
- Edge pre-select, pulse width and start/stop trigger modes
- Long time exposure with external VD pulse
- Frame-delay readout mode in connection with pulse width controlled shutter
- Exposure enable EEN, write enable WEN and pixel clock out
- Short ASCII commands for modes setting via serial port
- Windows 98/NT/ME/2000 setup software

4. Camera Housing and Dimensions

Unit: mm (inch)
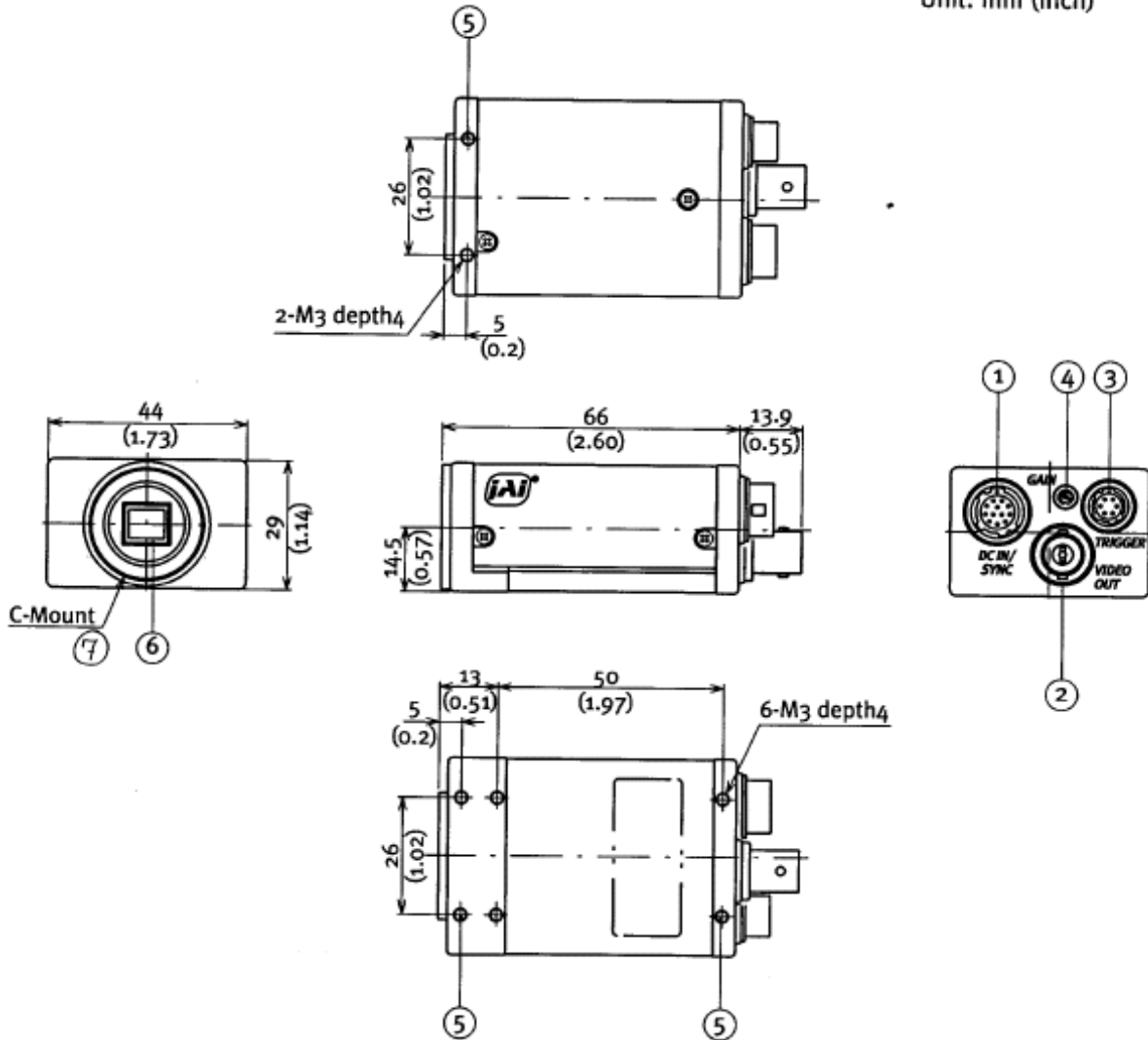
Fig. 1. Locations and dimensions.

1. 12 pin Hirose connector for frame grabber interfacing and power (12V DC).
2. BNC connector for video output. VS 1.0 Vpp 75 Ohm.
3. 6 pin Hirose connector for trigger input and RS-232C control interface.
4. Gain potentiometer for manual gain setting.
5. Mounting holes, 8 x M3. For precision mounting use only the 4 holes located at the forward part of the bottom plate.
6. 1/3" interline-transfer type CCD sensor.
7. Lens mount for C-mount lenses. *1)

Note *1): Rear protrusion on the C-mount lens must be less than 10mm (0.4 inches approx.). When IR-cut filter is used, it must be less than 7.0 mm (0.28 inches approx.).

The IR-cut filter is placed in the C-mount thread.
The C-mount IR-cut filter must be ordered separately.

5. Pin Assignment

5.1. 12-pin Multi-connector (DC-IN/VIDEO OUT, EXT.HD/VD IN)
Type: HR10A-10R-12PB-01 (Hirose) male

Seen from rear.   *Pin configuration is compatible with EIAJ standard*

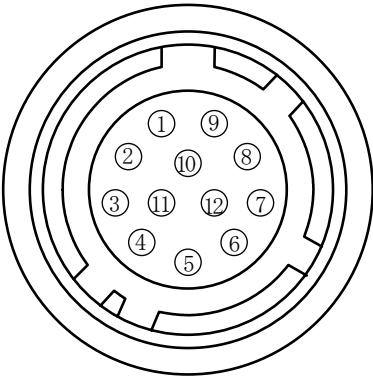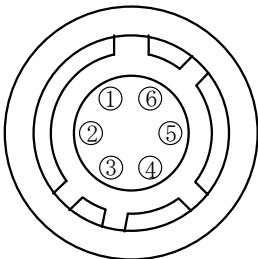| Pin no.	Signal	Remarks
1	GND	
2	+12 V DC input	
3	GND	
4	Video output	Parallel with the BNC connector.
5	GND	
6	*HD input*/HD output	*) SW2.1 on for 75Ω. SW1.1 on for HD out.
7	*VD input*/VD output	*) SW2.2 on for75Ω. SW1.2 on for VD out.
8	GND	
9	Pixel clk/WEN output	*)JP2 short. CW=1 for pclk. CW=0 for WEN
10	*WEN output*	*) *2) GND if JP5 open and JP3 short
11	*Trigger input*	*) +12V DC if JP1 short and JP4 open
12	GND	

Fig. 2. 12-pin connector.

Plugs for cable: HR10A-10P-12S

5.2. 6-pin Multi-connector (TRIGGER and RS232C)
Type: HR10A-7R-6PB (Hirose) male

Seen from rear.

Pin no.	Signal	Remarks
1	TXD out	RS-232C
2	RXD in	RS-232C
3	GND	
4	GND	
5	*Trigger input*	*) Parallel with pin 11 on 12 pin con
6	*EEN output*	*) *3). For WEN out refer to chapter 10.2.

Fig. 3. 6-pin connector.

Plugs for cable: HR10A-7P-6S

Notes:
*)   Alternative signals can be placed on these pins by switch or jumper settings or
            RS-232C commands. See chapter 10.1. and 10.2. for alternative signals.
            Configurations shown in *Bold + italic* is factory setting.
*2)   WEN (Write Enable) pulse indicates the period of effective video signal output. It is usefull
            for setting the timing with framegrabber.

*3)   EEN (Exposure Enable) pulse indicates the duration of the shutter, and can be used for
            controlling strobe illumination.
            EEN will be low all the time in normal continous mode (TR=0), if the selected
            exposure time is longer than the frame readout time.

For schematic diagram of the input and output circuit alternative settings refer to 5.3.

5.3. Input and Output Circuits

In the following schematic diagrams the input and output circuits for video and timing signals are shown. For alternative connections refer to "10.1. CV-A11 emulating CV-M10 interfacing." Jumper settings are shown as for factory default.

