See the possibilities

User's Manual

CM/CB-140MCL
CM/CB-140PMCL

CM-140MCL-UV
CM-140PMCL-UV
Digital Monochrome / Color
Compact Mini-CL Camera

Document Version: 3.3
CMB-140MCL/PMCL/UV_Ver.3.3_May2011

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Warranty

For information about the warranty, please contact your factory representative.

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that CM-140MCL,CM-140PMCL,CM-140MCL-UV,CM-140PMCL-UV,CB-140MCL,and CB-140PMCL comply with the following provisions applying to its standards.
EN 61000-6-3 (Generic emission standard part 1)
EN 61000-6-2 (Generic immunity standard part 1)

FCC

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Warning

Changes or modifications to this unit not expressly approved by the party responsible for FCC compliance could void the user's authority to operate the equipment.

Supplement

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

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

重要注意事项

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

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PPB)	多溴二苯醚 (PBDE)
螺丝固定座	×	○	○	○	○	○
.....	.....	.....	.....	.....	.....	.....

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

环保使用期限
电子信息产品中含有的有毒有害物质或元素在正常使用的条件下不会发生外泄或突变、电子信息产品用户使用该电子信息产品不会对环境造成严重污染或对基人身、财产造成严重损害的期限。
数字「15」为期限15年。

Supplement

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

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

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数字「15」为期限15年。

- Contents -

1. General

CM-140MCL/CM-140PMCL is a monochrome progressive scan CCD camera and the CB-140MCL/CB-140PMCL is the equivalent Bayer mosaic progressive scan CCD camera. Both have 1.45 M pixels resolutions.
While the MCL version is powered by an external 12-volt supply, the PMCL (Power over Mini-CL) version is powered by a compatible frame grabber.
These cameras are suitable for a wide range of applications within factory automation, an also for applications outside the factory floor, such as ITS (Intelligent Traffic Solutions), high-end surveillance and medical.

The CM-140MCL-UV and CM-140PMCL-UV uses the same 1.45 M pixels CCD but having the sensitivity in UV area.

The latest version of this manual can be downloaded from: www.jai.com
The latest version of Camera Control Tool for CM/CB-140MCL ,CM/CB-140PMCL and UV versions can be downloaded from: www.jai.com
For camera revision history, please contact your local JAI distributor.

2. Camera nomenclature

The standard camera composition consists of the camera main body and C-mount protection cap.

The camera is available in the following versions:
CM-140 MCL/MCL-UV/PMCL/PMCL-UV
Where **C** stands for "Compact" family, **M** stands for "Monochrome", **140** represents the resolution "1.4 million pixel" , **MCL** stands for " Mini-CL" interface , **PMCL** for " Power over Mini-CL" and **UV** for specific feature, UV sensitive

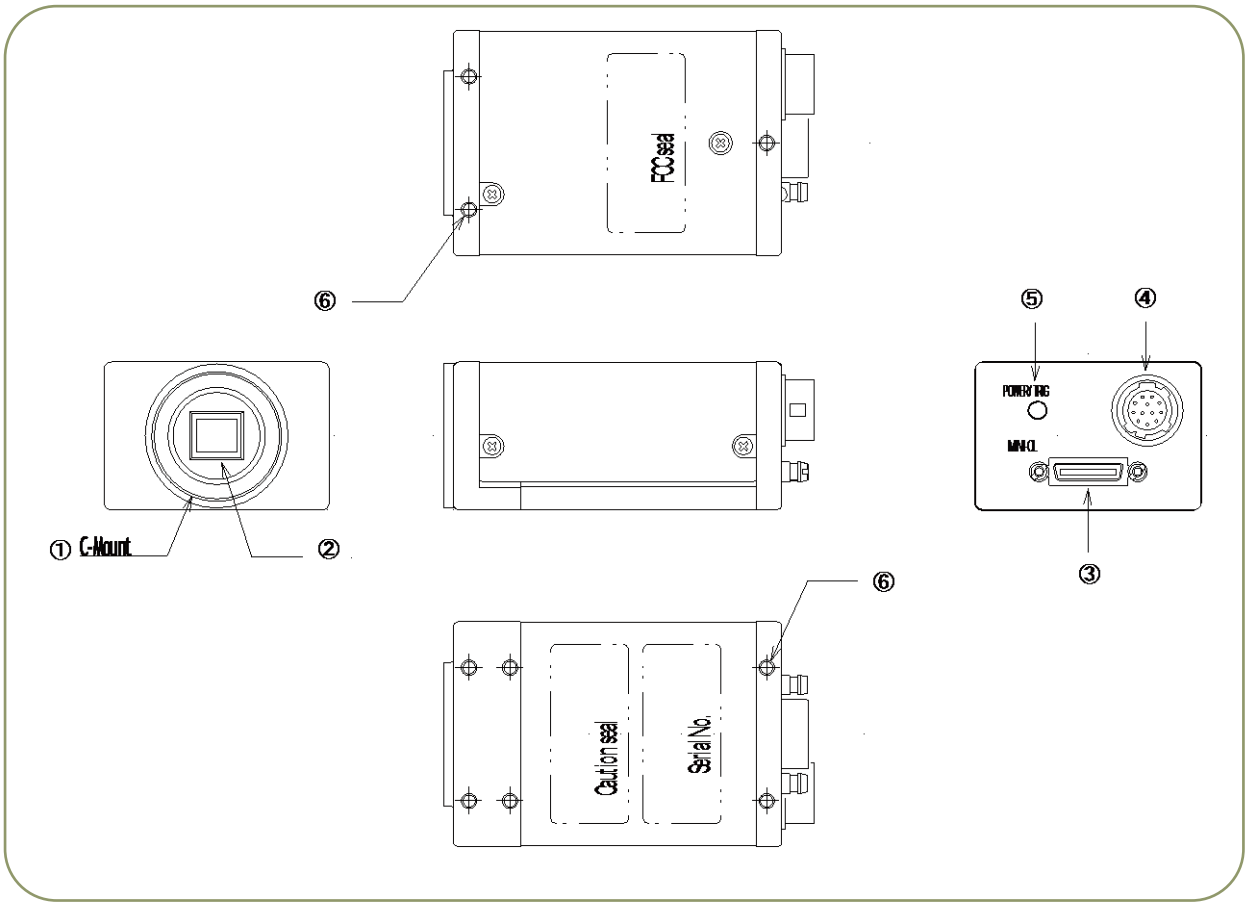
CB-140 MCL/PMCL
Where **C** stands for "Compact" family, **B** stands for "Bayer mosaic color", **140** represents the resolution "1.4 million pixel" , **MCL** stands for "Mini-CL" interface and **PMCL** for " Power over Mini-CL"

3. Main Features

- Compact series 1/2" progressive scan camera
- Monochrome and Bayer mosaic color versions
- UV sensitive versions, CM-140MCL-UV and CM-140PMCL-UV
- 1380 (h) x 1040 (v) active pixels
- 4.65 µm square pixels
- 31 frames/second with full resolution in continuous operation
- 30 frames/second with external trigger and full resolution
- Up to 74 frames/second with partial scan
- 48 frames/second with vertical binning (CM-140 MCL only)
- Shutter speed from 32µs to 2 sec. using Pulse Width Control
- Programmable exposure from 64µs to 40 ms
- Pre-select and Pulse width trigger modes
- LVAL-synchronous/-asynchronous operation (auto-detect)
- CM-140PMCL and CB-140PMCL comply with PoCL (Power over CL) standard
- Auto iris lens video output allows a wider range of light
- 10 or 8-bit output
- Setup by Windows NT/2000/XP via serial communication

4. Locations and Functions

4.1. CM-140 MCL / CB-140 MCL



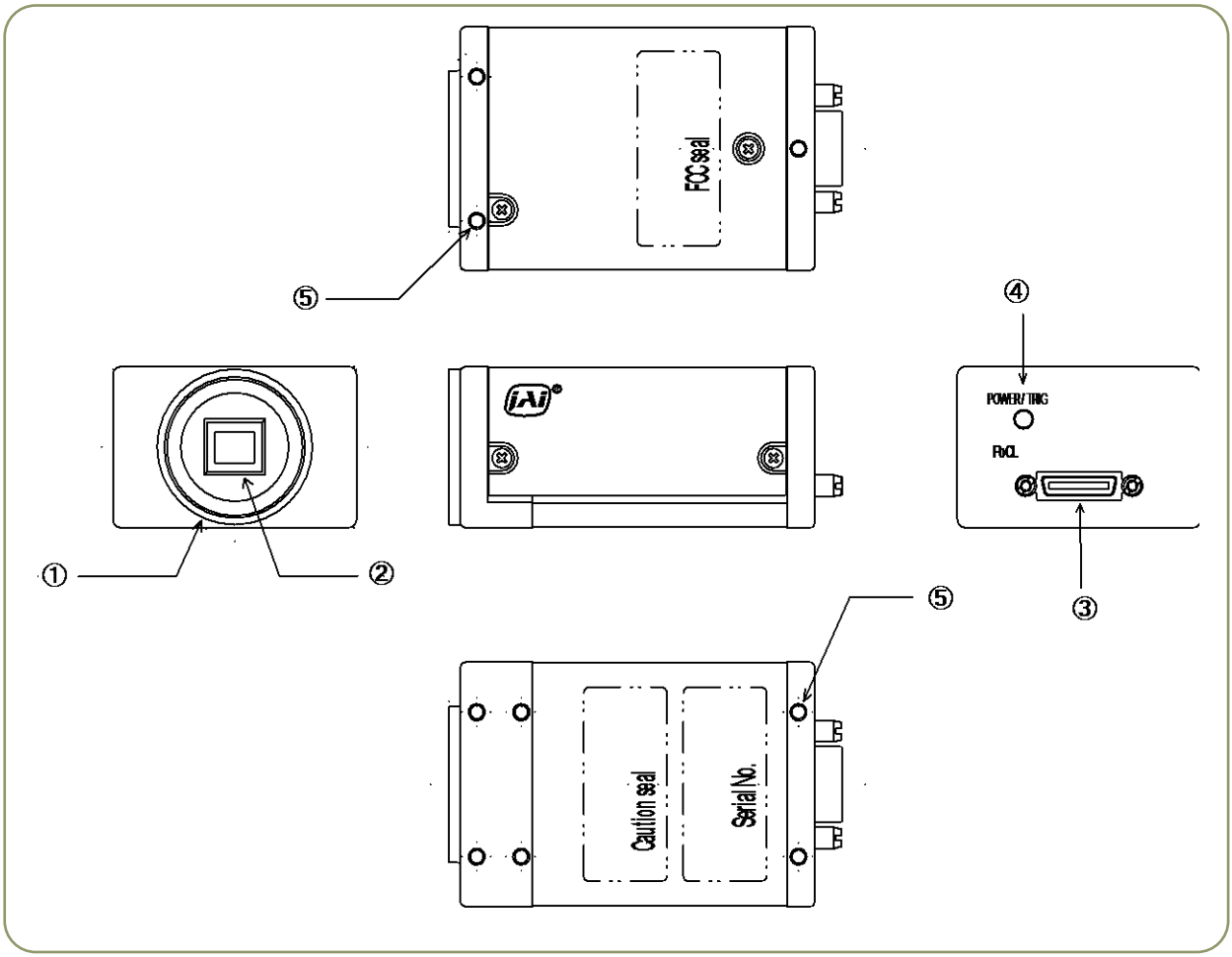
①	Lens mount	C-mount (Note *1)
②	CCD sensor	1/2 inch CCD sensor
③	26-pin connector	Camera Link Interface (Mini-CL) (Note 2)
④	12-pin connector	DC+12V and trigger input
⑤	LED	Indication for power and trigger input
⑥	Mounting holes	M3 depth 3.5mm for tripod mount plate

*1) Note: Rear protrusion on C-mount lens must be less than 10.0mm.

*2) Note: When a Camera Link cable is connected to the camera, please do not excessively tighten screws by using a screw driver. The Camera Link receptacle on the camera might be damaged.
For security, the strength to tighten screws is less than 0.291 Newton meter (Nm). Tightening by hand is sufficient in order to achieve this.

