MAIN FEATURES

- **High sensitivity and high SNR performance linear CCD**
- **1024, 2048 or 4096 resolution with 10µm square pixels**
- **512, 1024 or 2048 resolution with 14µm square pixels**
- **100 % aperture, Built-in anti blooming, No lag**
- **Camera Link™ data format (base configuration)**
- **High data rate up to 60 Mpixels/s**
- **Flexible and easy to operate via RS232 control**
  - gain : 0dB to 40dB by step of 0.05dB
  - dynamic range : 8, 10 or 12bits data
  - offset (for contrast expansion)
  - trigger mode : free run or external trigger modes
  - data output mode (dual, single)
- **Multi camera synchronization**
- **Single power supply : DC 12 V to 24 V**
- **Very Compact design : 56 x 60 x 38.6 mm (w,h,l)**
- **High reliability - CE & FCC compliant**
- **C, F (Nikon) or K (Pentax) mount adapter (lens not supplied)**

PRODUCT DESCRIPTION

This camera is designed with three concepts in mind : Compactness, accuracy and versatility.

- A very compact mechanical design incorporates a 0.5K to 4K sensors
- ATMEL manages the whole chain, from the sensor to the camera. The result is a camera able to work in 12 bits, with a dedicated electronics offering an excellent signal to noise ratio.
- The programmable settings let you work at different integration time, gain and offset. External clock and trigger allow to synchronise several cameras.

APPLICATIONS

Performance and reliability of this camera make it well suited for the most demanding industrial applications, from web inspection to document scanning, from surface inspection to metrology.

AVIIVA™

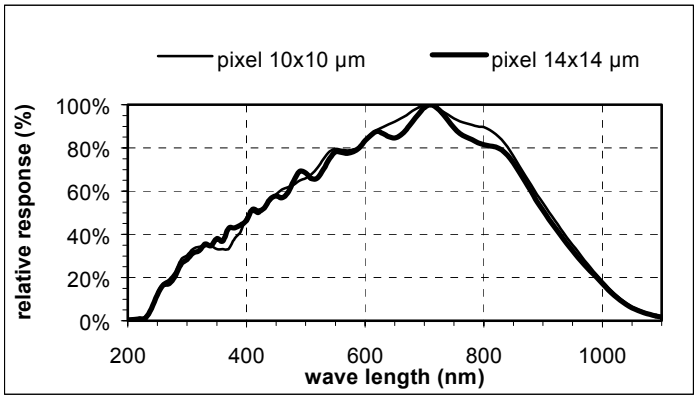
CameraLink™ linescan camera

Issue 2.4 – 07 FEB 2002

1. TYPICAL PERFORMANCES

Sensor characteristics at maximum pixel rate					
Resolution	pixels	512	1024	2048	4096
Pixel size (square)	µm	14	14	14	-
	µm	-	10	10	10
Max Line rate	kHz	109	57	29	15
Anti blooming		x 150			
Radiometric performances at maximum pixel rate					
Dynamic range	bits	12 (also configurable in 8 or 10)			
Spectral range	nm	250 - 1100			
Linearity	%	<< 1%			
Gain range (step of 0.047dB)		Gmin	Gnom	Gmax	
	dB	0	18	30	
Peak response (typical)					
14µm pitch	LSB/nJ/cm²	130	1040	4180	
10µm pitch	LSB/nJ/cm²	50	400	1600	
Output RMS noise (typical)					
SNR	dB	67.4	49	37	
Effective bits	bits	11.2	8.2	6.2	
Input RMS Noise (typical)					
14µm pitch	pJ/cm²	14			
10µm pitch	pJ/cm²	37			
Mechanical & electrical interface					
Size (w x h x l)	mm	56 x 60 x 38.6			
Lens mount		C, F, K			
Sensor alignment (refer to §8.4)	µm	Δx,y=± 50 µm		Δz= 0-30 µm	
		$\Delta\theta_{x,y}$=± 0.2 °		$\Delta tilt_z$= 0-35 µm	
Power supply	V	DC, single 12 to 24 V			
Power dissipation	W	< 8			
Operating temperature	°C	0 to 55 (non condensing)			
Storage temperature	°C	0 to 75 (non condensing)			