5.3.1. Video output

The video output is a 75 Ω DC coupled circuit. The BNC connector and pin #4 on the 12-pin connector is in parallel. Avoid double termination. The video DC level is shown with 75 Ω termination.
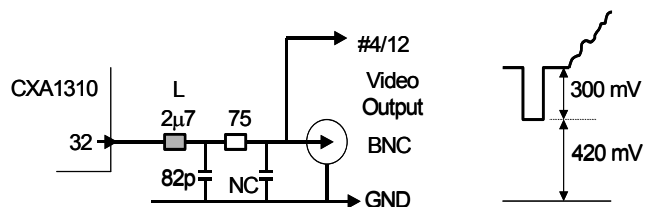
Fig. 4. Video output.

5.3.2. Trigger input

The trigger input is AC coupled. To allow a long pulse width, the input circuit is a flip flop, which is toggled by the negative or positive differentiated spikes caused by the falling or rising trigger edges.
The trigger polarity can be changed.
Trigger input level 4 V ±2 V.
The trigger-input impedance is 1 kΩ.
JP1 and JP4 are for alternative configuration for pin #10.
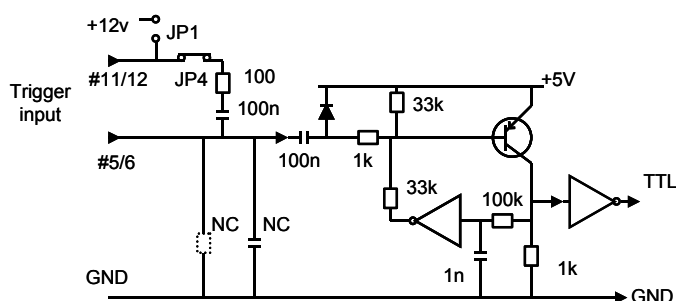
Fig. 5. Trigger input.

5.3.3. HD and VD input

The input circuit for external HD and VD signals are shown. It can be 75 Ω terminated by closing SW2. SW1 will switch to output the internal HD and VD signal.
HD and VD input level is 4 V ±2 V.
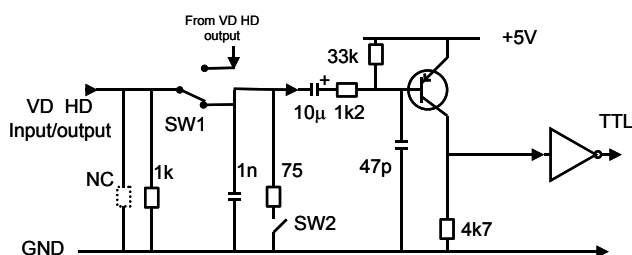
Fig. 6. HD and VD input.

5.3.4. HD, VD, PCLK, WEN and EEN output

Output circuit for these signals are 75 Ω complementary emitter followers. It will deliver a full TTL signal. JP5 and JP3 are for alternative configuration for pin #10.
Output level ≥4 V from 75Ω. (No termination).
The WEN polarity can be changed.
Signal on pin #6/6 can be changed.
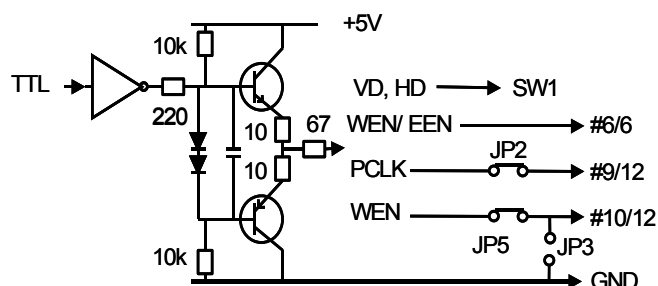
Fig. 7. HD, VD, PCLK, WEN and EEN output.

6. Functions and Operations

Apart from the standard continuous operation, the CV-A11 features three external asynchronous trigger modes (edge pre-select, pulse width controlled and start/stop) and a special frame-delay readout mode. Long integration time mode is also supported.
In addition, the CV-A11 also provides a partial scan readout function.

6.1. Basic functions

Some of the primary camera functions need a general introduction before the operation modes are described. The list below shows the primary functions from the command list.

|		
SM	Shutter Mode	Normal shutter, Programmable Exposure
SH	Shutter Speed	Off to 1/100,000 second
PE	Programmable Exposure	1.5 H to 1023.5 H
SC	Scanning Format	Full frame, 1/2 partial, 1/3, 1/6 partial
TR	Trigger Mode	Normal, Edge, PWC, frame delay readout
		Long time exposure, start-stop, smearless (Edge)
HC	HD Accumulation	H Synchronous, H Asynchronous.

The shutter *SM* can be set to normal (SM=0), where the exposure time is selected from 15 fixed step with the command *SH*, or programmable exposure (SM=1). Here the command *PE* allows 1023 step with 1 line period resolution (63.5 μs) in triggered mode. For normal mode, PE can be up to 523 for full, 275 for 1/2, 195 for 1/3 and 115 for 1/6 partial scan.
The CCD scanning format *SC* can be selected between full or partial scanning. With partial scanning, only the vertical central part of the CCD sensor is read out with a higher frame rate. The partial scan is done by a fast dump read out of the lines in the vertical ccd register down to the top of the partial image. The partial part of the image is read out with normal speed. The lines below the partial image are read out and dumped with a high speed.
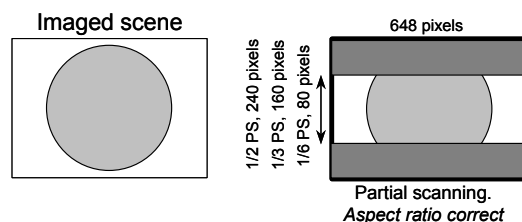
Fig. 8. Partial scanning.

The accumulation mode *HC* is H synchronous (HC=0). For PWC mode (TR =2) and Frame Delay readout (TR=3) it can also be set to asynchronous accumulation (HC=1).
In H synchronous mode, the exposure in will start at the first HD pulse after the trigger falling edge. In H asynchronous mode the exposure will start immediately at the leading edge of the trigger pulse without waiting for the HD. Fig. 9 and fig. 10 shows the details.
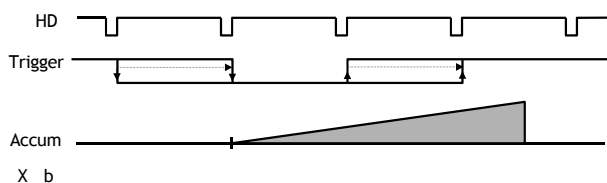
Fig. 9. PWC H synchronous accumulation.
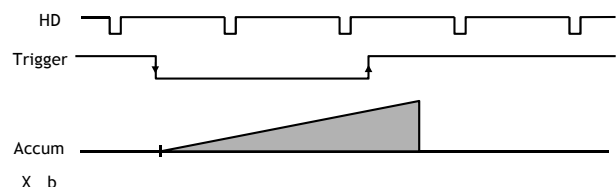
Fig 10. PWC asynchronous accumulation.

In normal continuous mode (TR=0) shutter speed up to 1/100,000 second can be used. In triggered shutter modes, the shortest shutter time is limited to ≥1,5 H or 1/10,000. In triggered shutter modes with full and partial scan, the exposure time is not limited to the frame read out time. It can be longer.

6.2. Input-output of HD/VD Signals

In the default setting the camera will accept external HD/VD signals on pin 6 and 7 of the 12 pin Hirose connector. If external HD/VD is applied, the camera will synchronize to it. If no external sync signals are applied, the camera will operate with its internal x-tal controlled sync. The camera scanning system should be set to the same as the external connected sync. In fig. 11 the time requirements to relation between VD and HD is shown.

The input is TTL level as factory setting. It can be 75 Ohm terminated by the internal switch on the PK8299 board. SW2-1 for HD and SW2-2 for VD. On for 75 Ohm termination.

To output the internal HD/VD signals on pin 6 and 7 the internal switch SW1-1 and 1-2 on the PK8299 board should be set ON. The output is TTL level from a 75-Ohm source.
Refer to "7.4. Internal Switch and Jumper settings."

In trigger modes there are no continuous VD out. Only after an external trigger pulse, a VD pulse will be output.