Fig. 1. Locations

4.2. CM-140 PMCL / CB-140 PMCL



①	Lens mount	C-mount (Note *1)
②	CCD sensor	1/2 inch CCD sensor
③	26-pin connector	Camera Link Interface (Mini-CL) (Note “2)
④	12-pin connector	DC+12V and trigger input
⑤	LED	Indication for power and trigger input
⑥	Mounting holes	M3 depth 3.5mm for tripod mount plate

*1) Note: Rear protrusion on C-mount lens must be less than 10.0mm.
*2) Note: When a Camera Link cable is connected to the camera, please do not excessively tighten screws by using a screw driver. The Camera Link receptacle on the camera might be damaged. For security, the strength to tighten screws is less than 0.291 Newton meter (Nm). Tightening by hand is sufficient in order to achieve this.

Fig. 2. Locations (PoCL version)

5. Pin Assignment

5.1. 12-pin Multi-connector (DC-IN/Trigger) – MCL-version only

Type: HR10A-10R-12PB-01 (Hirose) male.
Use the part number HR10A-10P-12S for the cable side

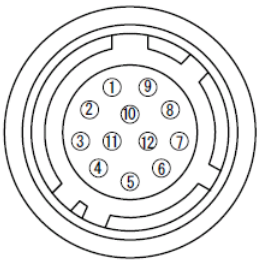
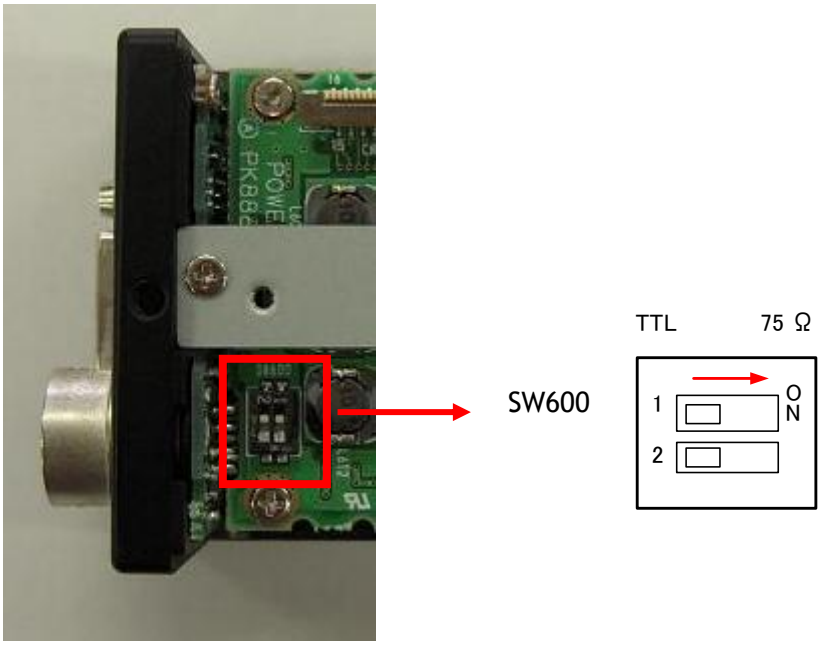


Fig. 3. Hirose 12-pin connector

Pin no.	Signal	Remarks
1	GND	
2	+12 V DC input	
3	GND	
4	Iris video	Only for Continuous mode. TR=0
5	GND	
6	NC	
7	NC	
8	GND	
9	XEEN out	
10	Trigger in	TI=1 (or Camera Link TI=0). *1) SW600 selects TTL or 75 ohm *2)
11	DC+12V	
12	GND	

*1) Factory default is through CameraLink (TI=0).
*2) To change DIP switch SW600 settings remove the top cover. To select 75 ohm termination both positions are set to ON position. The factory default OFF the position.



Note: 12-pin connector is only present on CM-140MCL and CB-140MCL.

5.2. Digital Output Connector for Mini-CL (Camera Link)

Type: 26-pin SDR connector (3M or Honda type) Mini-CL connector

5.2.1. CM-140MCL / CB-140MCL

Fig.4. Mini-CL connector

Pin No	I/O	Name	Note
1,13,14,26		GND	DC GND
7(+),20(-)	I/O	RXD	Serial Com.
8(-),21(+)	O	TXD	
10(+),23(-)	I	Reserve	
9(-),22(+)	I	Trigger	CC1 Ext. Trigger in
6(-),19(+)	O	TxOUT3	Camera Link out
4(-),17(+)	O	TxOUT2	
3(-),16(+)	O	TxOUT1	
2(-),15(+)	O	TxOUT0	
5(-),18(+)	O	TxClk	Clock for CL

5.2.2. CM-140PMCL / CB-140PMCL

Fig.5. Mini-CL connector

Pin No	I/O	Name	Note
1	I	DC +12V	
13	I	GND	For # 26 pin
14	I	GND	For # 1 pin
26	I	DC +12V	
7(+),20(-)	I/O	RXD	Serial Com.
8(-),21(+)	O	TXD	
10(+),23(-)	I	Reserve	
9(-),22(+)	I	Trigger	CC1 Ext. Trigger in
6(-),19(+)	O	TxOUT3	Camera Link out
4(-),17(+)	O	TxOUT2	
3(-),16(+)	O	TxOUT1	
2(-),15(+)	O	TxOUT0	
5(-),18(+)	O	TxClk	Clock for CL

Important Note for PMCL version

CM-140 PMCL and CB-140 PMCL cameras feature “Safe Power” circuit which is stipulated by the PoCL standard. This circuit is used to verify the presence of camera and PoCL cable before the frame grabber provides power.

5.3. Input and output circuits

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

5.3.1. Iris video output

This signal can be used for lens iris control in Continuous mode.
The signal for iris video output is taken from the CCD output and digitized. It goes through the process circuit and is converted analogue signal via the integrator. This signal is influenced by gain settings. The signal is 0.7 Vpp (without sync) from 75 Ω without termination.

NOTE: This function is not available in the PoCL version

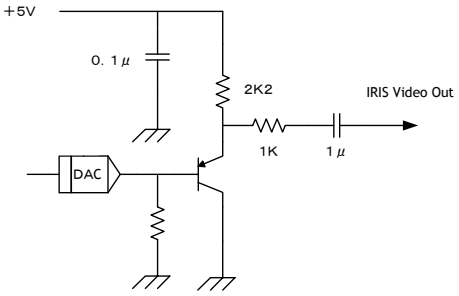


Fig. 6. Iris video

5.3.2. Trigger input

An external trigger input can be applied to pin 10 of 12-pin Hirose connector (when the command TI=1 has been set). The input is AC coupled. To allow long pulses the input circuit is designed as a flip-flop circuit. The leading and trailing edges of the trigger pulse activate the circuit.
The trigger polarity can be changed by TP=1.
Trigger input level 4 V ±2 V.
Trigger can also be applied through the Camera Link connector, when the command TI=0 has been sent.

NOTE: In the PoCL version trigger can only be applied through the Camera Link connector

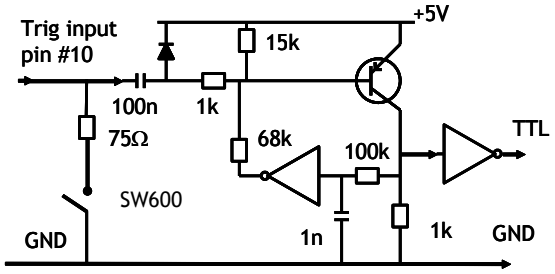


Fig. 7. Trigger input.

5.3.3. XEEN output

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

NOTE: In the PoCL version EEN only appears on the Camera Link connector

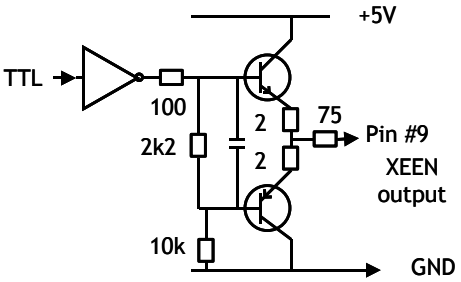


Fig. 8. XEEN output

5.3.4. Camera Link interface

The digital video is available via Camera Link, with 8 or 10-bit pixel depth, using the CL Base configuration. The digital output signals follow the Camera Link standard using Channel Link chip sets.
The data bits from the digital video, FVAL, LVAL, DVAL and EEN are multiplexed into the twisted pairs, which are a part of the Camera Link. Trigger signals and the serial camera control are feed directly through its own pairs.

The 26-pin Mini-CL SDR connector pin assignment follows the Camera Link base configuration.

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

6. Functions and Operations

6.1. Basic functions

The CMCB-140 MCL / CMCB-140 PMCL /CM-140MCL-UV/PMCL-UV cameras are progressive scan camera with 1.4 Mega pixels monochrome and Bayer mosaic color CCDs. The interface to the host PC is via digital Mini Camera Link (Mini-CL). Both models output video as 8 or 10 bits. The CB-140 MCL /PMCL outputs raw Bayer video, requiring host based color interpolation.
An analogue iris-video signal can be used for controlling the iris of an auto-iris lens when operating in continuous mode.
The camera has 2/3, 1/2, 1/4 or 1/8 partial scanning and vertical binning (CM-140 MCL /-UV/PMCL/-UV only) for faster frame rates.
There are 2 trigger modes in addition to continuous operation. The Pre-Select and Pulse Width control are available with a unique automatic LVAL sync or async selection function.
Below the functions are described in detail.

6.1.1. Digital Video Output (Bit Allocation)

The 10-bit digital output is set 890 LSB as 100% video level when CCD output is 200mV.
The white clip level is set at 1023 LSB when CCD output is 230mV.

CCD out	Analogue level	Digital Out(10 bits)
Black	Setup 3.6%, 25mV	32LSB
200mV	700mV	890LSB
230mV ↑	800mV	1023LSB

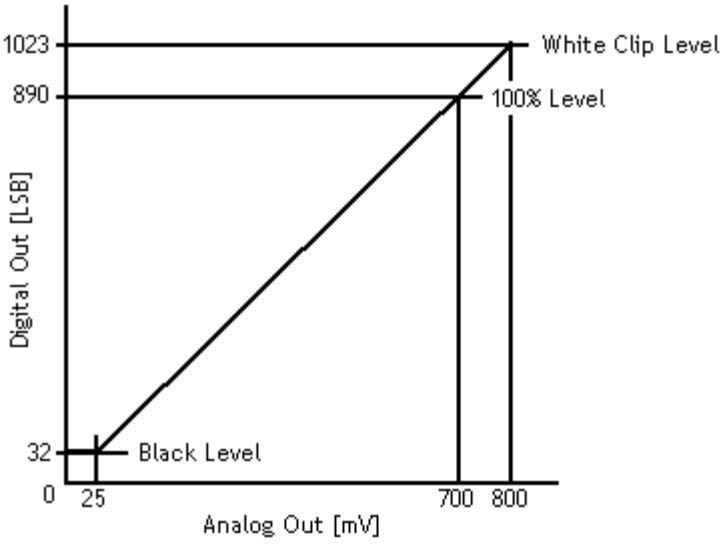


Fig.9. Digital Output Bit Allocation (10 Bits output)

6.1.2. Electronic Shutter

The CM/CB-140 MCL ,CM/CB-140PMCL and CM-140MCL-UV/PMCL-UV allow selecting shutter speed in two ways; preset shutter (10 fixed steps) and programmable exposure (in 1051 line period, LVAL, increments).

Preset Shutter

The following shutter speeds can be selected by command SH=0 through SH=9.
OFF (1/31), 1/60, 1/100, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000, 1/10000 seconds
Note: UV version is OFF (1/16), 1/30,1/60, 1/100, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/10000 seconds

Programmable Exposure (PE)

The exposure time can be programmed in 30.58µs (LVAL period) increments. The range is from 2 LVAL to 1051 LVAL.

