How to Install a VDS Vosskühler GigE Camera

Version 1.0.1

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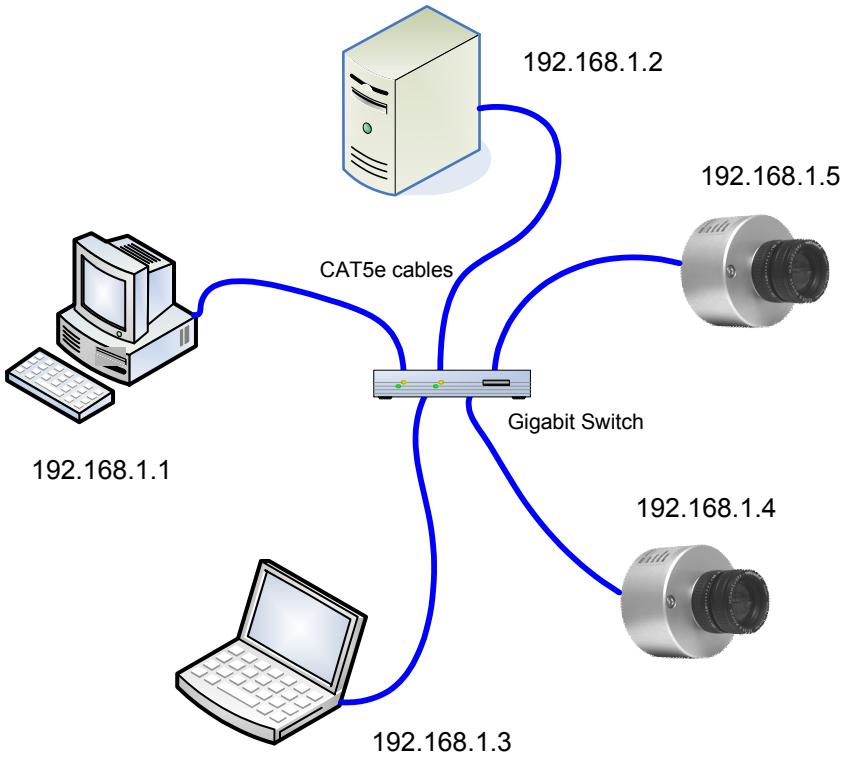
1 IP Based Camera Access: Background Information

In order to access a camera (or any other device) in the network, it is necessary that the camera and also the Network Interface Card (NIC) have a valid IP address. Every device in the network must have a unique IP address.
The following graphics illustrates the assembling of such network:



The chosen IP addresses and the way how the devices are connected in the illustration above are just an example. It is also possible to connect the camera directly to a PC/notebook.
The following subchapters describe what IP addresses can be used and how they are obtained.

In order to work properly with a VDS GigE camera please take care of the following:

- The NIC (Network Interface Card) of the PC should be **Gigabit Ethernet** (1000Base-T) compatible.
- If Windows XP is used as operating system, make sure that the Microsoft Hotfix **KB926255** is installed.
- Verify that the network communication with the camera is not blocked. Disable any firewalls (Windows Firewall & Personal Firewall). Some antivirus solutions may also disturb network traffic. Please disable these applications also.
- After the first functional test of the camera you can try to re-enable Firewalls and antivirus solutions step by step (See *chapter 8, Adjusting Firewall Settings*).
- If your PC/Notebook has more than one network port, it is recommended to use one port for normal LAN traffic and the second port only for camera traffic.

2 IP Settings: Preliminary Considerations

There are several different ways how the camera gets its IP address. Please refer to the following subchapters to choose the best solution for your application. Please also refer to the *chapter 3, General Hints for Setting IP Addresses* for additional information how to set an IP address for a NIC (Network Interface Card).

2.1 Link Local Address

The Link Local Address scheme (*Zero Configuration Networking* or *Automatic Private IP Addressing*) is the easiest way to set the IP. The IP address of the camera is automatically set without any external server. In order to use this method the IP address of the NIC just has to be set to a special range. Go to the TCP/IP configuration page of your computers NIC and add an IP address with the following parameters (see screenshots in *chapter 3, General Hints for Setting IP Addresses*):

IP: `169.254.xxx.xxx`
Subnet: `255.255.000.000`

```
Example:    PC          169.254.1.1       <- Set by the user once
            Camera      169.254.1.152     <- Set automatically after every
                                             camera power up to a random
                                             number within the subnet.
```

2.2 DHCP

The Dynamic Host Configuration Protocol is used to set the IP address of a network device (the camera) dynamically by an external DHCP server. If your LAN already uses a DHCP server you only have to connect the camera to the LAN and the IP configuration is done automatically. Please contact your local network administrator regarding DHCP.

```
Example:    PC          192.168.101.21    <- Set by the DHCP server
                                             automatically after every
                                             PC power up to a random
                                             number within the subnet.
            Camera      192.168.101.198   <- Set by the DHCP server
                                             automatically after every
                                             camera power up to a random
                                             number within the subnet.
```

2.3 Static IP

The camera can also use a static IP address. This address can be set while connecting to the camera with an external tool like Coyote, GEV-Player or VDS Vosskühler AcquireControl. Please note that the Pleora driver and SDK have to be installed to run these applications.

```
Example:    PC          192.168.1.1       <- Set by the user once
            Camera      192.168.1.2       <- Set by the user manually after
                                             every camera power up.
```

2.4 Static Persistent IP

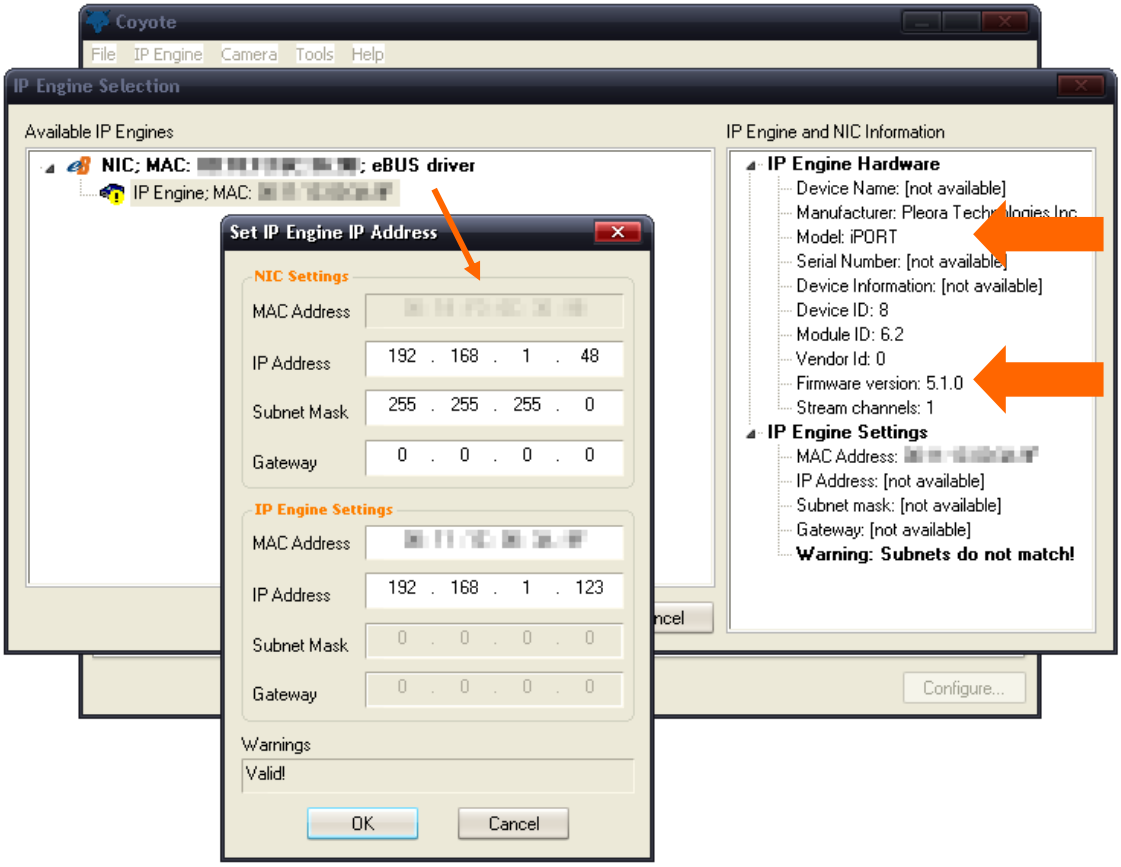
Here the camera gets a static IP address which is stored persistently in the camera. So after every power up of the camera the same IP address is available.
To use this address scheme it is necessary to have a GIP-1000 module with at least iPORT firmware 5.1.0. or GEV firmware 1.22.

```
Example:    PC          192.168.1.1       <- Set by the user once
            Camera      192.168.1.2       <- Set by the user once
```