To use this mode:
Set function: SW 1 on PK8299 to IN for external VD/HD input. *Factory default.*
                         SW 2 on PK8299 to 75 Ω for termination of VD/HD.
                         SW 2 on PK8299 to TTL for TTL level for VD/HD. *Factory defaults.*
                         SW 1 on PK8299 to OUT for internal VD/HD output.
Input: Ext. VD in or int. VD out on pin 7 on 12-pin connector.
                         Ext. HD in or int. HD out on pin 6 on 12-pin connector.

Important notes on using this mode
External sync system should follow the camera scanning system.
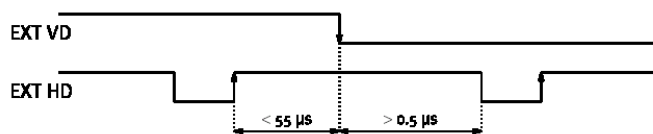
Fig. 11. Ext. HD and ext. VD phase conditions.

6.3. Continuous Operation (Non triggered)

For applications that do not require asynchronous external trigger (continuous operation). This is the factory default setting of the camera.
See chapter 7.1 on how to select this mode.

To use this mode:
Set function: Trigger mode to "Normal"   TR=0
                         Shutter mode "Normal" or "Programmable"   SM=0, SM=1
                         "Shutter Speed"   SH=0 through 15
                         "Programmable exposure" for full scanning PE=1 through 523
                         PE for 1/2, 1/3 and 1/6 partial scan.   < 275, 195, 115
                         Other functions
Input: Ext. VD on pin 7 on 12-pin connector. If used.
                         Ext. HD on pin 6 on 12-pin connector. If used.

Fig. 12. Horizontal timing details and pixel numbering for the CCD array.

Fig. 13. Vertical timing details and lines numbering for the CCD array.

NOTE. Fig. 12 and fig. 13 are omitted.

6.4. External Trigger Modes

This camera has 6 external asynchronous trigger modes, which can be set by RS-232C commands.

1.	*Edge Pre-select Mode.TR=1*	Pre-selected exposure. (SM=0, SM=1)
2.	*Pulse Width Control Mode. TR=2*	Pulse width controlled exposure. (HC=0, HC=1)
3.	*Frame Delay read out mode. TR=3*	PWC exposure read out by ext. VD. (HC=0, HC=1)
4.	*Long Time Exposure Mode. TR=4*	Exposure is interval between ext. VD.
5.	*Start/stop Mode. TR=5*	Exposure start by trigger and stop by ext. VD
6.	*Smearless Read out mode. TR=6*	EPS Exp. after fast dump readout.(SM=0, SM=1)

The default accumulation is HD synchronously accumulation (HC=0). The accumulation starts at the first HD after the trigger leading edge. Details are shown in fig.15.

In PWC mode (TR =2) and Frame Delay readout (TR=3), the accumulation mode *HC* can be set to asynchronous accumulation (HC=1). The exposure will start immediately at the leading edge of the trigger pulse without waiting for the HD. Fig. 16. below shows the details.

In Edge pre-select TR=1 and smearless TR=6, the shutter mode can be SM=0 or SM=1.

Smearless read out will reduce the smear caused by highlighted zones seen in images taken with a short shutter speed. Before the accumulation can start, a fast dump read out is performed. It takes 28H from trigger leading edge to start of accumulation.

Important notes on using trigger modes

- The HD synchronized accumulation starts at the first HD after the trigger leading edge. To avoid the <1H jitter caused by this delay, synchronize the external trigger to HD as shown in fig. 14. The trigger level translations should be placed inside A, which is 8 μsec.
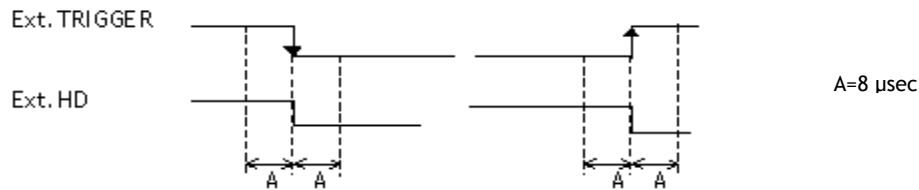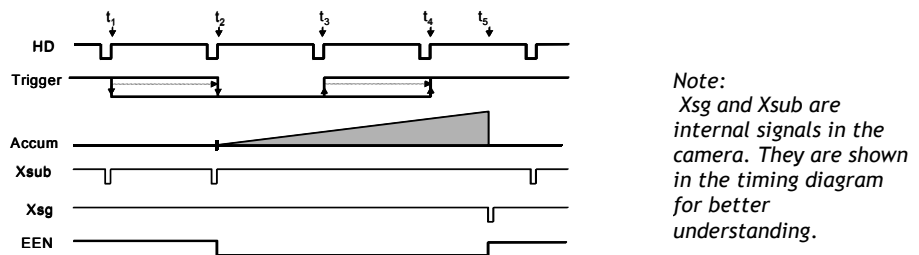- Do not input a new trigger before the previous video is read out. (WEN is high).

Fig. 14. Trigger/HD timing.

Note:
Xsg and Xsub are internal signals in the camera. They are shown in the timing diagram for better understanding.
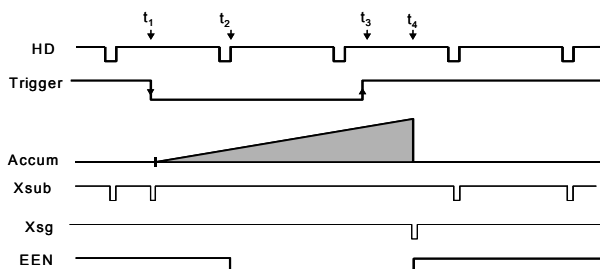
Fig. 15. Pulse Width H synchronous accumulation.


Fig. 16. Pulse Width H asynchronous accumulation.

6.5. Edge Pre-select Mode

An external trigger pulse initiates the capture (input on pin 11 of the 12-pin Hirose connector or pin 5 of the 6-pin Hirose). The leading edge of the trigger pulse initiates the exposure (this is a falling edge if factory default). If the polarity of this pulse is reversed, the camera can be configured to correct for it. The exposure time (accumulation time) is governed by the pre-defined shutter speed set by RS-232C.

To use this mode:

Set function:	Trigger mode "Edge Pre-select"	TR=1
	Shutter mode to "Normal" or "Programmable"	SM=0, SM=1
	Shutter Speed using fixed steps	SH=0 through 7
	or Programmable exposure	PE=1 through 1023
	Polarity and other functions	
Input:	Ext. trigger to pin 5 on 6 pin connector (or 11 on 12 pin connector)	
	Ext. HD to pin 6 on 12 pin connector. (If used).	

Edge pre-select mode
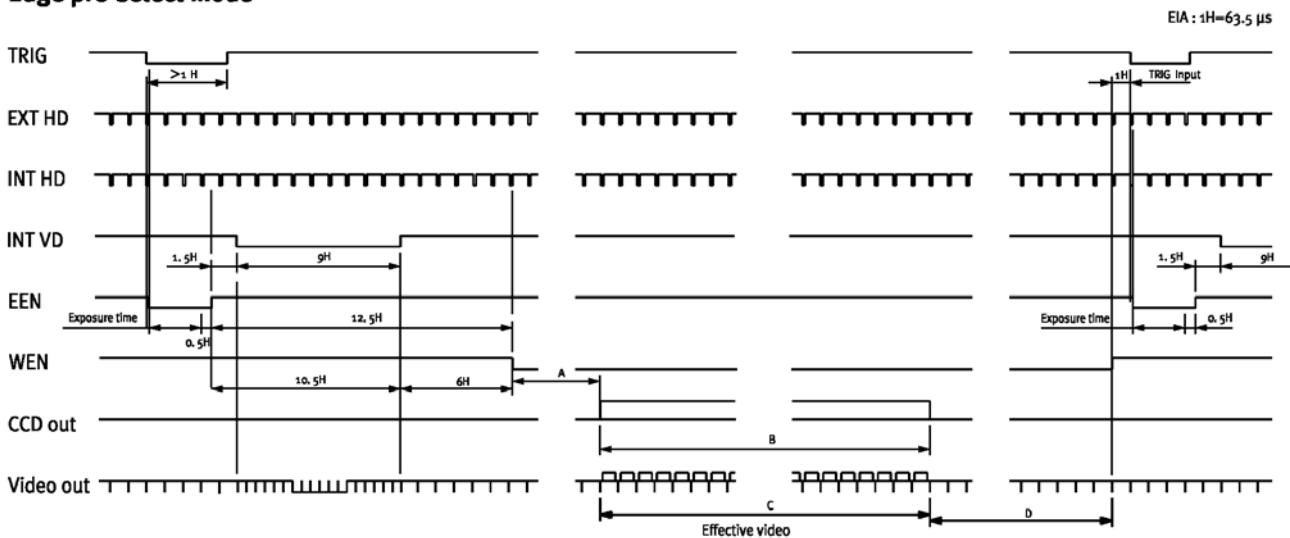
EIA : 1H=63.5 μs

MODE	A	B	C	D
Full Frame	14 H	2 H ~ 493 H	492 H	18 H
1/2 Partial	22 H	134 H ~ 373 H	240 H	14 H
1/3 Partial	22 H	174 H ~ 333 H	160 H	14 H
1/6 Partial	22 H	214 H ~ 293 H	80 H	14 H

