CEDIP Infrared Systems

Since 1989

A Word Class Supplier of IR Imaging System

CEDIP Cameras USER MANUAL

History of Modification

Date	Rev.	Author	Modification
4th May 2004	A	Ph. DARSES	Creation

SUMMARY

1. Introduction

Our Infrared cameras are infrared focal plane array cameras operating in SWIR, MWIR and LWIR wavelength bands. They use the most advanced focal plane array technology as InSb and MCT detectors operating in snap shot mode. A various set of optical lenses is available for short range and long range detection applications.

Our cameras are stand alone units which can operate without the need of external control. For advanced applications, a remote link is provided. This allows controlling the camera parameters from a remote terminal such as a PC computer for example.

The key features of the our cameras are :

- Available in SWIR, LWIR and MWIR
- Cooled or uncooled
- Fully programmable frame rate (up to 200 Hz under defined conditions)
- Fully programmable integration time
- External FPA synchronization
- Sub-Windowing mode, allowing increase of frame rate

2. Notation

Here is a list of common acronyms and abbreviations :

Acronym	Explanation
AGC	Auto Gain Correction
AOC	Auto Offset Correction (Gain fixed)
BPR	Bad Pixel Replacement
CMT	Cadmium Mercure Telluride, a type of optical detector used on focal plane arrays
H/W	Hardware
InSb	Indium Antimonide, a type of optical detector used on focal plane arrays
LSB	Least Significant Bit
LVDS	
LWIR	Long Wave Infrared (8 - 12 µm)
MSB	Most Significant Bit
MWIR	Mid Wave Infrared (3.5 – 5µm)
NETD	Noise equivalent temperature difference
NDT	Non Destructive Testing
NTSC	National Standards Television Committee, a television standard used in the USA and some other countries
NUC	Non-Uniformity Correction
OEM	Original Equipment Manufacturer
PAL	Phase Alternation by Line, a television signal standard used in most of Europe, some Middle Eastern, Asian countries and others
QWIP	Quantum Well Infrared Photodetector, a type of optical detector used on focal plane arrays
ROI	Region of Interest
RS232	Recommended Standard 232, refers to a standard issued by EIA specifying signal voltage, signal timing, signal function, protocol for information exchange and mechanical connectors; can also be referred to as EIA232
RS422	
S/W	Software
SDK	Software Developers Kit
SWIR	Mid Wave Infrared (0.8 – 2.5µm)
TEC	Thermoelectric controller, a cooling mechanism used in Jade SWIR and Jade UC
Tint	Period of time for the integration
USB2	

3. Camera Deliveries

Below a table of cameras vs power supply and cables deliveries:

Name	CEDIP P/N	Power Supply	Serial Cable	Digital Cable	Frame Grabber	PC Backpanel
Jade SWIR 	C0101**c**IDMS076 (commercial connectors)	24V DC X0220 15V DC X0237	X9827L…	X9934L…	E9801R	n/a
	C0101**i**IDMS076 (industrial connectors)	?	X0213L…	X02144L…	E9801T	E0008R
Jade UC LWIR 	C0302**l**IDML073 (LVDS output)	12V DC X0251	X9827L…	X9934L…	E9801L	n/a
	C0302**u**IDML073 (USB2 output)	12V DC X0251	X0442L…		n/a	n/a
Jade 3 SWB / MWIR / LWIR	C9903**c**… (commercial connectors)	24V DC X0220	X9827L…	X9934L…	E9801R	n/a
	C9903**i**… (industrial connectors)	?	X0213L…	X02144L…	E9801T	E0008R
Jade III MWIR / LWIR 	C9906c… (commercial connectors)	24V DC X0220	X0006L…	X9934L…	E9801R	n/a
Jade LR MWIR 	C0305iGEMINI (industrial connectors)	24V DC X0220	X0213L…	X0214L…	E9801T	E0008R
Emerald MWIR 	C0103i… (industrial connectors)	24VDC JWS150-24A				E0008L
Emerald LWIR	C0201iQWIP (industrial connectors)					
Orion SWB	C0202i…					E0008R
Jade VLWIR	C0203iIDML084					

Component that is or must be integrated inside PC

4. Getting Start

4.1. Unpacking the camera

The camera is delivered within its reusable transportable suitcase.

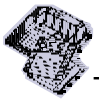
Please double-check that deliveries is compatible with the attached packing list. In case of discrepancy, inform CEDIP.

4.2. Setting up the equipment

Depending on the type of camera, connecting should be made according to 1 of the following figure.

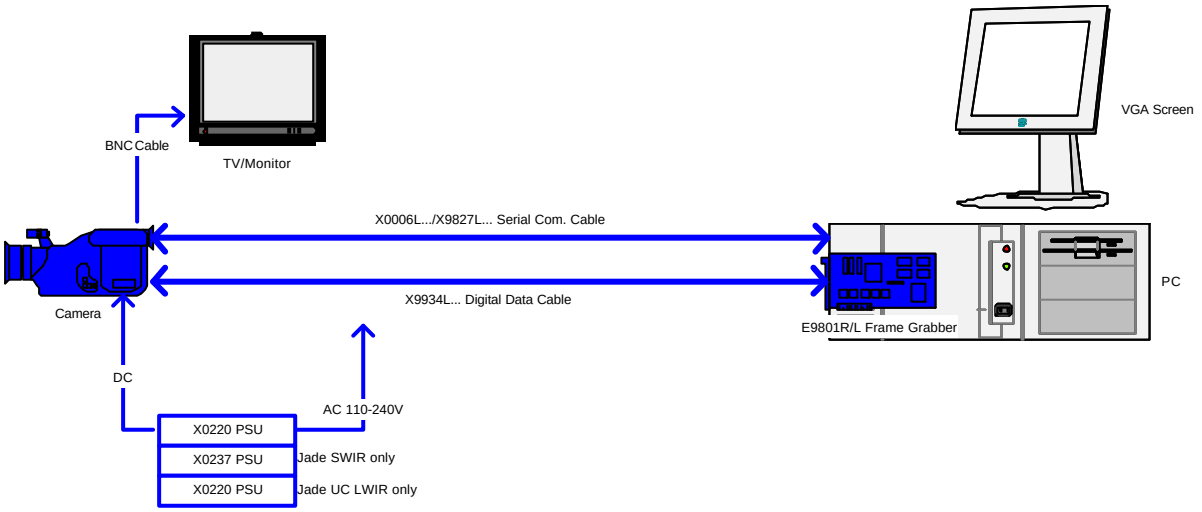
The power supply module generates DC voltage from any AC source ranging from 100V AC to 240V AC.

The TV video signal is connected to a video screen trough a coax cable of 75 ohms.