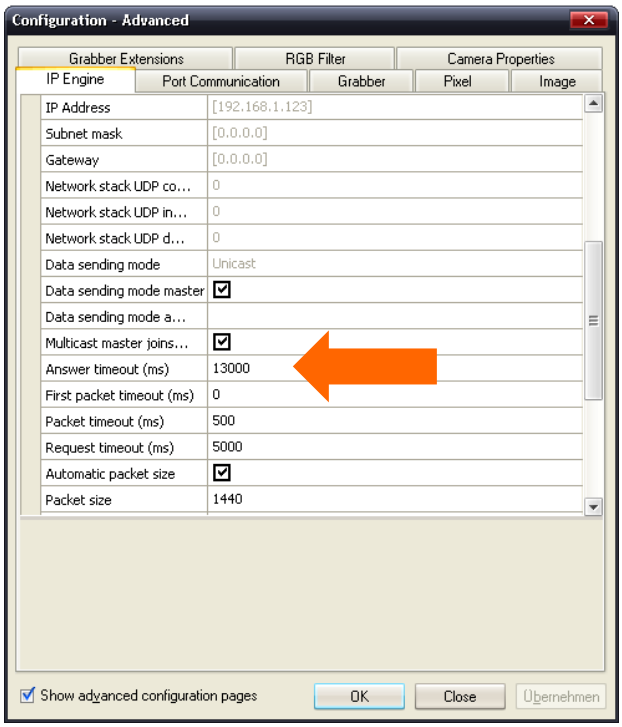
2.4.1 Static Persistent IP for iPORT Device

To store a persistent IP for a camera with iPORT firmware the Pleora software Coyote has to be used. Please refer to *chapter 4, Installing the Gigabit Ethernet Driver from Pleora* regarding installation of this software.

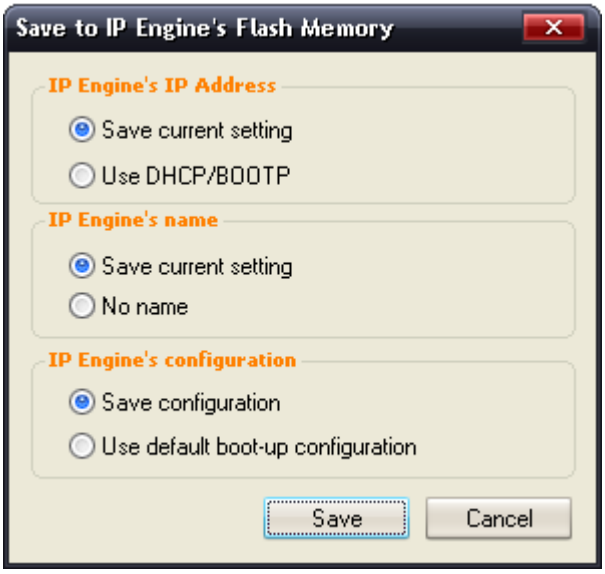
- Open Coyote, select the camera and set the desired persistent IP



- Select a camera type and click on the connect button.
- Click on the "**Configure…**" button and select the "**IP Engine**" tab. Find the "**Answer timeout (ms)**" value and increase this value from 1000 to **13000**. If the camera should use a special name you can enter it in the field "**IP Engine device name**".
- Click OK to close this dialog



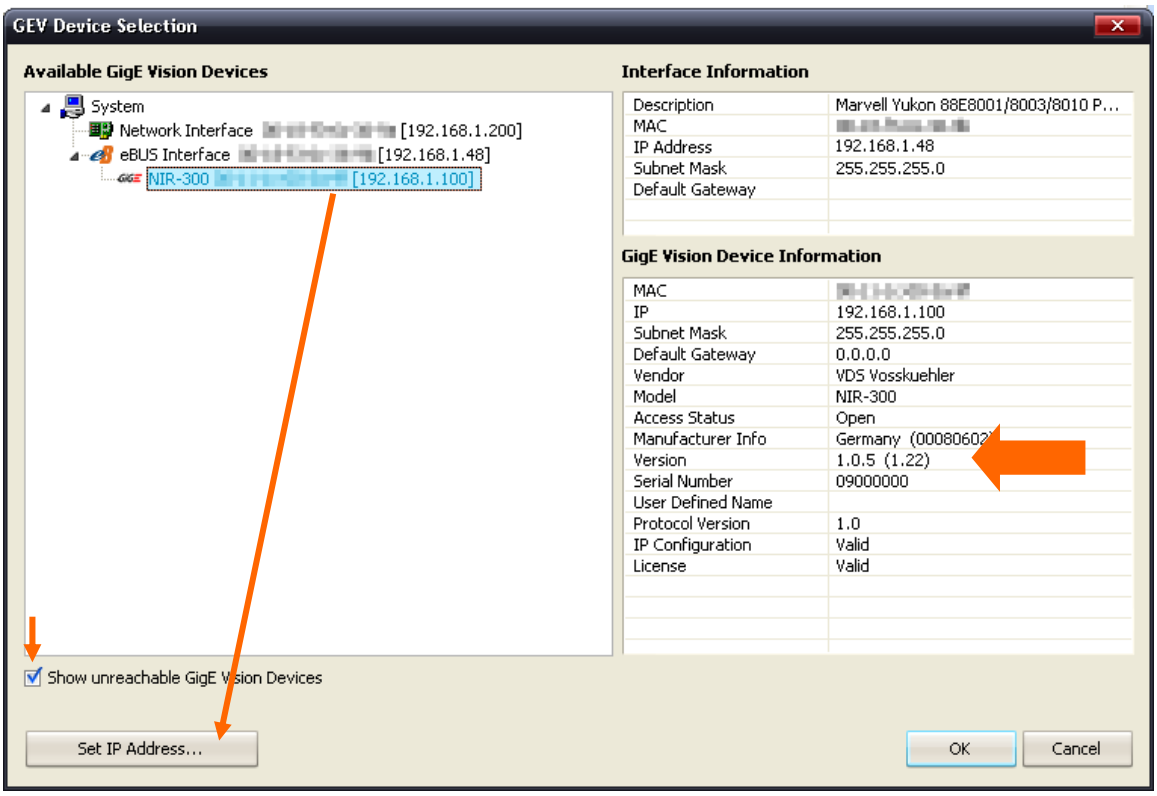
- In the main window from Coyote select the menu "**IP Engine**" and click on "**Save to flash memory**". Click "**Save**" to store the current setting in the GIP-1000 module.



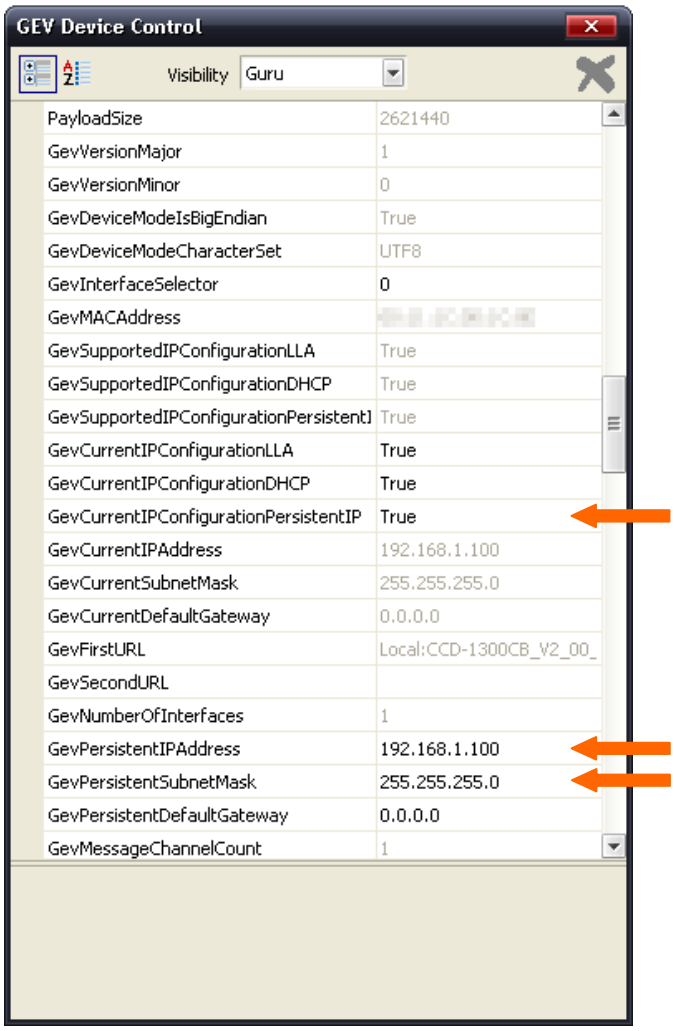
2.4.2 Static Persistent IP for GEV Device

To store a persistent IP for a camera with GEV firmware the Pleora software GEV Player should be used. Please refer to *chapter 4, Installing the Gigabit Ethernet Driver from Pleora* regarding installation of this software.

