

Leuze



LCAM 408*i*

Industrial Ethernet Camera

User Manual

Revision 1.3

Revision	Changes	Date Name
1.0	First Edition	20.05.2016 esh
1.1	Addition RTSP-Protocol, Live stream in Browser	04.01.2018 esh
1.2.	RTSP limits	30.01.2018
1.3.	Image settings Update	29.07.2020 esh

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1 Hardware

This manual covers the industrial LCAM 408i with MJPEG streaming capabilities and its software. The LCAM 408i C7F-XX has outer dimensions of approx. 75 mm (L), 55 mm (W), 113 mm (H)

For more details see the datasheet.

1.1 M12 connectors

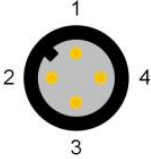
The M12 connectors on the bottom side are used for Ethernet connection (named with SERVICE) and the other for Power Supply (named with PWR). It is an X-coded M12 with 8 pins (female) and an A-Coded M12 with 4 Pins. Be sure to use only matching cables.



1.2 Pin definition Ethernet connector

M12 X-Coded female	Pin	Signal Name
	1	D1+
	2	D1-
	3	D2+
	4	D2-
	5	D4+
	6	D4-
	7	D3-
	8	D3+

1.3 Pin definition Power connector

M12 A-Coded male	Pin	Signal Name	Description
	1	+VIN	Supply Voltage, positive terminal
	2		not connected
	3	-VIN	Supply Voltage, negative terminal
	4		not connected

The camera needs 3,6 W for operation. The device can be powered in the range from 18 to 30 Volt DC.

1.4 Switching off

The unit may be switched off anytime, since an overlay file system is used to store persistent data.

1.5 Optics

The lens (M12) is mounted behind a protective front glass (no optical requirements) that cannot be changed by the user.

The setup the lens focus is done in the production, and cannot be changed by the user.

The field of view is

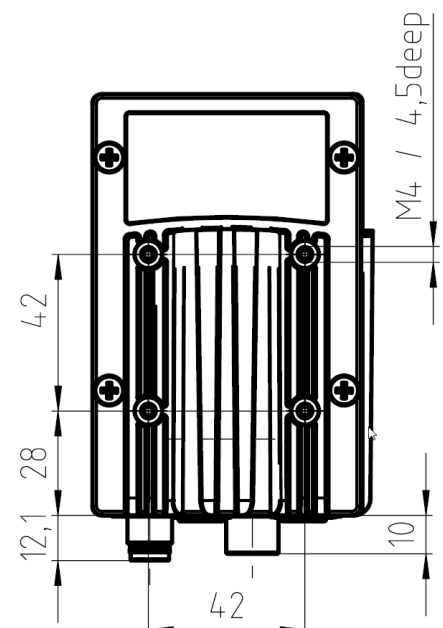
1,80 x 1,40 m	@ 1 Meter distance
2,50 x 1,90 m	@ 1,5 Meter distance
3,40 x 2,60 m	@ 2 Meter distance

1.6 Mounting the camera

There are different options to mount the LCAM 408i

1.6.1 With screws

The camera can be mounted to a flat surface with four M4 * 4 screws. There is no preferred mounting direction.



1.6.2 At a rod (10-20mm)

with the BT 56-1 or BT 300-1



1.6.3 With a mounting angle

The camera can mount to the BT 300W and adjust in different directions



2 First Steps

2.1 What's needed

Before you start, you will need:

- The LCAM 408i
- Ethernet cable with connectors M12 X-coded – RJ-45, CAT6
- Switch (1000BaseT) or direct PC connected with Gigabit Ethernet interface
- Streaming video viewer Leuze viewer, VLC or equivalent.

2.2 What to do

After unpacking the camera, the following steps for a first use are:

- Connect an M12 – RJ45 Ethernet cable between the LCAM and a Ethernetport (PC or switch)
- Connect a Cable for Power supply to the other M12 connector
- Power up the cable, wait for approx. 1 minute for LCAM to boot. If you hear a faint noise, do not worry.
- Detect the LCAM's address
- Either: Run the program 'hipca detect.exe' and identify the LCAM you want to talk with
- Or: Use default fixed address (see below). You may have to change the PC's IP to an address like 192.168.60.101, so it is in the same sub-net
- Open Internet browser on the computer
- In the browser's address line type in the IP address of the LCAM in the form "192.168.60.101"
- Watch for the camera's web server surface to show up, should appear as in "Menu general appearance"
- Proceed with setting password and video parameters. For that you need a password (see below for default)
- Start streaming video
- When finished, start the streaming client as shown below.

3 Technical terms

3.1 Binning

For a video sensor the process of "binning" combines a group of pixels, to reduce resolution and to enhance the sensivity.

See: https://en.wikipedia.org/wiki/Data_binning

The camera sensor has 3 binning modes.