Spectral response



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2. CAMERA DESCRIPTION

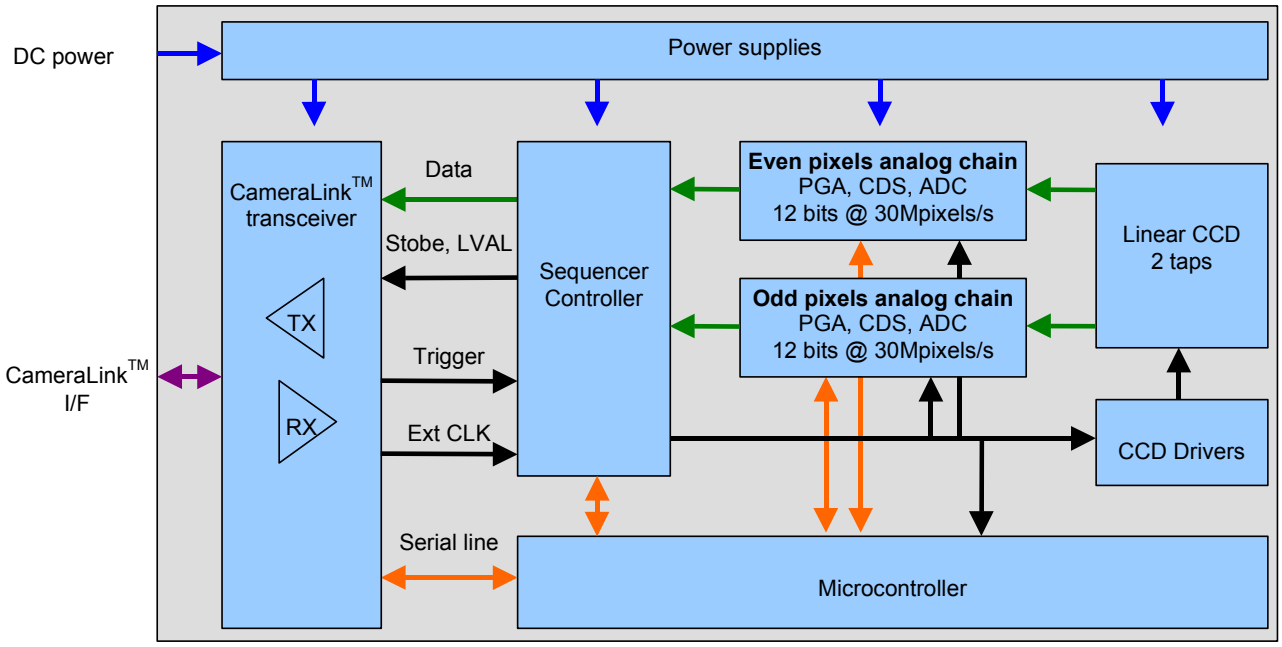

Figure 2 – Camera synoptic

The camera is based on a two taps linear CCD. Therefore, two analog chains process odd and even pixels of the linear sensor. The analog chains performed the CCD output processing. It encompasses the correlated double sampling (CDS), the dark level correction (dark pixel clamping), the gain (PGA) and offset correction and finally the analog to digital conversion on 12 bits.

Note : PGA stands for programmable gain array

The camera is supplied by a single DC power voltage from 12 to 24 V.

The functional interface (data and control) is provided by the CameraLink™ interface.

The camera uses the base configuration of Cameralink™ standard.

Note : DVAL=1 and FVAL=0

The data can be provided on two channels or in a single multiplexed channel. The data format can be configured in 8, 10 or 12 bits.

The camera can be used with external triggers (TRIG1 and TRIG2 signals) in different trigger modes (refer to §5.1). The camera can be also clocked externally, allowing system synchronisation and/or multi-camera synchronisation.

The camera configuration and settings is performed via a serial line. This interface is used for :

- Gain, offset setting
- Dynamic range, data rate setting
- Trigger mode setting : free run or external trigger modes
- Integration time setting : in free running & external trigger mode

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3. STANDARD CONFORMITY

The cameras have been tested in the following conditions :

- Shielded power supply cable
- CameraLink data transfer cable ref. 14B26-SZLB-500-OLC (3M)
- Linear AC-DC power supply

We recommend to use the same configuration to ensure the compliance with the following standards.

3.1 CE CONFORMITY

AVIIVA Cameras complies with the European directive 89/336/CEE (EN 50081-2, EN 61000-6-2)

3.2 FCC CONFORMITY

AVIIVA Cameras complies with Part 15 of FCC rules. Operation is subject to the following two conditions :

- This device may not cause harmful interference, and
- This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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

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4. CAMERA COMMAND AND CONTROL

Camera configuration is set by the serial interface. Please refer to §6.4 for the detailed protocol of the serial line.