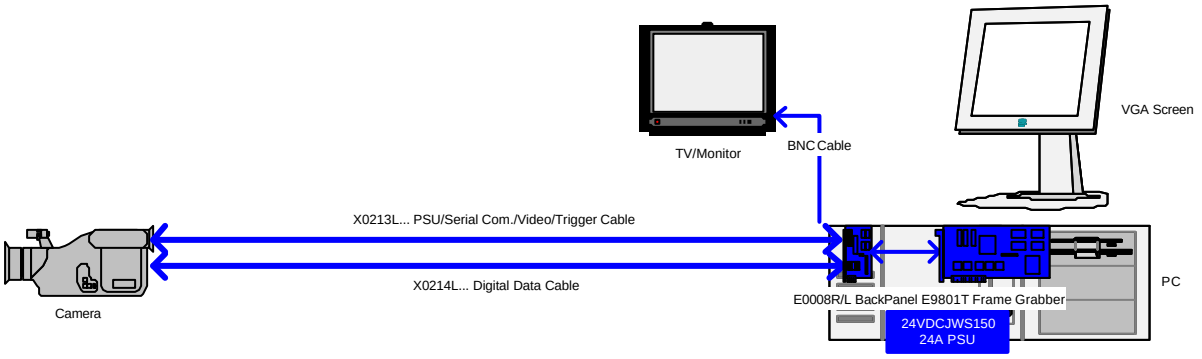


To control the camera a communication cable is connected from the camera head to a PC computer. The PC must operate under Windows 2K or XP. The CIRRUS Win software must be installed on the PC hard disk.

4.2.1. Commercial Like Setup

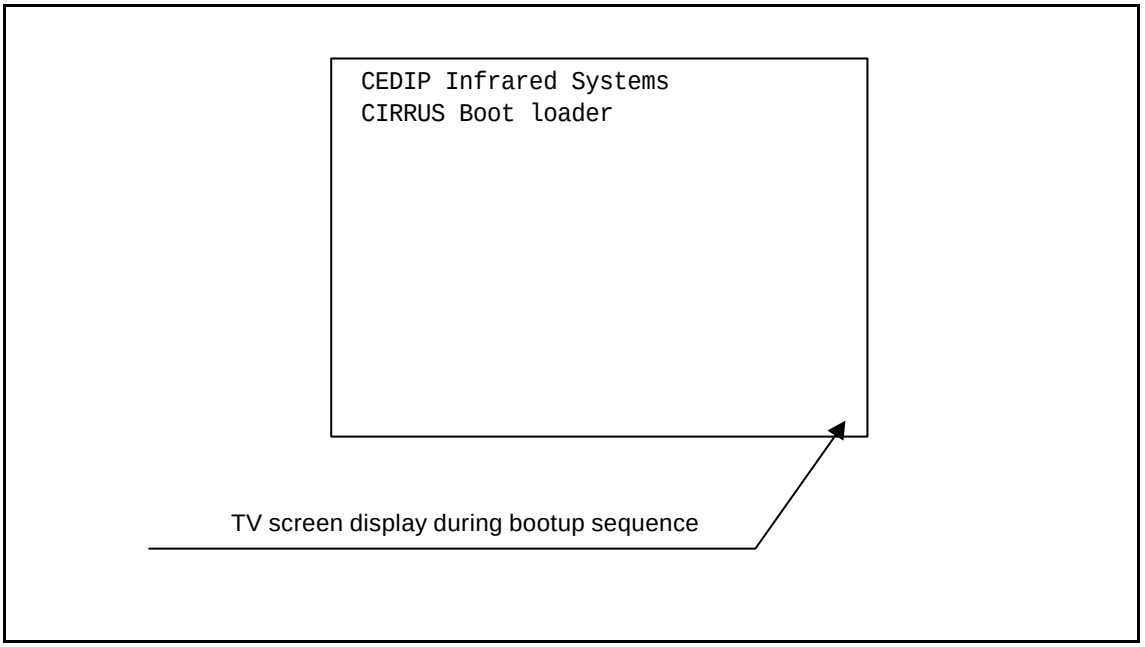


4.2.2. Industrial Like Setup



4.3. Turning on the camera

When powering on the camera the TV screen display a boot up screen, as shown in the following figure:



During this phase an internal built-in test of the camera and its components is performed, result of those tests are displayed on the screen.

After several seconds (10 s typical), the system will display a pattern of the analog video output while the detector is not cooled enough (refer to “Cirrus User Manual” for advanced options about this).

4.4. Cooling down the detector

Depending on the type of cooling device, the system can require several minutes for cooling down the detector.

Below a table of cooldown temperature and typical time to reach it:

Name	Temp.	Time	Cooler Type
Jade UC LWIR	300 K	1 min.	TEC
Jade SWIR	200 K	3 min.	
Jade III MWIR (MCT)	90 K	7 min.	Rotary Stirling
Jade 3/III SWB / LW	77 K	7 min.	
Jade III MWIR (InSb)			
Jade LR MWIR			
Emerald MWIR (InSb)			
Orion MWIR			
Jade VLWIR	70 K	6 min.	Linear Stirling
Emerald LWIR	60 K	10 min.	

As soon the detector reaches its working temperature, the cooler's sound decreases and soon a live image will become available on the TV screen.

5. Getting an image

5.1. Controlling the camera from a remote PC

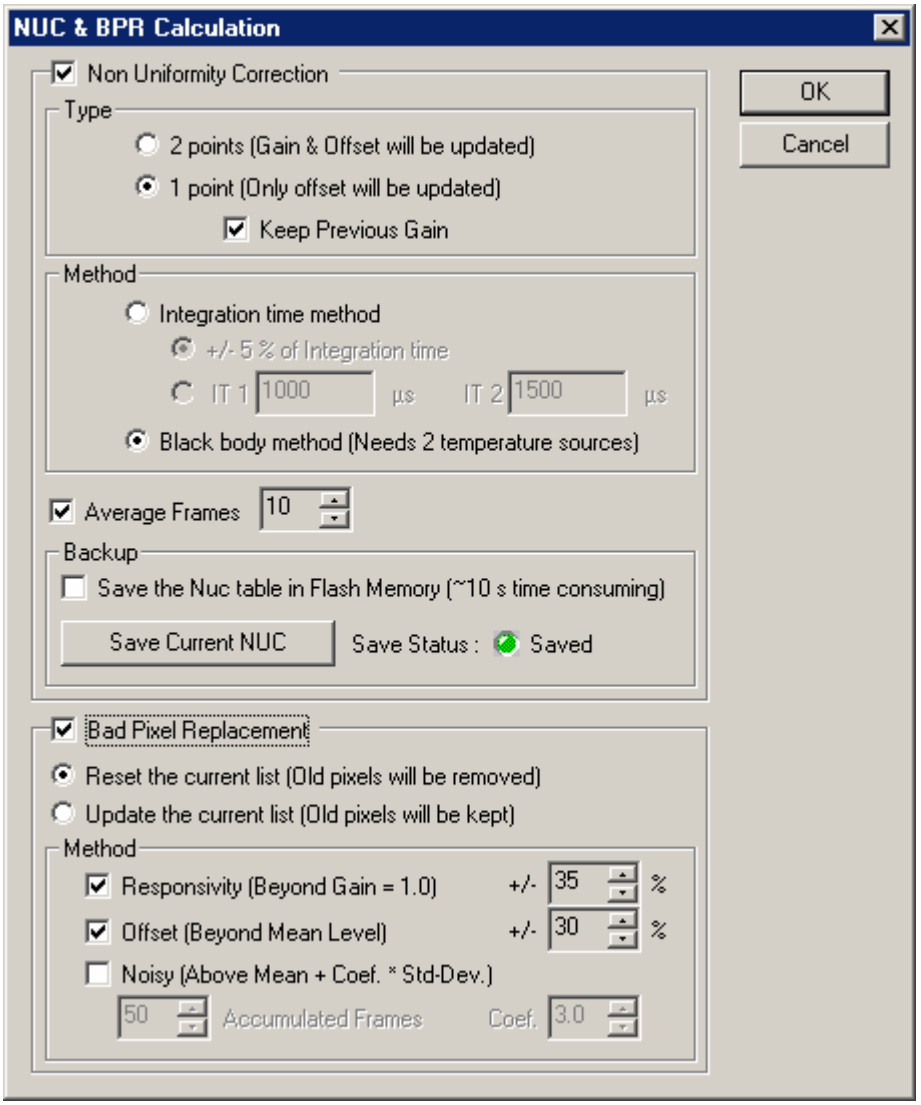
Our line of camera can be controlled from a remote computer while it's connected through a communication cable (serial RS232, USB2, etc…).