- 1: No binning.
- 2: Combine 2x2 pixels to one. This reduces the resolution by a factor of 2 for width and height.
- 4: Combine 4x4 pixels to one. This reduces the resolution by a factor of 4 for width and height.

With a binning mode other than 1 the framerate can be increased.

3.2 RTP / RTSP

RTP is a streaming protocol used for video and audio.

See: https://en.wikipedia.org/wiki/Real-time_Transport_Protocol

https://en.wikipedia.org/wiki/Real_Time_Streaming_Protocol

The camera can be configured to supply the images using RTP.

4 Software

4.1 Still image

A JPEG file of the video stream, which is updated once a second, can be accessed under the URL http://Your_IP_here/camera/current.jpg

4.2 MJPEG Streaming

This document gives an introduction into the use of the LCAM 408i with MJPEG streaming.

To watch the streamed image with the VideoLANClient VLC on a 64-Bit Windows system use the line:

```
"C:\Program Files (x86)\VideoLAN\VLC\vlc.exe" tcp://IPaddress:5001 --network-caching=0
```

Fill in the IP address of the camera and adjust the path to vlc.exe as needed.

The typical setting in VLC looks like this:

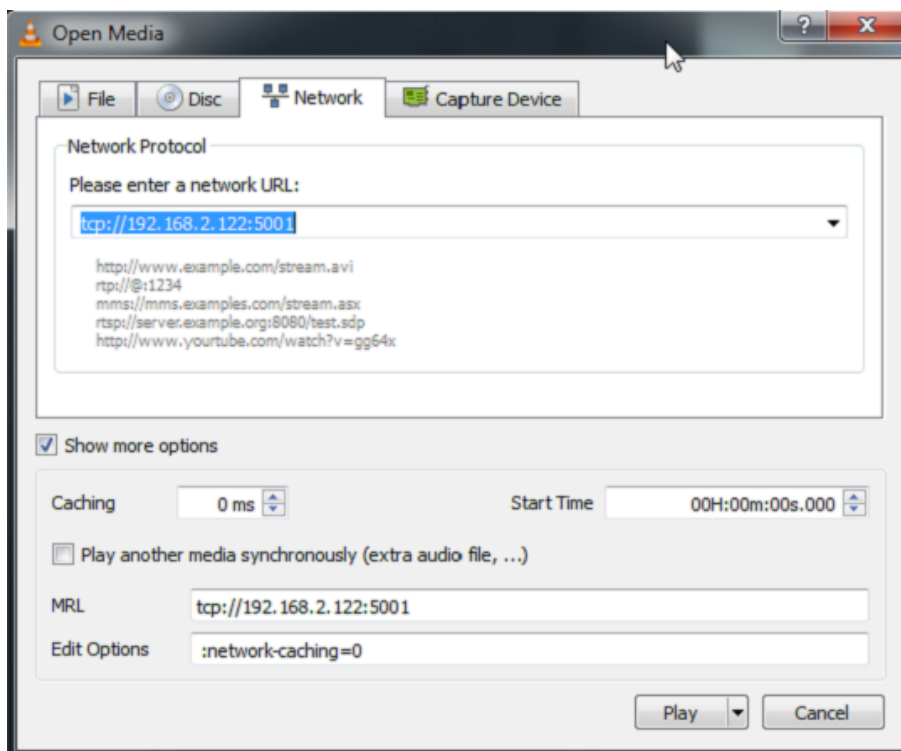


Figure 1 Screenshot network settings

'Show more options' may have to be selected. Be sure to set caching time and IP address if not done so on the command line. Long caching times make streaming more drop-out-resistant but also introduces latencies.

4.2.1 Stream data structure

To access the video data in your own software, open a socket to port 5001 of the camera and scan the incoming data for the separator string ---jworudfg83h231sow2z04. The following line contains the content type and the next the length of the image data.

The typical structure of the stream data is:

```
---jworudfg83h231sow2z04
```

```
Content-Type: image/jpeg
```

```
Content-Length: 200976
```

```
|
```

```
|
```

```
jpeg
```

```
data
```

```
here
```

```
|
```

```
|
```

```
---jworudfg83h231sow2z04
```

```
Content-Type: image/jpeg
```

```
Content-Length: 200437
```

```
|
```

```
|
```

4.3 RTP Streaming

If RTP streaming is enabled, the camera stream jpeg images using RTP port 554.

Again VideoLANClient VLC can be used to display the images:

```
vlc rtsp://IPaddress/jpeg
```

4.4 Ring buffer

All jpeg images grabbed on the camera are buffered in a ring buffer.

Currently the ring buffer can hold **25** images.

The ring buffer can be triggered to stop buffering and storing the images into the file system.