Setting	Command	Parameter	Description
Configuration record	E=	0	The camera configuration is recorded on each change
		1	The camera configuration is recorded only on request
Gain (1)	G=	0 to 851	Gain setting from 0 to 40 dB (~0.047dB steps)
Data transfer (2)	H=	0	Two outputs on external clock
		1	One output (multiplexed) on external clock
		3	One output (multiplexed) at 20MHz data rate
		5	One output (multiplexed) at 30MHz data rate
		6	Two outputs at 20MHz data rate
		7	One output (multiplexed) at 40MHz data rate
		8	Two outputs at 30MHz data rate
		9	One output (multiplexed) at 60MHz data rate
Output format (3)	S=	0	12 bits Output data
		1	10 bits Output data
		2	8 bits Output data
Pattern (4)	T=	0	Standard
		1	Pattern
Integration Time	I=	5 to 13000	Integration time (µs) in free run or external triggered mode
Trigger mode	M=	1	Free run with integration time setting (see timing diagram)
		2	External trigger with integration time setting (see timing diagram)
		3	Trigger and Integration time controlled
		4	Trigger and integration time controlled by two inputs
Even data Offset (5)	O=	0 to 15	Even Offset setting from 0 to approx. 200 LSB
Odd data Offset (5)	P=	0 to 15	Odd Offset setting from 0 to approx. 200 LSB
Special commands	!=	0	Camera identification readout
		1	User camera identification readout
		2	Software version readout
		3	Camera configuration readout
		4	Current camera configuration record
		5	Default camera configuration restoration
User camera ID	$=	String of Char.	Writing and record of the user camera identification

(1) Camera gain (dB) = G x 0.047

(2) Commands “H=2” and “H=4” will give 10 and 15MHz data rate which are not compatible with Camera Link standard. Please don’t use it.

(3) The pinout corresponding to this options is fully compatible with the Camera Link standard (see par. 7)

(4) The pattern is useful to check if the interfacing is well done. You should see a jagged image of 255 pixels steps.

(5) The offset is set in manufacturing to balance both the channels. The initial setting is about 8 (~ 130 LSB). In some cases, you may have to change it (for example if the ambient temperature is very high).

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5. TIMING

5.1 SYNCHRONISATION MODE

Four different modes may be used under user control.

The TRIG1 and TRIG2 signals may be used to trigger an external event and to control the integration time.

The Master clock is either external or internal clock.

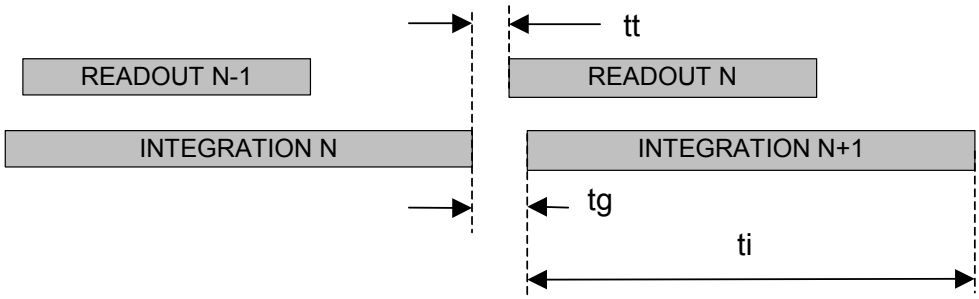
5.1.1 FREE RUN MODE WITH INTEGRATION TIME SETTING

The integration and readout periods start automatically and immediately after the previous period.

*The Integration time is set by the serial line and should be higher than the read-out time (otherwise it is adjusted to the readout time).

The read-out time depends on pixel number and pixel rate.

Label	Description	Min	Typ	Max
ti	Integration time duration	*		13 ms
tg	Consecutive integration period gap *(at maximum frequency)*		6 µs	
tt	Integration period to read-out delay		1 µs	

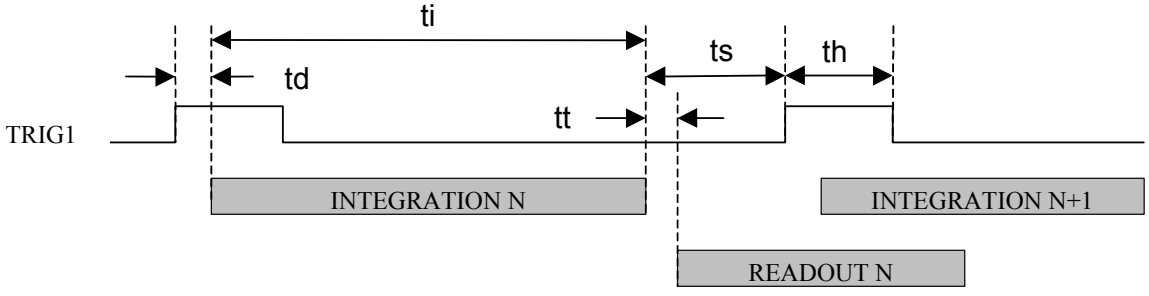


5.1.2 TRIGGERED MODE WITH INTEGRATION TIME SETTING

The integration period starts immediately after the rising edge of TRIG1 input signal. The Integration time is set by the serial line.

This integration period is immediately followed by a readout period. The read-out time depends on pixel number and the pixel rate.

