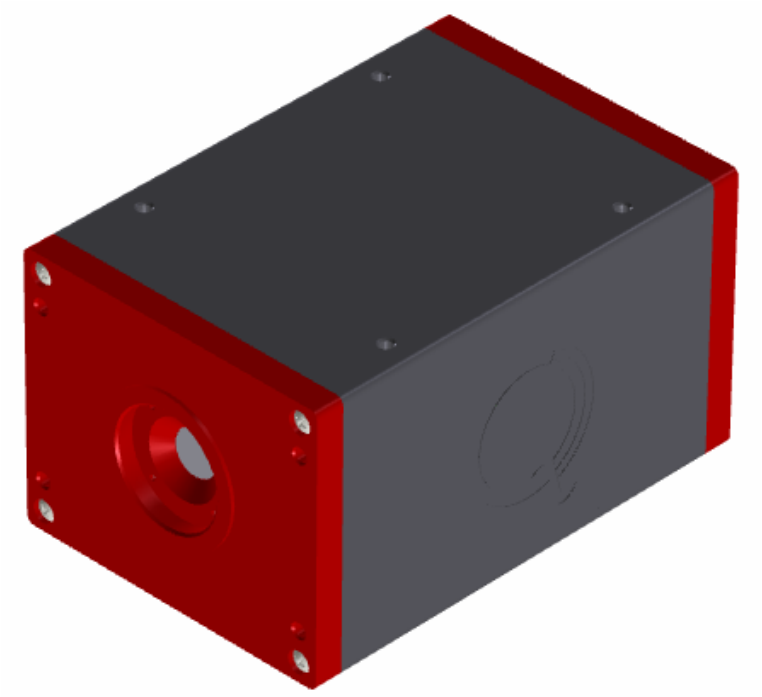
User Manual

CONDOR3 - VNN - ICX692 - CL01



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Version 1.0

Table of contents

List of Figures

List of Tables

1 Introduction

The Condor3-VNN-ICX692-CL01 is a prism based camera using three Sony ICX692 image sensors. Each sensor captures a distinct part of the light spectrum. It is intended for scientific and industrial applications requiring high image quality under low light levels with high resolution. This camera is available in different configurations, each with their own customer defined spectral response curves.

INFORMATION: The Sony ICX692 sensor uses the EXview HAD CCD II technology for high sensitivity in the near infrared light region and is ideal for low-light photography.

1.1 Camera features

- Effective sensor resolution of 1280(H) x 720(V) pixels
- Three CCD sensors, each with a customer defined spectral filter, on one prism
- High sensitivity, high saturation signal level and low smear CCD sensors
- Sony EXview HAD CCD II technology
- 4.08µm square pixels
- Aspect Ratio 16:9
- M30x1 lens mount
- 3 x 8 bit and 3 x 12 bit of separate channels over Camera Link
- External trigger mode

1.2 Applications

The Condor3-VNN-ICX692-CL01 is the best choice for:

- Monitoring production processes
- Medical applications
- Fluorescence imaging
- Microscopy

1.3 Performance

Sensor size		
Sensor	Sony ICX692	CCD
Pixel resolution	1280x720	pixels
Pixel size	4.08x4.08	µm
Sensor type	1/3	inch
Sensor diagonal	6.0	mm
Frame rate CL		
Pixel clock	30	MHz
Frame time	42	ms
Frame rate (maximum)	24	fps
Electro-optical data		
Full well capacity	≥ 11,000	e^-
Dynamic range	≥ 59	dB
Read noise	< 12	e-
Peak Quantum Efficiency (QE)	72	%
ADC resolution	14	Bits
Power		
Supply voltage	19..24	V
Power consumption	<18	W
Environment		
Operating temperature range	-20..40	°C
Humidity	50..80	%
Physical properties		
Dimensions excl. lens (L x W x H)	126x85x70	mm
Weight (without lens)	550	g

Table 1. Camera performance specification.