Minimum exposure time 2L	Maximum exposure time 1052L	
30.584µs x 2(L) = 61.168 µs	30.584µs x 1052 (L) ≈ 32.17ms	MCL/PMCL
58.9µs x 2(L) = 117.8 µs	58.9µs x 1052 (L) ≈ 61.92ms	UV version

In V binning mode:

Minimum Exposure time 2L	Maximum exposure time 527L	
38.83 µs x 2(L) = 77.66 µs	38.83 µs x 527 (L) ≈ 20.46 ms	MCL/PMCL
74.793 µs x 2(L) = 149.58 µs	74.793 µs x 527 (L) ≈ 39.4 ms	UV version

6.1.3. Continuous operation or triggered operation

The camera can operate in continuous operation applications not requiring asynchronous external trigger. This mode permits the use of a lens with video controlled iris. The camera will operate at its maximum frame rate, 31 frames/seconds (16 frames /second for UV) in this mode.

For applications that require an external trigger, the camera can accept an external trigger input on pin 10 of the 12-pin Hirose connector or via the Camera Link interface. The command "TI" is used to switch between inputs.
The camera can operate up to 30 frames/second (16 frames /sec. for UV)in triggered operation.

6.1.4. Iris video output.

The iris video output in pin 4 on 12-pin HR is 700 mV for 100% video out in Camera Link. The iris video signal is taken before the gain circuit. It is without sync.
The iris video signal can be used for auto iris lens drive in continuous mode.
NOTE: In the PoCL version this function is not available.

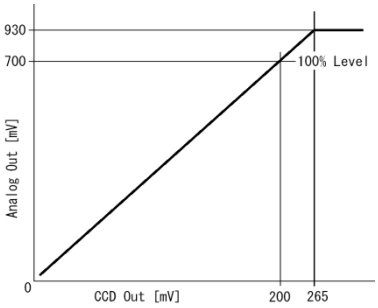


Fig.10. Iris video output.

6.1.5. Rear panel indicator.

The rear panel mounted LED provides the following information:

- Amber:
  Power connected - initiating
- Steady green:
  Camera is operating in Continuous mode
- Flashing green:
  The camera is receiving external trigger

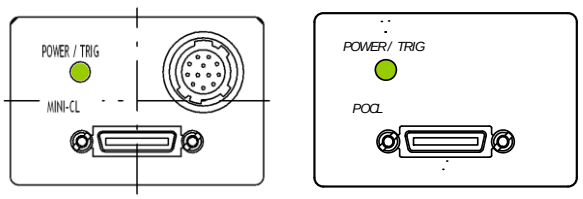
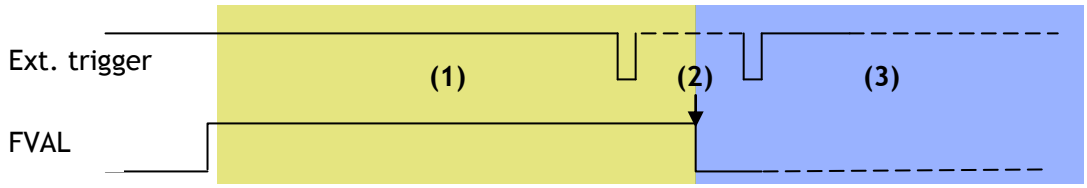


Fig.11. Rear panel (Left for MCL, Right for PMCL)

6.1.6. Auto-detect LVAL-sync / async. accumulation

This function replaces the manual setting found in older JAI cameras. Whether accumulation is synchronous or a-synchronous in relationship to LVAL depends on the timing of the trigger input. When trigger is received while FVAL is high (during readout), the camera works in LVAL synchronous mode, preventing reset feed trough in the video signal. There is a maximum jitter of one LVAL period from issuing a trigger and accumulation start.
When trigger is received when FVAL is low, the cameras works in LVAL-asynchronous mode (no delay) mode.

This applies to both pre-select (PS) trigger mode and pulse width trigger (PW) modes.



(1) In this period camera executes trigger at next LVAL (prevents feed-through noise)
(2) Avoid trigger at FVAL transition (+/- 1 LVAL period), as the function may randomly switch between "next LVAL" and "immediate".
(3) In this period camera executes trigger immediately (no delay)

Fig. 12. Auto-detect LVAL sync /a-sync accumulation

6.1.7. Starting pixel - Bayer color mosaic

The CB-140MCL/MPCL is a color camera based on a CCD sensor with a Bayer color mosaic.
The color image reconstruction is done in the host PC.
The color sequence in the video signal differs from full scanning to partial scanning. The right hand drawing shows the color sequence at the image start.
The starting line number is shown from LVAL.
The first active pixel starts from LVAL, when DVAL rises.

Even lines start with GBG.
Odd lines start with RGR

See also chapter 6.3, Partial Scan

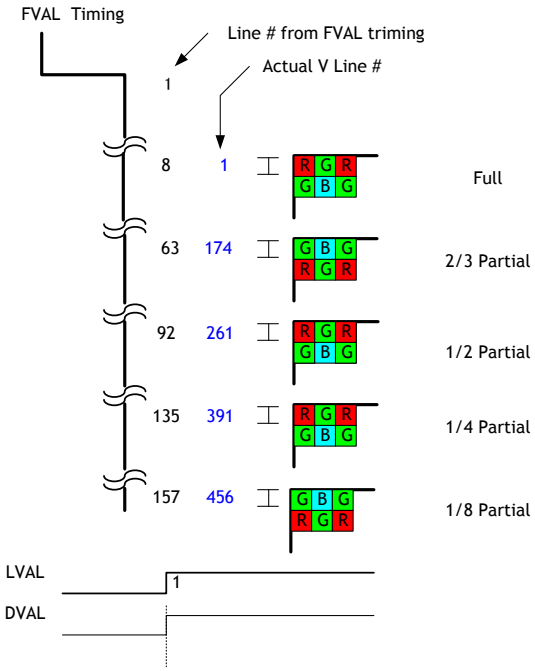


Fig. 13. Bayer RGB color sequence

6.1.8. Vertical Binning

This function is only available on the CM-140MCL/-UV/PMCL/-UV camera.
Binning mode (Command VB) is a function where the signal charge from 2 adjacent (vertical) pixels are added together and read out as one pixel. Binning results in half vertical resolution and higher frame rate. By adding 2 pixels together, the sensitivity is doubled. The charge accumulated in 2 adjacent lines is added together in the horizontal CCD register. This is done by providing two pulses to the vertical CCD register for each line readout. Vertical binning can not be used together with the Partial scan.

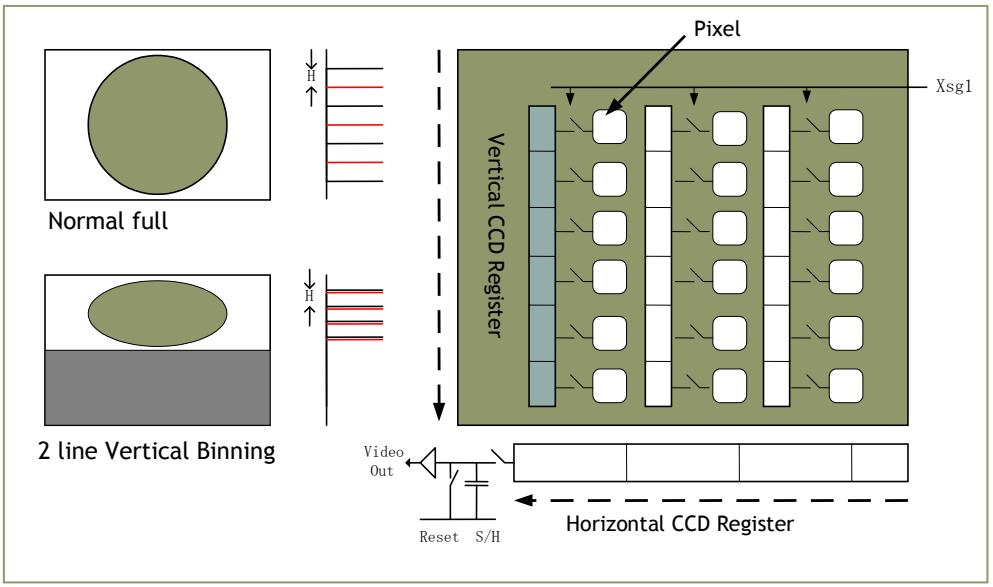


Fig. 14. Vertical Binning

6.2. Sensor Layout and timing

6.2.1. CCD Sensor Layout

The CCD sensor layout with respect to pixels and lines used in the timing and video full frame read out is shown below. For Bayer color sequence, refer to chapter 6.1.3.

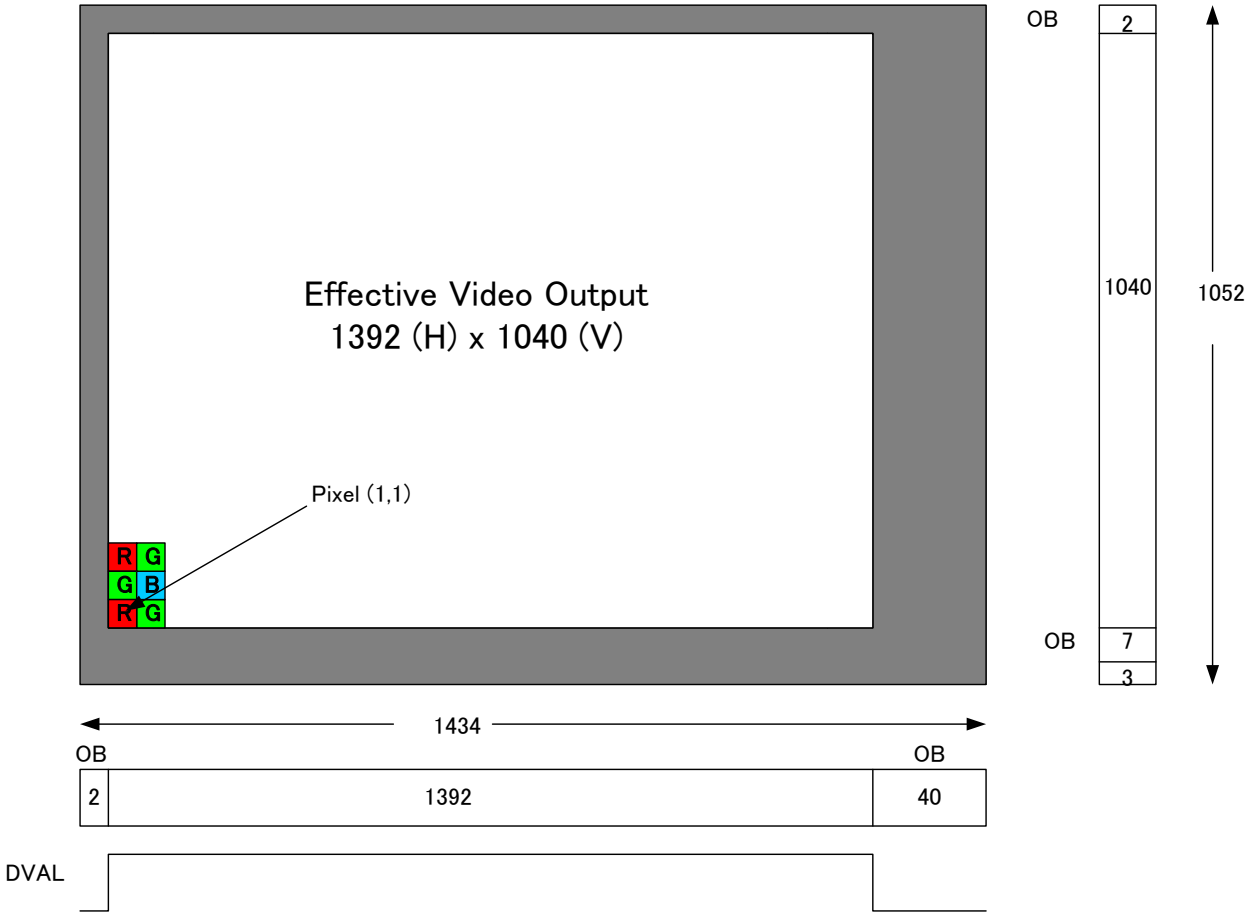


Fig. 15. CCD sensor layout

6.2.2. Horizontal timing

The LVAL period is shown for continuous mode.