Fig. 17. Edge pre-select

Important notes on using this mode:

- As the start of exposure will be synchronized with the internal H signal, the start of exposure may be shifted by max 1H. To avoid this shift (jitter), synchronize the camera with an external HD and make sure that the trigger pulse aligns to the HD signal as shown in Fig. 14.
- The duration of the external trigger pulse must be greater than 1H. It is recommended to make this longer, typically 9H. This is a TTL level pulse, which can be positive or negative going (the camera can be set to accept any polarity).
- Do not input ext. VD signal at pin 7 on 12 pin connector, as it may disturb the external trigger function.
- Do not input a new trigger before the previous video is read out. (WEN is high).

6.6. Pulse Width Control Mode

The leading edge of the trigger pulse initiates the capture. The exposure time (accumulation time) is governed by the duration of the trigger pulse. If the polarity of this pulse is reversed, the camera can be configured to correct for it.
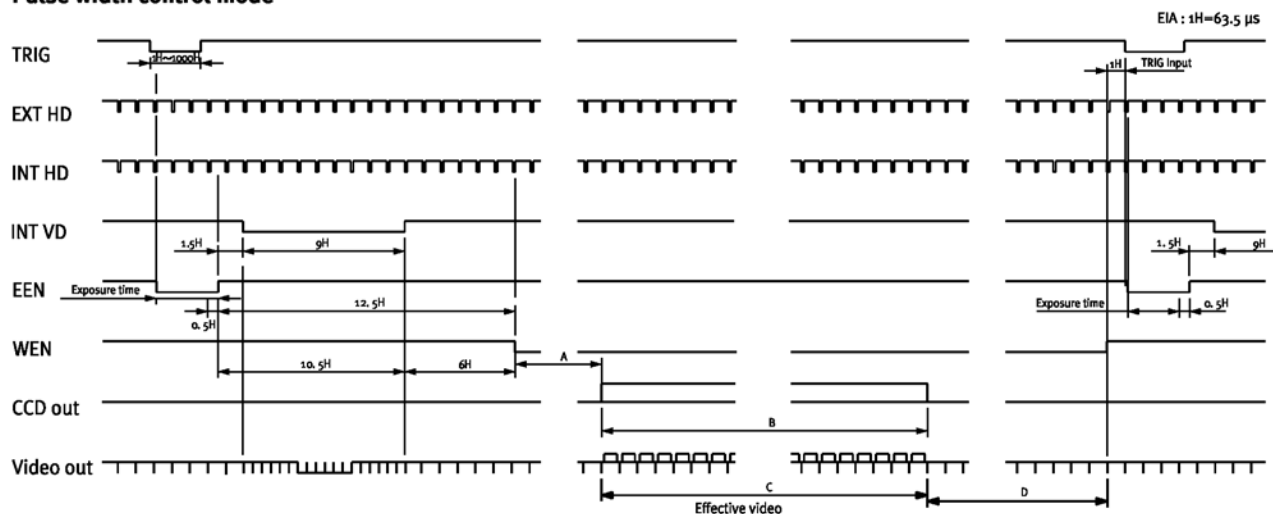The exposure time range is 1.5H to 1000H (shortest and longest pulse duration).

To use this mode:
Set function: Trigger mode to "Pulse Width Control"   TR=2
                  HD accumulation   HC=0, HC=1
                  Polarity and other functions
Input: Ext. trigger to pin 5 on 6 pin connector (or 11 on 12 pin connector)
                  Ext. HD to pin 6 on 12 pin connector. (If used).

Pulse width control mode

MODE	A	B	C	D
Full Frame	14 H	2 H ~ 493 H	492 H	18 H
1/2 Partial	22 H	134 H ~ 373 H	240 H	14 H
1/3 Partial	22 H	174 H ~ 333 H	160 H	14 H
1/6 Partial	22 H	214 H ~ 293 H	80 H	14 H

Fig. 18. Pulse width control.

Important notes on using this mode:
- The exposure will start and stop synchronized to the internal H signal. It result in 1H jitter. To avoid this jitter, synchronize the camera with an external HD and make sure that the trigger pulse aligns to the HD signal as shown in Fig. 14.
- This trigger mode is also supported by a function called "HD Asynchronous Accumulation", ACSII command "HC". This function allows integration to start immediately at the leading (falling) edge of the Ext. Trig pulse instead of at the next horizontal drive pulse HD. Please refer to fig. 15 and fig. 16. To enable this function, set HC=1. (Factory default is HC=0). If the falling edge of the trigger falls inside the HD low pulse, a jitter up to 7.5μsec. can be expected. The exposure will start up to 7.5μsec. after the falling edge of the trigger.
- In HD asynchronous PWC mode avoid the trigger to raise inside the HD low period. It will cause 1 line image position jitter.
- Please note that the timing chart in Fig. 18 only shows the HD synchronous mode.
- Do not input external VD signal at Pin No. 7 of the 12-pin Hirose connector, as it may disturb the external trigger function.
- Do not input a new trigger before the previous video is read out. (WEN is high).

6.7. Frame-delay read out Mode

This mode allows simultaneous capture of multiple camera using a common external trigger pulse subsequent multiplexed (sequential) readout using a single input frame grabber, as the user has control over when the image is read out from the CCD sensor. The exposure starts at the falling edge of the ext. trigger signal, and ends at the rising edge of the ext. trigger signal (in the same way as Pulse Width Control mode). The captured image is now stored in the CCD until an ext. VD signal is given to the camera. The effective video signal is output 14H after the falling edge of WEN signal.

To use this mode:
Set function: Trigger mode to "Frame Delay Readout"   TR=3
                  HD accumulation   HC=0, HC=1
                  Polarity and other functions
Input: Ext. trigger to pin 5 on 6 pin connector (or 11 on 12 pin connector)
                  Ext. VD to pin 7 on 12 pin connector.
                  Ext. HD to pin 6 on 12 pin connector. (If used).
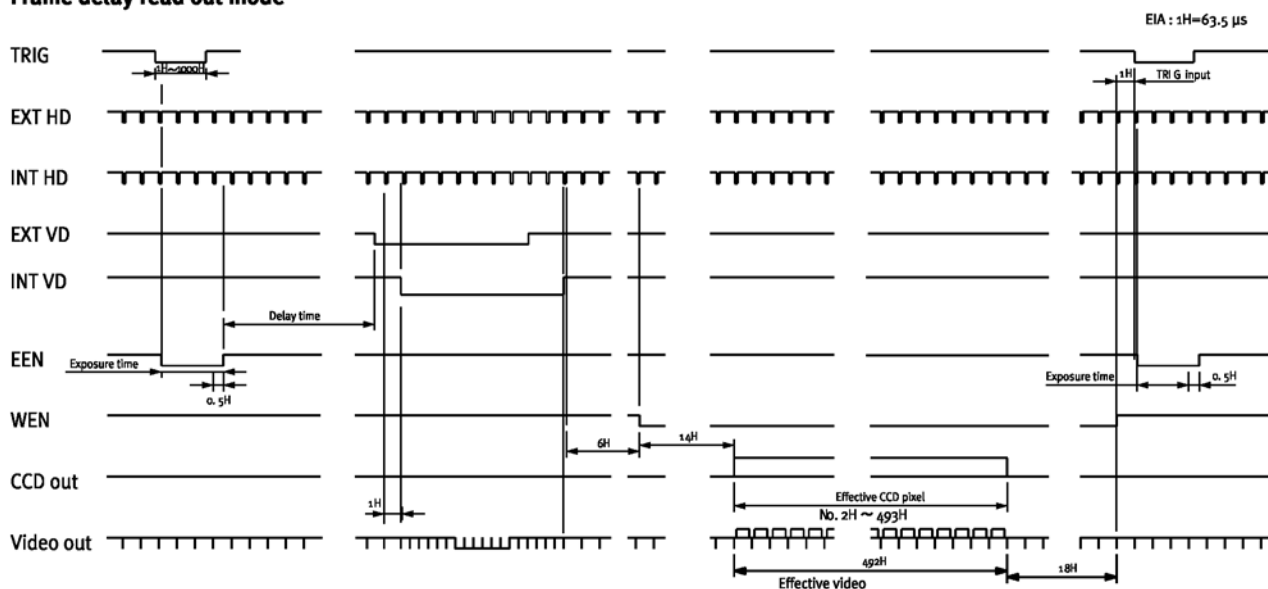
Frame delay read out mode