1.4 Spectral response

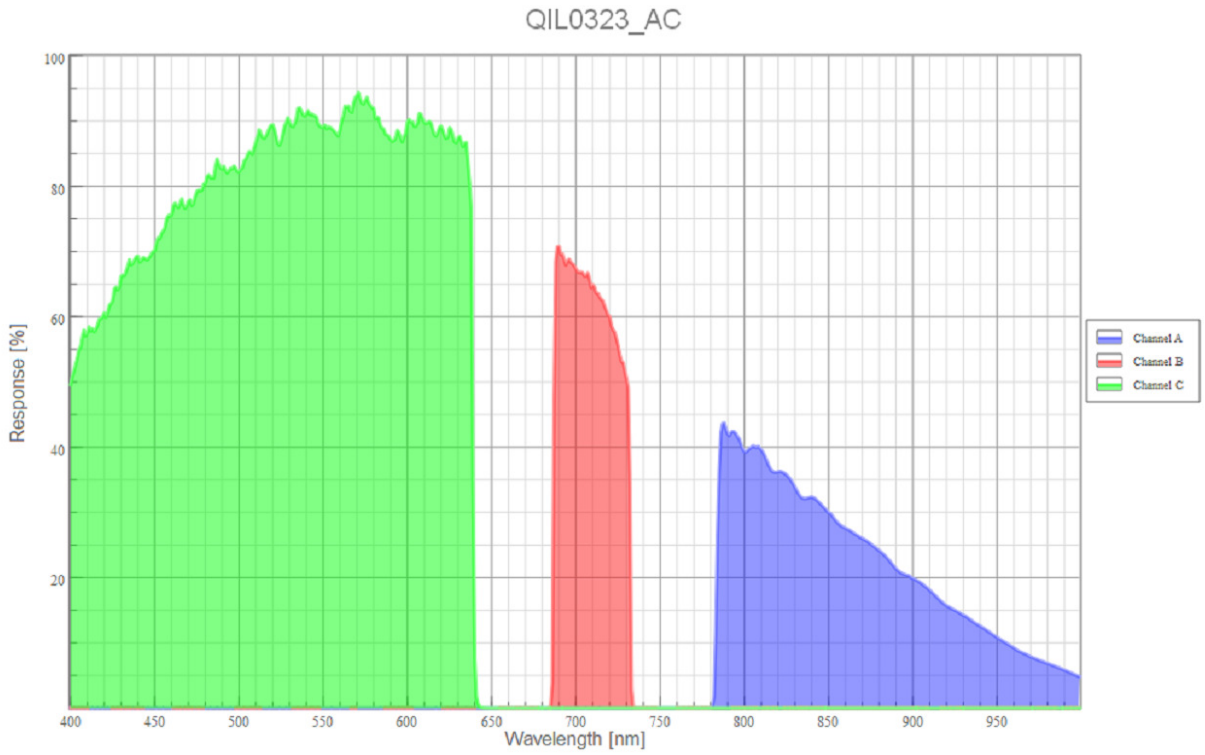


Figure 1. Spectral response of the Condor3-VNN-ICX692-CL01

2 Mechanical details

2.1 Housing specification

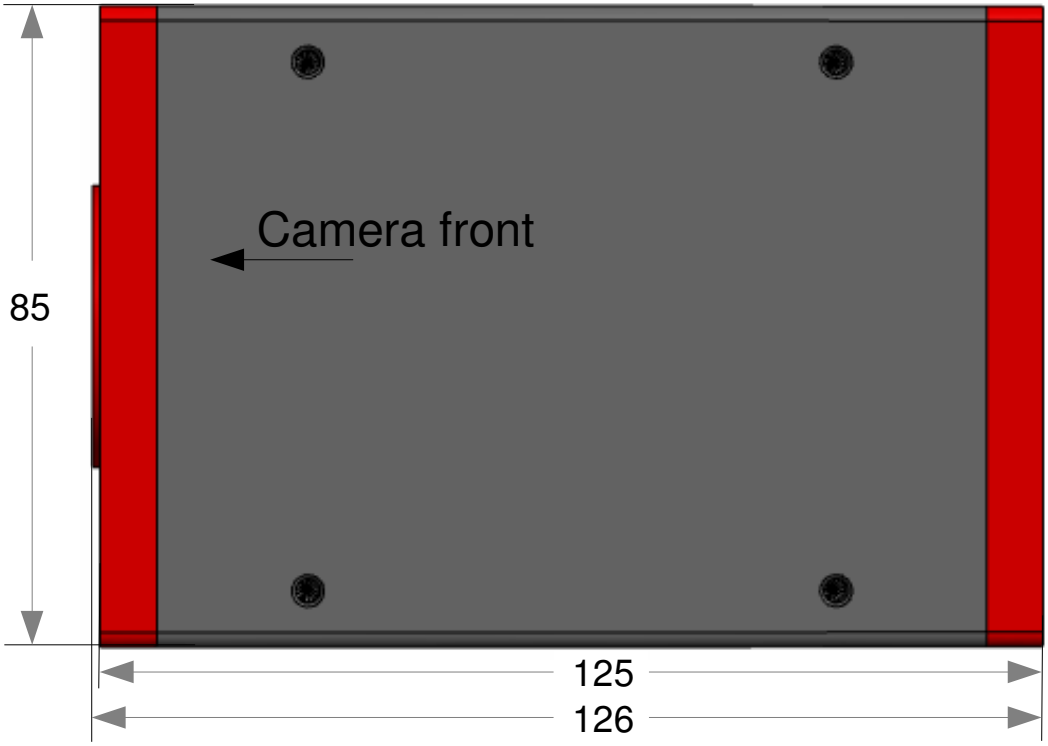


Figure 2. Dimensions of camera without lens (top view). All dimensions in mm.

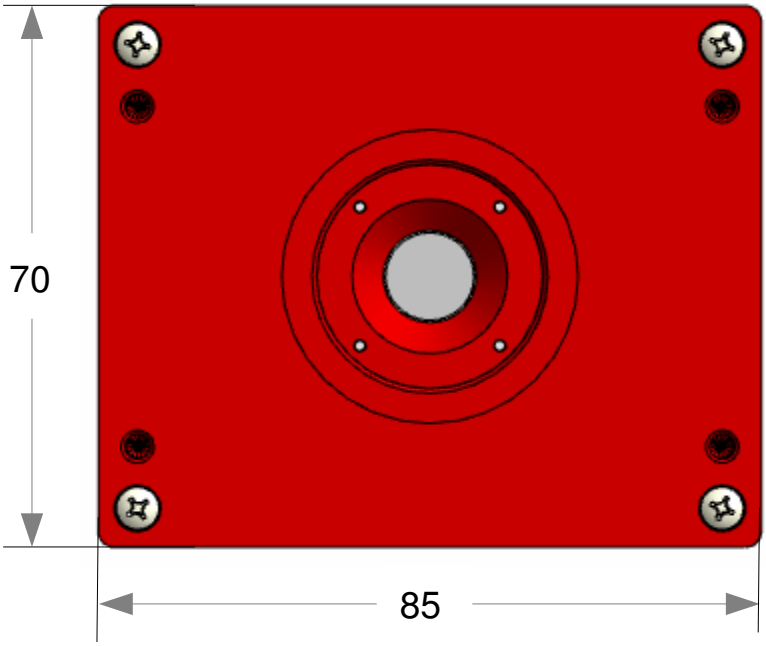


Figure 3. Dimensions of camera (front view). Dimensions in mm.

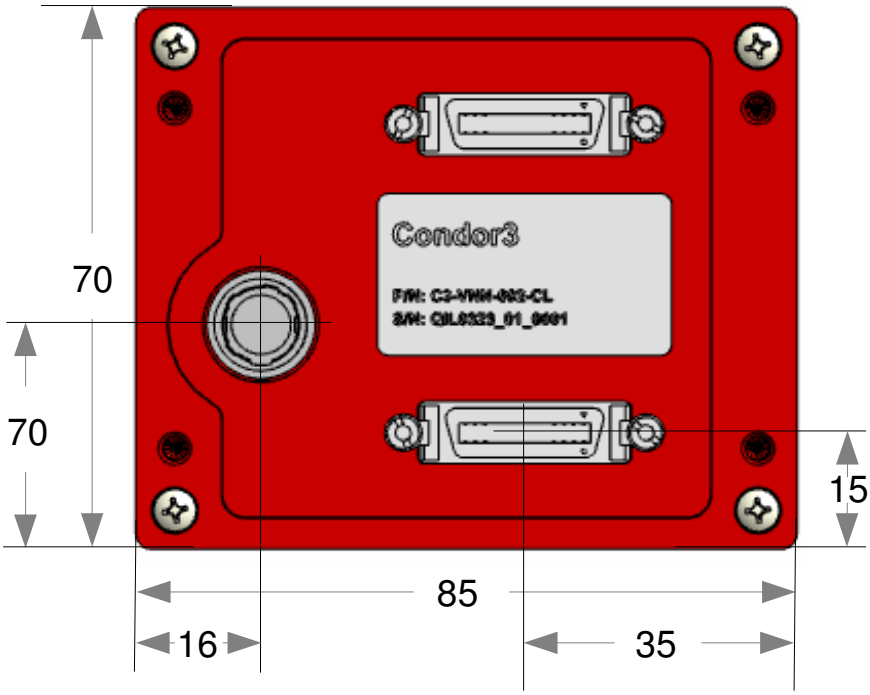


Figure 4. Dimensions of camera (rear view). Dimensions in mm.