- Open GEV Player, select the camera and set the desired persistent IP



- Open the "**GEV Device Control**" dialog and change the following values:



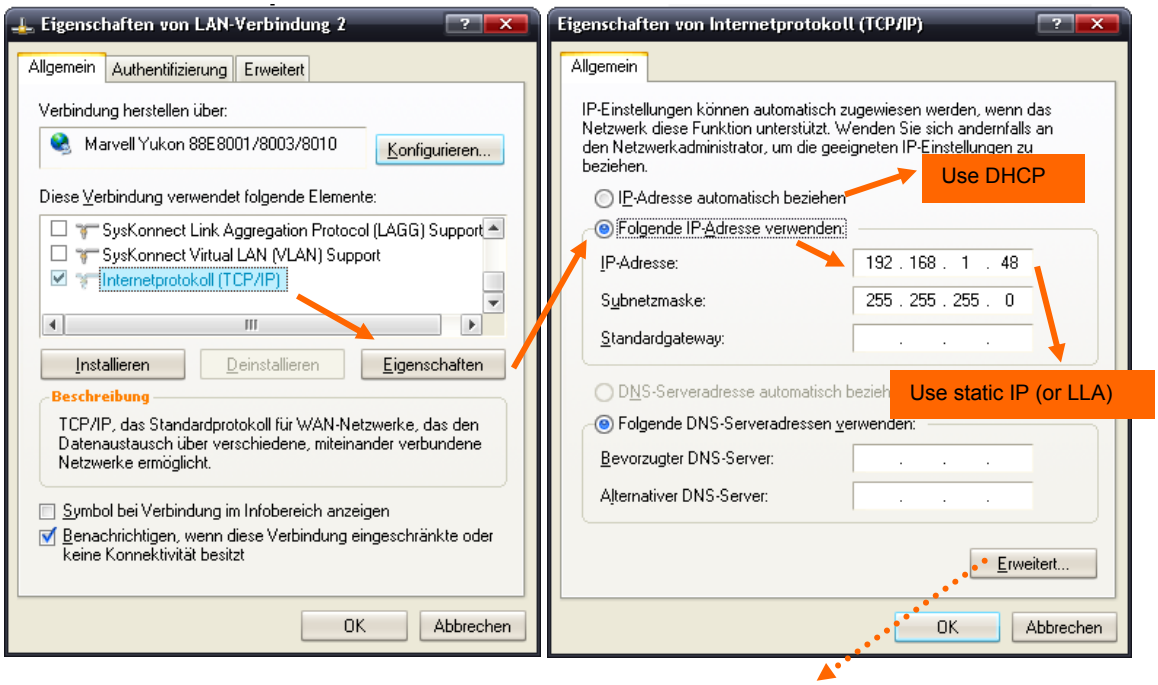
GevCurrentIPConfigurationPersistentIP
→ Set to true

GevPersistentIPAddress
→ Set IP Address

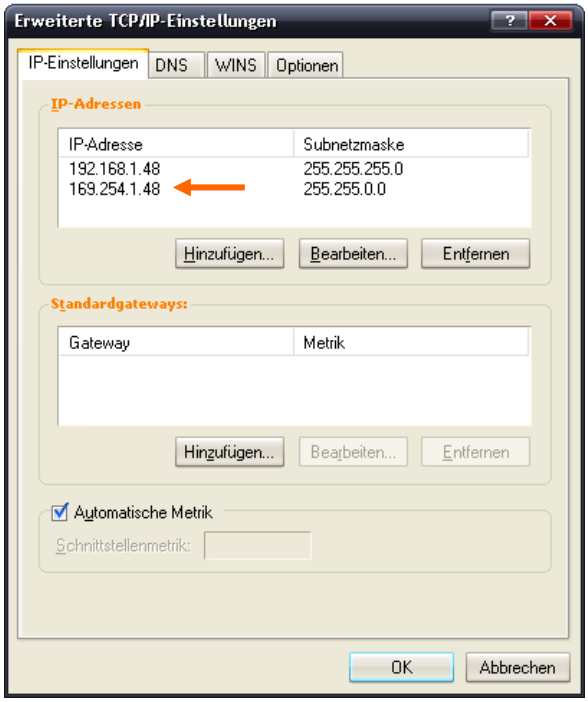
GevPersistentSubnetMask
→ Set Subnet Mask

3 General Hints for Setting IP Addresses

- While changing Windows IP address settings make sure that no camera application is running.
- To set the IP address of a PC NIC, open the network connections (Start → Settings → Network connections). Then open the properties window of the desired connection.

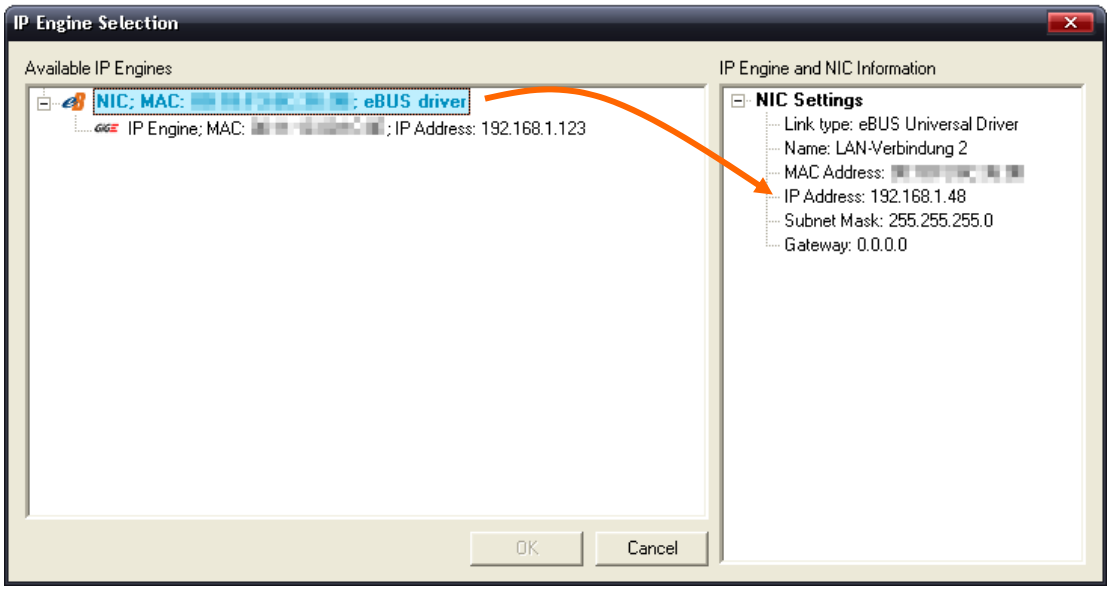


- It is also possible to add a second (or even more) IP address(es) to the NIC. In this case the Pleora IP engine always uses the **last entry** of the IP list:
  Example: This NIC works with two IP ranges:
  - Static IP address for LAN traffic
  - LLA for a camera



If the two entries in this example were swapped the camera would work in the 192.168.1.XXX range.

To verify which NIC IP address is used by the Pleora IP engine, click on the NIC entry during camera selection process.