Below is a screen copy of our standard Cirrus software delivered in standard with your camera. This front-end can control parameters and setup of your camera as:

- Frame Rate
- Integration Time
- NUC & BPR
- Analog Video Output
  - AGC
  - Black/Hot palette or White/Hot
  - Horizontal & Vertical Flip
- Up/download of data/software
- Serial link parameters (baudate,etc.)
- Detector target (factory set)

5.2. NUC & BPR

NUC function is dedicated to perform a perfect uniformity in the pixel response according to the environmental conditions and specifically the housing and lens temperatures. Stored at factory, the NUC tables can be updated at any moment by the user though the icon  , the following window should prompt:



NUC correction can be performed on 1 or 2 points :

NUC 1 point : Offset correction of the FPA pixels. Needs only one uniform target and can be done in the fields with the lens cover for example.

NUC 2 points : Offset and Gain correction. Needs 2 references and involve at least an adjustable temperature source.

The NUC table updated can be saved or not in the embedded electronics. If not saved, it is used as long as the camera is powered. If the new NUC table is saved, it will erase the previous one. If a computer is connected to the serial port, that original NUC can be saved before, using Put and Get in Preferences, putting the old NUC in the computer memory and getting it back later if necessary.

Synchronize allows to associate the NUC to parameters IT, filter, …

 Note for **advanced users** : refer to “Cirrus User Manual” for advanced options about this.

6. Annexes

6.1. Cameras Technical Specifications

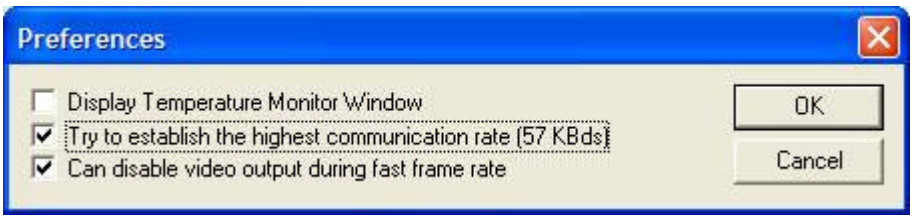
Wave Band	Name	Spectral Range (µm)	Pixel Pitch (µm)	Max Frame Rate (Hz)	Image Size	Pixel Clock (MHz)	Ext. Trigger	Mat.
1	Jade SWIR	0.9-2.5	30	100	320*256	10	TTL or Genlock	MCT
1	Jade 3 SWB	1.5-5.1	30	170	320*240	16	TTL or gunlock	InSb
1	Orion SWB	1.5-5.1	30	150	256*256	16	TTL and Genlock	InSb
2	Jade 3/III MWIR	3.7-4.8	30	200/250	320*240	16/20	TTL or genlock	MCT
2	Jade 3/III MWIR	3.6-5.1	30	170	320*240	16	TTL or gunlock	InSb
2	Jade LR MWIR	3.6-5.1	30	170	320*240	16	TTL or gunlock	InSb
2	Emerald MWIR	3.6-5.1	20/25	70/80	640*512	28/32	TTL and Genlock	InSb
3	Emerald LWIR	7.1-9.1	24	50	640*512	20	Genlock	QWIP
3	Jade 3/III LWIR	7.7-9.3	30	200/250	320*240	16/20	TTL or genlock	MCT
3	Jade VLWIR	7.7-11.0	30	200/250	320*240	16/20	TTL or genlock	MCT
3	Jade UC LWIR	8-14	45	50-60	320*240	~5	No	ASi

6.2. Frequently Asked Questions

6.2.1. Why my camera is not able to achieve high frame rate according to the spec.?

On some of our cameras, a faster frame rate can be achieved by turning off the analog video output.

Under Cirrus win preferences screen there is an option to operate faster which must be activated. The is the last one in the below screen. (Refer to Cirrus User Manual).



6.2.2. How to perform a NUC with a SWIR camera?

Due to spectral range (0.9-2.5 µm) operation of the Jade SWIR camera, NUC using a black body will be of no use. For the two sources (low & high temperature), this is our suggestion:

- Iris closed (or cover the lens.) for the low temperature
- Iris open and using a material like a white paper at a 45 degree angle with a light source pointed down for the high temperature.

6.2.3. How to NUC my camera when operated in external trigger mode?

To perform a NUC when the camera works in external mode triggering, you must check the frequency of the camera in free running.

The frame rate value of the camera must be close to the external trigger.