2.2 Lens mount specification

The *Condor3-VNN-ICX692-CL01* is equipped with an M30x1 lens mount. Only lenses sold by Quest Innovations B.V. are guaranteed to work with this camera.

Quest Innovations B.V. offers lenses that have been designed specifically to keep the adverse effects of chromatic aberration to a minimum over the whole spectral range of the camera, including in the IR-part of the spectrum.

3 Connectors

The connectors of the Condor3-VNN-ICX692-CL01 camera are located at the rear of the camera.

3.1 Connector locations

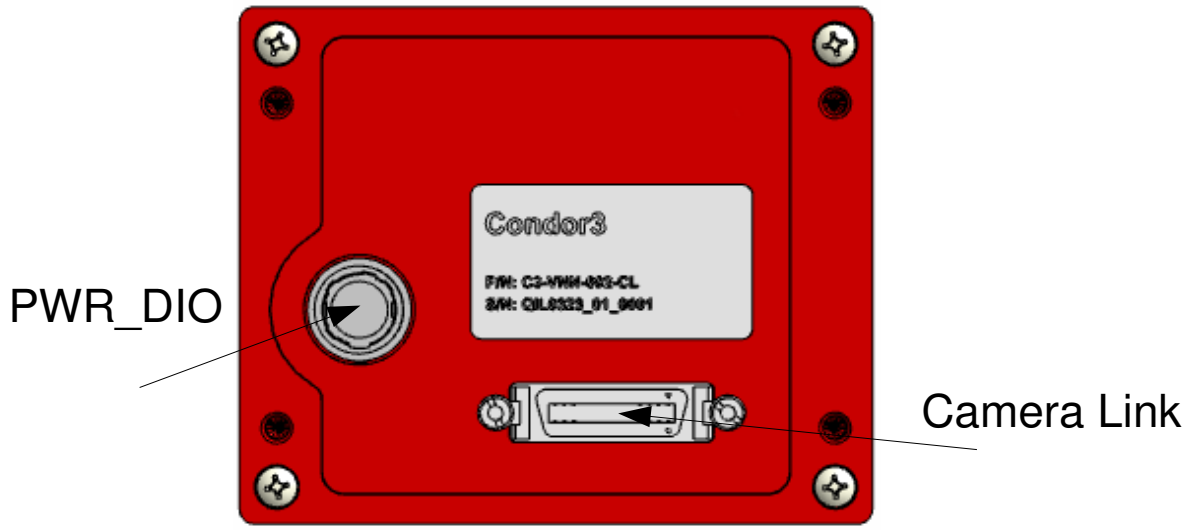


Figure 5. Location of camera connectors.

Connectors GigE	
PWR_DIO	**Power and digital I/O**
Camera Link	**Camera Link Base connector**

Table 2. Connectors.

3.2 Power and digital I/O Connector

Use the Female connector Hirose HR10A-10P-12S for power and digital I/O.

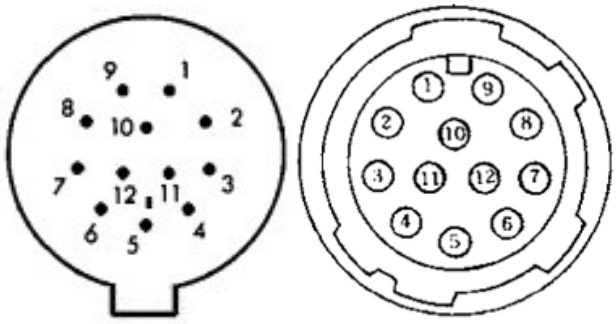


Figure 6. Hirose HR10A-10P-12S

Pin mapping of PWR_DIO connector		
Pin	**Function**	**Description**
1	**GND**	**Ground from external power supply / Ground for Trigger signals**
2	**V_{in}**	**V_{in} from external power supply (+19..+24V)**
3	**DNC**	*Do not connect*
4	**DNC**	*Do not connect*
5	**DNC**	*Do not connect*
6	**DNC**	*Do not connect*
7	**T_{in}**	**Trigger input (24V)**
8	**T_{out}**	**Trigger output (24V)**
9	**DNC**	*Do not connect*
10	**DNC**	*Do not connect*
11	**DNC**	*Do not connect*
12	**DNC**	*Do not connect*

Table 3. Pin mapping of PWR_DIO connector.

WARNING:

Risk of damaging the camera. Always check the voltage and polarity before connecting the camera with the power supply. Incorrect voltages can seriously damage the camera device. Use a fast-blow fuse between the camera and the power supply to protect the camera.