4 Installing the Gigabit Ethernet Driver from Pleora

In order to access a camera it is necessary to install a driver. All driver versions have in common that three possible architectures can be used:

- Manufacturers Driver (Slow performance)
- iPORT Filterdriver or eBUS Filterdriver (High performance)
- Intel High Performance Driver (Highest performance, only for Intel PRO1000 cards)

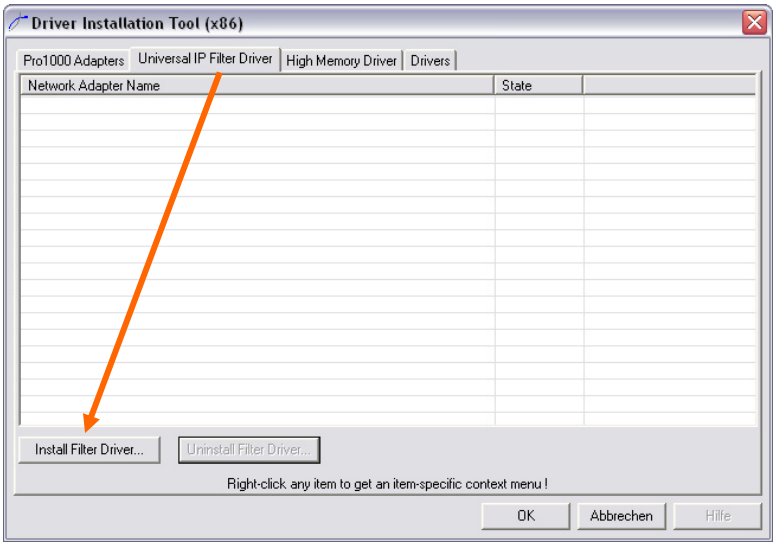
We recommend to use the iPORT/eBUS Filterdriver architecture for the best performance.

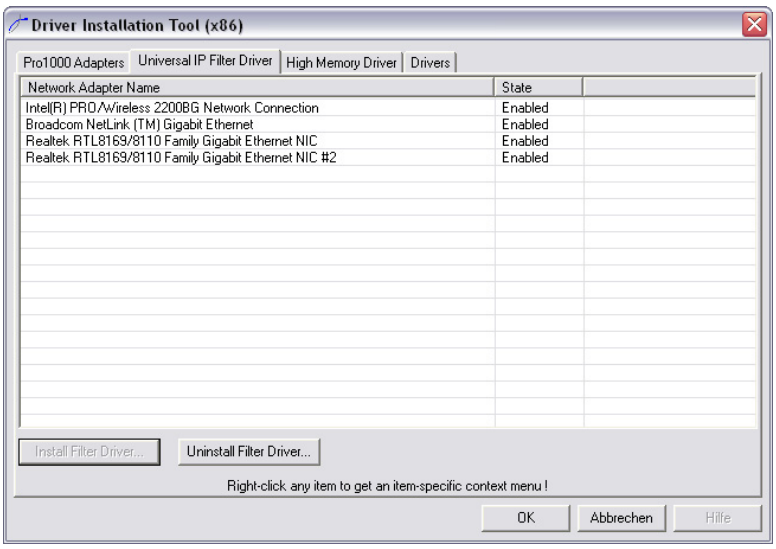
It is **not** necessary to install any driver if you **ONLY** want to work with **National Instruments** applications. Nevertheless it does not harm the operation of the National Instruments software if you install the software. Refer to *chapter 6.5, Using National Instruments* regarding this issue.

Before you install a driver make sure that all old Pleora drivers have been deinstalled. After deinstallation restart the computer.
Depending on the version of the driver/SDK the installation steps differ:

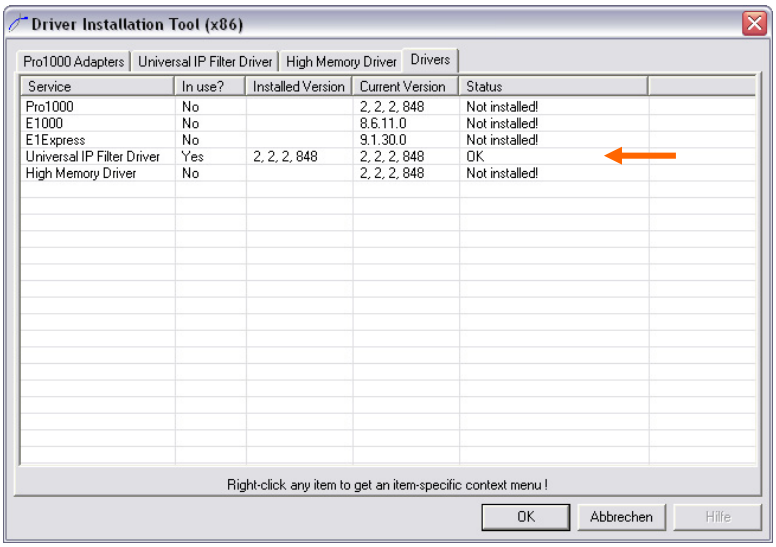
4.1 Driver V 2.2.x

- Start the SDK-Setup `iPORT_IPEngineSDK_2.2.2.848.exe` to install the driver for the Gigabit-Ethernet communication.
- After installation go to the start menu entry "Start → Programs → Pleora Technologies Inc → iPORT Software → Launch Driver Installation Tool". Then go to the "**Universal IP Filter Driver**" Tab and click on "**Install Filter Driver**".

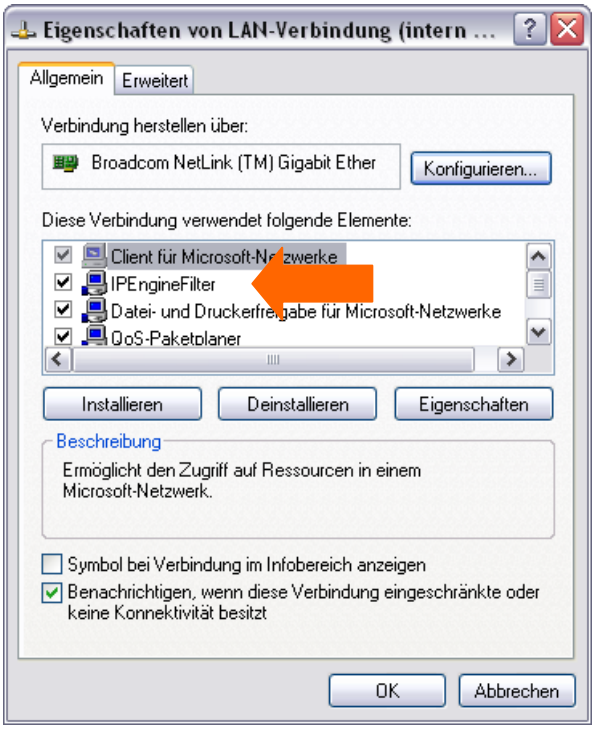




- To verify the installation you can select the “Drivers” tab.

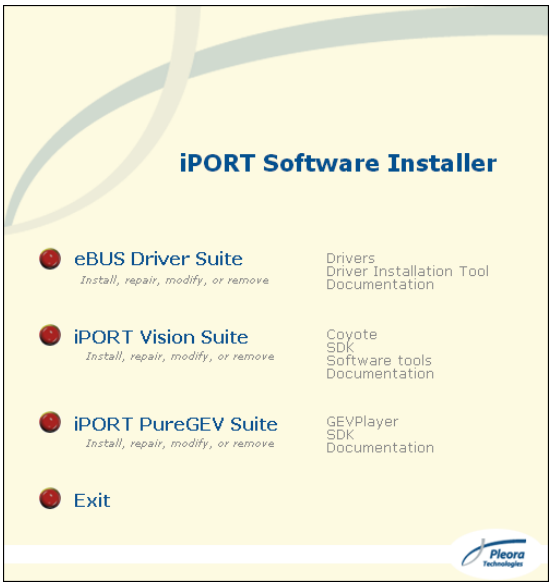


- Restart the computer.
- To verify if the filter driver has been installed properly, go to the properties dialog of the network connection. The entry “**IPEngineFilter**” must exist and been enabled. On some systems additional filter drivers were already installed (e.g. for special VPN connections). Such additional drivers may interfere with the Pleora driver. Please contact your system administrator for further assistance.