Fig. 19. Frame delay read out

Important notes on using this mode:

- The readout delay time must not exceed 2 seconds. This is because visible dark current noise may appear on the video signal due to the long time exposure of the CCD image sensor.
- This trigger mode is also supported by a function called "HD Asynchronous Accumulation", ACSII command "HC". This function allows integration to start immediately at the leading (falling) edge of the Ext. Trig pulse instead of at the next horizontal drive pulse HD. Please refer to fig. 15 and fig. 16. To enable this function, set HC=1. (Factory default is HC=0). If the falling edge of the trigger falls inside the HD low pulse, a jitter up to 7.5μsec. can be expected. The exposure will start up to 7.5μsec. after the falling edge of the trigger.
- In HD asynchronous Frame-delay mode avoid the trigger to raise inside the HD low period. It will cause 1 line image position jitter.
- As the start of exposure will be synchronized with the internal H signal, the start of exposure may be shifted by max 1H. To avoid this shift (jitter), synchronize the camera with an external HD and make sure that the trigger pulse aligns to the HD signal as shown in Fig. 14.
- It is recommended to use a strobe light (e.g. LEDs or Xenon tube), as the CCD must not be illuminated during readout delay time. The EEN signal can be used to trigger a strobe light
- See Fig. 11 for the phase relationship between ext. HD and ext. VD pulses.
- Do not input a new trigger before the previous video is read out. (WEN is high).

6.8. Long Time Exposure Mode

The exposure time is the interval between 2 ext. VD pulses sent to the VD input of the camera (Pin No. 7 of the 12-pin Hirose connector). The exposure starts after input of the first ext. VD pulse, and ends after the next input of the next ext. VD pulse, which again starts a new exposure. The long time exposure is a continuous process where each external VD will synchronize the camera, stop on exposure, start a new exposure and read out the previous accumulated signal. The exposure time can be selected in intervals of complete vertical timing periods (=525H).

To use this mode:
Set function: Trigger mode to "Long Time exposure"   TR=4
                      Polarity and other functions
Input: Ext. trigger to pin 5 on 6 pin connector (or 11 on 12 pin connector)
                      Ext. VD to pin 7 on 12 pin connector.
                      Ext. HD to pin 6 on 12 pin connector.
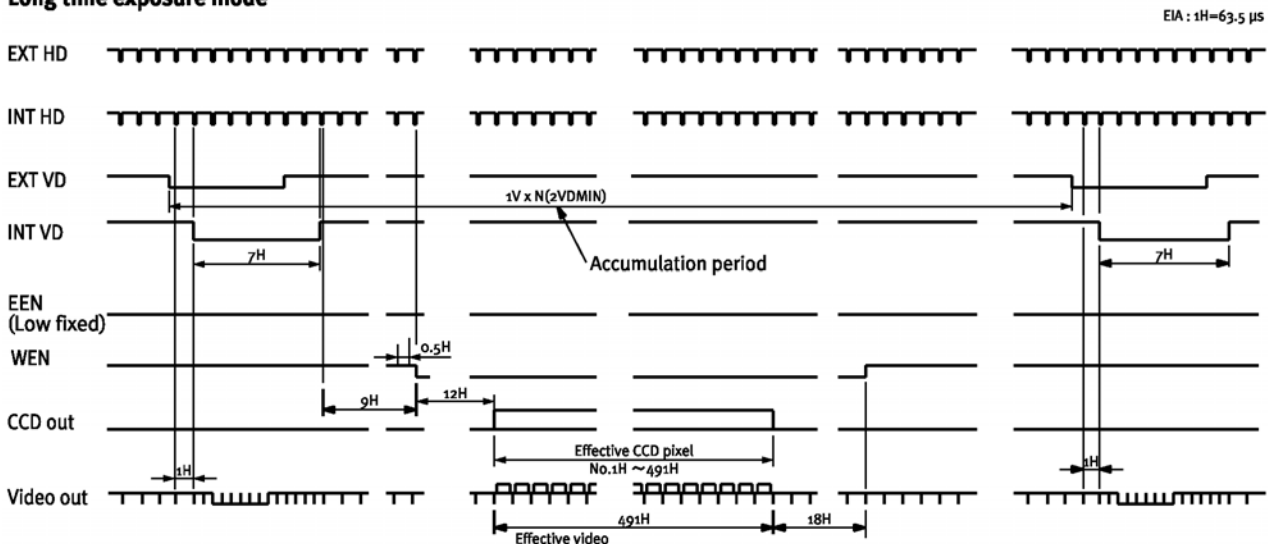
Fig. 20. Long time exposure.

Important notes on using this mode:
- Exposure time range is 1/30 sec. to ∞. However, it is recommended not to use exposure over 2.0 sec. This is because visible dark current noise may appear on the video signal due to the long time exposure of the CCD image sensor.
- External sync system should follow the camera scanning system.
- Ext. HD signal (TTL 2.0~5.0V) has to be input continuously.
- See Fig. 11 for the phase relationship between ext. HD and ext. VD pulses
- The EEN pulse is not provided when using this mode.

6.9. Start/Stop Mode

The exposure time is controlled by the interval between the ext. trigger and the ext. VD signal. The exposure starts at the first HD pulse after the falling edge of the ext. trigger, and stops at the rising edge of the VD pulse. The range can be between 1/30 to 1/10,000 second. The Start/Stop mode is a continuous mode where the VD signal must be given continuously. It is not possible to input external VD randomly.

To use this mode:
Set function: Trigger mode to "Start/Stop"   TR=5
                     Polarity and other functions
Input: Ext. trigger to pin 5 on 6 pin connector (or 11 on 12 pin connector)
                     Ext. VD to pin 7 on 12 pin connector.
   Ext. HD to pin 6 on 12 pin connector. (If used).

Fig. 21. Start/stop mode.

Important notes on using this mode:

- As the start of exposure will be synchronized with the internal H signal, the start of exposure may be shifted by max 1H. To avoid this shift (jitter), synchronize the camera with an external HD and make sure that the trigger pulse aligns to the HD signal as shown in Fig. 14.
- Remark that the trigger should be applied up to 15.5 H *after* the ext. VD for the shortest exposure.
- External sync system should follow the camera scanning system.
- See fig. 11 for the relationship between ext. HD and ext. VD.
- Do not input a new trigger before the previous video is read out. (WEN is high).

6.10. Smearless Mode

This mode will reduce the unwanted smear signal from a highlighted scene when a short exposure time is used. The trigger mode is like edge pre-select, but a fast dump readout is performed before the active accumulation is started. It will remove the smear over 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 28 H before the exposure start.
The exposure stops and the resulting video signal is read out after the selected shutter time. It can be the 9 first steps normal or 1023 step programmable. SM=0 or SM=1.
This mode will operate with full and partial scanning. An EEN pulse will indicate the active accumulation time, and a WEN pulse indicates that the resulting video is read out.

To use this mode:
Set function: Trigger mode "Smearless"   TR=6
                       Shutter mode to "Normal" or "Programmable"   SM=0, SM=1
                       Shutter Speed using fixed steps   SH=0 through 7
                       or Programmable exposure   PE=1 through 1023
                       Polarity and other functions
Input: Ext. trigger to pin 5 on 6 pin connector (or 11 on 12 pin connector)
                       Ext. HD to pin 6 on 12 pin connector. (If used).