4 Installation guide

4.1 Connecting the camera

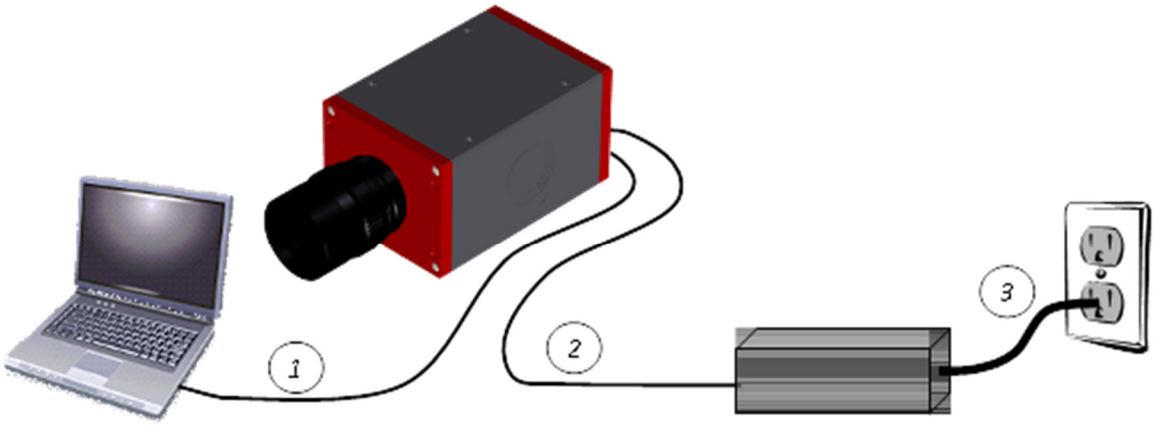


Figure 7. Connecting the camera

1. *Connect the camera to a frame grabber using an Camera Link compliant cable*
2. *Connect the Hirose power connector of the camera power supply to the camera's PWR_DIO connector*
3. *Plug in the power supply to a mains outlet*
4. *The camera is now ready to operate.*

IMPORTANT:

Make sure the camera is operated within its temperature limits.

The camera generates heat while it is operating. An enclosed space may raise the camera temperature significantly.

4.2 Using the camera in the Architector Vision Suite

Create a camera object

To use a camera in the Architector Vision Suite, you must first create a camera object. This can be done by either:

- *Clicking on the camera button (*  *).*
- *Double clicking on the "new" option in the "Currently created cameras" panel (*  *).*

Either of these methods will open the "Camera and frame grabber management" window (see Figure 8).

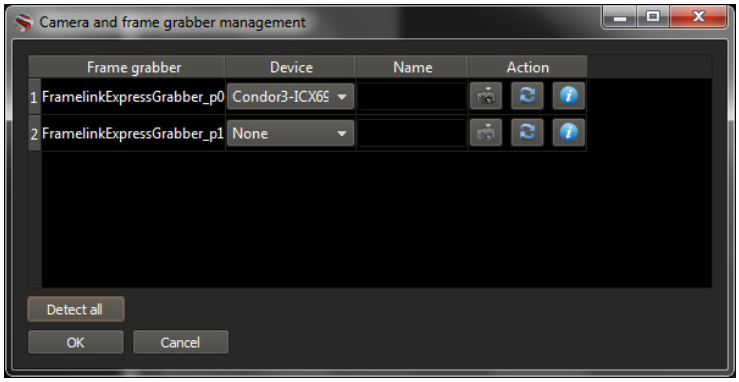


Figure 8. Camera devices panel

If this is the first time opening this window, the application will automatically try to detect all connected frame grabbers. Once detection is done, double click on the frame grabber to which your device is connected.

Once double clicked, the "Image viewer" app will automatically open and start streaming images with your camera.

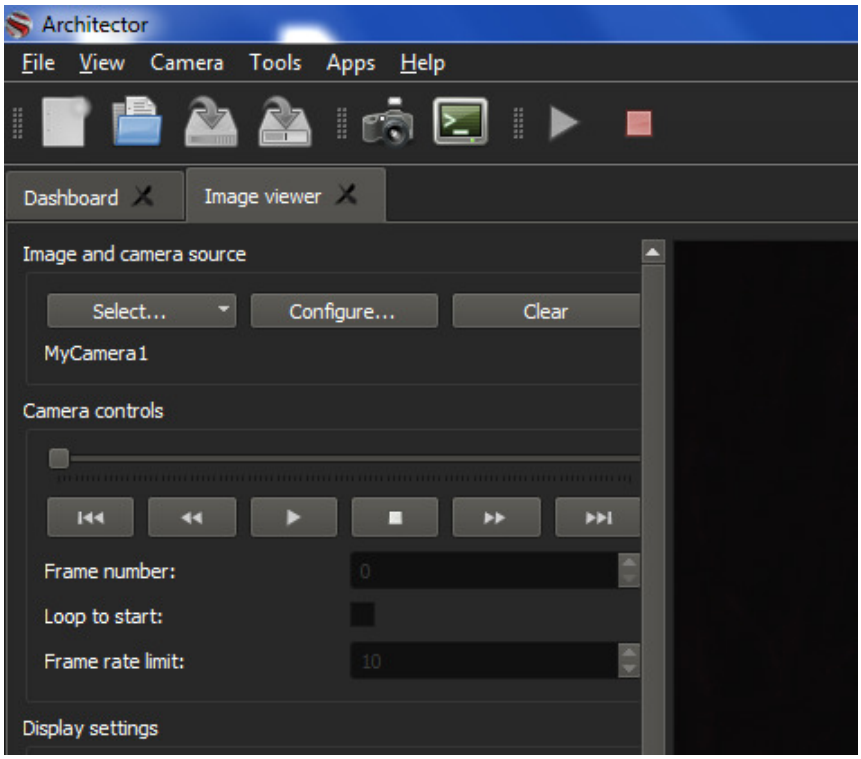


Figure 9. Image viewer app

Configuring the camera

If you wish to change the settings of the camera, click the "configure…" button on the top panel of the "Image viewer" app, which will cause the following window to pop up.

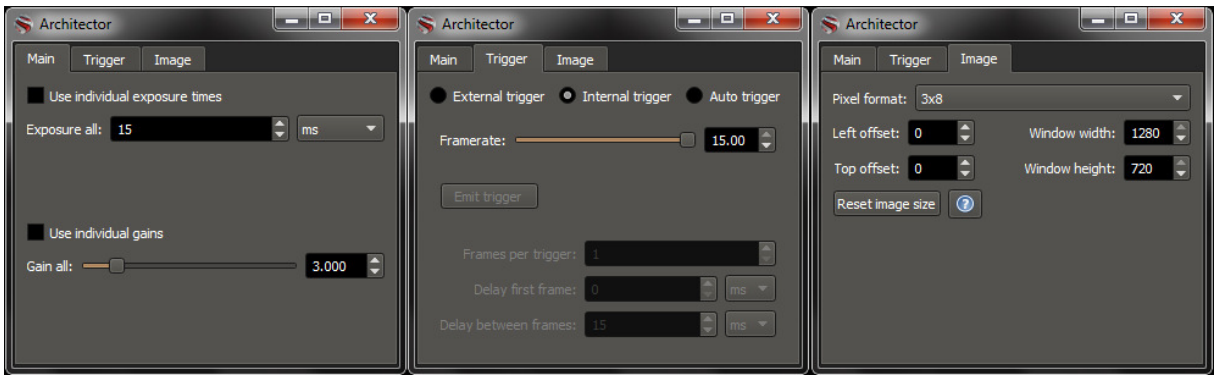


Figure 10. Device settings window

5 Triggering

Triggering the camera externally provides a sophisticated imaging method where image acquisition is synchronized with other parts of your system. Every time the trigger source signal is asserted an exposure-readout cycle is started which results in an image frame.