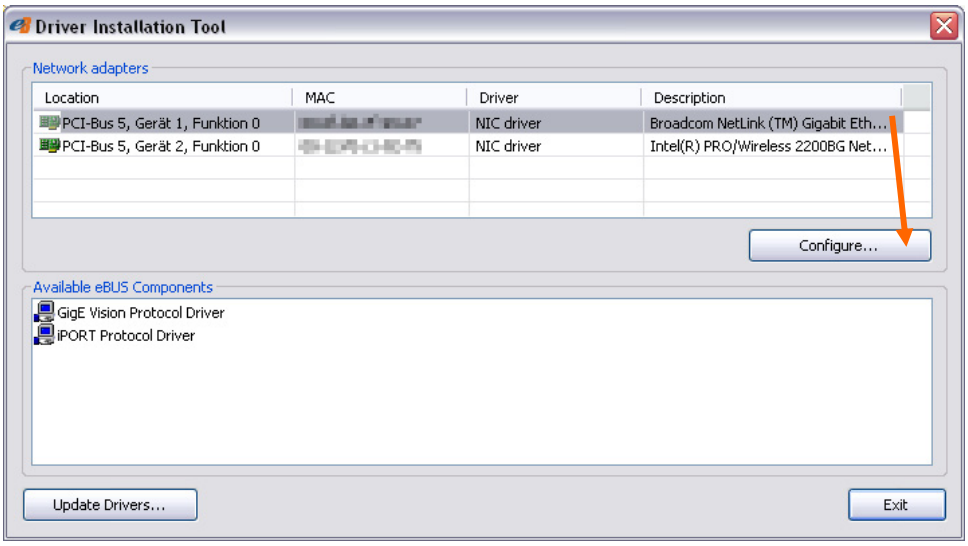


4.2 Driver V 2.3.x

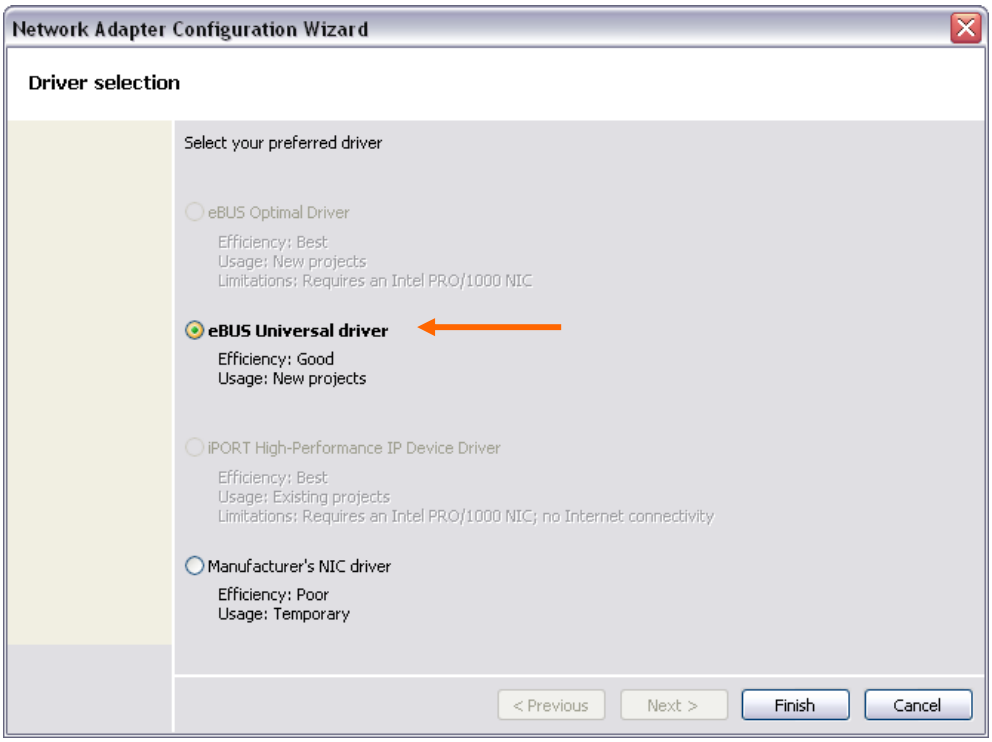
- Start the SDK-Setup `IPEngineSDK_2.3.3.740.exe` to install the driver for the Gigabit-Ethernet communication. You have to install the "**eBUS Driver Suite**" and the "**iPORT Vision Suite**" at least. It is recommended also to install the "**iPORT PureGEV Suite**".



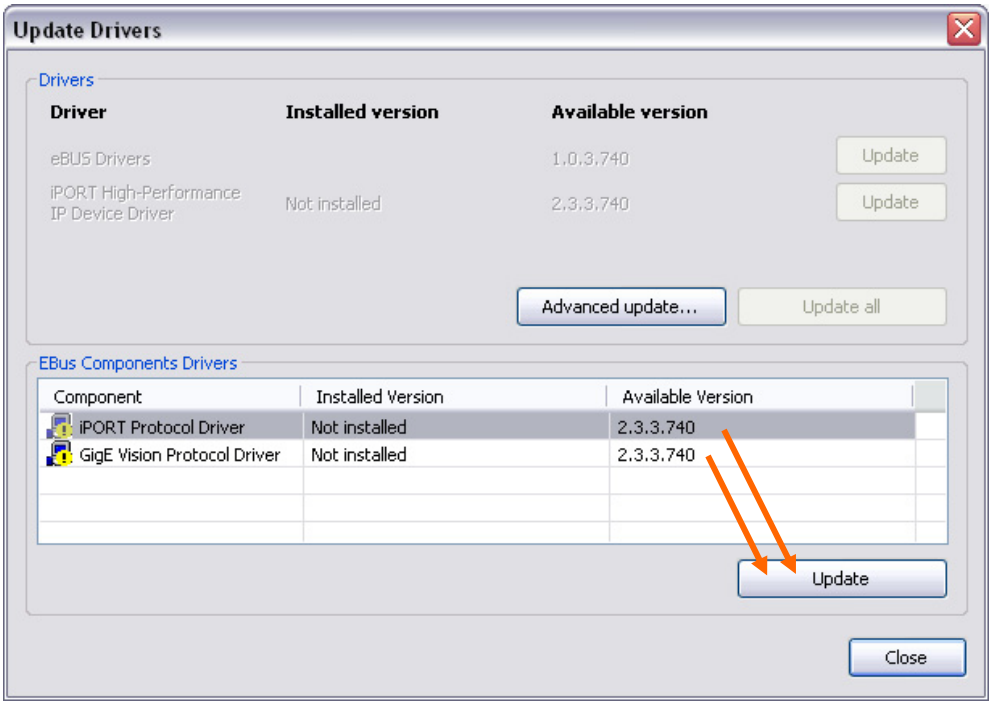
- Please also install the **Hotfix 2.3.3.740** from the installation CD (`Hotfix_2.3.3.740.cmd`).
- After the installation open the Pleora "**Driver Installation Tool**". (Start → Programs → Pleora Technologies Inc → eBus Driver Suite → Driver Installation Tool). Select the network adapter you want to use with the camera and click "**Configure…**".



- For the best performance you should use the eBUS Universal driver.

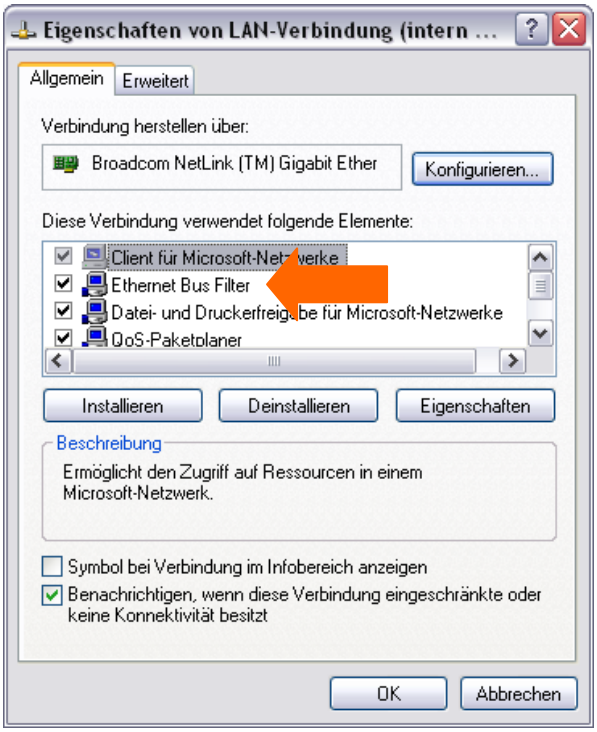


- Back in the main dialog click on "**Update Drivers…**". Select each entry in the list and click on "**Update**" for each entry.