The images are stored in the web servers home directory as "/camera/ring-buffer/main_imgNNN.jpg", where "NNN" are "000" to "024".

After triggering the ring buffer, it must be re-armed. This can be done using the web page.

Alternatively the webserver URL <http://ipaddress/api/rearmRingBuffer.cgi> can be used. The URL allows supplying the number of post alarm images: http://ipaddress/api/rearmRingBuffer.cgi?post_trigger=2.

The script returns a Json formatted string.

Below there is an example using "curl" on the commandline. With "libcurl" such a call can be implemented in a C/C++ program. The cameras IP address is 192.168.2.159.

```
$ curl http://192.168.2.159/api/rearmRingBuffer.cgi?post_trigger=3
{"error_string":"","post_trigger":"3","trigger_port":5000,"enable":true,"post_trigger_config":0}
```

The ring buffer can be triggered using software by opening a TCP connection on port 5000.

Below there is an example using "Netcat" on a Linux system:

```
$ nc 192.168.2.159
OK
```

5 Web Interface

5.1 Default network settings

The default factory settings for network are:

DHCP	off	
IP	192.168.60.101	This is in one of the private IP spaces
IP Mask	255.255.0.0	
Gateway	192.168.3.1	Not needed for test, change for large nets
DNS server	192.168.3.62	Not needed for test, change for large nets
Order number	xxx	Camera-individual

5.2 Default login data

5.2.1 Web interface

User: admin

Password: leuze

5.2.2 SSH

User: root

Password: rootLogin

6 Web menus

The LCAM has an internal web server that has the following menus.

6.1 Network

6.1.1 Network menu

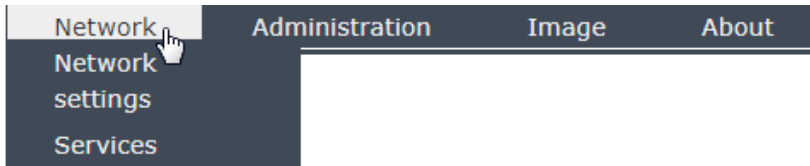


Figure 2 Network menu

In the network menu, the network settings and the state of some network services can be configured.

6.1.2 Network settings

Network	Administration	Image	About
Network mode	Static		
IP address	192.168.60.102		
Network mask	255.255.255.0		
Gateway			
DNS server			
Save data	Restart network		

Figure 3 Screenshot network settings

Here you can choose between static address assignment and DHCP mode.

For static IP, fill out the fields as needed. And press "Save data". To use the new settings, pressing "Restart network" is needed. For DHCP mode, no addresses are needed, they are obtained from the DHCP server.

6.1.3 Services – SSH and FTP

Here SSH and FTP can be selected.

Network	Administration	Image	About
<input checked="" type="checkbox"/> SSH daemon			
<input type="checkbox"/> FTP daemon			
Save settings	Restart services		

Figure 4 Screenshot services

6.2 Administration

6.2.1 Administration menu

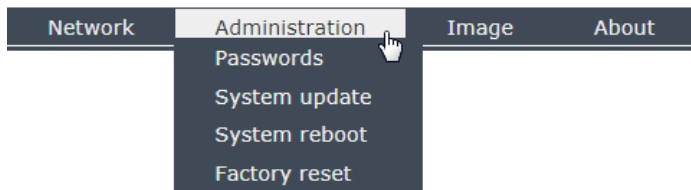


Figure 5 Administration menu

Using the administration menu, you can change passwords, do a system update or perform a system reboot or a factory reset.

6.2.2 Password page

Here one of the two possible passwords can be selected to be changed or set.

The "admin" password is the one used for the web server pages.

The "root" password is the one used for e.g. SSH connections.

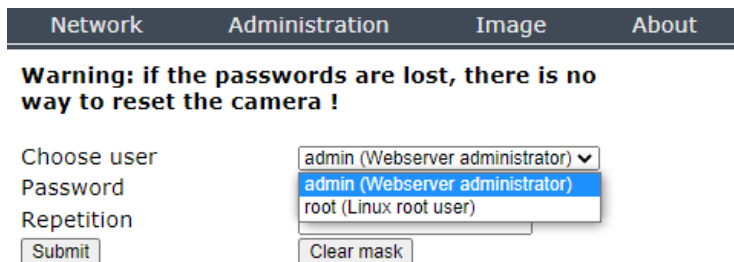


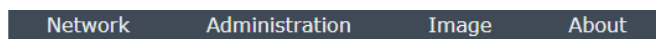
Figure 6 Screenshot password selection

Supply the new password and repeat it.

If the passwords are lost, there is no way to reset the camera!

6.2.3 Update

The update process needs a path to a firmware file.