Label	Description	Min	Typ	Max
ti	Integration time duration	5 µs		13 ms
td	TRIG1 rising to integration period delay		5.5 µs	
tt	Integration period to read-out delay		1 µs	
ts	Integration period to TRIG1 rising set-up time	4 µs		
th	TRIG1 hold time (pulse high duration)	1 µs		



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5.1.3 TRIGGED AND INTEGRATION TIME CONTROLLED

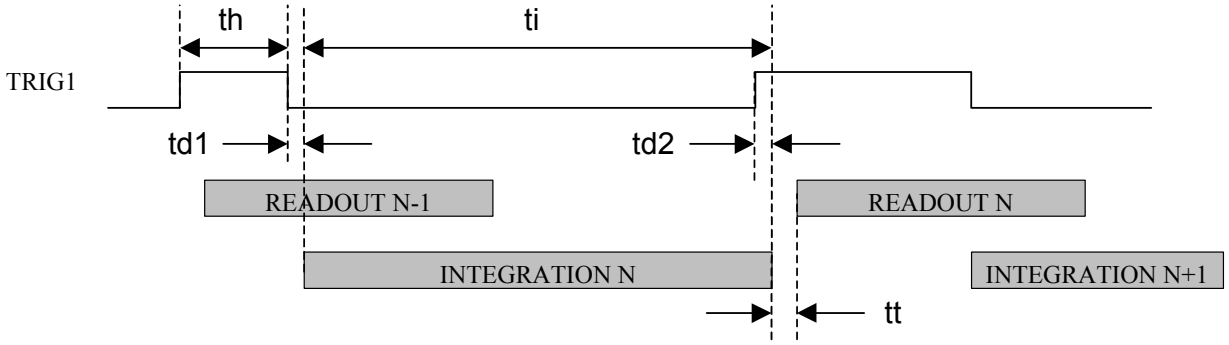
The integration period starts immediately after the falling edge of TRIG1 input signal.

The integration period stops immediately after the rising edge of TRIG1 input signal.

This integration period is immediately followed by a readout period.

The read-out time depends on pixel number and pixel rate.

Label	Description	Min	Typ	Max
ti	Integration time duration	5 µs		
td1	TRIG1 rising to integration period delay		100 ns	
td2	TRIG2 rising to integration period delay		1.3 µs	
tt	Integration period to read-out delay		1 µs	
th	TRIG1 hold time (pulse high duration)	1 µs		



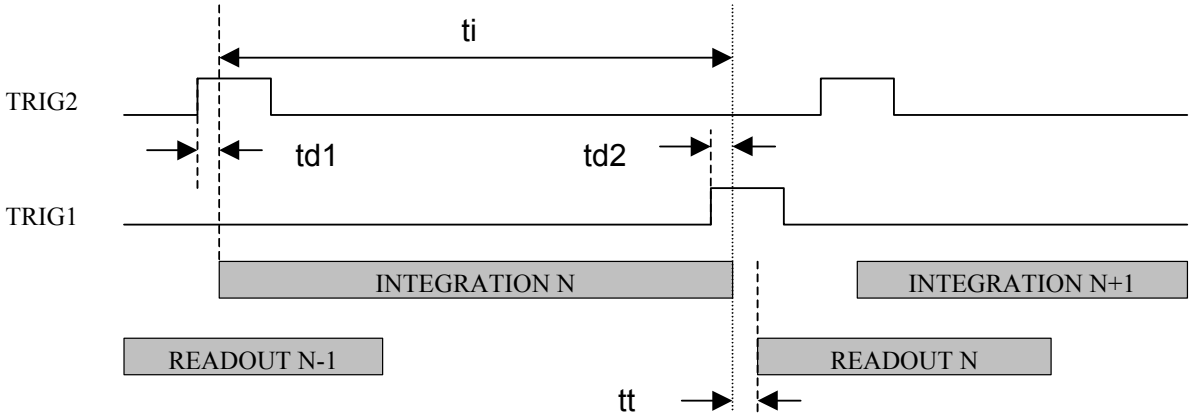
5.1.4 TRIGGER AND INTEGRATION TIME CONTROLLED BY TWO INPUTS

TRIG2 rising edge start the integration period.

TRIG1 rising edge stop the integration period.

This period is immediately followed by a readout period.

Label	Description	Min	Typ	Max
ti	Integration time duration	5 µs		
td1	TRIG2 rising to integration period delay		100 ns	
td2	TRIG1 rising to integration period delay		1.3 µs	
tt	Integration period to read-out delay		1 µs	
th	TRIG1 & TRIG2 hold time (pulse high duration)	1 µs		