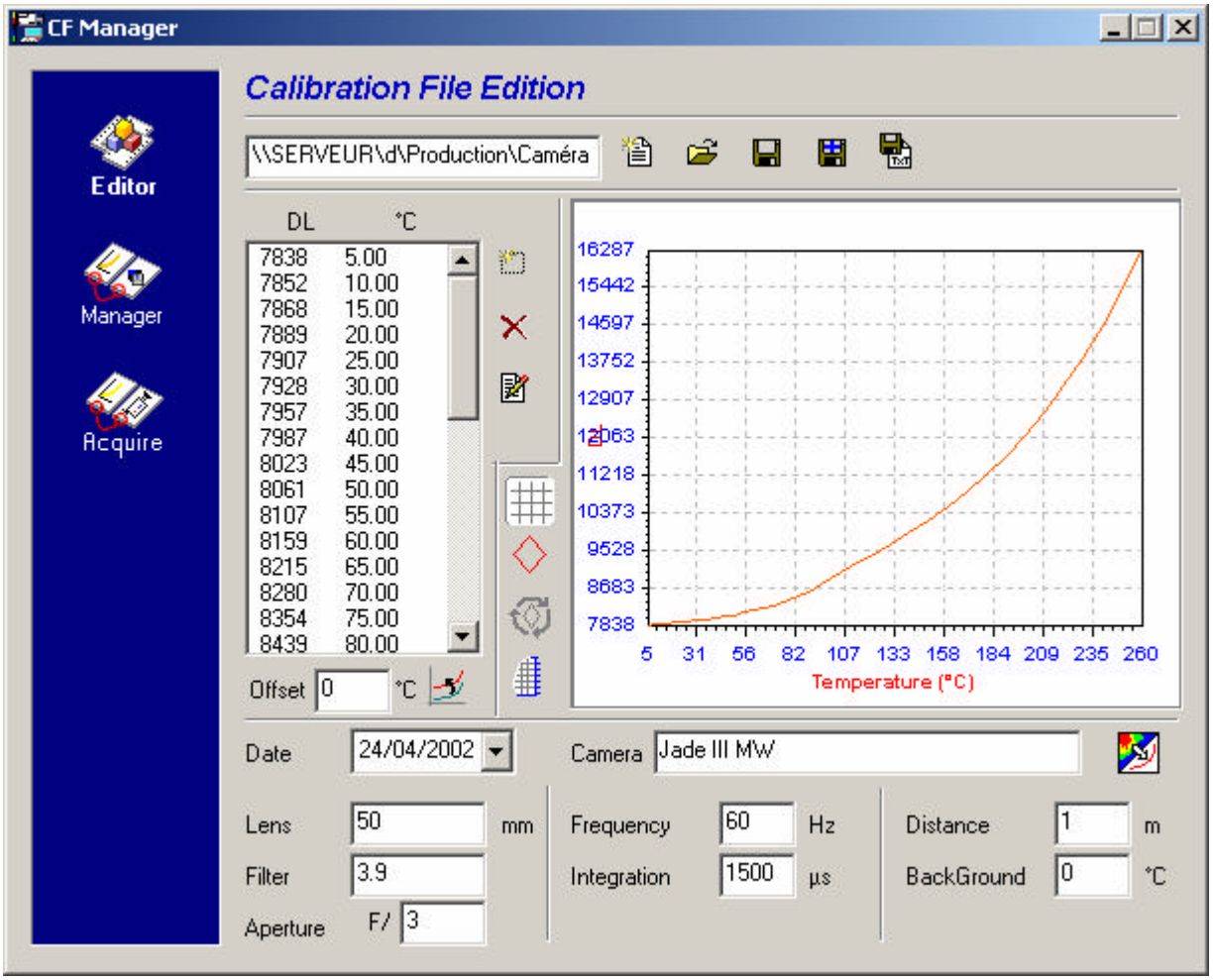
In case of the frame rate is too far from the real external trigger frame rate, the NUC process can generate a time-out error.

6.2.4. Can the calibration process be done in-house?

Our Altair software has a calibration file manager software, which is accessible to the user. To calibrate the camera it is necessary to have a black body and to record the signal reading of the camera at the position of the black body in the image versus the black body temperature.

A file is created for each calibration set, which can be further reused on the field on live images or at the lab when processing the data.

A printout of the calibration file manager is given at the next figure. (note that DL indicates Digital Level or signal readout from the camera in A/D count)



6.2.5. Can the spectral response of my camera adjusted?

For instance, a Jade MWIR (InSb) has a standard spectral response between 3.6 µm to 5.1 µm. The 3.6 µm is chosen to minimize solar reflexion.

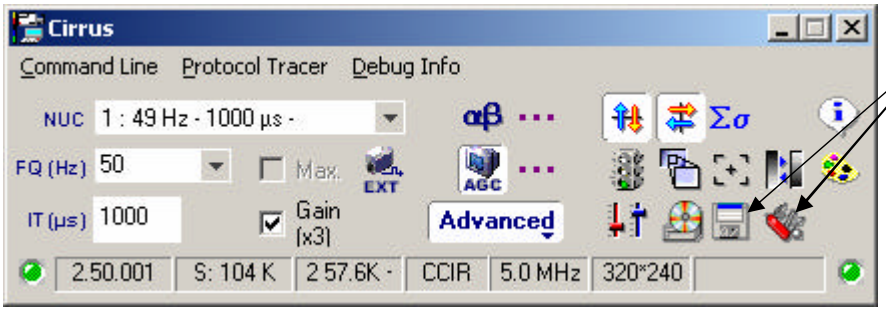
There is a filter wheel in the camera with 3 to 4 empty slots. Each slot can accept 1'' diameter filter, and the user can mount the filter by himself.

The filter wheel is motorized and controlled by software.

: This wheel is **not available** for Jade UC & Jade SWIR cameras.

6.2.6. Why a password is required within some Cirrus options?

The password locks access to system's vital function. A wrong manipulation of these parameters could result in troubles on your system.
A Message "Password required" appears on the screen after you click on "set-up parameters" or "upload new software to the camera" icons, like shown below.



Both icons require password to access.

To unlock this protection you need to execute *"Cirrus.reg"* file that CEDIP can provide you upon request. Operation is successful if this message appears.

Close Cirrus, Run it again, both icons are not anymore password protected.
After you have made your operations, you must lock Cirrus Win to avoid unwanted operations.

To reverse protection you need to execute *"Cirrus Secure password.reg"* file CEDIP can provide you upon request. Same message as before appears on screen when operation is successful.

Close Cirrus, Run it again, both icons are password protected again.

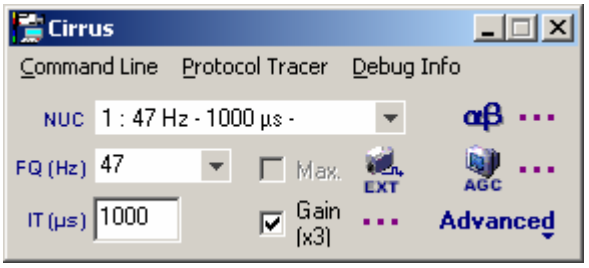
6.2.7. How can I bypass Bad Pixel Replacement inside the camera?

To remove the bad pixel replacement (BPR) on the live image, you must send to the camera one specific command.

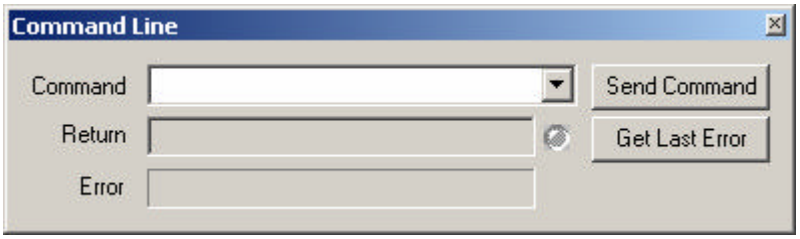
To send a specific command to the camera, you need to use Cirrus win software in debug mode.

To launch Cirrus win software in debug mode, you must add in the line command the extra parameter “/debug” (Refer to Cirrus User Manual).

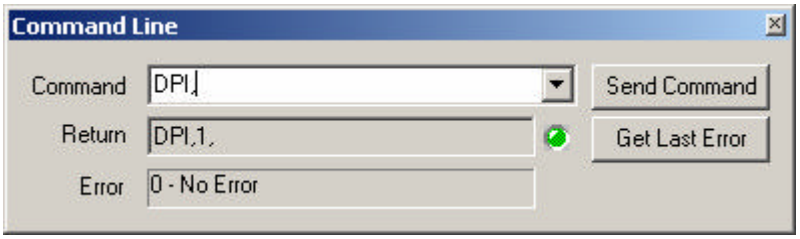
When you launch cirrus win software in debug mode, an additional menu appear in the main window of this software.