System update

**The update needs some minutes.
Please do not interrupt after starting.
Do not reload or change the page.**

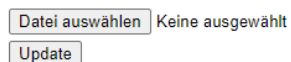
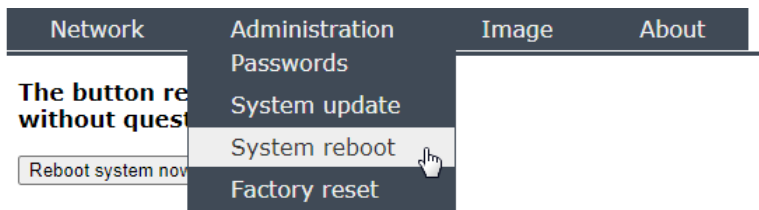


Figure 7 Screenshot system update

Please be patient. The update process needs several minutes. When finished, there will be additional output shown on the page.

6.2.4 Reboot

System reboot is done without further data and should be finished after two minutes.



The button reboots the system without questions !

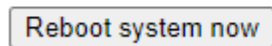
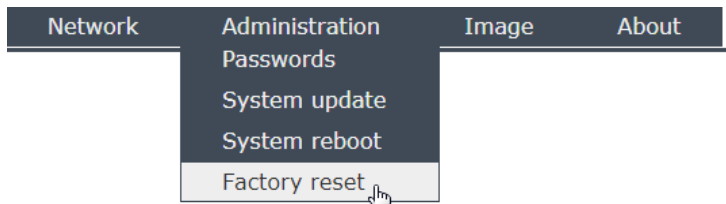


Figure 8 Screenshot system reboot

6.2.5 Factory reset



The system will be reset to factory settings and rebooted.

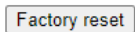


Figure 9 Screenshot factory reset

When you hit the button "Factory reset", network and image settings are reset and the camera is rebooted.

It comes up with the factory network and image settings.

6.3 Image settings

6.3.1 Image menu

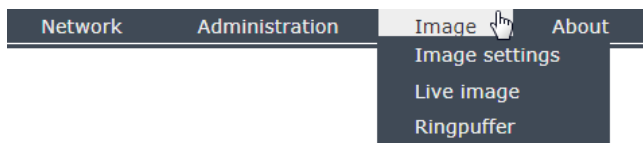


Figure 10 **Image menu**

The image menu allows adjusting image settings (e.g. regions of interest), watch the live images and handle the ringbuffer.

6.3.2 Image settings

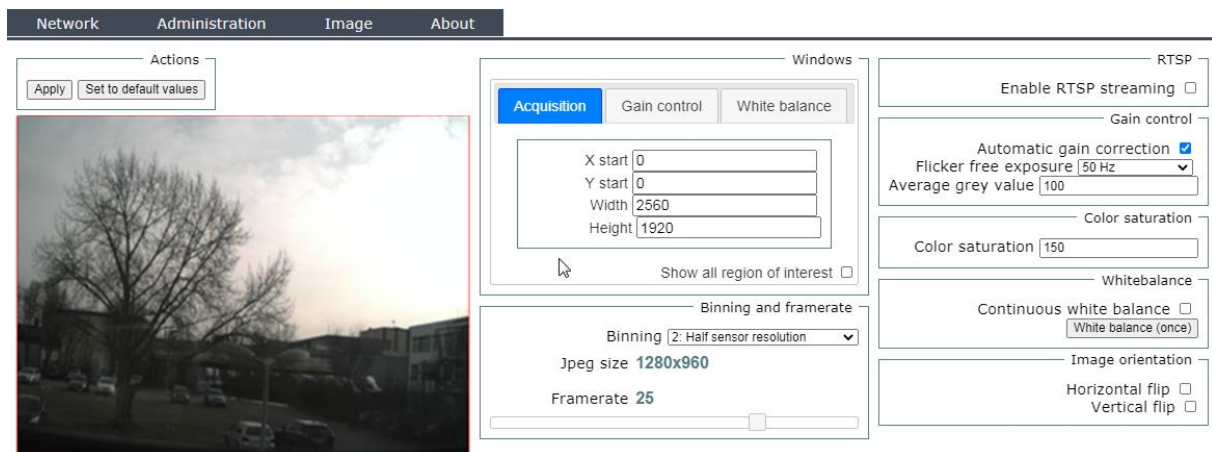


Figure 11 **Image settings menu**

The image settings menu allows configuring the sensor. The subsequent text describes all settings.

6.3.2.1 General remarks

When you enter the page, you will see a warning message.