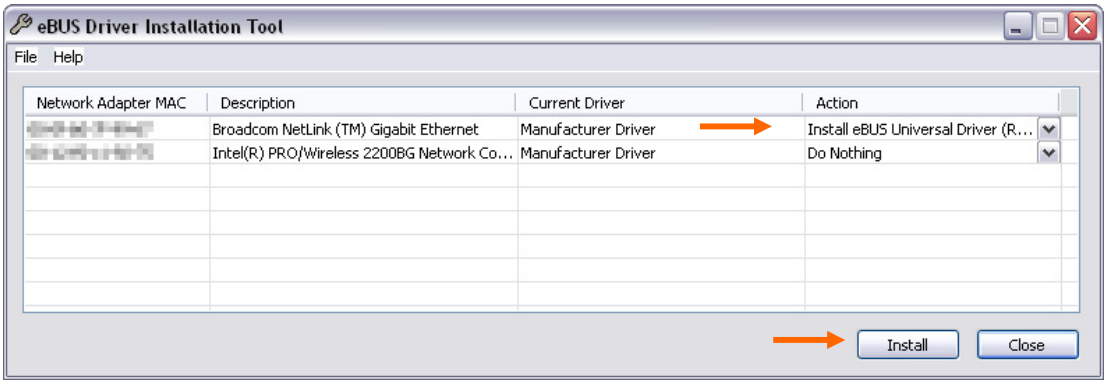
- Restart the computer.

- To verify if the filter driver has been installed properly, go to the properties dialog of the network connection. The entry "**Ethernet Bus Filter**" must exist and been enabled. On some systems additional filter drivers were already installed (e.g. for special VPN connections). Such additional drivers may interfere with the Pleora driver. Please contact your system administrator for further assistance.



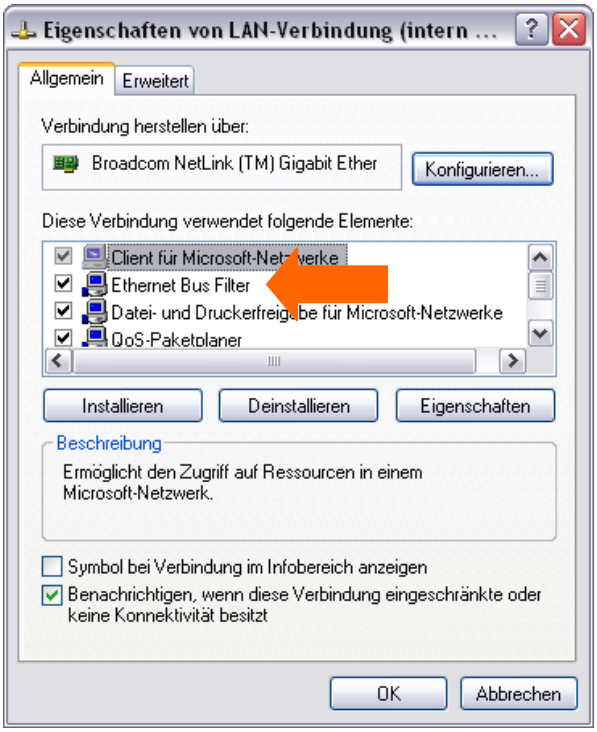
4.3 Driver V 3.1.x

- Please note that the setup needs Microsoft .NET 2.0 to be installed.
- Start the SDK-Setup `eBUS-Vision_Package_3.1.0.1383.exe` to install the driver for the Gigabit-Ethernet communication. During the installation process the driver installation tool pops up. Here you can select for which network adaptor the filter driver should be installed.



- Restart the computer.

- To verify if the filter driver has been installed properly, go to the properties dialog of the network connection. The entry "**Ethernet Bus Filter**" must exist and been enabled. On some systems additional filter drivers were already installed (e.g. for special VPN connections). Such additional drivers may interfere with the Pleora driver. Please contact your system administrator for further assistance.



5 Hardware Connection & First Power Up

- Connect the camera via a CAT5e cable to the PC/notebook. This can be done directly or over a gigabit network switch.
- Connect the camera to the power supply.
- Power on the camera and verify the state of the LEDs on the backside of the camera (GIP-1000 module). It can take up to 5 seconds until the LEDs reach their final state.

LED states for different camera models		
Standard cameras	**NIR Cameras**	**IRC cameras**
L2: Constantly ON **L3:** OFF (IOD or temperature state for COOL cameras) **Power:** Constantly ON **L4:** OFF (Exposure input) **L5:** ON (for every frame)	**L2:** Constantly ON **L3:** OFF (Cooling state, OFF = OK) **Power:** Constantly ON **L4:** OFF (Exposure input) **L5:** ON (for every frame)	**L2:** Constantly ON **L3:** OFF (Cooling state OFF = OK) **Power:** Constantly ON **L4:** No function **L5:** No function

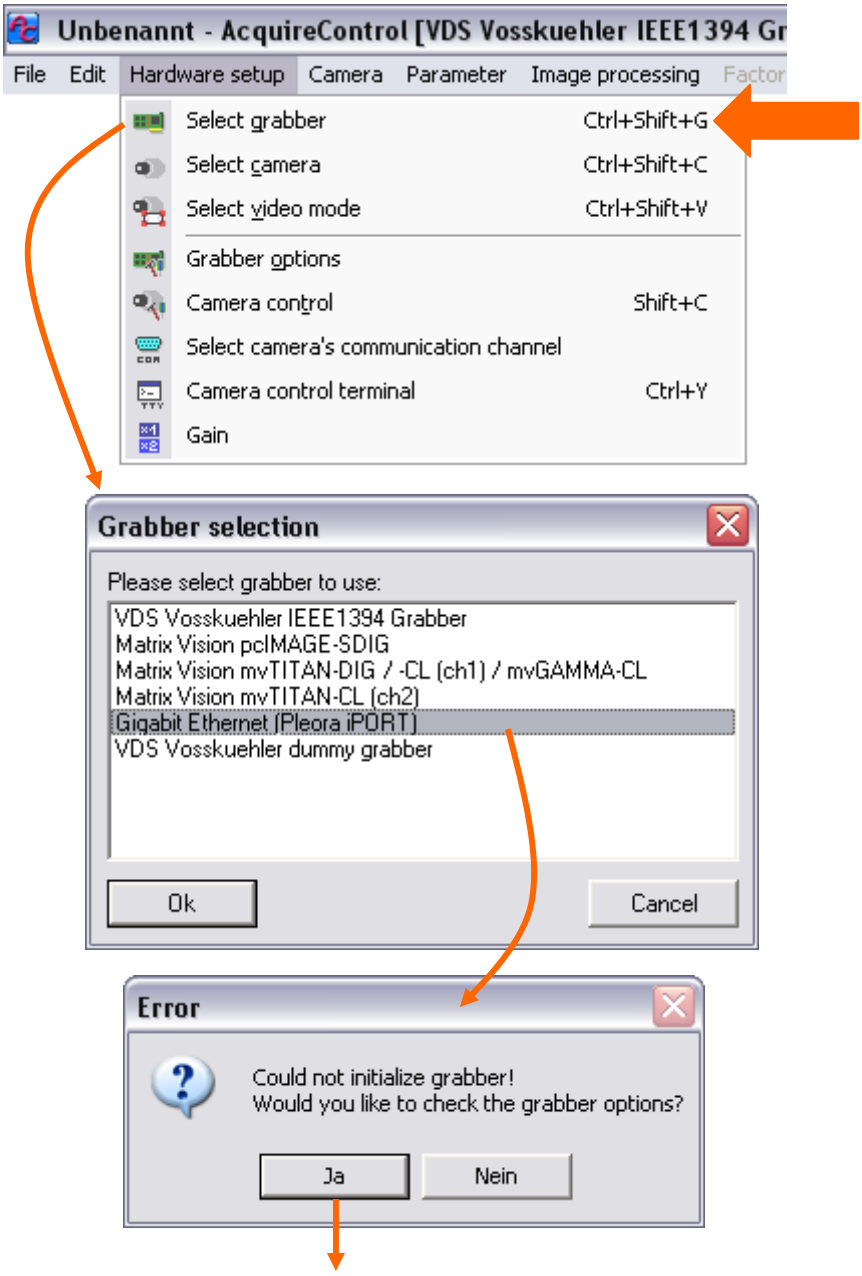
6 Display Camera Live Images

In order to display live images from the camera several programs can be used. The following subchapters describe how to get a live image using these programs. Please also refer to the detailed manual of the chosen application.

6.1 Using AcquireControl

Most of the following settings are stored by the application, so these configuration steps are necessary only once.