Fig. 22. Smearless mode.

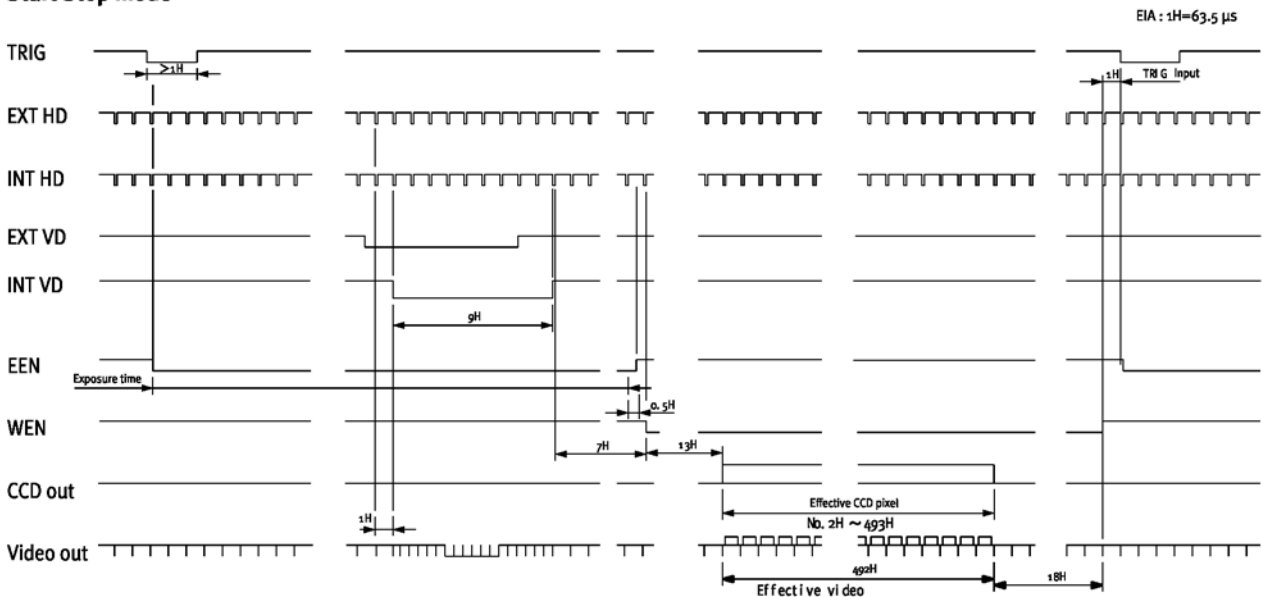*NOTE. Fig. 22 is omitted.*

Important notes on using this mode.
- As the start of exposure will be synchronized with the internal H signal, the start of exposure may be shifted by max 1H. To avoid this shift (jitter), synchronize the camera with an external HD and make sure that the trigger pulse aligns to the HD signal as shown in Fig. 14.
- The duration of the external trigger pulse must be greater than 1H. It is recommended to make this longer, typically 9H. This is a TTL level pulse, which can be positive or negative going (the camera can be set to accept any polarity).
- Do not input ext. VD signal at pin 7 on 12 pin connector, as it may disturb the external trigger function.
- Do not input a new trigger before the previous video is read out. (WEN is high).

6.11. Partial scan readout mode

This mode allows increased frame rate, as only a selected number of lines are read out. The vertical resolution is reduced as outlined below. Partial scan will operate in normal continuous mode and all trigger modes.
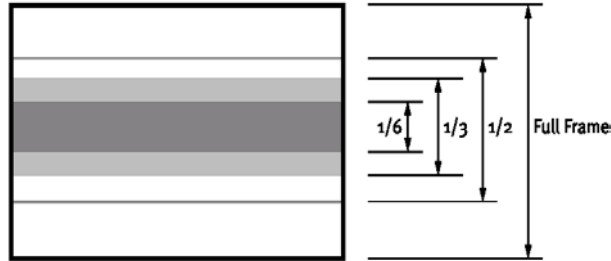

Fig. 23. Partial scanning.

The partial scanning settings are as follows:

Readout format	Frame rate	Effective lines	ASCII-Command
Full frame readout	30 fps	492	SC=0
1/2 partial readout	58 fps	240	SC=1
1/3 partial readout	73 fps	160	SC=2
1/6 partial readout	124 fps	80	SC=3

To use this mode:
Set function: Trigger mode to any   TR=0 through TR=6
     Shutter mode to "Normal" or "Programmable"   SM=0, SM=1
     Shutter Speed using fixed steps   SH=0 through 7
     or Programmable exposure   PE=1 through 1023
     Polarity and other functions
Input: Ext. trigger to pin 5 on 6 pin connector (or 11 on 12 pin connector)
     Ext. VD to pin 7 on 12 pin connector.
     Ext. HD to pin 6 on 12 pin connector. (If used).

Important notes on using this mode:
- In order to minimize smear effects on the image, it is recommended to avoid strong light outside the active partial scanned region.

6.12. Other Functions

Gain and analogue settings.

!! Do not adjust these settings unless you have knowledge to video adjustments !!

AS, AGC Switch
The video gain can be set to **AGC** or **manual**.
In AGC mode the video level is kept constant by the automatic gain control circuit within a 12 dB range. Normal 700 mVpp ±30 mV. The level can be adjusted with **AG**, **AGC level** in the range 0 to 255.

RP, Rear Potentiometer
In manual gain mode, the gain level can be adjusted by the **rear potentiometer**, or it can be adjusted by **GA, Manual Gain level** in the range 0 to 255.

SU, Setup level. This setting can adjust the setup level (or black level). Normal 20 mVpp ±2 mv.

WC, White clip level. To adjusting the desired white clip level. Normal 800 mVpp ±30 mv.

GA, Gamma select.
Gamma can be 1 (linear) or 0.45.

Signal and Polarity.

CW, Pixel clock/WEN out.
Select between Pixel clock or WEN out on pin #6 on the 6 pin connector. Note that JP2 on the rear board PK8304 should be closed. (Factory setting). Refer to chapter 10.2
Set to on if the pixel clock is used. To avoid interference the pixel clock out should be off when not used.

TP, Trigger polarity.
Will invert the trigger-input signal.

WP, WEN polarity.
Will invert the WEN output signal.

7. Configuring the Camera

7.1. RS-232C control.

All configuration of the CV-A11 camera is done via the RS-232C port. 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.

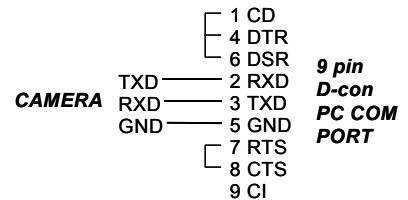| Baud Rate	9600 bps
Data Length	8 bit
Start Bit	1 bit
Stop Bit	1 bit
Parity	None
Xon/Xoff Control	None

Fig. 24. RS-232C cable.

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

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

Transmit the following to see the current parameter for a command:
  NN?<CR><LF> (NN is any commands with parameters.)
The camera answers: **NN=[Parameter]**

Transmit the following to see the current camera settings:
  ST?<CR><LF>
The camera returns the current parameter settings.

Transmit the following to get command list help:
  HP?<CR><LF>
The camera returns a complete command list.