The “Command Line” menu will prompt the following window and allow you to send ASCII command line through an editor :



You must type the command : “DPI,” and push the button “Send Command”. In result, all BPR are deactivate in the current table of the camera. If this action have no error, the return from the camera is “DPI,1,”.

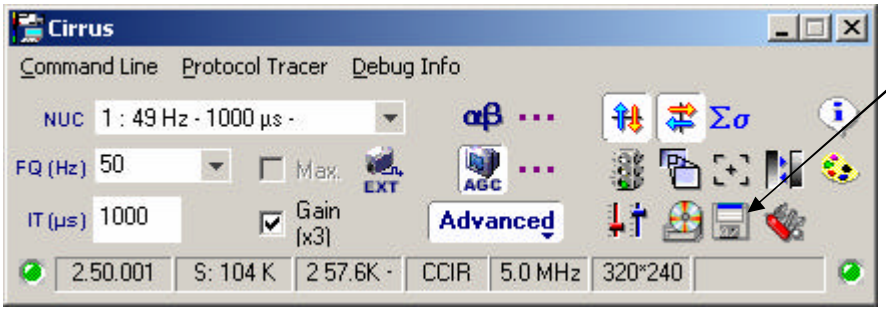


To reactivate all BPR in this current table you must send this command : “API,”.

6.2.8. How to upgrade the internal software of my camera?

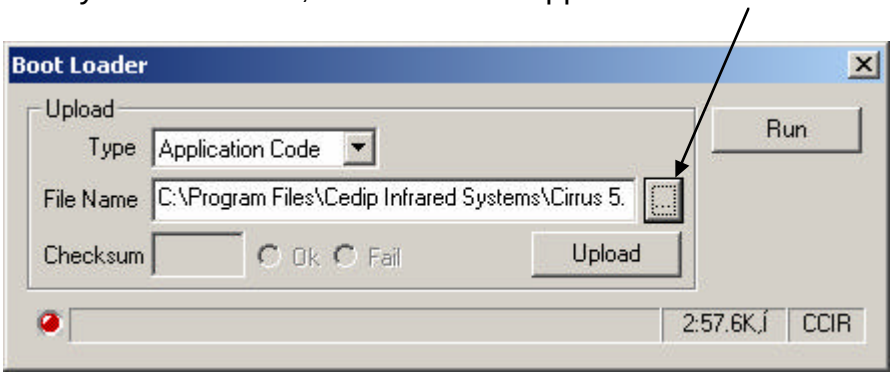
Application code is the embedded software of your camera. You can upload this software by clicking on “upload new software to the camera” icon but this function is protected.

You can un-protected the Cirrus Win with the help of FAQ-03010 that explained to you the write process to follow.



Upload new software to the camera icon.

After you had clicked, a new window appears. And click on “Browser” button.



Select the directory where you had copy the new file or go into CEDIP Infrared Systems directory by this way *C:\Program Files\CEDIP Infrared Systems\Cirrus\C31 Codes\ .*

The new application code will be uploaded by clicking onto “Upload” button.

When transfer is done, you need to return under application by clicking “Run” button.

6.3. Connectors Pinout

6.3.1. Commercial Digital output pinout

Within the Jade & Emerald camera cabinet the digital output is relayed on the backside through a ribbon cable to an SCSI3 type connector (µSub-D 68 pins) according to the following pinout:

Signal	Pin#	Signal	Pin#	
GND	1	**GND**	35	
HD0	2	LD0	36	LSB
HD1	3	LD1	37	
HD2	4	LD2	38	
HD3	5	LD3	39	
HD4	6	LD4	40	
HD5	7	LD5	41	
HD6	8	LD6	42	
HD7	9	LD7	43	
HD8	10	LD8	44	
HD9	11	LD9	45	
HD10	12	LD10	46	
HD11	13	LD11	47	
HD12	14	LD12	48	
HD13	15	LD13	49	
HD14	16	LD14	50	
HD15	17	LD15	51	MSB
H Continuous CLOCK	31	L Continuous CLOCK	65	
HCLOCK	32	LCLOCK	66	
HFRAME	33	LFRAME	67	
HLINE	34	LLINE	68	

6.3.2. Industrial Digital output pinout

Within the Jade & Emerald camera cabinet the digital output is relayed on the backside through a ribbon cable to an military type connector (Souriau 41 pins) according to the following pinout:

Signal	Pin#	Signal	Pin#	
HD0	A	LD0	B	LSB
HD1	C	LD1	D	
HD2	E	LD2	F	
HD3	G	LD3	H	
HD4	J	LD4	K	
HD5	L	LD5	M	
HD6	N	LD6	P	
HD7	R	LD7	S	
HD8	T	LD8	U	
HD9	V	LD9	W	
HD10	X	LD10	Y	
HD11	Z	LD11	a	
HD12	b	LD12	c	
HD13	d	LD13	e	
HD14	f	LD14	g	
HD15	h	LD15	i	MSB
HLINE	j	LLINE	k	
HFRAME	m	LFRAME	n	
HCLOCK	p	LCLOCK	q	
GND	r			
H Continuous CLOCK	s	L Continuous CLOCK	t	

6.4. Digital Video Output Timing

6.4.1. Digital output Standard

Voltage standard depends on the embedded electronic generation according to the following table:

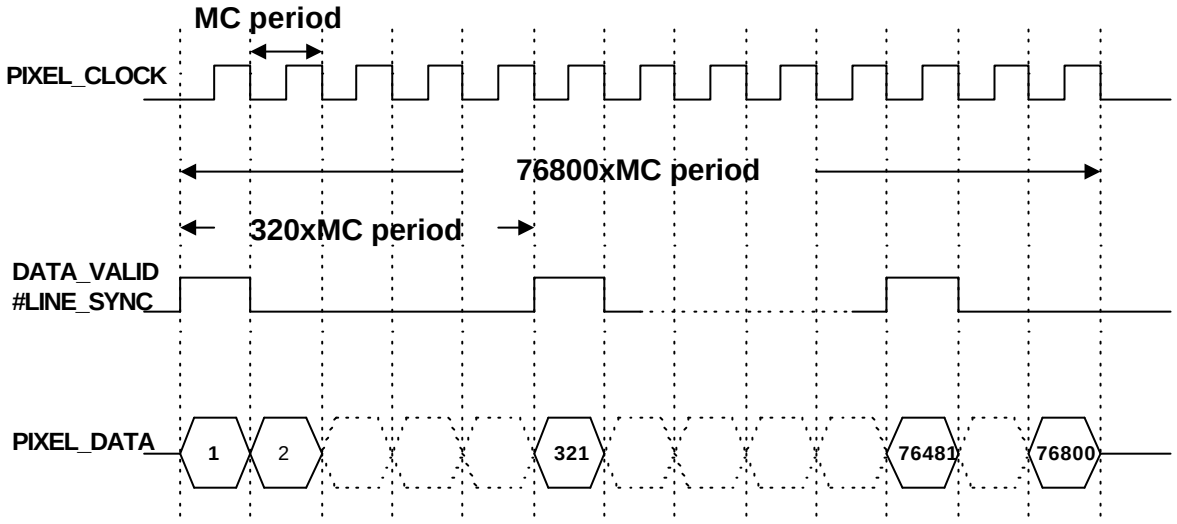
Electronics	Standard	Cameras
Cirrus	RS422	Agate / Aquamarine / Jade 3 / Jade III / Jade SWIR / Jade UC / all Orion / Jade LR : Jade VLWIR
Cassiopea	LVDS	all Emerald
Pegasus	LVDS	Jade UC² / Jade UC3 / Ruby