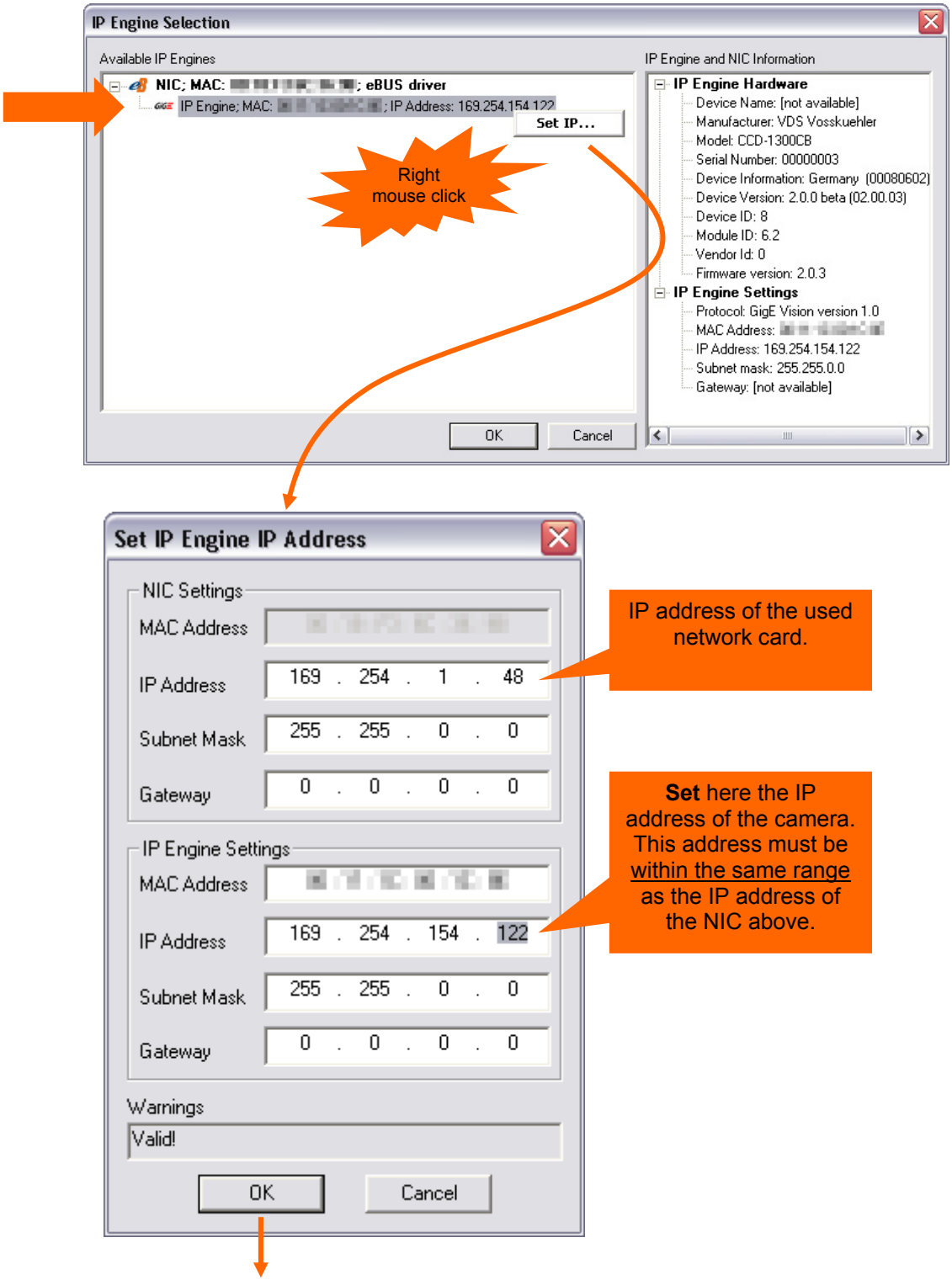
6.1.1 Select the grabber



Now the “IP Engine Selection” dialog pops up.

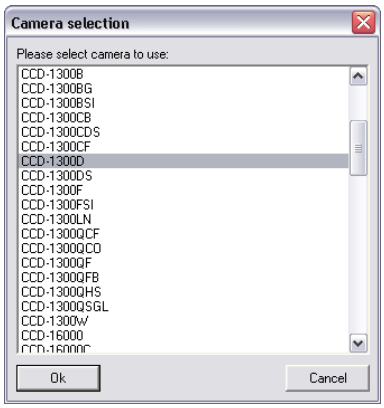
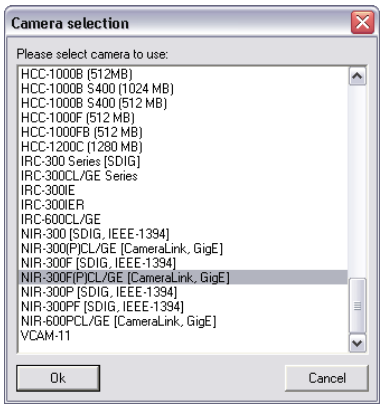
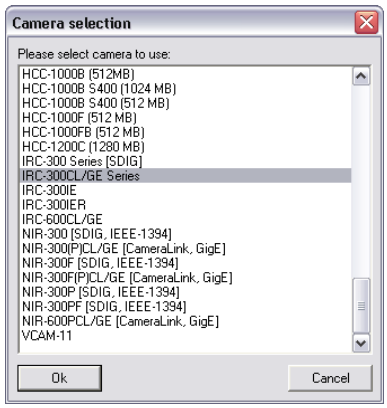
6.1.2 Select the IP address

In dependence of the driver version you use, the appearance of this dialog may differ.

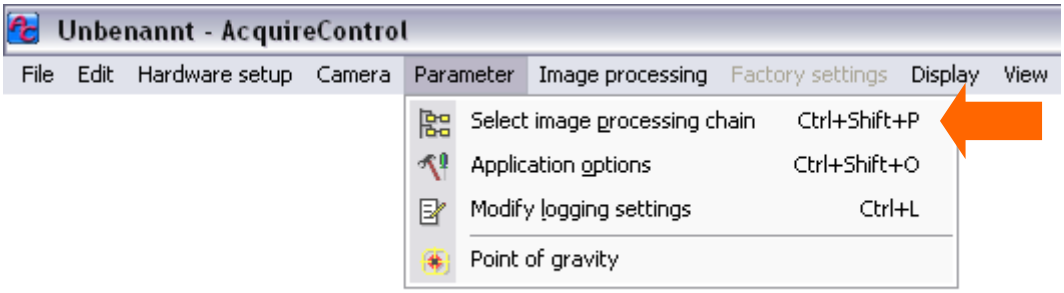


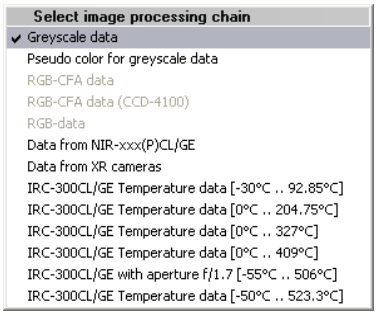
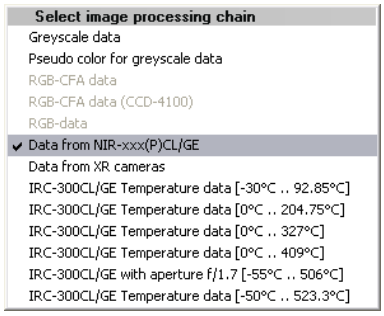
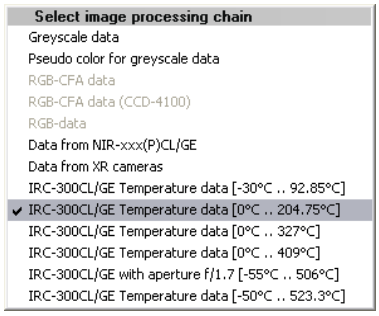
After closing the “Set IP Engine IP Address” dialog you now can select the eBUS Filter driver entry.

6.1.3 Select the camera

Standard cameras	NIR Cameras	IRC cameras
		
Select the camera model you want to use.	Select `NIR-300(P)CL/GE`, `NIR-300F(P)CL/GE` or `NIR-600PCL/GE`.	Select the `IRC-300CL/GE` entry.

6.1.4 Select the Image Processing Chain



Standard cameras	NIR Cameras	IRC cameras
		
Select `Greyscale data` for monochrome cameras or `RGB-CFA data` for a color camera.	Select `Data from NIR-xxx(F)CL/GE`.	Select one of the IRC-300 chains, regarding to the temperature range of your camera.