Unknown commands send to camera: (XY is unknown command).
  XY=1<CR><LF>
The camera answers: **01 Unknown Command!!<CR><LF>**

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

7.2. CV-A11 RS-232C 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
	B – Timing and shutter related commands				
SC	Scanning format	SC=[Param.]<CR><LF>	0=full frame 2=1/3 partial	1=1/2 partial 3=1/6 partial	
TR	Trigger mode	TR=[Param.]<CR><LF>	0=normal 2=Pulse width 4=Long time 6=Smearless	1=Edge 3=Frame delay 5=Start/stop	
SM	Shutter mode	SM=[Param.]<CR><LF>	0=Normal	1=Programmab.	
SH	Shutter speed	SH=[Param.]<CR><LF>	0=1/30 2=1/60 4=1/250 6=1/1000 8=1/4000 10=1/20,000 12=1/60,000 14=1/100,000	1=1/50 3=1/125 5=1/500 7=1/2000 9=1/10,000 11=1/40,000 13=1/80,000	All15 step is valid in normal trigger mode. In all trigger modes shutter speeds higher than 9 will result in 1/10,000
PE	Programmable expos.	PE=[Param.]<CR><LF>	0=*1), 1=1.5H	1023=1023.5 H	H= 63.56μsec
HC	HD accumulation	HC=[Param.]<CR><LF>	0=H synchron accumulation	1=a-synchron accumulation	a-sync. only for TR=2 and TR=3
	C – Signals and polarity				
SO	Sync signal	SO=[Param.]<CR><LF>	0=no sync	1=sync on video	
CW	Clock/WEN	CW=[Param.]<CR><LF>	0= WEN out	1=Clock out	CW=0 if clock not used
TP	Trigger polarity	TP=[Param.]<CR><LF>	0= active low	1= active high	*2)
WP	WEN polarity	WP=[Param.]<CR><LF>	0= active low	1= active high	
	D – Gain and analogue signals setting				
AS	AGC Switch	AS=[Param.]<CR><LF>	0=AGC off	1=AGC on	0= manual gain
AG	AGC Level	AG=[Param.]<CR><LF>	0=low	255=high	Range 0 to 255
GA	Manual gain Level	GA=[Param.]<CR><LF>	0=low	255=high	Range 0 to 255
RP	Rear Potentiometer	RP=[Param.]<CR><LF>	0=manual gain	1=rear potm.	
SU	Setup Level	SU=[Param.]<CR><LF>	0=low	255=high	Range 0 to 255
WC	White clip Level	WC=[Param.]<CR><LF>	0=low	255=high	Range 0 to 255
GS	Gamma Select	GS=[Param.]<CR><LF>	0=gamma 1	1=gamma 0.45	
	E – 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	Latest used data area becomes default at next power up
SA	Save settings to camera EEPROM	SA=[Param.]<CR><LF>	1=User 1 area 3=User 3 area	2=User 2 area	

*1)   PE=0 has no function in triggered mode. PE=1 is 0.5H in continuous mode
*2)   If positive logic is used (TP=1), the first trigger pulse after power up will be ignored.
!!   Do not try to use commands not shown in the list.

7.3. Camera Control Tool for CV-A11

From www.jai.com CV-A11 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. Below the different windows are shown.
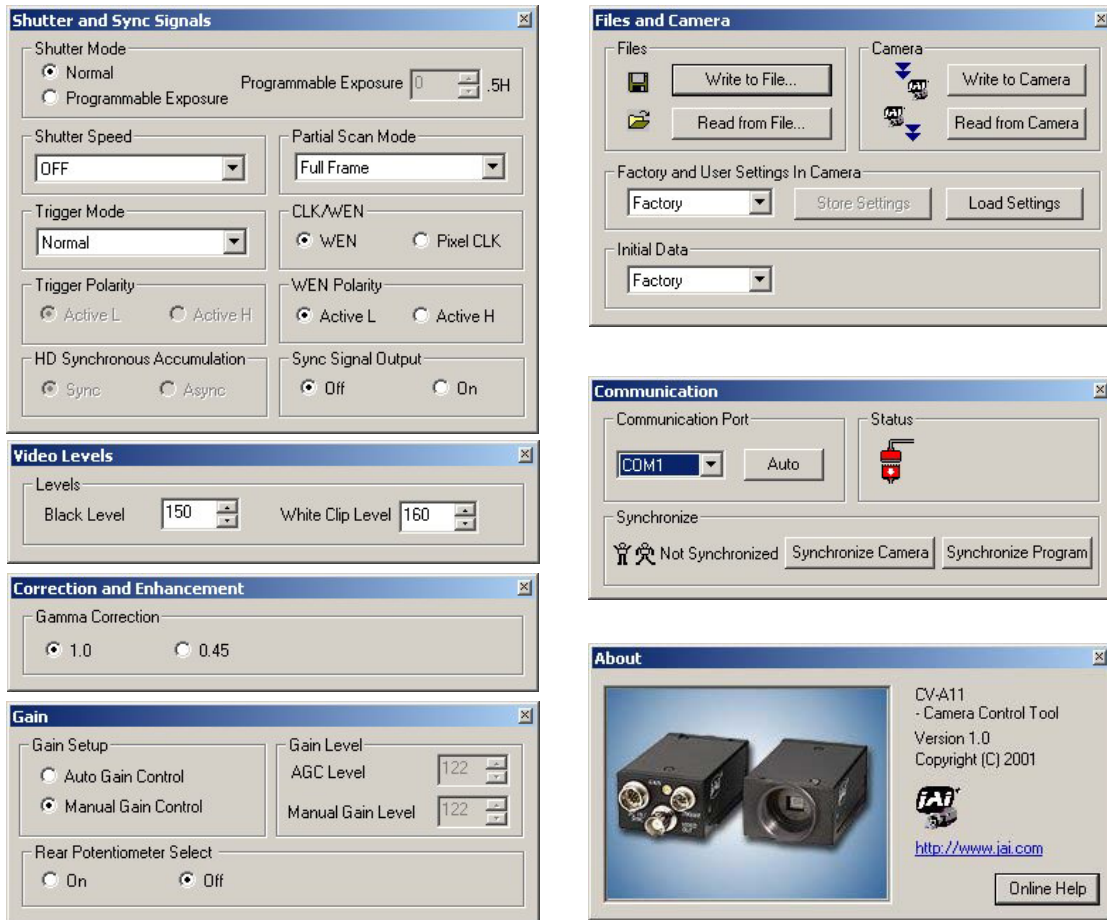
Control bar

Windows for all functions

Fig. 25. Windows from Camera Tools.

For the integrator and experienced user, the Camera Control Toll is much more than a program with a window interface. It also provides an easy and efficient ActiveX interface built for MS Windows 98, ME, NT and 2000. The OCX interface has the ability to connect to the camera using the serial interface of the PC by reading and writing properties for the camera. This integration requires simple programming skills within Visual Basic, Visual C++ or similar languages in a Microsoft Windows environment.

7.4. Internal Switch and Jumper Settings.

7.4.1. HD/VD input-output selection

In the default setting the camera will accept external HD/VD signals on pins 6 and 7 of the 12 pin Hirose connector. The composite video signal from the camera will be synchronized to an external HD/VD source connected to the camera. TTL level (between 2 and 5 V).

To set up the camera to **output HD/VD signals** on pins 6 and 7 on the Hirose connector follow these steps

1. Switch off the power to the camera.
2. Remove the camera cover, by removing the 5 screws.
3. Locate switches SW1-1 and SW1-2 on the PK8299 circuit board, and set both in the ON position. See fig. 26.

Note: The termination of HD/VD output is 75 Ohm.

7.4.2. Selecting termination of HD/VD input signals

The default setting of the HD/VD input is high impedance TTL. The camera expects to get a signal that swings between 2 and 5 volts. This setting allows the largest number of camera to be synchronized from a single HD/VD source (such as another camera or a frame grabber).
Under certain circumstances it may be necessary to terminate the HD/VD input, in order to match the impedance of the signal source, to eliminate over/undershoot or standing waves in the signal.