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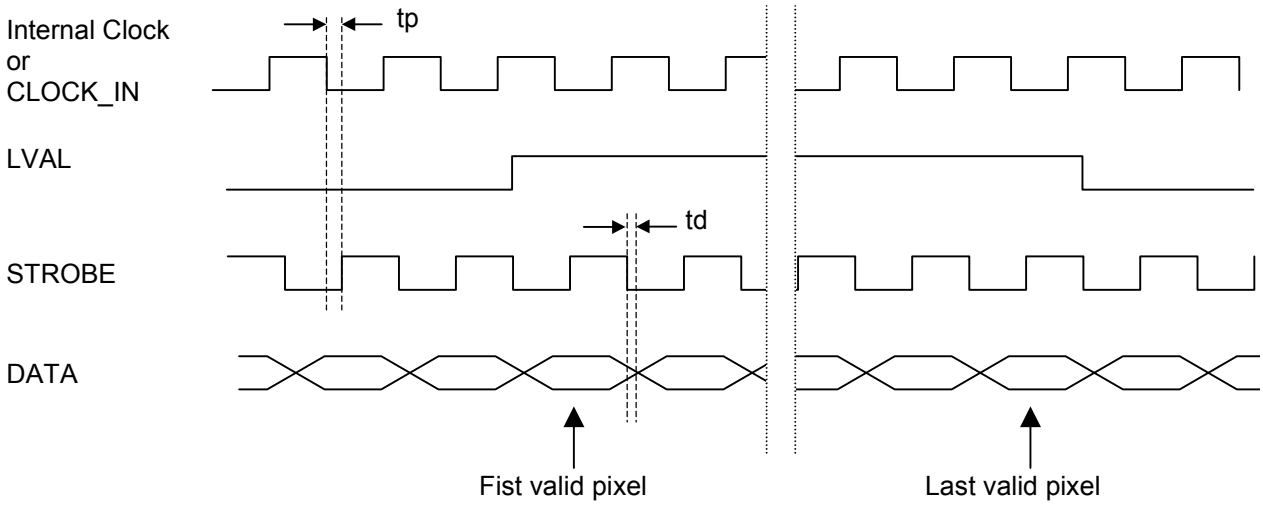
5.2 OUTPUT DATA TIMING

This timing correspond to the input data of the “Chanel Link” interface. The camera output data are not detailed here because fully compliant with the Camera Link standard (serial high speed interface)

Label	Description	Min	Typ	Max
tp	Input falling edge to output clock propagation delay		7 ns	
td	STROBE to synchronised signals delay	-5 ns		+5 ns



Note : CLOCK_IN Input must stay between 5 to 60MHz. Out of this range, the performances may be decreased.

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6. ELECTRICAL INTERFACE

6.1 POWER SUPPLY

It is recommended to insert a 1A fuse between the power supply and the camera.

Signal name	I/O	Type	Description
PWR	P	-	DC power input : +12V to +24V (+-0.5V)
GND	P	-	Electrical and Mechanical ground

I = input, O = output, IO = bi-directional signal, P = power/ground, NC = not connected

6.2 CAMERA CONTROL

The CameraLink™ interface provides four LVDS signals dedicated to camera control (CC1 to CC4).
On the AVIIVA, three of them are used to synchronise the camera on external events.

Signal name	I/O	Type	Description
TRIG1	I	RS644	CC1 - Synchronisation input (refer to §5.1)
TRIG2	I	RS644	CC2 - Start Integration period in dual synchro mode (refer to §5.1)
CLOCK_IN	I	RS644	CC4 - External clock for (multi-)camera synchronisation (refer to §5.1)

I = input, O = output, IO = bi-directional signal, P = power/ground, NC = not connected

Note : CC3 is not used.

6.3 VIDEO DATA

Data and enable signals are provided on the CameraLink™ interface

Signal name	I/O	Type	Description
ODD[11-0]	O	RS644	Odd pixel data (refer to §5.2), ODD-00 = LSB, ODD-11 = MSB
EVEN[11-0]	O	RS644	Even pixel data (refer to §5.2), EVEN-00 = LSB, EVEN-11 = MSB
STROBE	O	RS644	Output data clock. (refer to §5.2), data valid on the rising edge
LVAL	O	RS644	Line valid (refer to §5.2), active high signal

I = input, O = output, IO = bi-directional signal, P = power/ground, NC = not connected

Notes : FVAL, as defined in the CameraLink™ standard, is not used. FVAL is permanently tied to 0 (low) level.
DVAL is not used. DVAL is permanently tied to 1 (high) level.

In case of Single output, the data (multiplexed) are output in place of Odd data.

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6.4 SERIAL COMMUNICATION

The CameraLink™ interface provides two LVDS signal pairs for the communication between the camera and the frame grabber. This is an asynchronous serial communication based on RS-232 protocol.

The configuration of the serial line is :

- Full duplex / without handshaking
- 9600 bauds, 8 bits data, no parity bit, 1 stop bit.

Signal name	I/O	Type	Description
SerTFG	O	RS644	Differential pair for serial communication to the frame grabber
SerTC	I	RS644	Differential pair for serial communication from the frame grabber

Command syntax

The valid syntax is : "S=n(CR)" with :

S : command identification as per §4. S is a single character in upper case.

n : setting value.