6.4.2. Jade 3 / III MWIR / LWIR (MCT Material)

This is applicable for the following cameras part number :

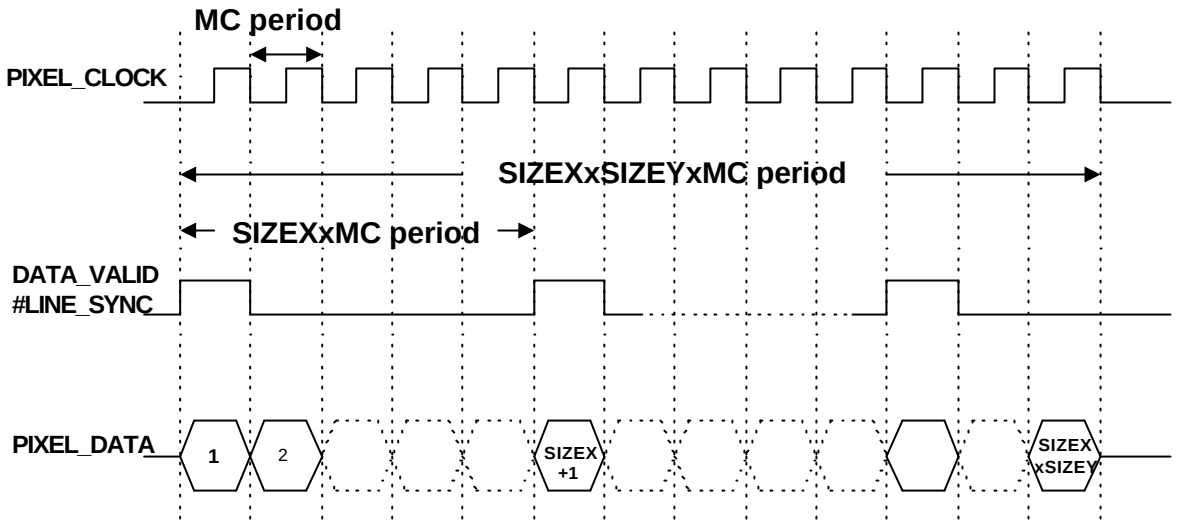
- C9903cIDMM067
- C9903iIDMM067
- C9903cIDML067
- C9903iIDML067
- C9906cIDMM067
- C9906cIDML067

320*240 Mode



(*) MC period depends on the FPA type and configuration. It varies from 250 ns to 60 ns
(#) LINE SYNC : 320*MC synchronization signal in Full Window , or SIZEX * MC defined Window Mode

Sub window Mode



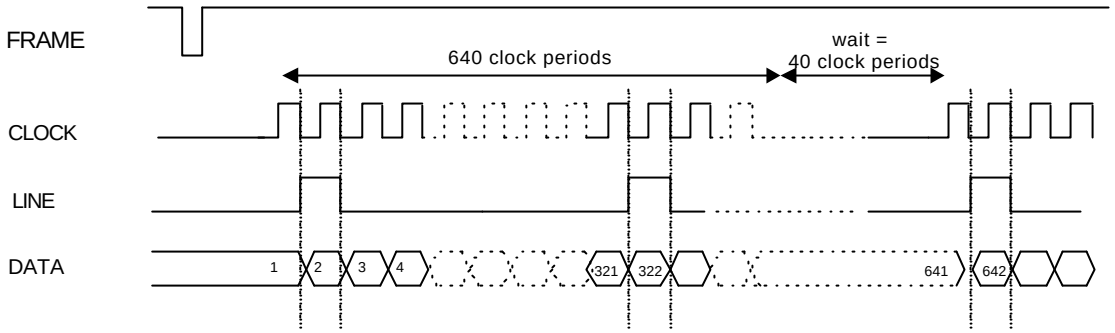
(*) MC period depends on the FPA type and configuration. It varies from 250 ns to 60 ns
(#) LINE SYNC : 320*MC synchronization signal in Full Window , or SIZEX * MC defined Window Mode

6.4.3. Jade 3 / III MWIR (InSb Material)

This is applicable for the following cameras part number :

- C9903cGEMINI
- C9903iGEMINI
- C9906cGEMINI

320*240 Mode : Rolling Integration Time Option



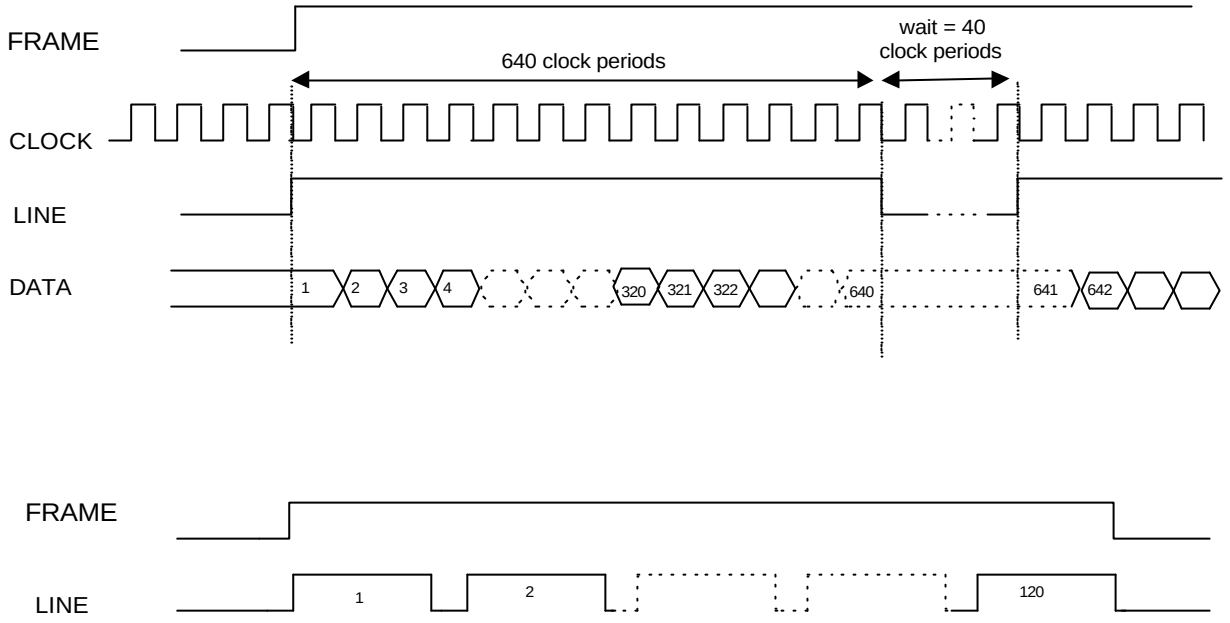
Frame signal is asserted low at the beginning of each frame.
Its width is between 1 and 10 µs.
Time between FRAME and first pixel is roughly integration time + 680 clock periods.