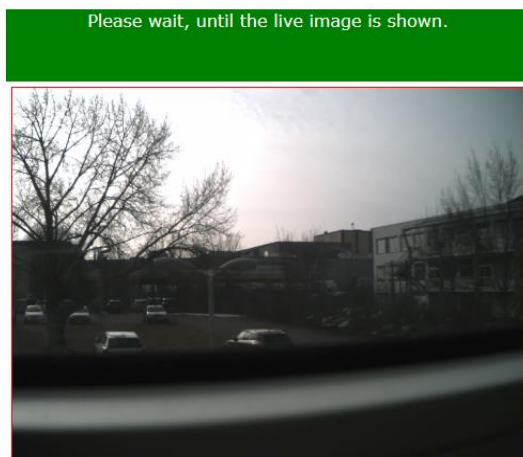


Figure 12 **Warning shown on page reload**

The image you see in image settings mode, is a full screen image (all sensor pixels shown), regardless which image region of interest (ROI) is used. This is done to allow selecting arbitrary ROI for acquisition, white balance and gain.

Switching the sensor and the acquisition to full screen mode needs some time, so this warning is shown. The warning message may disappear before the live image is shown.

When you leave the page and enter e.g. the live image page, sensor and acquisition must be reconfigured. This again needs several seconds.

6.3.2.2 Saving setting

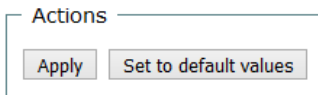


Figure 13 **Apply settings or set default values**

The buttons shown above allow to save the changes made or to set some default values stored on the camera.

When *Apply* is clicked, the current settings are stored, but *current* sensor settings are not changed. To achieve this, the web page must be reloaded.

6.3.2.3 Regions of interest

There are three regions of interest (ROI).

1. The acquisition ROI
2. The ROI for calculating the white balance
3. The ROI for gain control

The regions can be set using the mouse or by changing the values in the edit fields.

To be able to change one of the ROI select one in the "Windows" area:

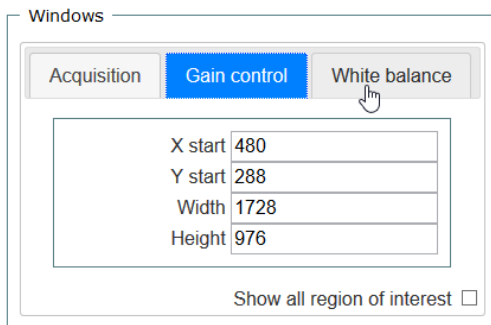


Figure 14 **Select ROI to change**

To change a ROI with the mouse, press the left mouse button nearby a corner for resizing, or in the middle of the ROI for moving it.



Figure 15 **Resize a ROI using the mouse**

While you move or resize, you will see the size and top left corner change.

Remark: The coordinates you see are sensor coordinates. So if you have e.g. flipped the image horizontally and vertically, the *upper left* corner of the sensor is in the *lower right* corner of the image shown. Additionally the width and height on the sensor must not be the same as the one of the resulting Jpeg file (see *binning* below).

All ROIs can be shown using the button "Show all region of interest". Only the active one can be changed.

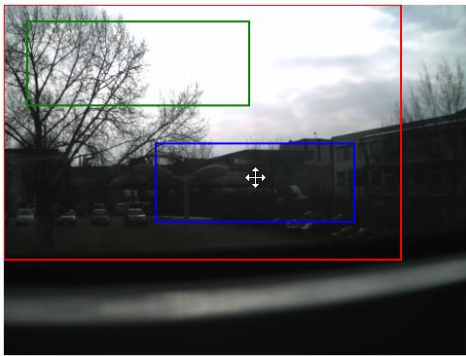


Figure 16 **Show all ROI**

6.3.2.4 Automatic ROI correction

The ROI for gain control and white balance must lie within the acquisition ROI. This is handled automatically.

Due to restrictions in the image acquisition, not all image width, height, or start values are allowed. Rounding the values is done automatically when moving or resizing the ROI with the mouse. When you enter the values manually and leave the input box e.g. using the "TAB" key, the values are rounded too.

6.3.2.5 Binning and framerate

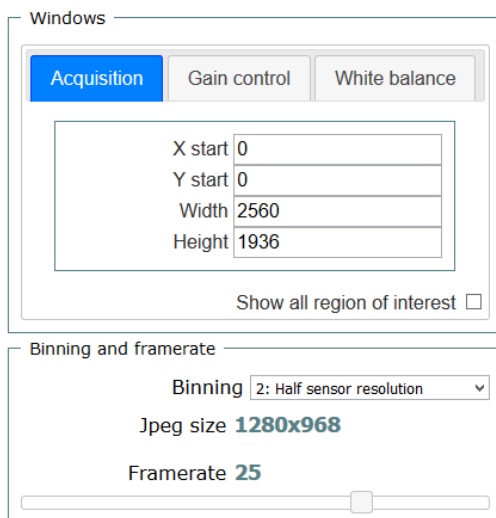


Figure 17 **Binning and framerate**

Under "binning and framerate", the binning mode can be changed. Changing the binning directly affects the size of the output jpeg image. See the chapter "Technical terms" for details.