Model	1 LVAL	1 clock
CMCB-140MCL/PMCL	1988 clks = 30.584 µs	15.38 ns
CM-140MCL-UV/PMCL-UV	1988 clks = 58.9 µs	29.63 ns

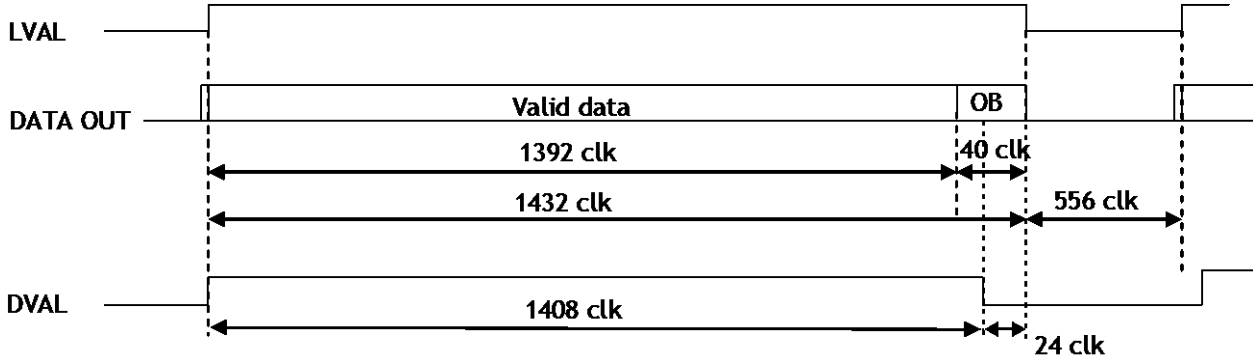


Fig. 16. Horizontal timing

6.2.3. Vertical timing

The FVAL period for continuous mode full scan is shown.

Model	Frame rate 1052L
CMCB-140MCL/PMCL	31.08 fps
CM-140MCL-UV/PMCL-UV	16.14 fps

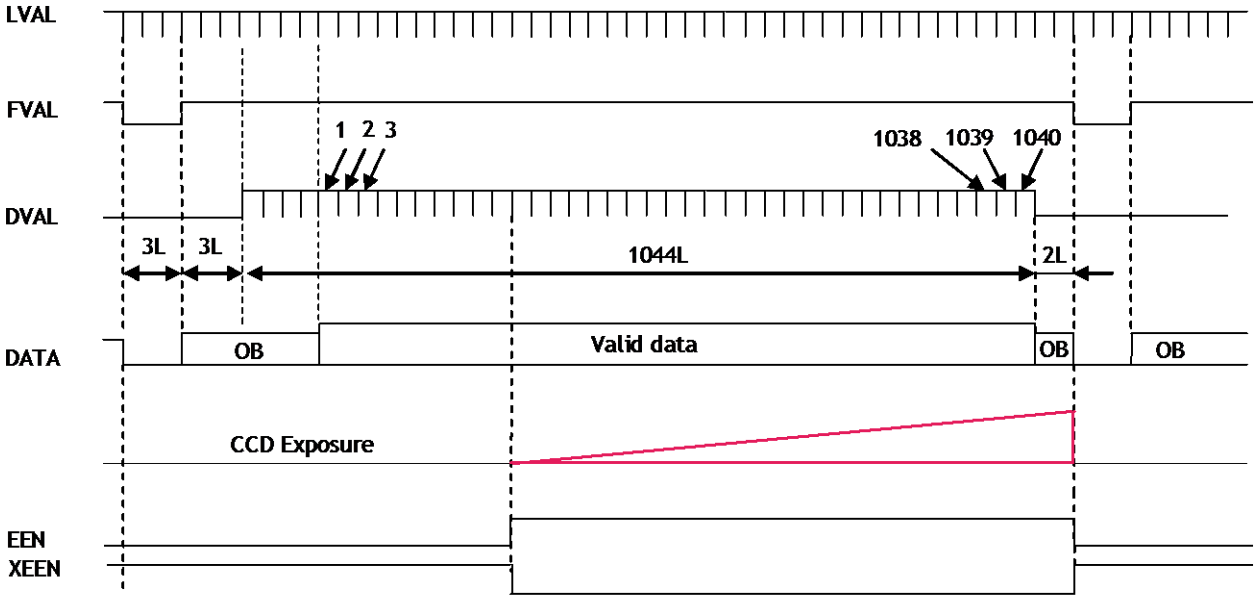
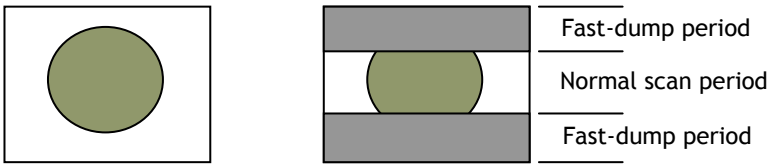


Fig. 17. Vertical timing for full scan

6.2.4. Partial Scan

Partial scan allows higher frame rate by reading out a smaller center portion of the image. This is particularly useful when inspecting objects that do not fill the whole height of the image.

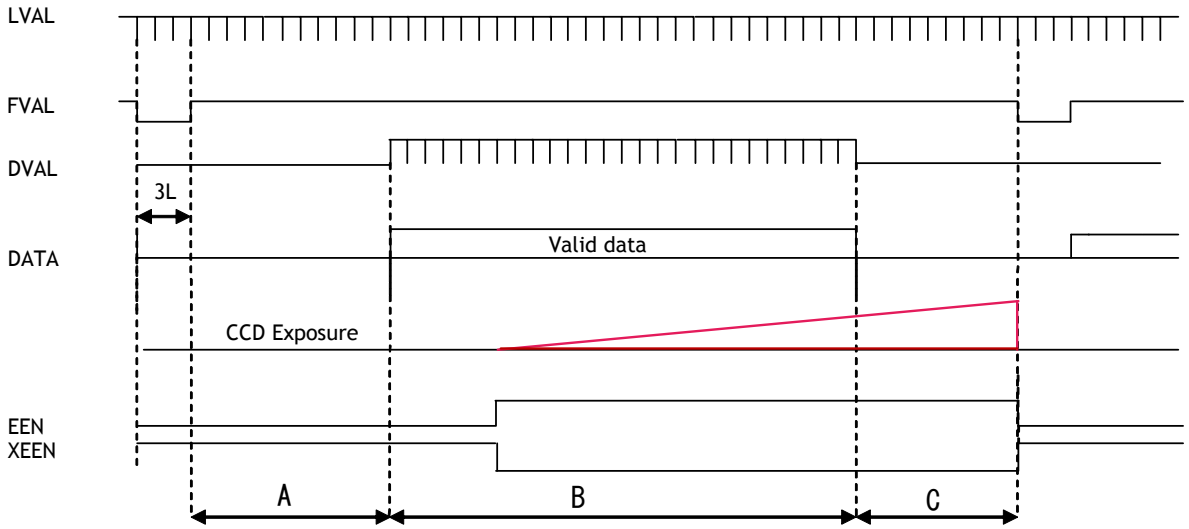


Full scan Partial scan

Vertical Timing

The below diagram and table provide vertical timing information for the fixed partial scan settings 1/2, 1/4, 1/3 and 2/3

Vertical Video Timing Partial Frame Read out



Values for vertical timing in partial scan continuous mode.

AREA	FVAL Low (L)	A (L)	B (L)		C (L)	Total line (L)	frame rate(L)	
			Start line	End line			MCL/PMCL	UV
1/2	3	91	520		88L	702L	46.57	24.19
			261	780				
1/4	3	134	260		131L	528L	61.92	32.16
			391	650				
1/8	3	156	130		153L	442L	73.97	38.41
			456	585				
2/3	3	62	694L		59L	818L	39.97	20.76
			174	867				

Remark! The color sequence for CB-140MCL/MPCL differs in partial scan. Refer to chapter 6.1.7.

Fig. 18. Vertical timing for partial scanning

Horizontal Timing

The horizontal timing is the same the full scanning.

Model	1 LVAL	1 clock
CMCB-140MCL/PMCL	1988 clks = 30.584 μs	15.38 ns
CM-140MCL-UV/PMCL-UV	1988 clks = 58.9 μs	29.63 ns

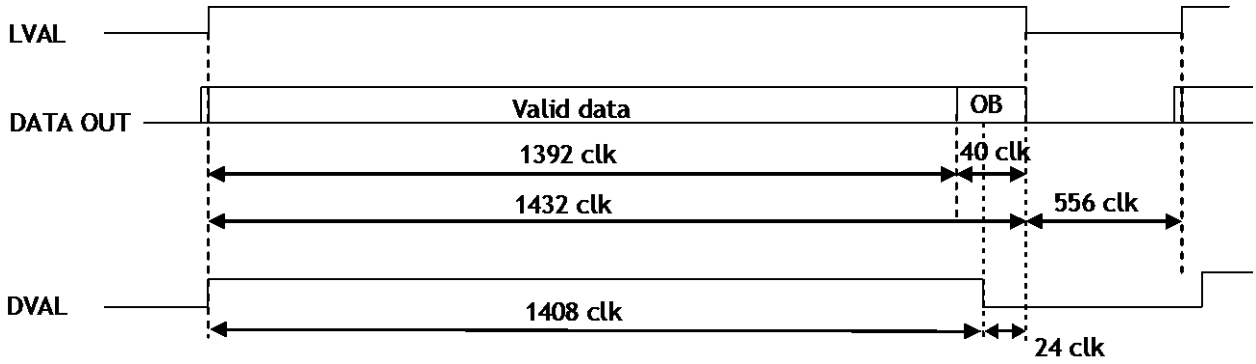


Fig. 19. Horizontal timing for partial scanning

6.2.5. Vertical Binning

Vertical binning combines charge from two adjacent lines, reducing the vertical resolution to half and at the same time increasing frame rate and sensitivity. By activating this function, the frame rate is increased to 48.87 fps.

This function is available only for CM-140MCL/PMCL.

Important Note

Vertical Binning can not be used together with the Partial Scanning.

Horizontal Timing

Model	1 LVAL	1 clock
CMCB-140MCL/PMCL	2524clks = 38.83 μs	15.38 ns
CM-140MCL-UV/PMCL-UV	2524 clks = 74.79 μs	29.63 ns