Digital output is composed of 120 bursts of 640 pixels. Each burst is separated with 40 clock periods where CLOCK is not sent.

76800 (640 x 120) CLOCK pulses are sent during one frame. Each pixel can be stored on CLOCK rising edge.

Line pulse is asserted high during the second pixel of each line.
Time between two line sync is alternatively 320 CLOCK periods or 360 CLOCK periods.

320*240 Mode : Non CEDIP Frame Grabber Option



CLOCK is continuously available.

Frame signal is asserted high (on CLOCK falling edge) at the beginning of each frame.
Frame signal is asserted low (on CLOCK falling edge) at the end of each frame.
It is high during all the data transfer.

Digital output is composed of 120 bursts of 640 pixels. Each burst is separated with 40 clock periods.

Each data is changing on CLOCK falling edge.
Each data can be stored on CLOCK rising edge.

Line pulse is asserted high (on CLOCK falling edge) during 640 clock period.
Line pulse is asserted low on CLOCK falling edge.

Line pulse is asserted high 120 times per frame.

In fact the camera output is composed of 120 lines of 640 pixels.

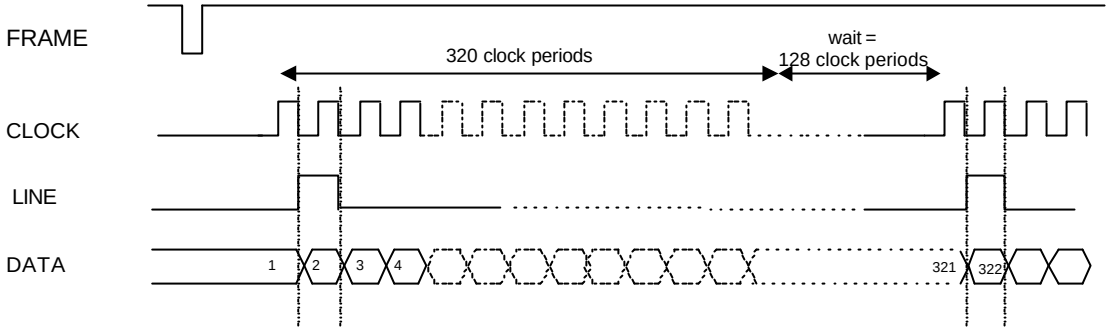
It is impossible to have 240 lines of 320 pixels.

6.4.4. Jade 3 SWB

This is applicable for the following cameras part number :

- C9903cINDIGO
- C9903iINDIGO

320*240 Mode



Frame signal is asserted low at the beginning of each frame.
Its width is between 1 and 10 µs.
Time between FRAME and first pixel is approximatively integration time + 448 clock periods.

Digital output is composed of 240 bursts of 320 pixels. Each burst is separated with 128 clock periods where CLOCK is not sent.

76800 (320 x 240) CLOCK pulses are sent during one frame. Each pixel can be stored on CLOCK rising edge.

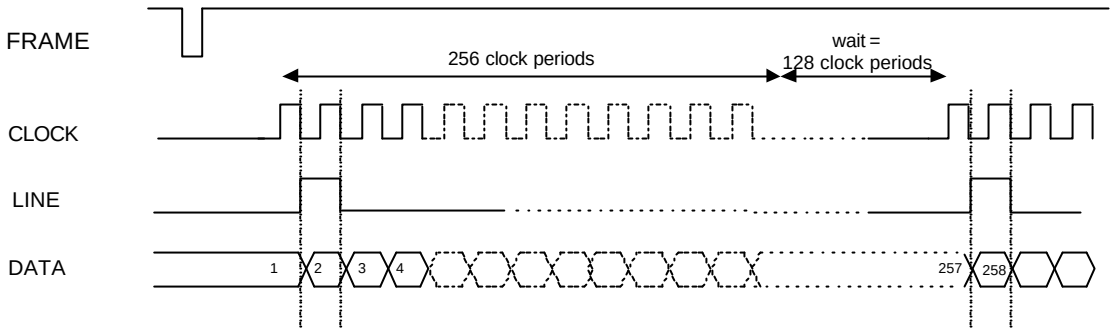
Line pulse is asserted high during the second pixel of each line.
Time between two line sync is 448 CLOCK periods.

6.4.5. Orion SWB

This is applicable for the following cameras part number :

- C0202iINDIGO

256*256 Mode



Frame signal is asserted low at the beginning of each frame.
Its width is between 1 and 10 µs.
Time between FRAME and first pixel is roughly integration time + 384 clock periods.

Digital output is composed of 256 bursts of 256 pixels. Each burst is separated with 128 clock periods where CLOCK is not sent.

65536 (256 x 256) CLOCK pulses are sent during one frame. Each pixel can be stored on CLOCK rising edge.

Line pulse is asserted high during the second pixel of each line.
Time between two line sync is 384 CLOCK periods.

The filter position is signed in the 2 most significant bits.