5.1 Selecting trigger source

*In order to be able to perform triggering, the '**TriggerMode**' feature must be set to* 'External'. *If **'TriggerMode'** is set to* 'Internal', *free run mode is enabled, which means that the acquisition speed is limited by the maximal exposure time and/or the acquisition frame rate defined in the according features.*

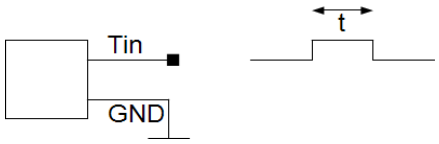
*The camera trigger source is selected with the '**TriggerSource**' feature. At the moment, just external triggering via the Line0 is available (see Figure 6 as well as Table 3 for connection details):*

Table 4. Available trigger sources.

Value	Trigger source
Line0	**External trigger T_{in} on Hirose connector**
CC1	**External trigger over the Camera Link cable**
CC3	**External trigger over the Camera Link cable**

5.2 Electrical connection

The trigger input T_{in} is a 5V digital signal, trigger output T_{out} is an open-collector type (max. 24V) digital signal. Other input or output types are available on customer request. Both signals are referenced to ground (GND):



The trigger output follows the trigger input and can be used to link other devices to the same trigger input as the camera.

5.3 Timing diagrams

It is important to know, that the trigger signal applies to the whole camera and hence, to all sensors. There's no possibility to assign different triggers to selected sensors. The trigger itself works closely with the exposure time. In fact, when a trigger signal is occurs, the exposure of the sensor is started. Immediately after the exposure time has expired, the readout is started and the frame is sent out of the camera via the according interface.

To utilize external triggering via the dedicated input line T_{in} (Hirose connector) one needs to:

- *Create a Hirose power connector with the T_{in} pin connected.*
- *Set **'TriggerMode'** to* 'External' and ***'TriggerSource'*** to 'Line0'.
- *Generate a trigger pulse on T_{in} of 24V (referenced to GND pin).*

The duration of the trigger pulse must be at least 0.1µs. The minimum period (A to F) of the trigger waveform (Figure 11) must be greater than the integration (B to D) and the readout time or frame time (D to E) combined.

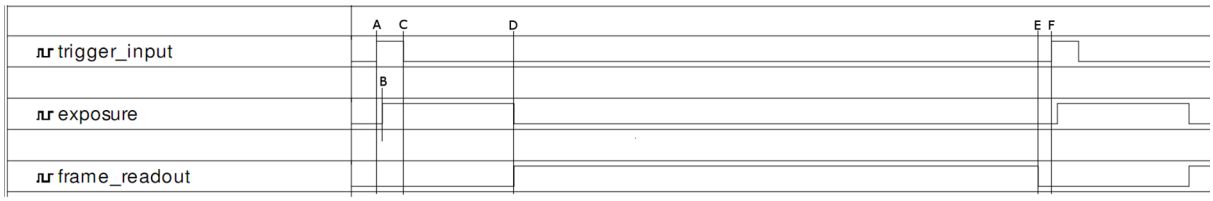


Figure 11. Timing diagram for triggering

5.4 Advanced timing diagrams

Basically, there are 4 different scenarios for triggering, each having their own requirements:

1. *Exposure smaller then frame time, no read during exposure*
2. *Exposure larger then frame time, no read during exposure*

Triggering can work with long and short exposure times, ranging from milliseconds to seconds. The clock speed of the sensor is not adjusted when changing the exposure times, so also long exposure times of several seconds are read out at the highest clock rate supported by the sensor.

Exposure smaller then frame time, no read during exposure

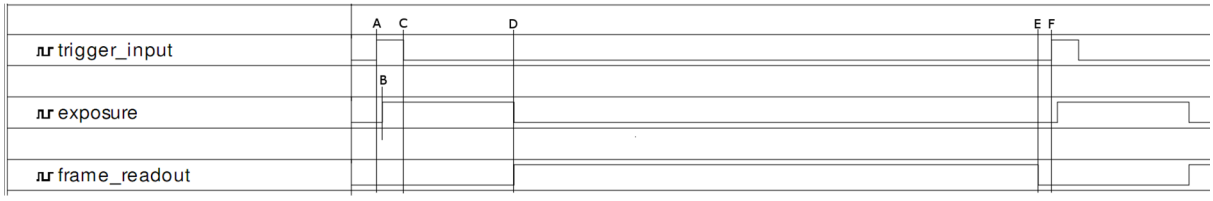


Figure 12. Timing diagram 2. Exposure time smaller then frame time, no exposure during read

At time A the trigger input is pulled HIGH. It takes 1 internal clock cycle for the exposure to start (B). The trigger input has to be high (A-C) for at least 100 ns. Depending on the exposure time (B-D) the readout is started immediately after the exposure time has finished. The frame time (D-E) is the time it takes to read out all the pixels from the sensor to the output. The fastest way the sensor can be read out thus, is the time it takes for D-E to finish. After the readout has stopped there must at least be a time (E-F) before the next trigger will be accepted. This time is 100 ns.

Before time E the trigger input must be pulled LOW. A second pulse of trigger input between A and F is ignored. If trigger input is not pulled LOW at F, a second frame starts immediately, resulting in 2 frames generated.