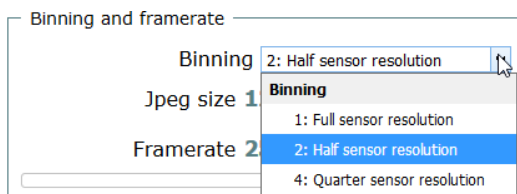


Figure 18 **Binning modes**

There are 3 possible binning modes 1 (full sensor resolution), 2 (half sensor resolution), 4 (quarter sensor resolution).

The frame rate depends on the amount of data that is transferred. If the effective image size is small, a high frame rate can be achieved. The maximum frame rate is calculated, whenever the image size or the binning mode changes. The frame rate slider limits are adjusted. If needed, the framerate is also reduced, when the image size changes.

6.3.2.6 RTP

RTP streaming (see "Technical terms") can be enabled or disabled using the checkbox shown below.

Remark: RTP streaming allows image a maximum width of 2040 pixel. As the acquisition width must have a certain granularity, for RTP the width can not exceed 1984. When the checkbox is clicked and the binning mode is "1", the acquisition width is corrected accordingly.

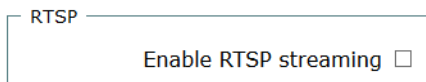


Figure 19 **Enabling RTP**

6.3.2.7 Gain control

Gain control can be done automatically or manually. For automatic gain control, the pixels in the gain control window are used. The gain control algorithm tries to adjust the image brightness so that the average grey value is reached inside the gain control ROI.

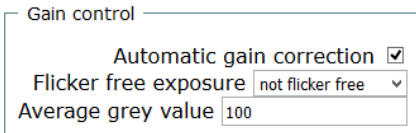


Figure 20 **Automatic gain control**

Flicker-free exposure is nice in a room with artificial illumination. Choose the power frequency used in your country (e.g. 50Hz in Germany).

For outdoor illumination best is to use "not flicker free". This allows the algorithm to use a wider range of exposure times.

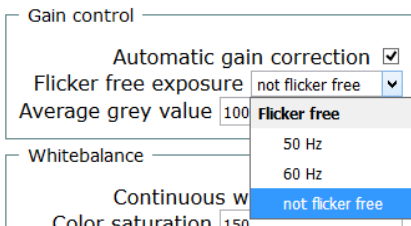


Figure 21 **Flicker free setting for automatic gain control**

With manual exposure, the exposure time and the gain for red, green and blue pixels can be chosen manually. The gain values can be 0-1024, the exposure time is 1-10000000

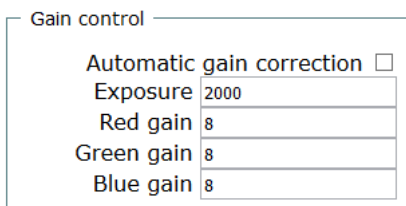
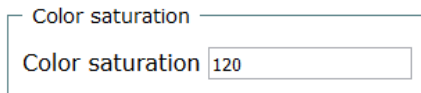


Figure 22 **Manual gain control**

6.3.2.8 Color saturation

The color saturation is a value between 0 and 200. Choosing "0" results in a grey level image, 200 results in very colorful images.

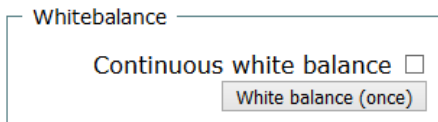


A screenshot of a web interface for color saturation. It features a label "Color saturation" above a text input field containing the value "120".

Figure 23 **Color saturation**

6.3.2.9 White balance

White balance can be done once or continuously. When "White balance (once)" is clicked, the white balance is calculated and the result is saved for the next reboot.



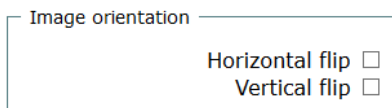
A screenshot of a web interface for white balance. It shows a label "Whitebalance" above two controls: "Continuous white balance" with an unchecked checkbox, and a button labeled "White balance (once)".

Figure 24 **White balance**

6.3.2.10 Image orientation

Sometimes it is convenient to change the image orientation, e.g. if the camera is installed upside down.

Image flip can be done using the flip checkboxes.



A screenshot of a web interface for image orientation. It shows a label "Image orientation" above two checkboxes: "Horizontal flip" and "Vertical flip", both of which are currently unchecked.