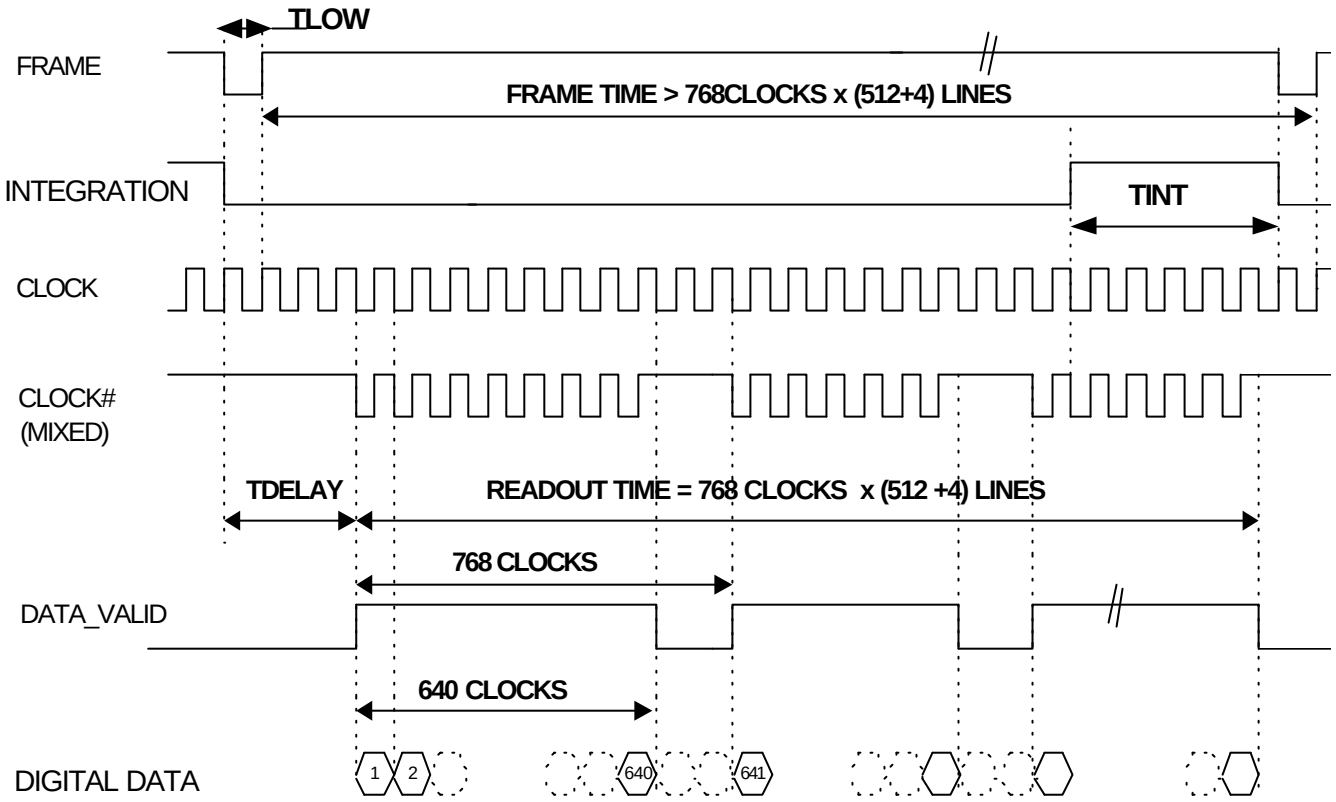
D15	D14	Filter
0	0	1
0	1	2
1	0	3
1	1	4

6.4.6. Emerald MWIR (InSb Material)

This is applicable for the following cameras part number :

- C0103cFALCON

640*512 Mode



TCLOCK Digital pixel clock period 31.25ns Min to 50ns Max fréquency in 20MHz to 32MHz Max

TLOW Frame signal is asserted low at the beginning of each frame.
Frame Low pulse 1 to 16 TCLOCK

TINT Integration Time 20us to 20ms

TDELAY The minimum delay time between FRAME and first pixel is roughly 3xLines periods 3x768xTCLOCK.

DATA_VALID Data valid lines period contains (640+128) pixels, is high during 640 valid pixels, and low during 128 pixel .

DIGITAL DATA Digital data can be sample on the rising edge of the clock

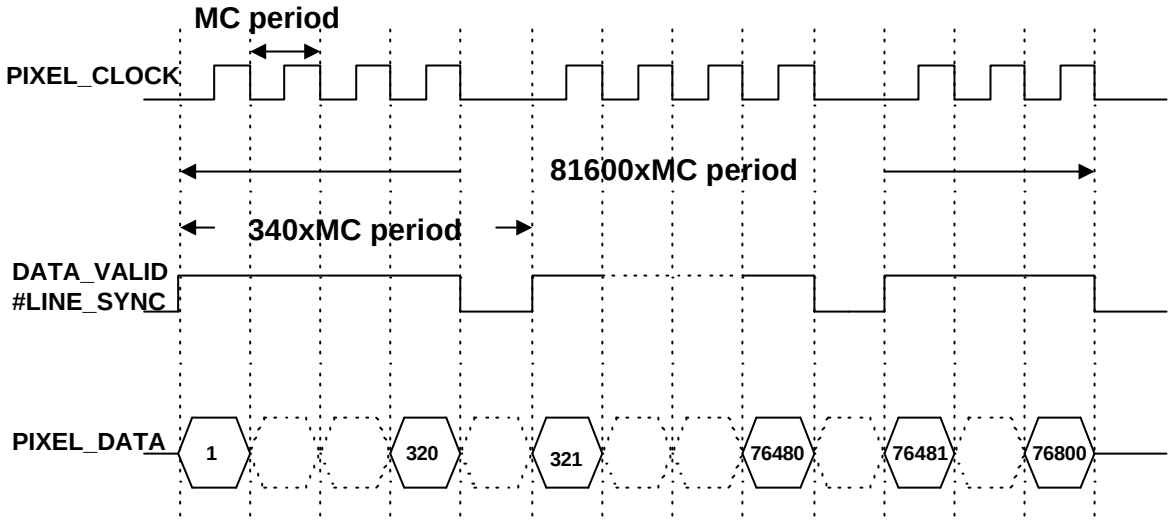
CLOCK	Software Programmable continuous clock
CLOCK#	Software programmable mixed clock with Data valid

6.4.7. Jade UC LWIR

This is applicable for the following cameras part number :

- C0302IIDMM073

320*240 Mode



(*) MC period depends on the FPA type and configuration. It varies from 250 ns to 60 ns

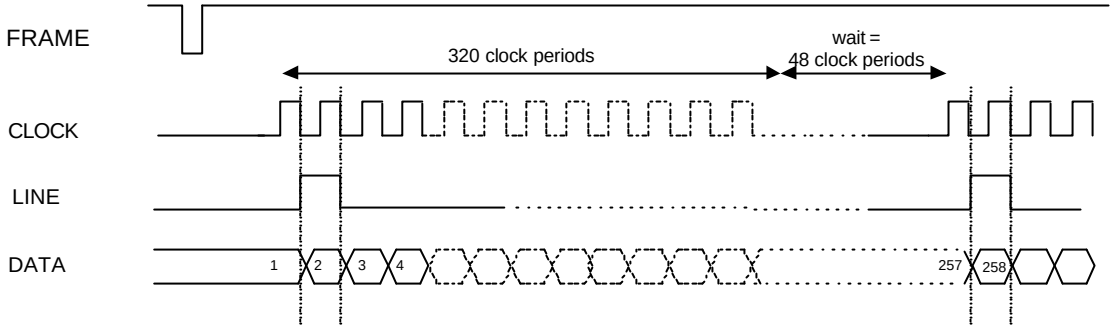
(#) LINE SYNC : 320*MC synchronization signal in Full Window , or SIZEX * MC defined Window Mode.

6.4.8. Jade SWIR

This is applicable for the following cameras part number :

- C0101cIDMS076
- C0101iIDMS076

320*256 Mode



Frame signal is asserted low at the beginning of each frame.
Its width is between 1 and 10 µs.
Time between FRAME and first pixel is approximatively 1000 clock periods.

Digital output is composed of 256 bursts of 320 pixels. Each burst is separated with 48 clock periods where CLOCK is not sent.

81920 (320 x 256) CLOCK pulses are sent during one frame. Each pixel can be stored on CLOCK rising edge.

Line pulse is asserted high during the second pixel of each line.
Time between two line sync is 368 CLOCK periods.