Exposure longer then frame time, no read during exposure

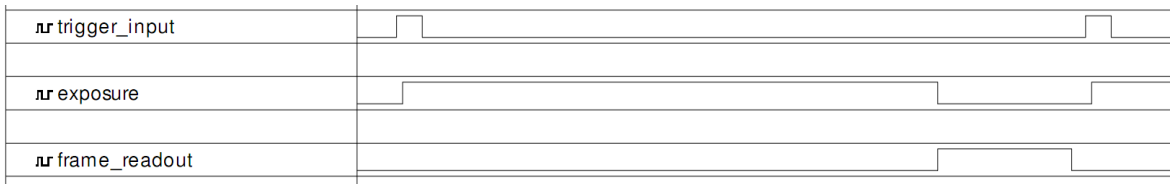


Figure 13. Timing diagram 3. Exposure time larger then frame time, no exposure during read

Figure 13 shows that the exposure time is longer than the readout pulse. This causes the exposure to be larger than the frame time.

INFORMATION: Trigger input is ignored when the camera is not ready to start a new exposure-readout cycle. Asserting the trigger input for a period longer than an exposure-readout cycle can result in multiple frames.

*For notice: in case that the camera is used by internal triggering, which means normal operation (**'TriggerMode'** set to 'Internal'), the signal generated at the T_{out} Hirose connector pin is set to active whenever the sensors themselves get a trigger impulse. The activation pattern of this pin follows the sensor activation. The period for which the pin is set to active is defined to be 1/4000 seconds.*

5.5 Properties, features and serial commands

Following is a list of all Architector properties, features and serial commands related to triggering. When using the AVS, users needn't worry about this as the application takes care of it. People creating their own applications using the Architector SDK, should use properties. People using the camera with 3rd party software must use serial commands).

For a complete list of commands see the chapter Properties, Features and Serial commands.

Trigger Control (1.0)

Property	Command	Description
TriggerMode	TRIGGER MODE	(Enumerator) Sets the trigger in AquisitionFrameRate mode or hw/sw trigger mode Values: • AcquisitionFrameRate (Dev value: 0x00) • HwSwTrigger (Dev value: 0x01)
TriggerSnapshot	TRIGGER SNAPSHOT	Generates an internal trigger. TriggerSource must be set to "Software". When using the SDK the trigger is generated when the property is set to true. After the trigger is emitted, the property resets to false.
TriggerSource	TRIGGER SOURCE	(Enumerator) Sets the source of the trigger See Table 6 (next page) for more information on valid values.
TrigggerActive	TRIGGER ACTIVE	(Enumerator) Sets the signature the hardware trigger will trigger on. See Table 7 for more information on valid values.
TriggerDelay	TRIGGER DELAY	(Unsigned Integer) Sets the delay in µs before the first trigger begins
TriggerInterimDelay	TRIGGER INTERIMDELAY	(Unsigned Integer) Sets the delay between trigger pulses when multiplier is set > 1

TriggerMultiplier	TRIGGER MULTIPLIER	(Unsigned Integer) Sets how many triggers are generated when a trigger activation is detected
AcquisitionFrameRate	TRIGGER RATE	(Double) Sets the frame rate (in fps).
AcquisitionFrameRateEnable	TRIGGER ACQFR	(Enumerator) Sets whether the frame rate follows the AcquisitionFrameRate or as high as possible with the current exposure time: • Off (Dev value: 0x00) • On (Dev value: 0x01)

Table 5 – Commands for triggering

Trigger source

When using Architector, the trigger source works slightly different than when using the serial commands. The following table shows the valid values for both properties and serial commands.

String value	Numeric value (Architector)	Numeric value (Serial)	Notes
Software	0	0	
CC1		1	Not supported with Architector.
CC3		3	Not supported with Architector.
Line0	1	5	Different values for property and command.

Table 6 - Trigger source values

Trigger activation

Like the trigger source, the trigger activation has different values for Architector properties and serial commands.

String value	Numeric value (Architector)	Numeric value (Serial)	Notes
Rising edge	0	0	
Falling edge	1	1	
High	2	3	Different values for property and command.
Low	3	4	Different values for property and command.

Table 7 - Trigger activation values

6 Camera Link pixel specification

The video output can be selected from several modes. Each mode represents a different video format (e.g. 3 x 8 bits, or 3 x 12 bits). The `PIXEL` *command allows you to specify the video output mode of the camera.*

The image format is configured in terms of Camera Link parameters. It supports the Camera Link Medium image formats.

The camera can be used in two different modes:

- *3 x 8 bit*
- *3 x 12 bit*

INFORMATION: Architector Vision Suite automatically configures the frame grabber appropriately for the selected pixel mode. The data format conversion is also handled automatically.

This chapter is essential for those wishing to implement their own software using the SDK.

6.1 Data order specification

Table 9 specifies the data order of the pixel output configuration and the mode identifier to use with the `PIXEL` *command to setup the camera in the corresponding mode.*

In the tables below, the image channels are labeled CA, CB, CC, …. Each channel data element is represented by bits that are labeled CA0, CA1, CA2, … CA15 for channel CA. Unused bits are set to zero and not specified in the table below. For example in 8 bit mode the bits of second channel CB are labeled CB0 to CB7 and in 12 bit mode the bits of the third channel CC are labeled CC0 to CC11. CA0 is the LSB bit of channel CA, CA15 is the MSB.

Channel specification	
CA	***VIS***
CB	***NIR A***
CC	***NIR B***

Table 8. Camera Link channel specification.

The following pixel modes are available (see PIXEL command in chapter 7).

PIXEL command mode identifiers	
`PIXEL` ***mode***	***Data mode description***
0	***3 x 8 bit (CA | CB | CC)***
1	***3 x 12 bit (CA | CB | CC)***

Table 9. PIXEL command mode identifiers.

The data format of the camera follows that of the Camera Link Base standard. To support 3 x 12 bit mode on the image is re-ordered to fit in the available bit formats of Camera Link Base.

In 3 x 12 bit mode, the camera outputs images that are twice (2x) as wide as usual. Every first column (0, 2, 4 …) contains the red and green channels. Every second column (1, 3, 5 …) contains the blue channel and a spare.

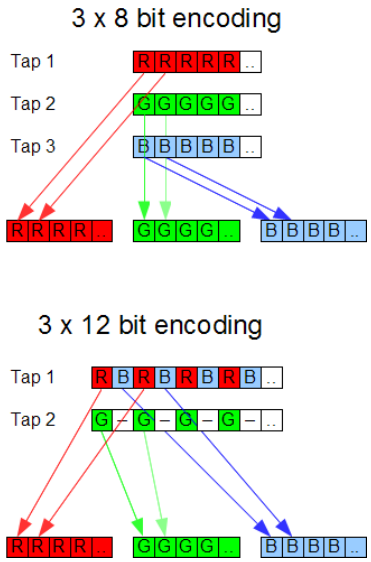


Figure 14. Encoding of 3-channel images in Camera Link Base configuration.