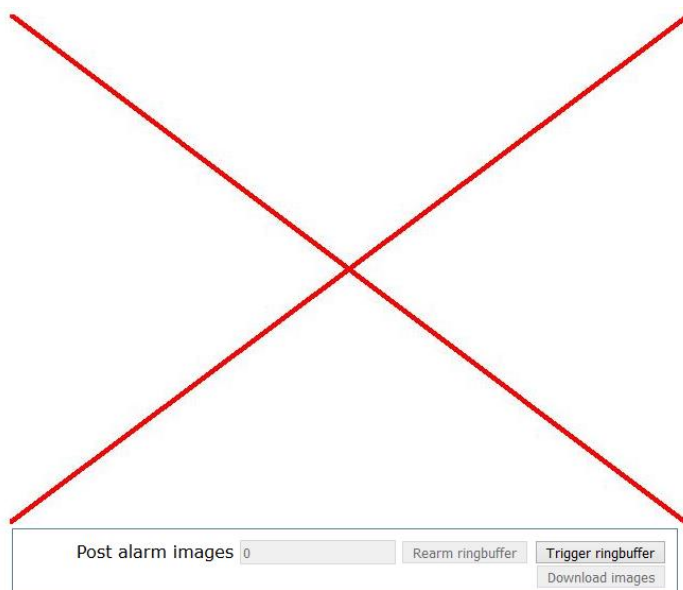
Figure 25 **Image orientation**

6.3.3 Live image

The live image page shows the live image using its current resolution.

To see the live image without the menu bar, the direct URL to the live image can be used: "http://camera_ip/camera/live_image.lp"

6.3.4 Ringbuffer



A screenshot of a web interface for the ringbuffer, which is crossed out with a large red 'X'. The interface includes a text input field for "Post alarm images" with the value "0", and three buttons: "Rearm ringbuffer", "Trigger ringbuffer", and "Download images".

Figure 26 **Trigger ringbuffer**

When no ringbuffer images are stored in the file system, the ringbuffer page comes up with a cross to show, that there are no images stored yet.

The button "Trigger ringbuffer" can be used to trigger the ringbuffer.



Figure 27 **Ringbuffer re-arm, download and display**

When the images are fetched from the ringbuffer and stored in the filesystem, the web page changes.

Use the slider to watch the different images.

The button "Download images" can be used to download the images packed as ZIP file.

The button "Rearm ringbuffer" restarts the ringbuffer recording which waits for a trigger.

"Post alarm images" denotes the number of images to be recorded after the trigger arrives.

6.4 About Menu

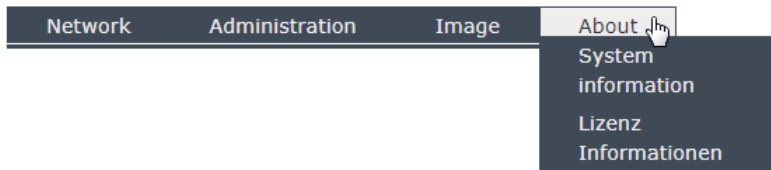
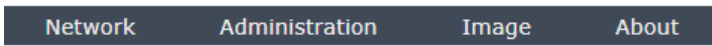


Figure 28 **About menu**

Using the menu "about", general system information can be retrieved. Additionally, the licenses of the OpenSource components used can be viewed.

6.4.1 System information



System information

Order number	50141925
Board revision	0A
Serial number	10810556
MAC address	00:00:5B:04:AD:F7
Software version	20200723h
Application version	20180307_2

Figure 29 **Screenshot system information**

This page shows the cameras system information. In case of support request, this information is needed.

6.4.2 Licenses

This page contains the information about the licenses of the OpenSource components used in the camera.

The page will look similar, but not identical to the image below.