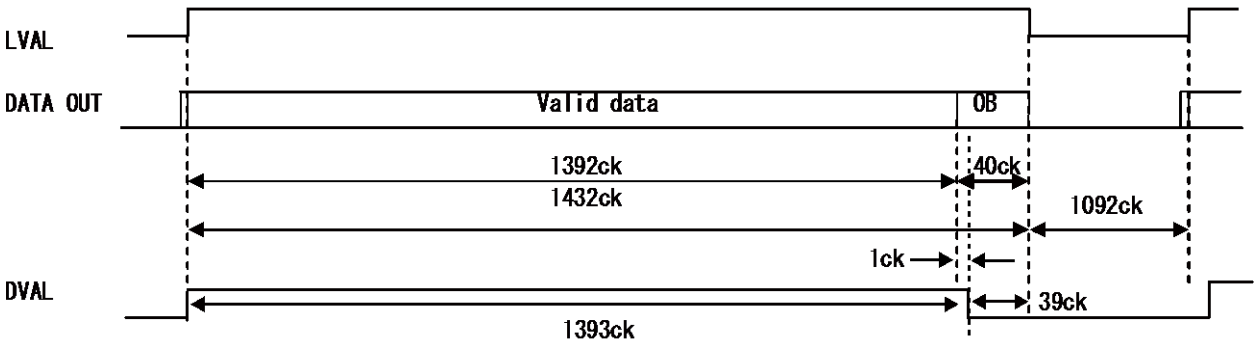


Fig.20. Horizontal Timing for Vertical Binning

Vertical timing

Model	Frame rate 527L
CMCB-140MCL/PMCL	48.87fps
CM-140MCL-UV/PMCL-UV	25.37fps

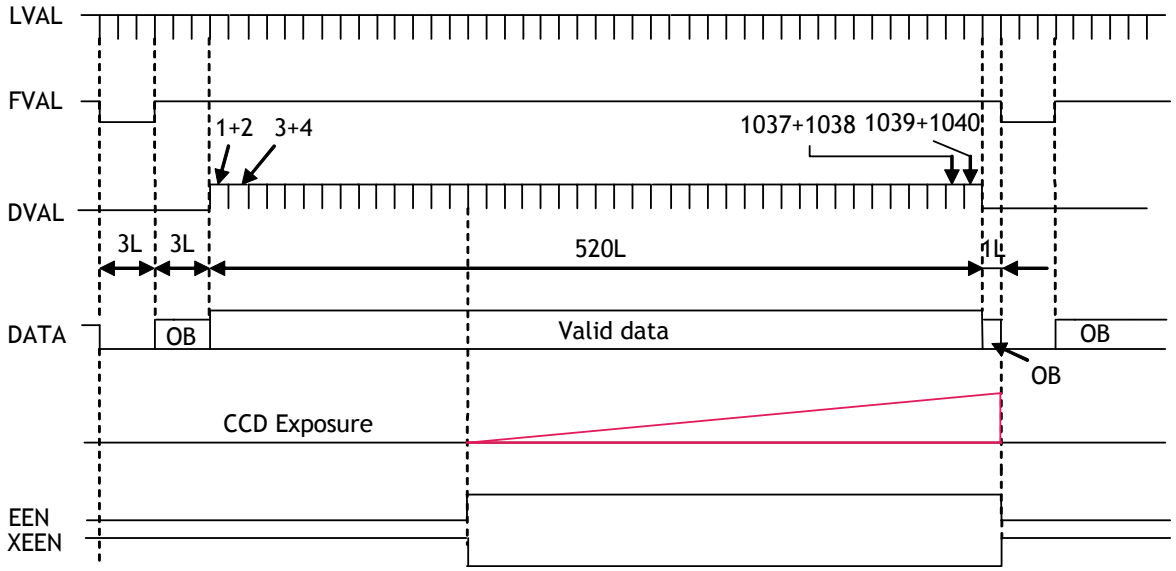


Fig.21. Vertical Timing for Vertical Binning

6.3. Operation Modes

This camera can operate in 3 primary modes.

1. ***TR=0*** *Continuous Mode.* Pre-selected exposure.
2. ***TR=1*** *Pre-select Mode.* Pre-selected exposure.
3. ***TR=2*** *Pulse Width Mode.* Pulse width controlled exposure.
4. ***TR=3*** *Reset Continuous* Pre-selected exposure

6.3.1. Continuous operation

For applications not requiring asynchronous external trigger, but should run in continuous operation, this mode is used.
For timing details, refer to fig. 16 through fig. 21.

To use this mode:

Set function:		
	Trigger mode to “Continuous”.	TR=0
	Scanning	SC=0 through 4
	V Binning	VB=0 or 1
	Shutter mode pre-set or programmable	SM=0 or 1
	Shutter speed	SH=0 to 9
	Programmable exp.	PE=2 to 1052
	Other functions and settings	

6.3.2. Pre-select Trigger Mode

An external trigger pulse initiates the capture, and the exposure time (accumulation time) is defined by the SH or PE commands.
The resulting video signal will start to be read out after the selected shutter time.

For timing details, refer to fig. 16 through fig. 21 and fig. 22 & 23.

To use this mode:

Set function:	Trigger mode to “Edge pre-select”.	TR=1
	Scanning	SC=0 to 4
	V Binning	VB=0 or 1
	Shutter mode to pre-set or programmable	SM=0 or 1
	Shutter speed	SH=0 to 9
	Programmable exp.	PE=2 to 1052
	Other functions and settings	
Input:	Ext. trigger. Camera Link or 12-pin Hirose	TI=0, TI=1

Important notes on using this mode

1. The minimum trigger interval >1 LVAL.
2. Depending on the timing of the leading edge of the trigger pulse in relationship to FVAL, accumulation will be synchronous or a-synchronous in relationship to LVAL. See chapter 6.1.1 for details.

LVAL_sync timing

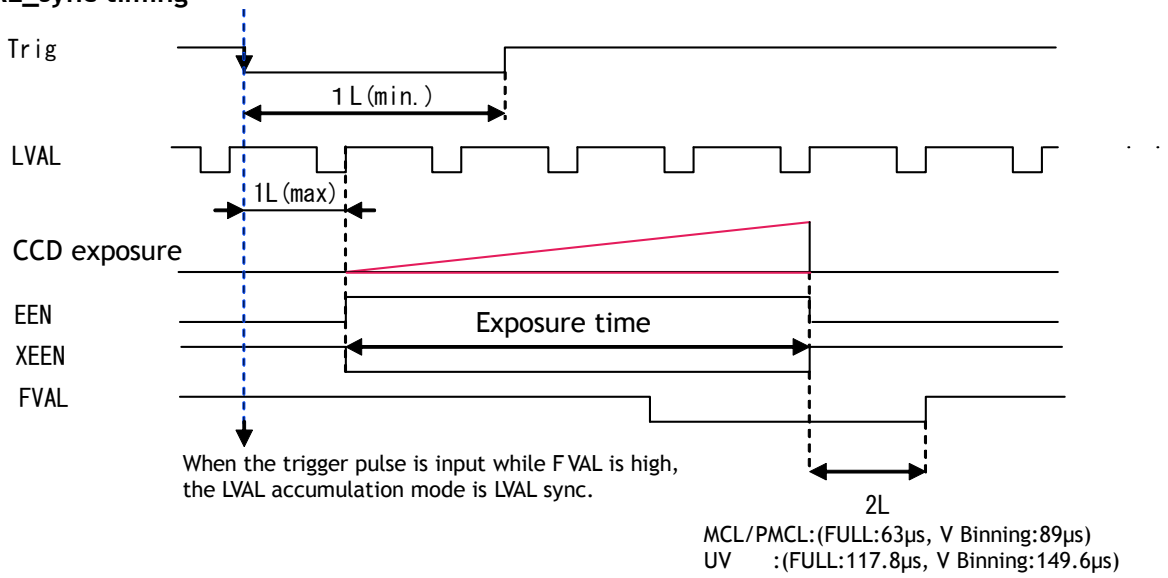


Fig. 22. Pre-select trigger mode. LVAL synchronized.

LVAL_async timing

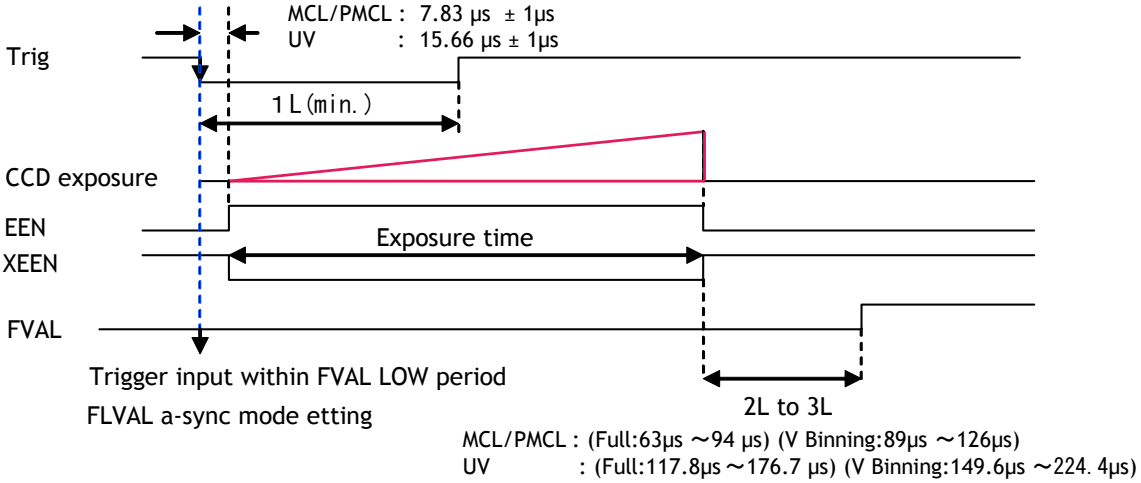


Fig.23. Pre-select trigger mode. LVAL asynchronous

Minimum frame rate (common for all models)

Full	1054L
V Binning	529L
2/3 partial	820L
1/2 partial	704L
1/4 partial	530L
1/8 partial	444L

6.3.3. Pulse Width Trigger Mode

In this mode the accumulation time is equal the trigger pulse width. Here it is possible to have long time exposure. The maximum recommended time is <60 frames.

For timing details, refer to fig. 16 through fig. 21 and fig. 24 & 25.

To use this mode:

Set function:	Trigger mode to “Pulse width control”.	TR=2
	Partial scan	SC=0 to 4
	Vertical binning	VB= 0 or 1
	Other functions and settings	
Input:	Ext. trigger. Camera Link or 12-pin Hirose	TI=0, TI=1

Important notes on using this mode

1. The minimum trigger interval > 1 LVAL
2. Depending on the timing of the leading edge of the trigger pulse in relationship to FVAL, accumulation will be synchronous or a-synchronous in relationship to LVAL. See chapter 6.1.1 for details.

LVAL_sync timing

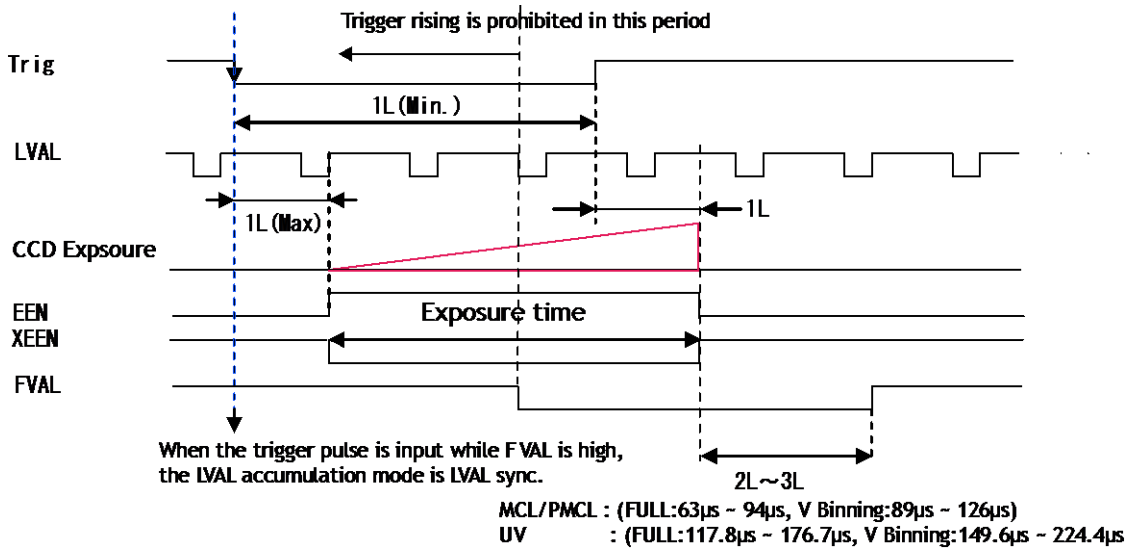


Fig. 24. Pulse width trigger mode. LVAL synchronized.