To change the **HD/VD input to 75Ohm terminated**, follow these steps

1. Switch off the power to the camera.
2. Remove the camera cover, by removing the 6 screws.
3. Locate switches SW2-1 and SW2-2 on the PK8299 circuit board, and set the according both in the ON position. See fig. 25.
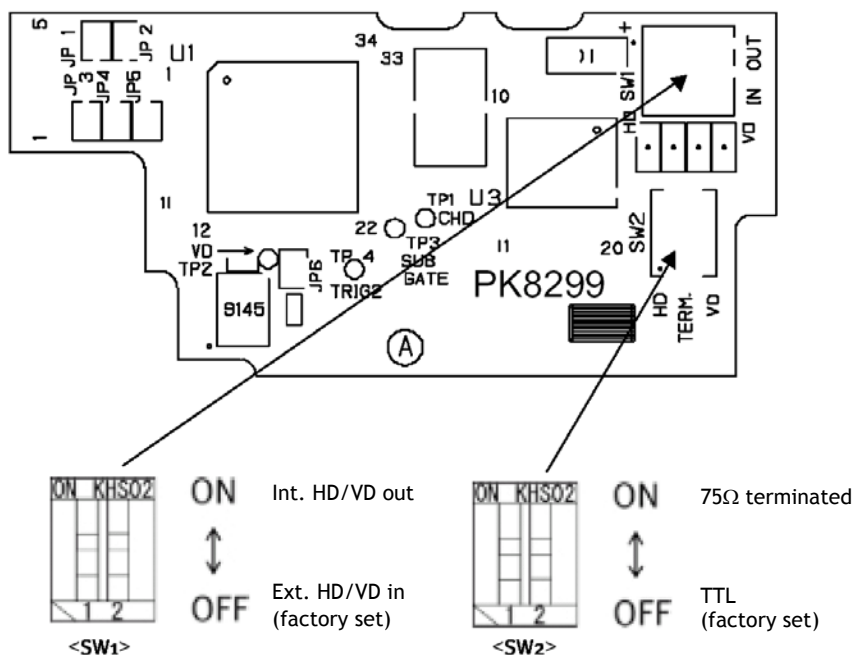

Fig. 26. HD/VD witch positions on PK8299.

8. Specifications

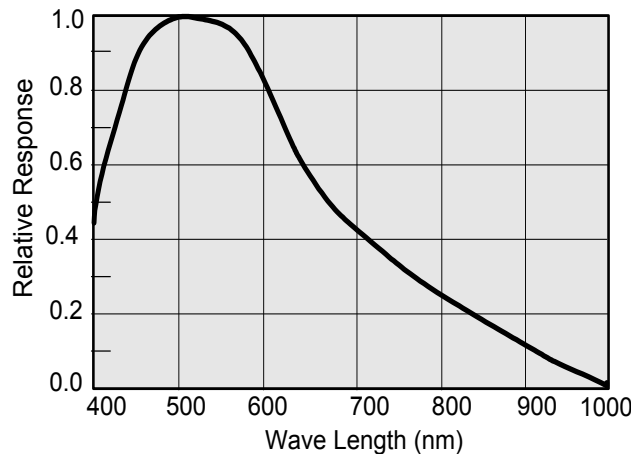| Specifications	CV-A11
Scanning System	Progressive 525 lines 30 frames/sec
Frame rate (Full frame)	29.96 Hz
Line frequency	15.734 kHz
CCD sensor	Monochrome 1/3" IT CCD. Sony ICX424AL, (ICX084AL-6, old)
Sensing area	4.9 (h) x 3.7 (v) mm
Effective pixels	659 (h) x 494 (v)
Pixels in video output	648 (h) x 492 (v)
Cell size	7.4 (h) x 7.4 (v) µm
Resolution horizontal	480 TV lines
Sensitivity on sensor	0.05 Lux, Max gain, 50% video
S/N ratio	> 56dB
Video output	Composite VS signal, 1.0 Vpp, 75 Ω, DC Coupled
Gamma	0.45 or 1.0
Gain Gain range	Manual – Automatic 0 to + 15 dB
Accumulation	Frame (Progressive scan)
Synchronization	Int. x-tal, Ext HD/VD or random trigger
HD sync Input/output	4 Vpp, 75Ω
Trigger input	4 Vpp, 75Ω
WEN output (write enable)	4 Vpp, 75Ω
EEN output (exposure enable)	4 Vpp, 75Ω
Pixel clock output	4 Vpp,75Ω
Shutter	1/30, 1/50, 1/60, 1/125,1/250,1/500, 1/1000, 1/2000,1/4000, 1/10 000, 1/20 000, 1/40 000, 1/80 000,1/100 000 sec.
Pulse width control	1.5 H to 1000H
Start/stop	1/30 to 1/10 000 second
Long time exposure	1 frame to ∞
Programmable exposure	0.5H to 1023.5H
Frame delay readout	Time from PWC trigger input to ext. VD input
Functions controlled by RS-232C	Scanning format, Trigger mode, Shutter speed, Trigger/WEN polarity, Accumulation, Shutter mode, Programmable exposure, AGC level, White clip, Setup, Manual gain, AGC/manual gain, Internal/ Potentiometer gain set, Gamma, Pixel clock, Commands and internal adjustments.
Functions controlled by Internal DIP switches	VD input/output, HD input/output HD, VD and 75Ω termination on/off
Operating temperature	-5 to + 45
Humidity	20 – 80% non-condensing
Storage temp./humidity	-25 to 60 /20% - 80%
Power	12V DC ± 10%, 1.8W Max.
Lens mount	C-mount
Dimensions	29 x 44 x 66mm (HxWxD)
Weight	150g

9. Spectral Sensitivity

Fig. 27. Spectral sensitivity.

10. Appendix

10.1. CV-A11 emulating CV-M10 interfacing

The CV-A11 has a slightly different pin configuration on the 12-pin Hirose connector, compared to the M-series. This new configuration is compliant to the EIA-J standard. This means, however, that the CV-A11 is not completely backward compatible with the CV-M10, CV-M40, etc in all cases (depending on the cable configuration). The table below shows how to change the pin configuration, by changing internal solder jumpers.
Please note: Only a qualified electronics technician or engineer should make these changes.

Hirose pin #	Function	JP2	JP3	JP5	JP1	JP4	Remarks
9	*PCLK output* enabled	*Short*					Note 2
9	No connection	Open					
10	*WEN output*		*Open*	*Short*			
10	Connected to ground		Short	Open			
11	*Ext Trigger input*				*Open*	*Short*	
11	+12V DC in				Short	Open	

Note 1: Configuration shown in *Bold+Italic* is factory default setting
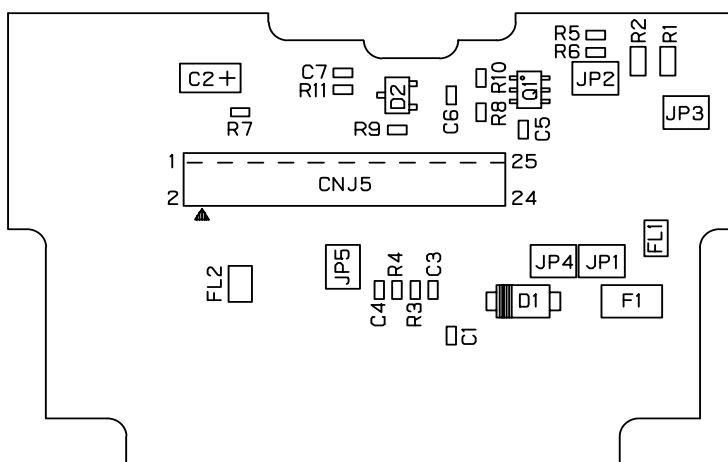Note 2: The RS-232C command "CW" must be set to CLK

Fig. 28. PK8304 Rear Board of CV-A11

10.2. WEN out on pin 6 on 6 pin connector

Instead of EEN output on pin #6 on the 6 pin Hirose connector, WEN can be output by jumper settings. The 2 jumpers are found on the main board PK8298B, if the bottom plate is removed.

Signal on pin #6	JP1	JP2	Remark
EEN out	*Open*	*Short*	default
WEN out	Short	Open	

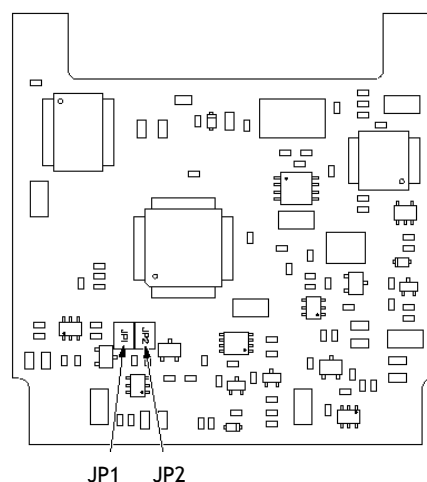*Bold+Italic* is factory default setting

Fig. 29. PK8298A main board.

10.2. 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.

10.3. Typical CCD Characteristics

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

V. Smear

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

V. Aliasing

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

Blemishes

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

Patterned Noise

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

11. Users Record

Camera type: **CV-A11**

Revision: **(Revision A)**

Serial No. **……………..**

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

Users Mode Settings:

Users Modifications:

THE MECHADEMIC COMPANY