(CR) : means "carriage return".

no spaces, nor tabs may be inserted between S, =, n and (CR).

example of a valid command :

G=3(CR) : sets the camera to gain 3 (refer to §4 for exact value calculation)

example of non valid commands :

G = 3(CR) : spaces

g=3(CR) : g instead of G

G=1040(CR) : 1040 is outside of range.

Command processing

Each command received by the camera is processed :

if the command is valid :

- the setting is done in case of a write command
- the camera returns the data separated by (CR) in case of the read command
- the camera returns : >OK(CR)

if the command is not valid :

- nothing is done.
- the camera returns : >1 = out of range ; >2 = syntax error ; >3 = command too long ; >4,>6,>7 = internal error ; >5 undefined function

example : when receiving "!=3(CR)'' the camera returns its current settings :

A=0(CR)
B=0(CR)
....
E=0(CR)
>OK(CR)

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7. CONNECTOR DESCRIPTION

All connectors are on the rear panel.

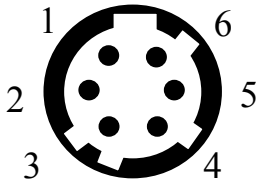
Note : cables for digital signals shall be shielded twisted pairs.

7.1 POWER SUPPLY

Camera connector type : Hirose HR10A-7R-6PB (male)

Cable connector type : Hirose HR10A-7P-6S (female)

Signal	Pin		Signal	Pin
PWR	1		GND	4
PWR	2		GND	5
PWR	3		GND	6



Receptacle viewed from camera back

7.2 CAMERALINK™ CONNECTOR

Standard Cameralink™ cable shall be used to ensure the full electrical compatibility.

Camera connector type : MDR-26 (female) ref. 10226-2210VE

Cable connector type : Standard CameraLink™ cable shall be used (ex. 3M - 14B26-SZLB-x00-OLC)

Signal	Pin		Signal	Pin
GND	1		GND	14
X0-	2		X0+	15
X1-	3		X1+	16
X2-	4		X2+	17
Xclk-	5		Xclk+	18
X3-	6		X3+	19
SerTC+	7		SerTC-	20
SerTFG-	8		SerTFG+	21
CC1-	9		CC1+	22
CC2+	10		CC2-	23
CC3-	11		CC3+	24
CC4+	12		CC4-	25
GND	13		GND	26

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Bit Assignments

This bit assignment is compliant with the CameraLink™ Specification in the **Base Configuration.**
In "single output" mode (multiplexed), the data are output on ODD-xx bits.

When used in 12 bits data (S=0)

Bit	DS90CR285 pin name		Bit	DS90CR285 pin name		Bit	DS90CR285 pin name		Bit	DS90CR285 pin name
ODD-00	Tx0		ODD-07	Tx5		EVEN-02	Tx19		EVEN-09	Tx14
ODD-01	Tx1		ODD-08	Tx7		EVEN-03	Tx20		EVEN-10	Tx10
ODD-02	Tx2		ODD-09	Tx8		EVEN-04	Tx21		EVEN-11	Tx11
ODD-03	Tx3		ODD-10	Tx9		EVEN-05	Tx22		STROBE	TxCLK
ODD-04	Tx4		ODD-11	Tx12		EVEN-06	Tx16		LVAL	Tx24
ODD-05	Tx6		EVEN-00	Tx15		EVEN-07	Tx17			
ODD-06	Tx27		EVEN-01	Tx18		EVEN-08	Tx13			

When used in 10 bits data (S=1)

Bit	DS90CR285 pin name		Bit	DS90CR285 pin name		Bit	DS90CR285 pin name		Bit	DS90CR285 pin name
ODD-00	Tx0		ODD-07	Tx5		EVEN-02	Tx19		EVEN-09	Tx14
ODD-01	Tx1		ODD-08	Tx7		EVEN-03	Tx20		NC	Tx10
ODD-02	Tx2		ODD-09	Tx8		EVEN-04	Tx21		NC	Tx11
ODD-03	Tx3		NC	Tx9		EVEN-05	Tx22		STROBE	TxCLK
ODD-04	Tx4		NC	Tx12		EVEN-06	Tx16		LVAL	Tx24
ODD-05	Tx6		EVEN-00	Tx15		EVEN-07	Tx17			
ODD-06	Tx27		EVEN-01	Tx18		EVEN-08	Tx13			

When used in 8 bits data (S=2)

Bit	DS90CR285 pin name		Bit	DS90CR285 pin name		Bit	DS90CR285 pin name		Bit	DS90CR285 pin name
ODD-00	Tx0		ODD-07	Tx5		NC	Tx19		EVEN-05	Tx14
ODD-01	Tx1		EVEN-00	Tx7		NC	Tx20		EVEN-06	Tx10
ODD-02	Tx2		EVEN-01	Tx8		NC	Tx21		EVEN-07	Tx11
ODD-03	Tx3		EVEN-02	Tx9		NC	Tx22		STROBE	TxCLK
ODD-04	Tx4		EVEN-03	Tx12		NC	Tx16		LVAL	Tx24
ODD-05	Tx6		NC	Tx15		NC	Tx17			
ODD-06	Tx27		NC	Tx18		EVEN-04	Tx13			