LVAL_async timing

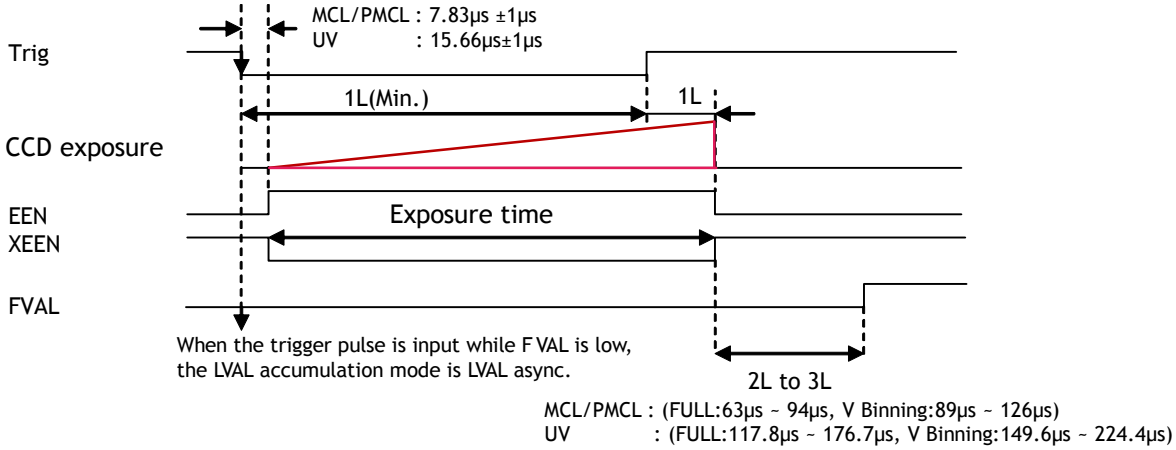


Fig.25. Pulse Width trigger mode. LVAL asynchronous

Minimum frame rate (common for all models)

Full	1055L
V Binning	530L
2/3 partial	821L
1/2 partial	705L
1/4 partial	531L
1/8 partial	445L

6.3.4 Reset Continuous (RCT) trigger mode

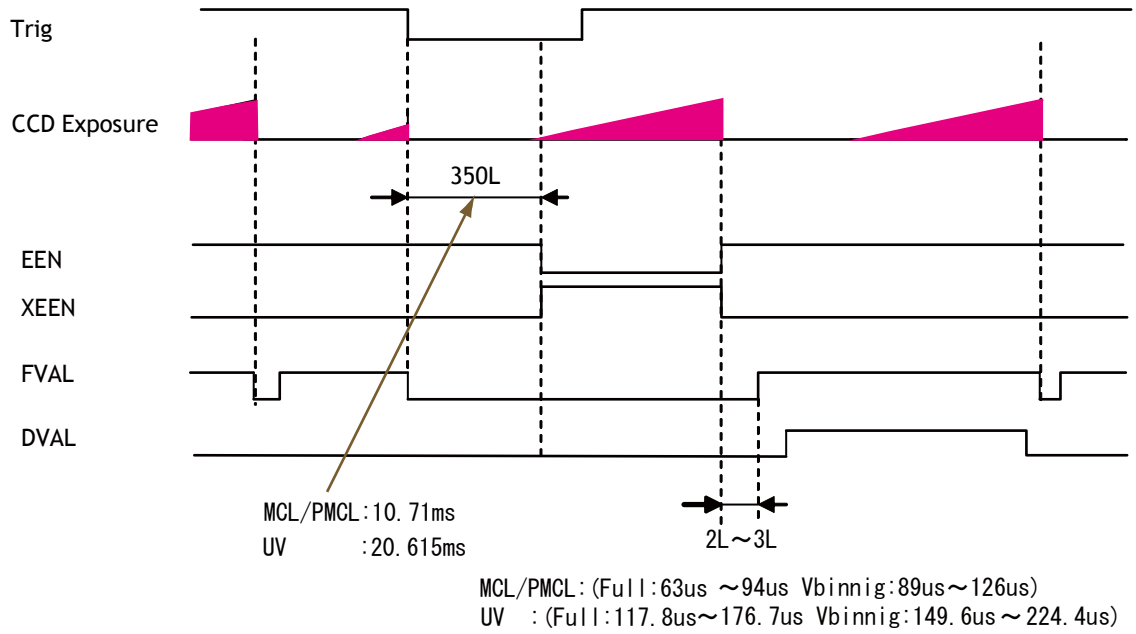
The RCT mode operates like EPS (edge preselect) mode with smearless function. An external trigger pulse will immediately stop the video read out, reset and restart the exposure, then operate as normal mode until the next trigger. After the trigger pulse is input, a fast dump read out is performed. In the CM-040MCL/ CB-040MCL, this period is 6.77ms which is 215L. The exposure time is determined by the pre-set shutter speed. If no further trigger pulses are applied, the camera will continue in normal mode and the video signal is not output. The fast dump read out has the same effect as “smearless read out”. Smear over highlight areas is reduced for the trigger frame. The reset continuous trigger mode makes it possible to use triggering in conjunction with a lens with video controlled iris.

To use this mode:

Set function:	Trigger mode	RCT
	Scanning	Full, Partial
	Vertical binning	ON / OFF (CM-040MCL only)
	Shutter mode	Preset, Programmable
	Shutter speed	1/61(OFF) to 1/10000
	Programmable exposure	2L to 596 L
	Accumulation	LVAL async only
	Other functions and settings	
Input:	External trigger	12-pin Hirose or Camera Link

Important notes on using this mode

- Trigger pulse >2 LVAL to <1 FVAL)



Note: When PE is set at 596 or the shutter is set at OFF, EEN is always HIGH.

Fig.26 RCT mode timing

6.4. Mode and function matrix.

The following table shows which functions will work in the different modes for CM/CB-140MCL and CM/ CB-140PMCL.

Trigger Mode \ Func.		Shutter		Partial scan	V Binning	Accumulation	Iris video
		Pre-select	Programmable			LVAL sync/async	out
Cont.	**TR=0**	Yes	Yes	Yes	Yes	-	Yes
EPS	**TR=1**	Yes	Yes	Yes	Yes	Auto	-
PWC	**TR=2**	-	-	Yes	Yes	Auto	-
RCT	**TR=3**	Yes	Yes	Yes	Yes	Async only	Yes

Fig. 27. Mode and function matrix.

7. Configuring the Camera

7.1. RS-232C control

All configuration of the CM/CB-140MCL and CM / CB-140PMCL cameras are done via the serial communication in the Camera Link 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.

Communication setting

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

Protocol.

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

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

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

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

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

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

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

7.2. Setting functions

7.2.1. Bit allocation. BA=0, BA=1

This command sets the output for either 8-bit or 10-bit.

7.2.2. Partial scan. SC=0 through 4.

The CCD scanning format can be selected between full or partial scanning. With partial scanning only the vertical central part of the CCD sensor is read out with a higher frame rate. The partial scan is done by a fast dump read out of the lines in the vertical CCD register down to the top of the partial image. This central part of the image is read out with normal speed. The lines below the partial image are read out and dumped with a high speed.
Note: The color sequence for CB-140 MCL/PMCL differs in partial scan modes. Refer to chapter 6.1.2.

7.2.3. Vertical binning. VB=0, VB=1

This function is only for CM-140MCL/PMCL camera.
The CM-140MCL/PMCL has only vertical binning mode. With V binning the pixel charge from 2 adjacent lines are added together in the horizontal CCD register. It is done by double pulses to the vertical CCD register.

Note: Vertical Binning can not be used together with the Partial scanning.

7.2.4. Shutter mode. SM=0 and SM=1

With SM=0 this function selects the shutter from the 9 fixed steps (SH=0 through SH=9SH).
With SM=1 from programmable in 1051 steps (PE=2 through PE=1052).

7.2.5. Trigger input select. TI=0, TI=1.

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

7.2.6. Trigger polarity. TP=0, TP=1.

The active trigger polarity is normal low (TP=0). It can be invert it to active high (TP=1).

7.2.7. Gain level. GA=-84 through +336.

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

7.2.8. Black level. BL=0 through BL=1023.

Black level (or set-up level) will set the video level for black. Factory setting is 32 LSB for 10bit or 8 LSB for 8bit.

7.3. Save and Load Functions.

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

***Load settings**. LD.*
This command will load previous stored settings to the camera. 3 user settings can be stored in the camera EEPROM. 1 factory setting is also stored in the camera. The settings stored in the last used user area is used as default settings at power up.

***Save Settings**. SA.*
This command will store the actual camera settings to 1 of the 3 user area in the camera EEPROM.

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

7.4. CM/CB-140MCL / CM/CB-140PMCL command list

	Command Name	Format	Parameter	Remarks
A - General settings and utility commands.				
1	Echo Back	**EB**=[Param.]<CR><LF> EB?<CR><LF>	0=Echo off 1=Echo on	Off at power up
2	Camera Status Request	**ST**?<CR><LF>		Actual setting
3	Online Help Request	**HP**?<CR><LF>		Command list
4	Firmware Version	**VN**?<CR><LF>		3 digits (e.g.) 100 = Version 1.00
5	Camera ID Request	**ID**?<CR><LF>		max 10 characters
6	Model Name Request	**MD**?<CR><LF>		max 16 characters
7	User ID	**UD**=[Param.]<CR><LF> UD?<CR><LF>		User can save and load free text.(16 or less characters)
B - Shutter				
1	Shutter Mode	**SM**=[Param.]<CR><LF> SM?<CR><LF>	0=Preset Shutter 1=Programmable exposure	
2	Preset Shutter	**SH**=[Param.]<CR><LF> SH?<CR><LF>	0=Off, 1=1/60, 2=1/100, 3=1/250, 4=1/500, 5=1/1000, 6=1/2000, 7=1/4000, 8=1/8000, 9=1/10000	Available when SM=0.
3	Programmable Exposure	**PE**=[Param.]<CR><LF> PE?<CR><LF>	**2** to **1052**	Available when SM=1.
C - Trigger mode				
1	Trigger Mode	**TR**=[Param.]<CR><LF> TR?<CR><LF>	0=Normal (Continuous) 1=EPS(Edge pre select) 2=PWC(Pulse width control) 3=RCT	
2	Trigger Polarity	**TP**=[Param.]<CR><LF> TP?<CR><LF>	0=Active Low 1=Active High	
3	Trigger Input	**TI**=[Param.]<CR><LF> TI? <CR><LF>	0=Camera Link 1=Hirose 12pin	

	Command Name	Format	Parameter	Remarks
D -Image Format				
1	Bit Allocation	**BA**=[Param.]<CR><LF> BA?<CR><LF>	0=10bit 1=8bit	
2	Scan Format	**SC**=[Param.]<CR><LF> SC? <CR><LF>	0=Full Frame 1=2/3 Partial 2=1/2 Partial 3=1/4 Partial 4=1/8 Partial	
3	V-Binning	**VB**=[Param.]<CR><LF> VB?<CR><LF>	0=OFF 1=On	Only for CM-140MCL
E - Gain, Black and signal settings				
1	Gain Level	**GA**=[Param.]<CR><LF> GA?<CR><LF>	**-84** to **336**	
2	Black Level	**BL**=[Param.]<CR><LF> BL?<CR><LF>	**0** to **1023**	
F - Saving and loading data in EEPROM				
1	Load Setttings (from Camera EEPROM)	**LD**=[Param.]<CR><LF>	0=Factory area 1=User 1 area 2=User 2 area 3=User 3 area	Latest used DATA AREA becomes default at next power up.
2	Save Settings (to Camera EEPROM)	**SA**=[Param.]<CR><LF>	1=User 1 area 2=User 2 area 3=User 3 area Note : parameter 0 is not allowed	
3	EEPROM Current Area No Request.	**EA**?<CR><LF>	0=Factory area 1=User 1 area 2=User 2 area 3=User 3 area	The camera return the latest used DATA AREA.

NOTE: Do not try to use commands not shown in this list.

8. Camera Control Tool for CM/CB-140 MCL / CM/CB-140 PMCL

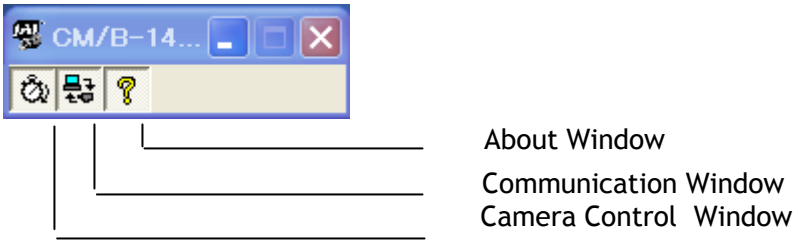
The Camera Control Tool for Windows 2000/XP can be downloaded from www.jai.com.
The control tool contains a camera control program and a developer's kit for integrating the control tool in your own software. For the integrator and experienced user, the Camera Control Toll is much more than a program with a window interface. It also provides an easy and efficient ActiveX interface built for MS Windows 2000/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 within Visual Basic, Visual C++ or similar languages in a Microsoft Windows environment.