***Example A**: if you select 3 x 8 bit mode and a resolution of 1360 x 1024, you should configure the frame grabber*

- *Taps: 3*
- *Bit depth: 8*
- *Width: 1360*
- *Height: 1024*

***Example B**: if you select 3 x 12 bit mode and a resolution of 1360 x 1024, you should configure the frame grabber*

- *Taps: 2*
- *Bit depth: 12*
- *Width: 2560 (= 2 * 1280)*
- *Height: 720*

Now even columns (0, 2, 4 …) contain R and G samples, the odd columns (1, 3, 5 …) contain the B samples (and an unused value).

6.2 Software Development

To develop custom software for this camera, you can use the SDK of the frame grabber used for the camera.

7 Properties, Features and Serial commands

Here's a full list of all properties, serial commands and in what they relate to.

This is the list of properties that developers using the SDK can utilize to control the camera.

Property	Type	Min	Max	Default	Description
ExposureAll	Unsigned integer	500	2,000,000	-	Exposure time for all channels
Exposure1	Unsigned integer	500	2,000,000	800	Exposure time for channel 1
Exposure2	Unsigned integer	500	2,000,000	15,000	Exposure time for channel 2
Exposure3	Unsigned integer	500	2,000,000	5,000	Exposure time for channel 3
GainAll	Floating point	1	36	-	Gain for all channels.
Gain1	Floating point	1	36	3	Gain for channel 1.
Gain2	Floating point	1	36	3	Gain for channel 2.
Gain3	Floating point	1	36	3	Gain for channel 3.
Framerate	Floating point	0.01	15	15	Frame rate.
PixelMode	Enum	-	-	3x8	Sets the cameras pixel mode.
TestPattern	Enum	-	-	Off	Use a test pattern.
Roi::X	Integer	-8	1287	0	Horizontal offset.
Roi::Y	Integer	-8	727	0	Vertical offset.
Roi::Width	Unsigned integer	1	1296	1280	Width of the images
Roi::Height	Unsigned integer	1	736	720	Height of the images
TriggerMode	Enum	-	-	Internal	See chapter 5.5 for more information.
TriggerAcqfr	Enum	-	-	On	See chapter 5.5 for more information.
TriggerSource	Enum	-	-	Software	See chapter 5.5 for more information.
TriggerActive	Enum	-	-	Rising edge	See chapter 5.5 for more information.
TriggerMultiplier	Unsigned integer	0	2^32-1	1	See chapter 5.5 for more information.
TriggerDelay	Unsigned integer	0	60,000,000	0	See chapter 5.5 for more information.
TriggerInterimDelay	Unsigned integer	0	60,000,000	15,000	See chapter 5.5 for more information.
TriggerSnapshot	Boolean	-	-	False	See chapter 5.5 for more information.

Table 10 - Property list for the camera.

Please keep the following in mind when using properties:

- *All property that use times (exposure time and trigger delays) have their values represented in micro seconds (µs).*
- *Gain is in decibel (dB).*

- *The properties are in pixels.*
- *The numeric values for enums (see below + chapter 5.5) are unsigned integers.*
- *ExposureAll and GainAll can be used to quickly set the exposure time and gain of all channels at once. It is not advised to use their value to retrieve these values, use the single channel variants for that.*

And here are the various enums used by the properties (excluding those covered in chapter 5.5.

String value	Numeric value	Description
3x8	0	3 channels, 8 bit (Default)
3x12	1	3 channels, 12 bit
Channel 1 – 14 bit	2	1 channel, 14 bit (channel 1)
Channel 2 – 14 bit	3	1 channel, 14 bit (channel 2)
Channel 3 – 14 bit	4	1 channel, 14 bit (channel 3)

Table 11 - Pixel modes

String value	Numeric value	Description
Off	0	No test pattern (default)
Device	1	Device generated test pattern.

Table 12 - Test patterns

7.1 Command syntax

Commands are text strings and are used to set camera features and to request their current values. The arguments are separated by the <space> character (ASCII: 0x20). Each command ends with an end-of-message character.

Syntax:

```
COMMAND <SPACE> [ARGS] <END>
```

After a command is received by the camera, it always sends the response:

- *OK*
- *NOT_OK*

For commands where a value is requested from the camera, the value is printed **before** *the OK response. For example:*

- *EXP*

```
[{ "EXP": [12100, 10500, 5500] }]OK
```

Special characters:

Special character	Name	ASCII value	Description
<SPACE>	Space character	0x20	Separator character
<END>	New Line Carriage Return	0x0A 0x0D	End of message character. Any of these characters (or any combination) will be accepted

Quest JSON implementation

Commands return output in JSON format (as shown in the EXP example above) when the command returns information. The return is valid JSON except the OK directly after the response.

In the JSON implementation the following constructions are used:

- *Numbers: 5.23*
- *Strings: "string can contain spaces"*
- *Array initializers: [2, 5, 2, 3, …]*
- *Object initializer: { "example": "JSON is cool", "number": 2.32 }*

The begin [and end] are mandatory.

7.2 Command list

The camera supports the commands specified below:

Command	Description
EXP ID VALUE	*Set exposure time for sensor/channel ID to VALUE (microseconds)*
EXP	*Request exposure times for all sensors*
EXP SEL ID	*Select a sensor to do an exposure operation on*
EXP VAL VALUE	*Set exposure time for selected sensor/channel to VALUE (microseconds)*
GAIN ID VALUE	*Set gain factor in dB for sensor/channel ID to VALUE. Floating point number*
GAIN	*Request the gain factors for all channels*
GAIN SEL ID	*Select a sensor to do an gain operation on*
GAIN VAL VALUE	*Set gain factor for selected channel to VALUE. Floating point number*
TRIGGER PARAM VALUE	*Set the trigger parameter PARAM to VALUE* *Parameters:* • *SOURCE <id>* *0 Software* *1 CC1* *3 CC3* *5 Line0* • *ACTIVE* *0 Rising Edge* *1 Falling Edge* *3 High level* *4 Low level* • *MODE*