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8. MECHANICAL CHARACTERISTICS

8.1 WEIGHT

The camera typical weight (without lens nor lens adapter) is 220 g (typical)

8.2 DIMENSIONS

The camera dimension (without lens) are W = 56 mm, H = 60 mm, L = 38.6 mm

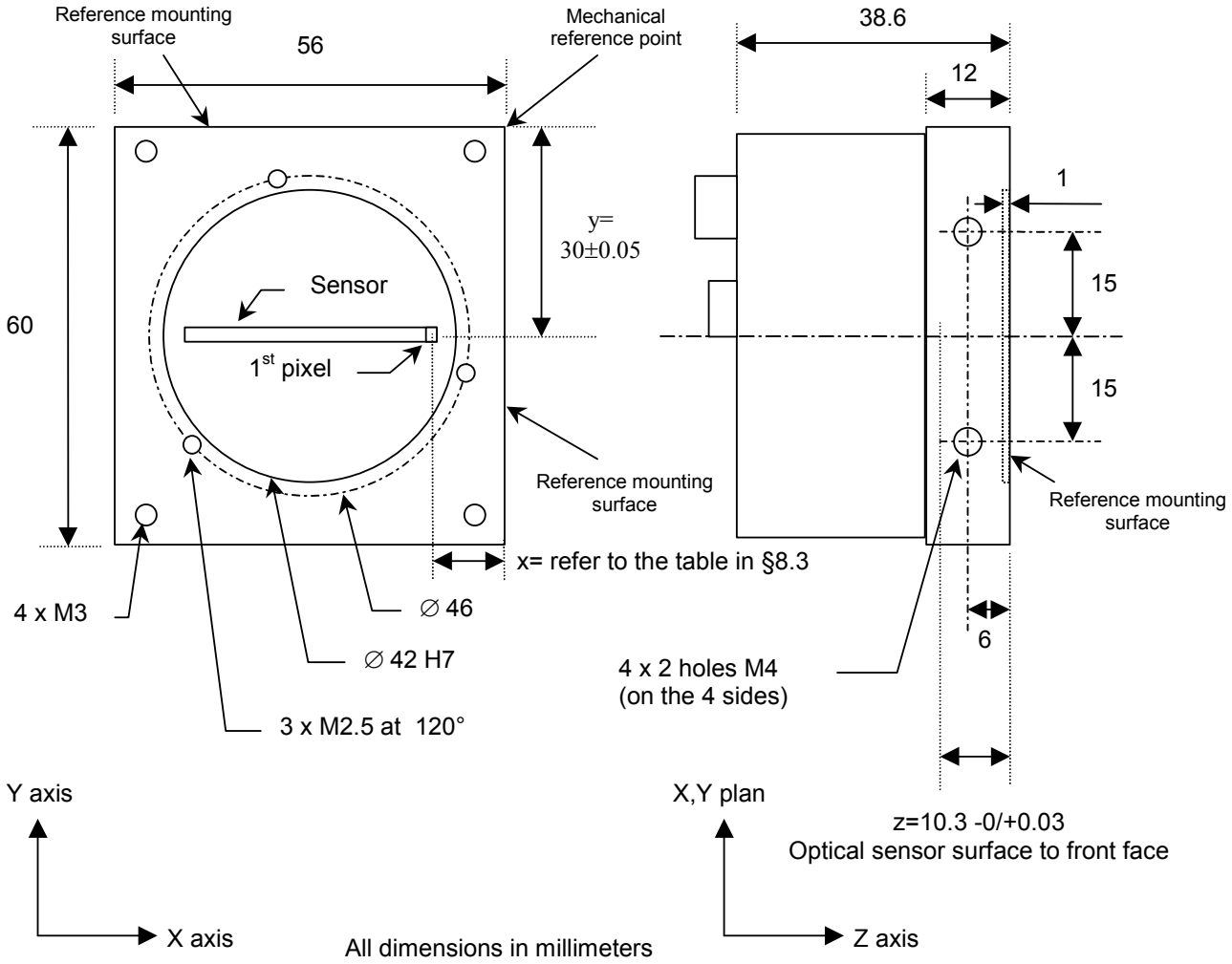

Figure 3 – Mechanical Box drawing and dimensions

8.3 MECHANICAL MOUNTING REFERENCE

The front panel mechanical part is design to support the mounting of the camera. On this mechanical part, three surfaces are considered as mounting reference surface : i.e. the distance between these surfaces and the first active pixel are known very precisely (better than ±50µm).