8.1. Camera Control Tool Interface

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

8.1.1. Camera Control Tool Bar

This is a Camera Control Tool Bar and when the button of each widow, each control GUI can be initiated.

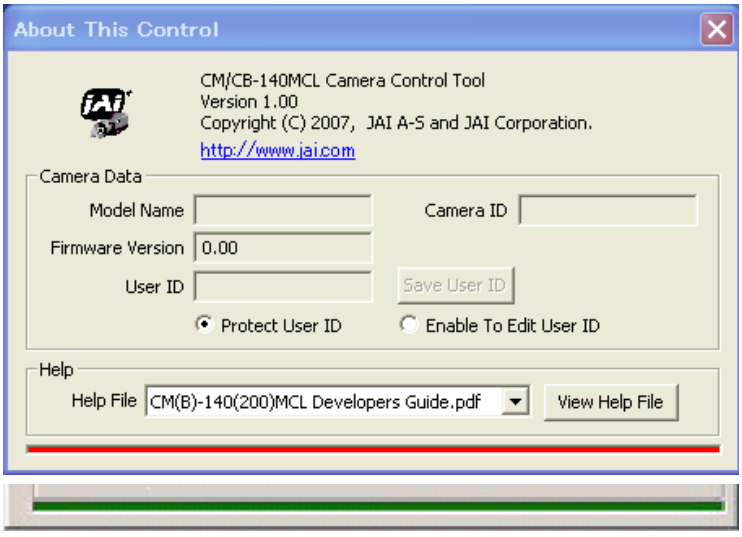


8.2. The About Window

The about window contains a picture of the camera and information about the version of the program, Internet connection to JAI A/S and access to the help documents.

The drop-down box labelled "Help File" 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"

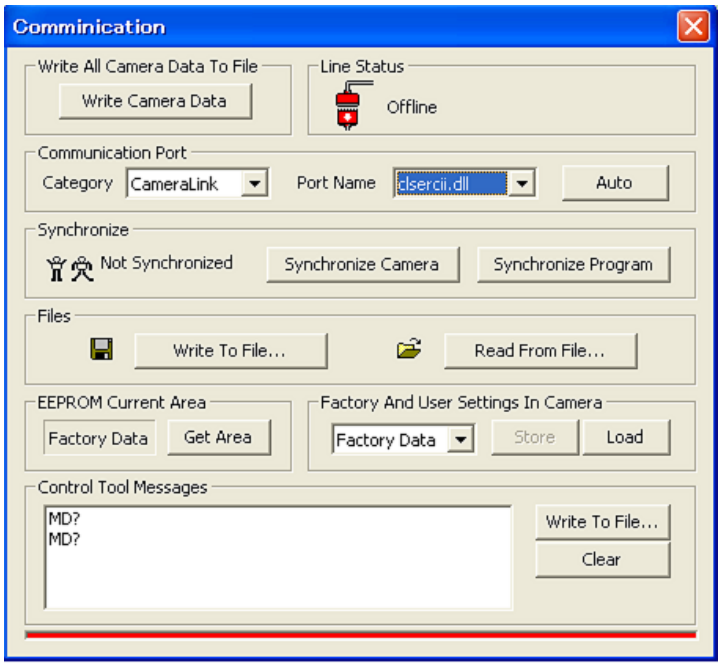


It is possible to download updated operation manuals from the jai website: http://www.jai.com
An updated manual can be saved in the folder address mentioned above and it will automatically be included in the list of help files.

At the bottom of the windows (all windows but 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.

8.3. Communication Window



The Communication Window is used to connect the Camera Control Tool with the JAI camera.

Camera Link communication:
Select "Camera Link "at the pull-down box for Category. Port Name shows DLL file names (or frame grabber names) for all Camera Link frame grabbers that are installed in the pc. This is done by using a DLL file called "clserial.dll" to upload all frame grabber DLLs that are found in the pc.
Just select the option for the frame grabber that is installed in the pc.

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

Off/On-line mode

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

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

Synchronize program and camera

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

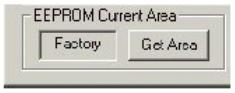
Files
When clicking the Write to File or Read from File button, the user is prompted for a file using a standard file dialog. New files are created if they do not already exist.

Files for camera settings have the extension cam. Information about the communication port is not stored in the files. All settings are automatically sent to the camera when a file has been loaded (if the camera is online).

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

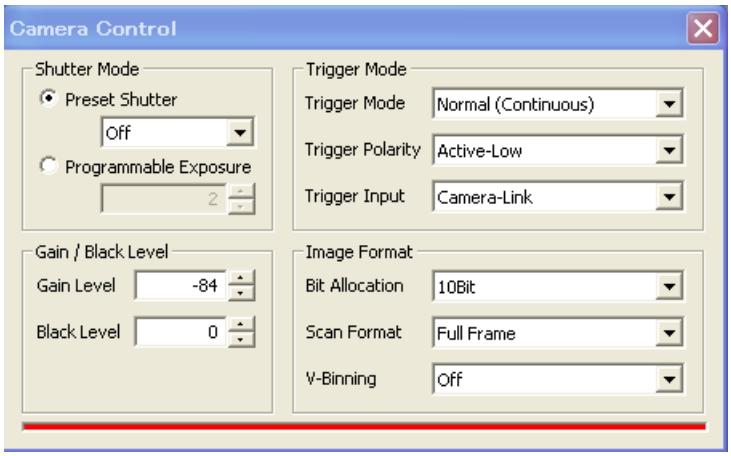
Write All Camera Data to File.
Click the "Write Camera Data" button to save all camera settings into a text file. The information that can be saved is:
Model Name, Camera ID, User ID, Firmware Version, Current Settings, Factory Settings and the available User Areas.
The file is formatted as shown in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

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



8.4. Camera Control Window

The Camera Control Window contains the fundamental camera setting functions.
It is possible to set the shutter mode, Trigger mode, image format, scan format, gain control and black setting.



8.5. Using the Camera Control Tool

Here is some practical information about the Camera Control Tool:

1. The Camera Control Tool bar is always on top of other windows.
2. When you minimize the Camera Control Tool bar all open windows will close.
3. It is possible to work with the Camera Control Tool when the camera is online and when the camera is offline.
4. The newer JAI cameras always start up with the last used user area (but for some old models it will start up with the last saved user area.)
5. The Camera Control Tool saves the last used settings (not the user area), which don't have to be the same as for the last saved user area.
6. The setup file 'CameraName.ini' stores all information about camera settings. When the program is started the last settings for the program are loaded from the file 'CameraName.ini'

7. When you turn on the camera and the Camera Control Tool, it is possible that the Camera Control Tool does not show the actual camera settings (see 4. and 5.).
    a. To obtain the camera settings click “Synchronize Program”.
    b. To send the settings that are saved in the Camera Control Tool (last used settings) to the camera click “Synchronize Camera”.
    c. To see which area the camera has started up in click “Get Area”.

9. External Appearance and Dimensions

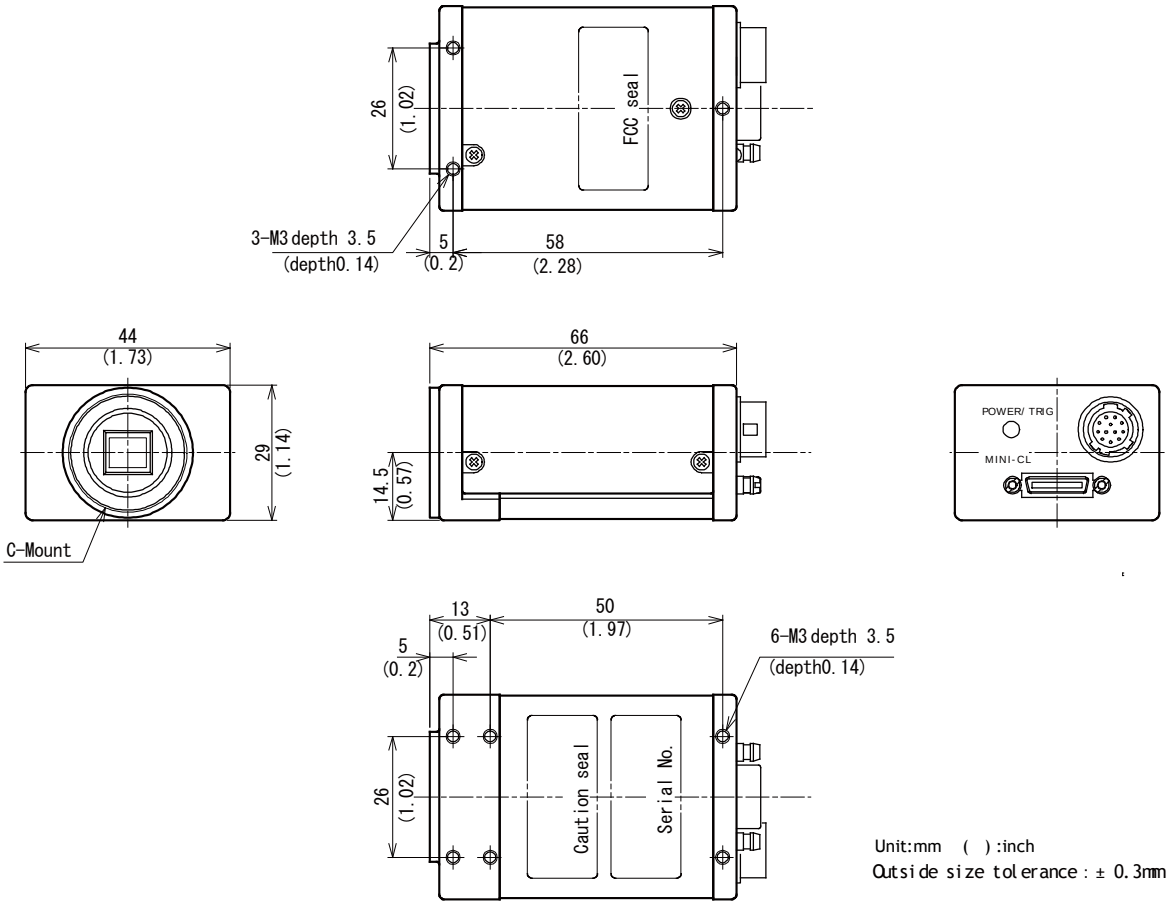
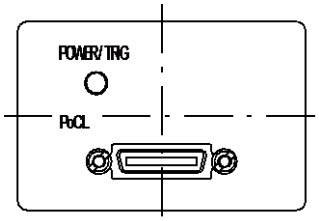


Fig. 28. Outline. (CM-140MCL/-UV/CB-140MCL)



Note: The outline for CM/CB-140PMCL is the same as CM/CB-140MCL but the rear panel of CM/CB-140PMCL does not have 12 pin HIROSE connector.