	0 Use TRIGGER RATE *1 Use selected TRIGGER SOURCE* • *RATE <fps>* *Floating point number* • *DELAY <usec>* • *INTERIMDELAY <usec>* • *MULTIPLY <count>* • *SNAPSHOT* • *ACQFR* *0 Use TRIGGER RATE* *1 Trigger rate is set as fast as possible based on exposure time*
TRIGGER PARAM	*Request current value for the trigger parameter PARAM.*
PIXEL FORMAT	*Set output pixel format to FORMAT* *Formats:* *Value Description* • *0 3x8 bit* • *1 3x12 bit* • *2 Ch1 14 bit* • *3 Ch2 14 bit* • *4 Ch3 14 bit*
PIXEL	*Request the pixel format*
ROI PARAM VALUE	*Set the Region Of Interest PARAM to VALUE* • *X <x-offset>* • *Y <y-offset>* • *W <width>* • *H <height>*
ROI PARAM	*Request the current value of PARAM of the Region Of Interest*
TESTPATTERN PATTERN	*Configure the camera to output a generated test pattern instead of captured images* *Patterns:* • *0 Sensor image* • *1 Test pattern 1*
TESTPATTERN	*Request the currently selected test pattern*
TYPE	*Prints model information about the camera, such as DeviceSerialNumber.*

8 Troubleshooting

This section gives information and tips in case you run into trouble while working with the Condor3-VNN-ICX692-CL01 camera.

8.1 Common solutions

If you have problems with the camera, check that it is not caused by one of the following common issues.

Connectors

Make sure that the correct connections are made.

Check voltage

Ensure that the correct voltages are present.

Triggering

*When the camera does not start streaming when you start it, check if the **'TriggerMode'** feature is set to 'Off'. If yes, set it to 'Internal'.*

8.2 Specific troubleshooting

High noise level

Camera noise increases at high temperatures. If a camera is getting hot, attach a heat sink to remove heat or place a fan near the camera.

Black lines

Check that the region of interest (ROI) is set up correctly. If it is set to include the optical black (light shielded) pixels of a sensor, this will show in the images as black lines near the edges of the images.

Black frames

Check that the lens cap is removed. Some frame grabbers return black frames when there is no data (timeout), for example due to a power cable failure.

No frames

Check power supply, the power cable and its connector.

Set the camera in free running mode to make sure it is not waiting for a trigger that is not connected.

Light and dark smudges

If the defect is a distinct "point" you may have found a black or hot pixel. This is a defective pixel that is no longer photo-sensitive.

However, if the defect is "smudgy" it is more likely that it is a fleck of dust or other contamination on the lens or the prism front face. See the chapter about cleaning the camera for more information how to remove the dirt.

Stuck bits

*Check that the **' PixelMode'** feature is set according to your buffer decoding (chapter 4.2).*

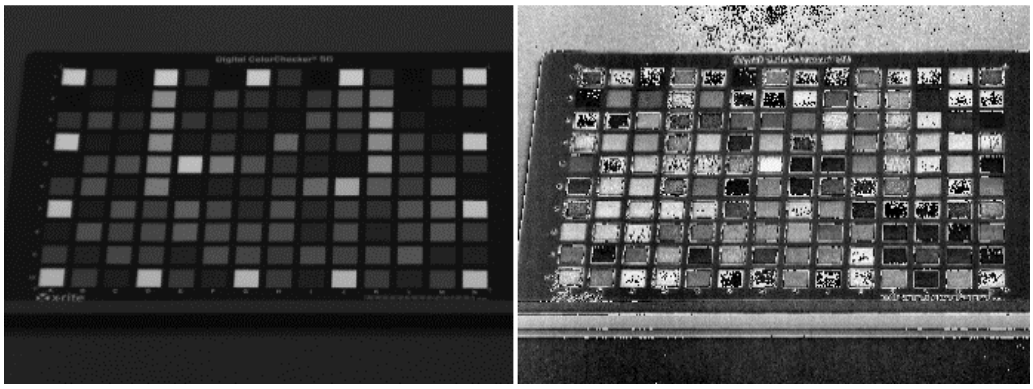


Figure 15. Example of a how an image can appear when the camera data decoder is not set up correctly.

9 Support

If there is a problem with your camera and the tips and solutions did not help, please contact our service department. We'll be happy to help you.

Service report	
Customer name	
Customer company	
Phone	
Fax	
Dealer	
Product code	
Serial number	
Frame grabber hardware	
Frame grabber software	
Detailed description of the problem	

Table 13. Service Report form

Please send this form to:

Quest Innovations B.V. - Support
Postbus 22
1770 AA Wieringerwerf
The Netherlands

Email: support@quest-innvations.com
Tel: +31 (0)227 604046
Fax: +31 (0)227 604053

10 Glossary

CMOS

Acronym: Complementary Metal–Oxide–Semiconductor. A type of image sensor that is often used in vision applications.

SCMOS

Scientific type CMOS image sensor with enhanced capabilities over standard CMOS types.

Color matrix

A transformation matrix that applies a linear color space transformation. This is used to improve the color accuracy of color cameras.

Dark image

A dark image is an image from a sensor without external stimulation. It captures the noise level that is present in the output images even if no light falls on the sensor. Hence the term: dark image.

DNC

Acronym: Do not connect.

Dynamic range

The ratio between the smallest and the largest signal that can be measured. The dynamic range is usually measured in decibel (dB).

Exposure

The amount of light that is allowed to fall on a sensor. This measure is often specified as the time that the sensor measures the incident light.

Field of view

The region "seen" by the camera lens and recorded by the image sensor. This is a measure of the size of the objects that the camera can view.

Gain

Gain is an amplifier circuit to increase the amplitude of the signal from photodiodes in the image sensor. The gain is often specified in decibels (dB).

Integration

See Exposure.

LUT

Acronym: Lookup table. A LUT is often used to modify pixel values, for example to linearize the sensor response curve.

M30x1 Lens Mount

An screw thread for mounting a lens to a camera.

Pixel

A single photosensitive element. A sensor contains a grid of pixels that form a full image frame.

S-Record

A file format that encodes binary data in ASCII characters. It is often used to program Flash memories, microprocessors and other embedded devices.

RS-232

Standard protocol for serial port communication.

ns, µs, ms, s

Acronym: nanosecond, microsecond, millisecond and second respectively