Number of pixel	512	1024	2048	4096
x in 14µm sensor (nm)	24.416	20.832	13.664	-
x in 10µm sensor (nm)	-	22.880	17.760	7.520

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8.4 SENSOR ALIGNEMENT

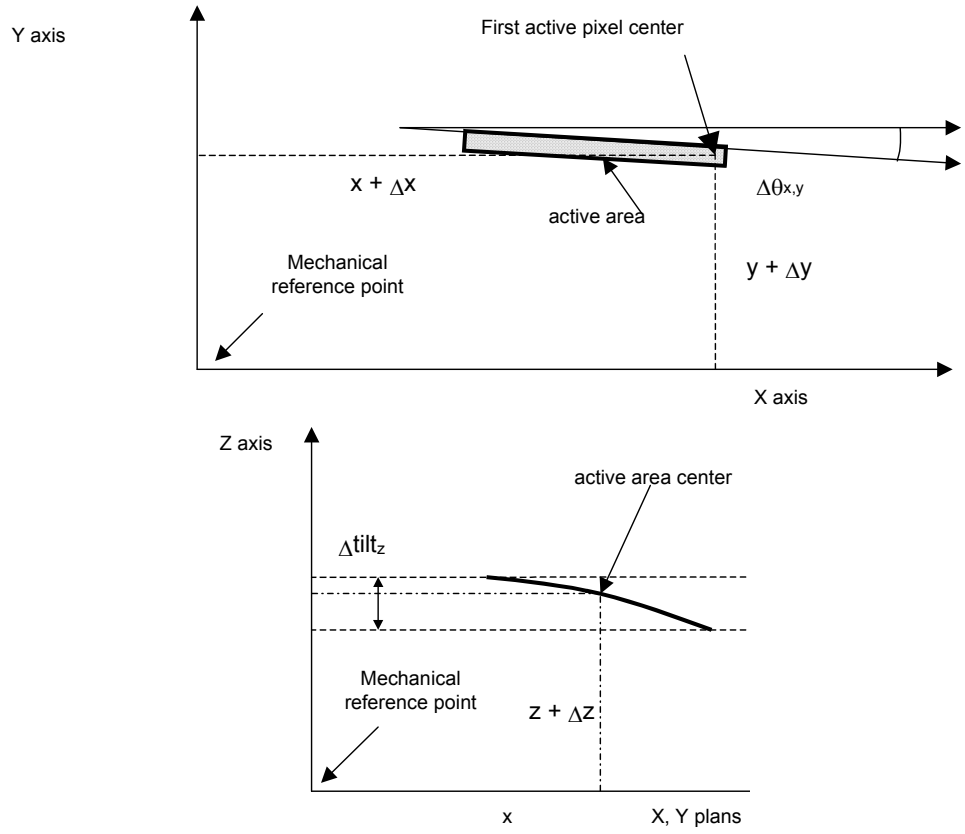

Figure 4 - Sensor alignment diagram

8.5 LENS MOUNTING (LENS NOT SUPPLIED)

The camera can be provided with three different lens adapter, corresponding to three different options. It is up to the customer to selected the correct adapter. The following table gives recommendation depending on the sensor size

Number of pixel	512 / 14µm	1024 / 10µm	1024 / 14µm	2048 / 10µm	2048 / 14µm	4096 / 10µm
C mount	OK	OK	≈OK	not usable	not usable	not usable
F mount	OK	OK	OK	OK	OK	OK
K mount	OK	OK	OK	OK	OK	OK

8.6 HEAT-SINK MOUNTING

In order to improve the power dissipation, the camera can be delivered with heat-sink to be mounted by the user on the side faces of the camera. The delivery of the heat-sinks corresponds to a dedicated option.

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For other countries, please contact, France : Phone +33 (0)1 49 75 96 00 – Fax +33 (0)1 49 75 96 01

ORDERING CODE

Part Number	Resolution	Pixels size	Description
AT71LKLB1K0F-BAA	1 K	10 µm	AVIIVA camera (without any mount)
AT71LKLB2K0F-BAA	2 K	10 µm	AVIIVA camera (without any mount)
AT71LKLB4K0F-BAA	4 K	10 µm	AVIIVA camera (without any mount)
AT71LKLB0K5K-BAA	512	14 µm	AVIIVA camera (without any mount)
AT71LKLB1K0K-BAA	1 K	14 µm	AVIIVA camera (without any mount)
AT71LKLB2K0K-BAA	2 K	14 µm	AVIIVA camera (without any mount)
AT71KFPAVIVA-ABA			F mount (NIKON)
AT71KFPAVIVA-ACA			C mount
AT71KFPAVIVA-AKA			K mount (PENTAX)
AT71KAVIVAP2C0D3A0			Cables kit : 10m power supply & 5m Camera Link cables

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