Fig.29. Rear Panel (CM-140PMCL / CB-140PMCL)

10. Specifications

10.1. Spectral response

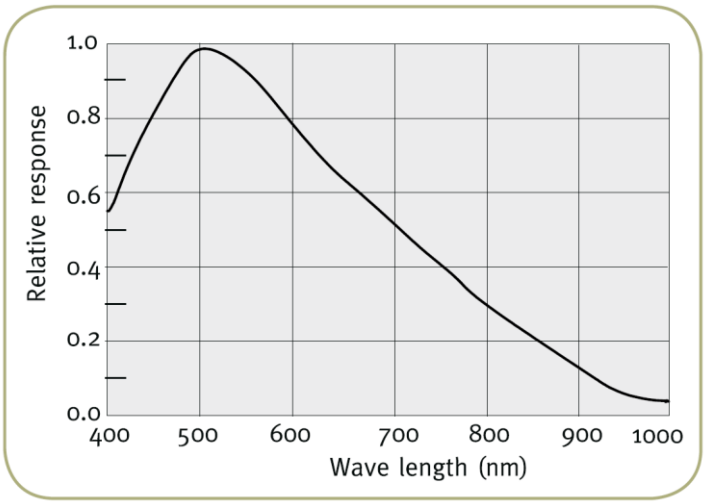


Fig. 30. Spectral response for CM-140MCL/PMCL

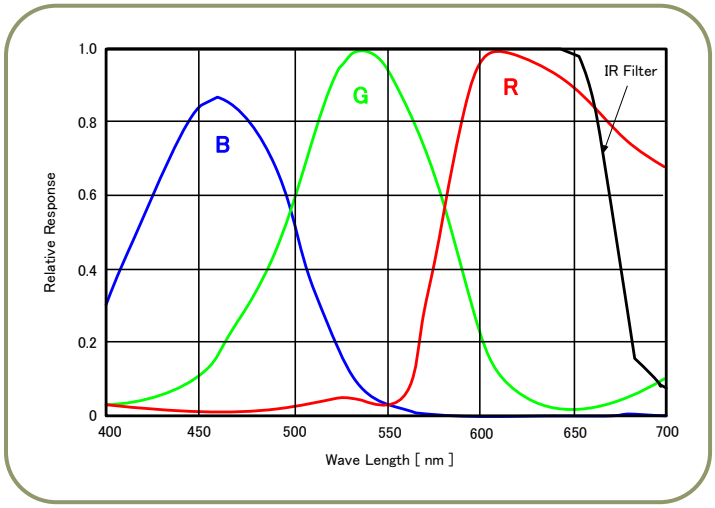


Fig.31. Spectral response for CB-140MCL/PMCL

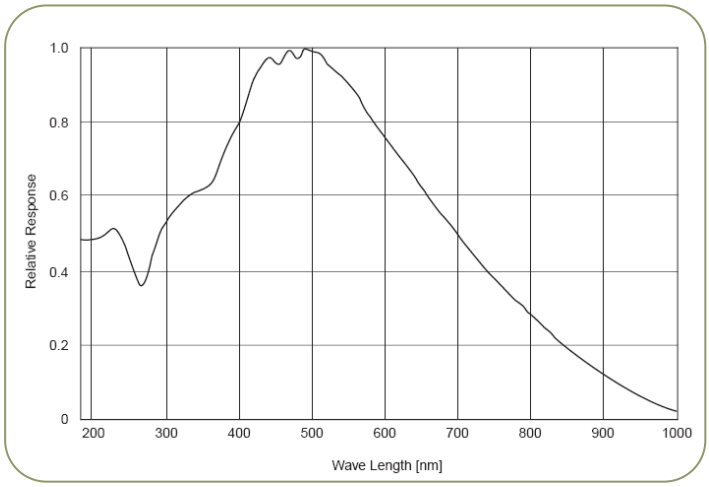


Fig 32. Spectral response for CM-140MCL-UV/PMCL-UV

10.2. Specification table(CMB-140MCL/CMB-140PMCL)

Specifications	CM-140 MCL	CB-140 MCL
Scanning system	Progressive scan	
Frame rate full frame	31.08 frames/sec. Progressive (1052 lines/frame)	
Pixel clock	65 MHz	
Line frequency	32.681kHz (1988 pixel clock/line)	
CCD sensor	1/2". Monochrome ICX267AL	1/2" Color ICX-267AK
Sensing area	6.4 (h) x 4.8 (v) mm	
Cell size	4.65 (h) x 4.65(v) μm	
Active pixels	1392 (h) x 1040 (v)	
Pixels in video output. Full 2/3 partial 1/2 partial 1/4 partial 1/8 partial	1392 (h) x 1040 (v) 31.08 fps. H = 32.696 kHz 1392 (h) x 694 (v) 39.97 fps H= 32.696 kHz 1392 (h) x 520(v) 46.57 fps. H = 32.696 kHz 1392 (h) x 269 (v) 61.92 fps. H = 32.696 kHz 1392 (h) x 130 (v) 73.97 fps. H = 32.696 kHz	
Sensitivity on sensor (minimum)	0.3 Lux (Max. gain, Shutter OFF, 50% video)	1.4 Lux (Max. gain, Shutter OFF,50% Green, w/IR cut filter)
S/N ratio	More than 50 dB (0dB gain)	
Digital Video output.	8 or 10 bit in Camera Link	8 or 10 bit raw Bayer video in Camera Link
Iris video output. Analogue	0.7 Vpp	
Gain	Manual -3 to +12 dB	
Gamma	1.0	
Synchronization	Int. X-tal.	
Trigger input. TTL Camera Link	4 V ±2 V. TTL Via Camera Link	
EEN output	4 V from 75 Ω source	
Trigger modes	Pre-Select , Pulse Width and Reset Continuous	
Accumulation	LVAL synchronous or asynchronous automatic selection	
Preset Shutter speed	9 fixed steps 1/60 to 1/10,000 second	
Programmable exposure	2 L to 1052 L (61.168 μs to 32.17 ms)	
Pulse width control	1 L to 60 frames.	
Readout modes	Full, Partial scan.(2/3, 1/2, 1/4, 1/8) V Binning	Full, Partial scan.(2/3,1/2, 1/4,1/8)
Control interface	Camera Link serial	
Functions controlled by RS 232C	Shutter, Trigger, Scanning, Read out, Polarity, Black level, Gain,	
Operating temperature	-5°C to +45°C	
Humidity	20 – 90% non-condensing	
Storage temp/humidity	-25°C to +60°C/20% to 90% non-condensing	
Vibration	10G (20Hz to 200Hz, XYZ)	
Shock	70G	
Regulatory	CE (EN61000-6-2 and EN61000-6-3), FCC part 15 class B, RoHS, WEEE	
Power	12V DC ± 10%. <0.25A (Normal Operation)	
Lens mount	C-mount (Flange back 17.526 mm -0.05mm) Image centre ±0.1mm from C-mount centre	
Dimensions	44 x 29 x 66 mm (HxWxD)	
Weight	115 g	115 g

Note: Above specifications are subject to change without notice

Note: Approximately 30 minutes pre heat requires to meet specifications.

10.3. Specification table(CM-140MCL-UV/CM-140PMCL-UV)

Specifications	CM-140 MCL-UV/CM-140PMCL-UV
Scanning system	Progressive scan
Frame rate full frame	16.14 frames/sec. Progressive (1052 lines/frame)
Pixel clock	33.75 MHz
Line frequency	16.978 kHz (1988 pixel clock/line)
CCD sensor	1/2" Monochrome UV sensitive ICX407BLA
Sensing area	6.4 (h) x 4.8 (v) mm
Cell size	4.65 (h) x 4.65(v) μm
Active pixels	1392 (h) x 1040 (v)
Pixels in video output. Full 2/3 partial 1/2 partial 1/4 partial 1/8 partial	1392 (h) x 1040 (v) 16.14 fps. H = 16.978 kHz 1392 (h) x 694 (v) 20.76 fps H= 16.978 kHz 1392(h) x 520(v) 24.16 fps. H = 16.978 kHz 1392 (h) x 269 (v) 32.16 fps. H = 16.978 kHz 1392(h) x 130 (v) 38.41 fps. H = 16.978 kHz
Sensitivity on sensor (minimum)	0.3 Lux (Max. gain, Shutter OFF, 50% video)
S/N ratio	More than 50 dB (0dB gain)
Digital Video output.	8 or 10 bit in Camera Link
Iris video output. Analogue	0.7 Vpp
Gain	Manual -3 to +12 dB
Gamma	1.0
Synchronization	Int. X-tal.
Trigger input. TTL Camera Link	4 V ±2 V. TTL Via Camera Link
EEN output	4 V from 75 Ω source
Trigger modes	Pre-Select , Pulse Width and Reset continuous
Accumulation	LVAL synchronous or asynchronous automatic selection
Preset Shutter speed	9 fixed steps 1/30 to 1/10,000 second
Programmable exposure	2 L to 1052 L (118 μs to 62 ms)
Pulse width control	1 L to 32 frames.
Readout modes	Full, Partial scan.(2/3, 1/2, 1/4, 1/8) V Binning
Control interface	Camera Link serial
Functions controlled by RS 232C	Shutter, Trigger, Scanning, Read out, Polarity, Black level, Gain,
Operating temperature	-5°C to +45°C
Humidity	20 – 90% non-condensing
Storage temp/humidity	-25°C to +60°C/20% to 90% non-condensing
Vibration	10G (20Hz to 200Hz, XYZ)
Shock	70G
Regulatory	CE (EN61000-6-2 and EN61000-6-3), FCC part 15 class B, RoHS, WEEE
Power	12V DC ± 10%. <0.14A (Normal Operation) <0.15A (Max. 1/8 partial operation)
Lens mount	C-mount (Flange back 17.526 mm -0.05mm) Image centre ±0.1mm from C-mount centre
Dimensions	44 x 29 x 66 mm (HxWxD)
Weight	120 g

Note: Above specifications are subject to change without notice

Note: Approximately 30 minutes pre heat requires to meet 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, including laser sources.
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.
Remove power from the camera during any modification work, such as changes of jumper and switch settings.

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

Blemishes
All cameras are shipped without visible image sensor blemishes.
Over time some pixel defects can occur. This does not have a practical effect on the operation of the camera. These will show up as white spots (blemishes).
Exposure to cosmic rays can cause blemishes to appear on the image sensor. Please take care to avoid exposure to cosmic rays during transportation and storage.
It is recommended using sea shipment instead of air flight in order to limit the influence of cosmic rays to camera.
Pixel defects/blemishes also may emerge due to prolonged operation at elevated ambient temperature, due to high gain setting or during long time exposure. It is therefore recommended to operate the camera within its specifications.

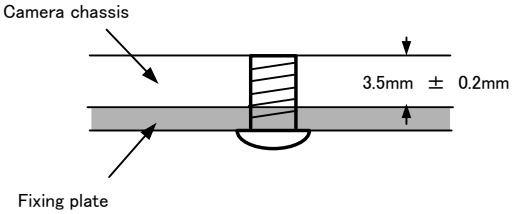
Patterned Noise
When the sensor captures a dark object at high temperature or is used for long time integration, fixed pattern noise may appear in the image.

11.3. Caution when mounting a lens on the camera

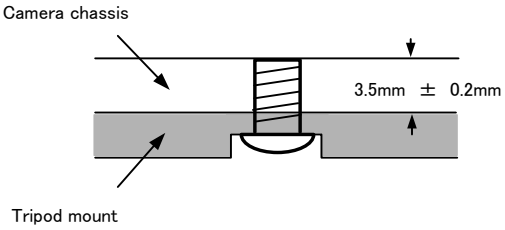
When mounting a lens on the camera dusts particles in the air may settle on the surface of the lens or the image sensor of the camera. It is therefore important to keep the protective caps on the lens and on the camera until the lens is mounted. Point the lens mount of the camera downward to prevent dust particles from landing on the optical surfaces of the camera. This work should be done in a dust free environment. Do not touch any of the optical surfaces of the camera or the lens.

11.4. Caution when mounting the camera

When you mount the camera on your system, please make sure to use screws of the recommended length described in the following drawing. Longer screws may cause serious damage to the PCB inside the camera.



If you mount the tripod mounting plate, please use the provided screws.



11.5. Exportation

When exporting this product, please follow the export regulation of your own country.

11.6. References

1. This manual for CM/CB-140 MCL / CM/CB-140 PMCL can be downloaded from www.jai.com
2. Datasheet for CM/CB-140 MCL / CM/CB-140PMCL can be downloaded from www.jai.com
3. Camera control software can be downloaded from www.jai.com

Index

Change History

Month/Year	Revision	Changes
June 2007	1.0	New release
June 2008	2.0	Add PMCL version
Sept 2009	3.0	Change the depth in chassis for screws from 4mm to 3.5mm and add caution, Add RCT trigger mode, Add UV version
Feb 2010	3.1	Correct effective horizontal pixel number from 1380 to 1392.
Feb 2011	3.2	Correct the unit of clock on chapters, 6.2.2, 6.2.4 and 6.2.5 from μs to ns.
May 2011	3.3	Correct the drawings for the vertical and horizontal timing of full and partial scan and the horizontal timing of vertical binning.

User's Record

Camera type:	**CM-140 MCL / -UV / CB-140 MCL** **CM-140 PMCL / -UV / CB-140 PMCL**
Revision:	**……..**
Serial No.	**……..**
Firmware version.	**……..**

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

User's Mode Settings.

User's Modifications.

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