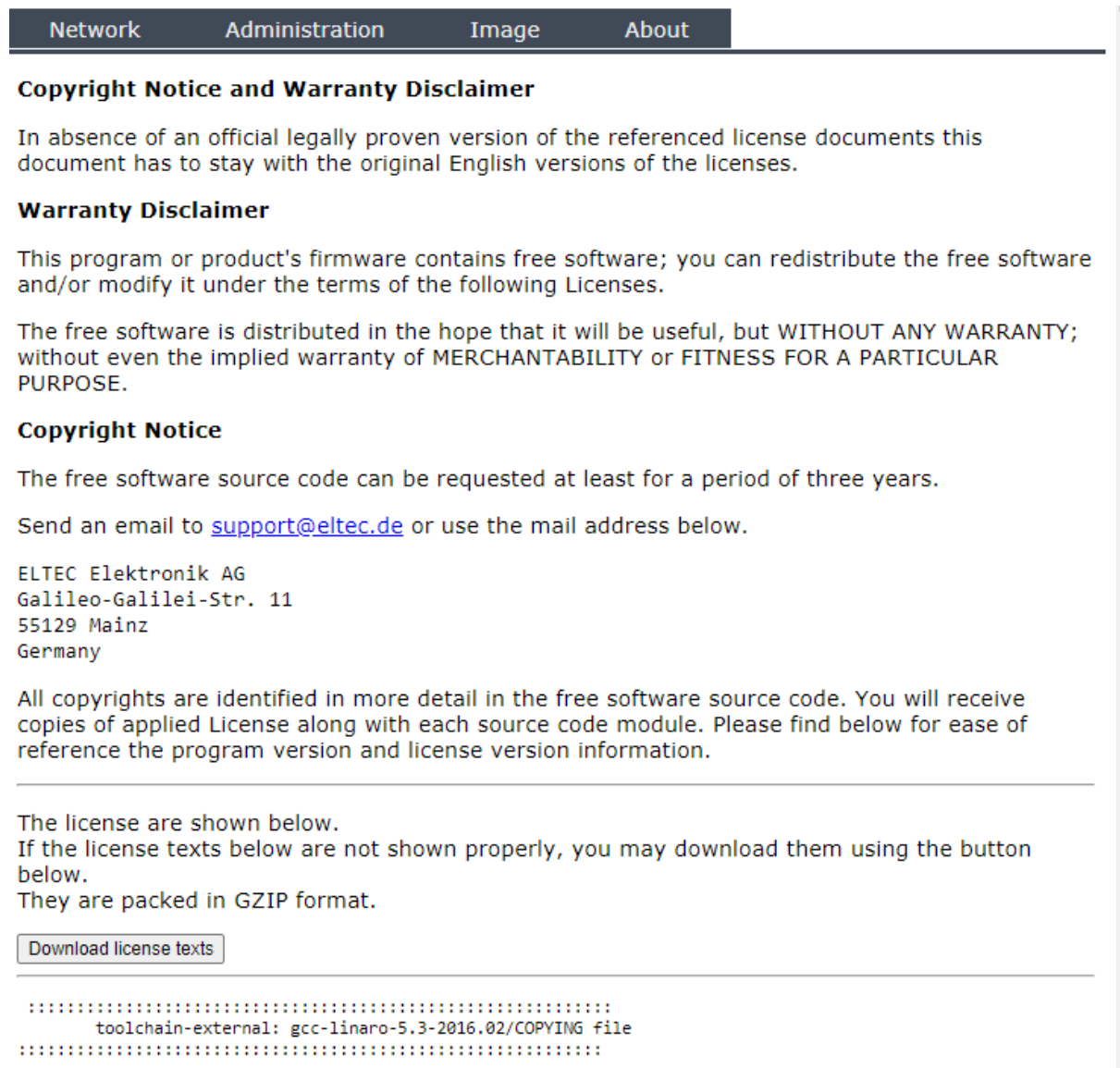


Figure 30 Licenses page

7 Appendix

7.1 Data sheet key data

Below you find a block diagram of the electronics and key data for the sensor.

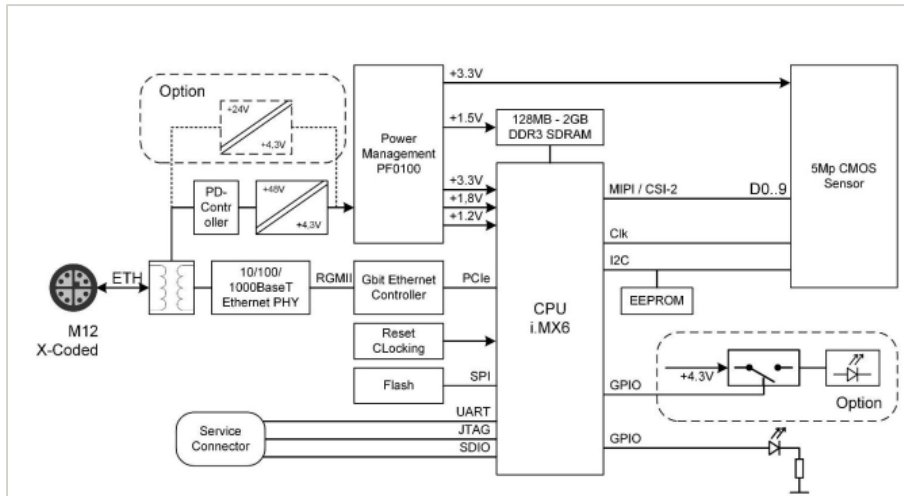


Figure 31 **Block diagram of the electronics**

CMOS Sensor	
Optical format	1/2.5-inch (4:3)
Active image size	5.70 mm (H) x 4.28 (V), 7.13 mm diagonal
Active pixels	2592 H x 1944 V
Pixel size	2.2 x 2.2 μm
Frame rate	Up to 14 fps at full resolution
	Up to 53 fps at VGA (640 x 480)
Binning factors	1, 2, 4 linear i.e. 1, 4, 16 area
ADC resolution	12-bit
Responsivity	1.4 V/lux-sec (550 nm)
Pixel dynamic range	70.1 dB
SNR _{MAX}	38.1 dB

Figure 32 **Sensor data**