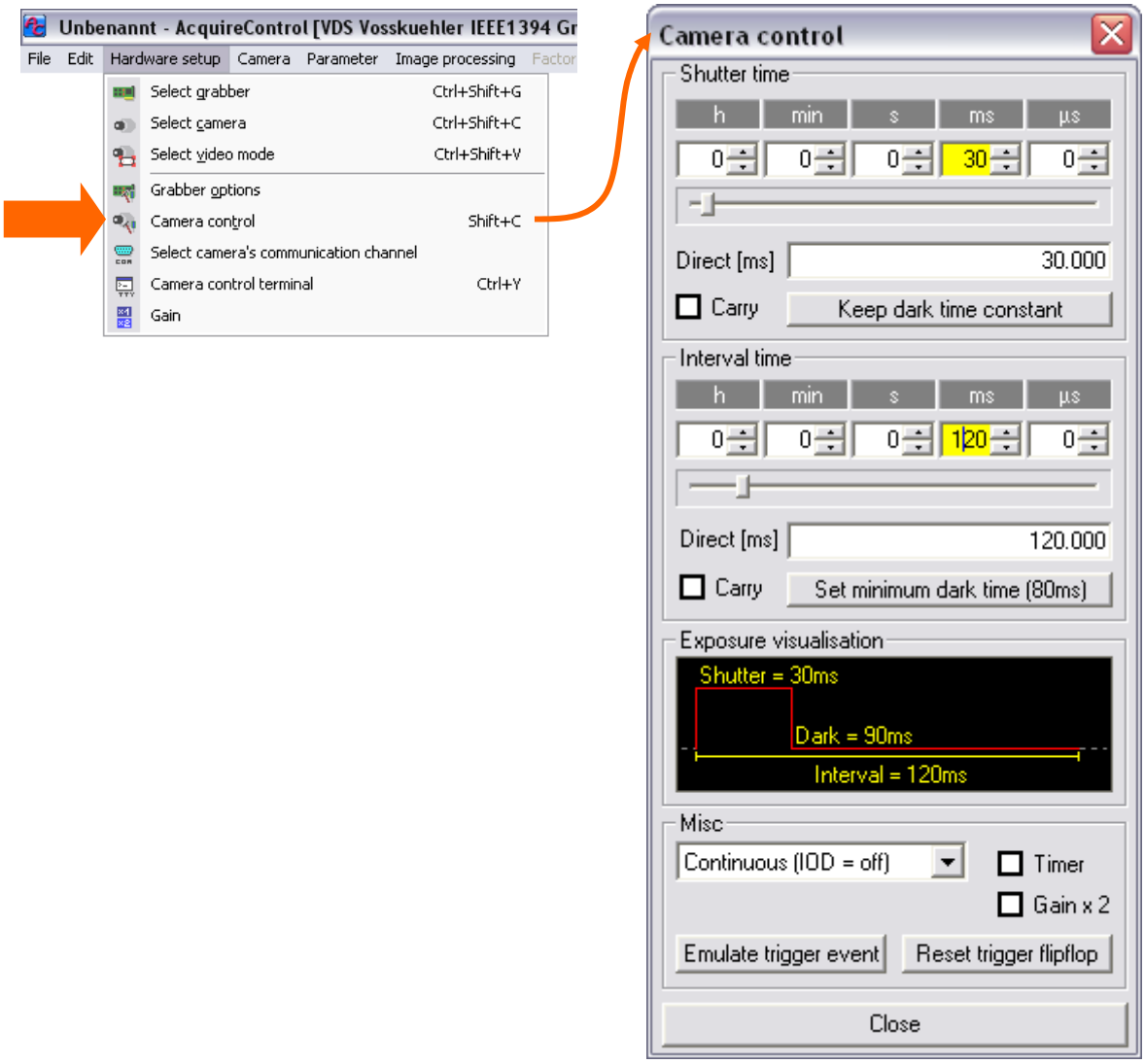
6.1.5 Start the Continuous Snap

Now you will get live images from the camera with the default exposure time and default camera settings. You can stop the live image by “Stop snap” at every time.

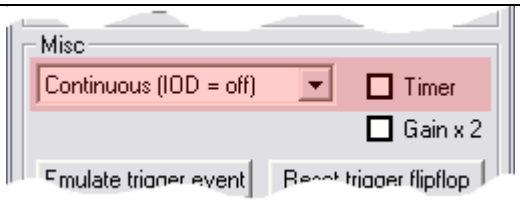
6.2 Advanced Operations

The AcquireControl software was developed for many different cameras, so we will try to introduce you in the basic commands for controlling your camera.

6.2.1 Exposure Control



6.2.1.1 CCD & CMOS Cameras

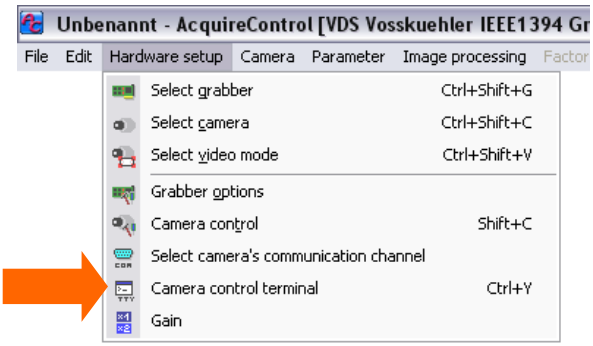
Continuous Mode. The camera will use it's build in exposure signal, which is always constant.	
IOD Timer Mode. The exposure signal is generated by a timer, which can be adjusted with the dialog.	
IOD Trigger Mode. The camera will wait for an external exposure signal.	

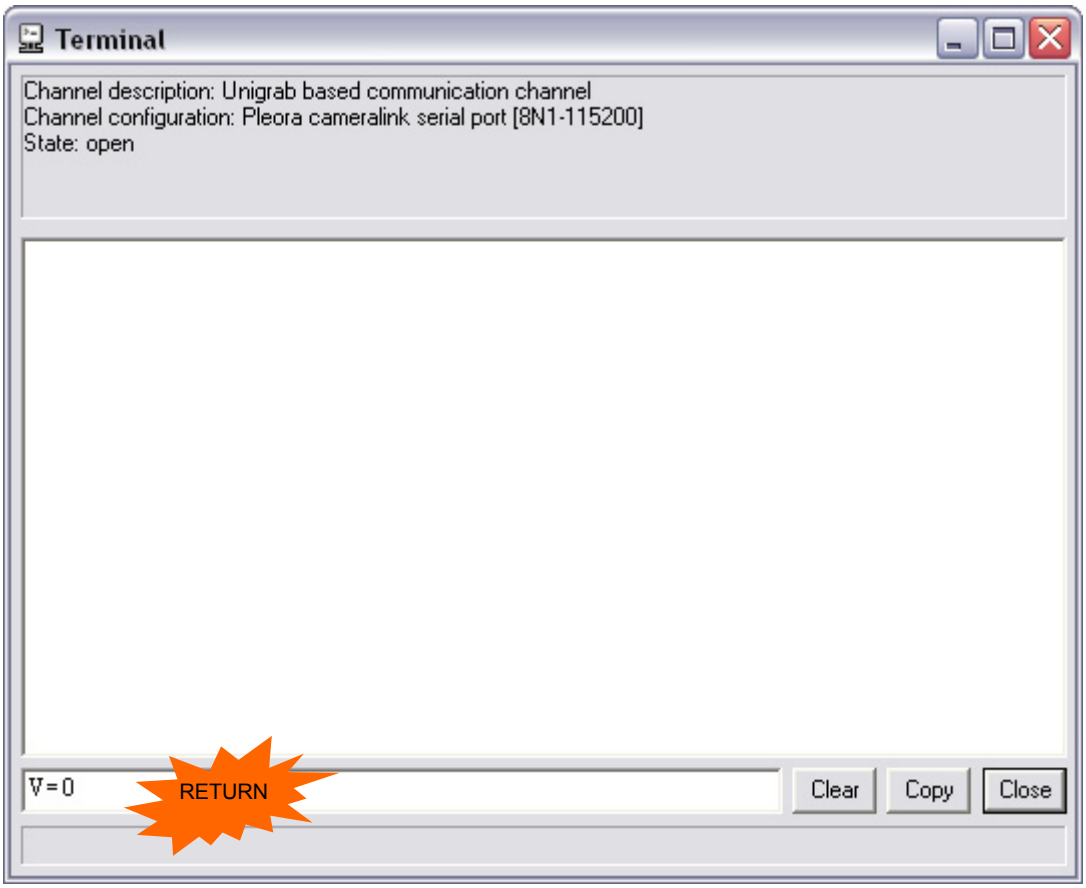
6.2.1.2 NIR Cameras

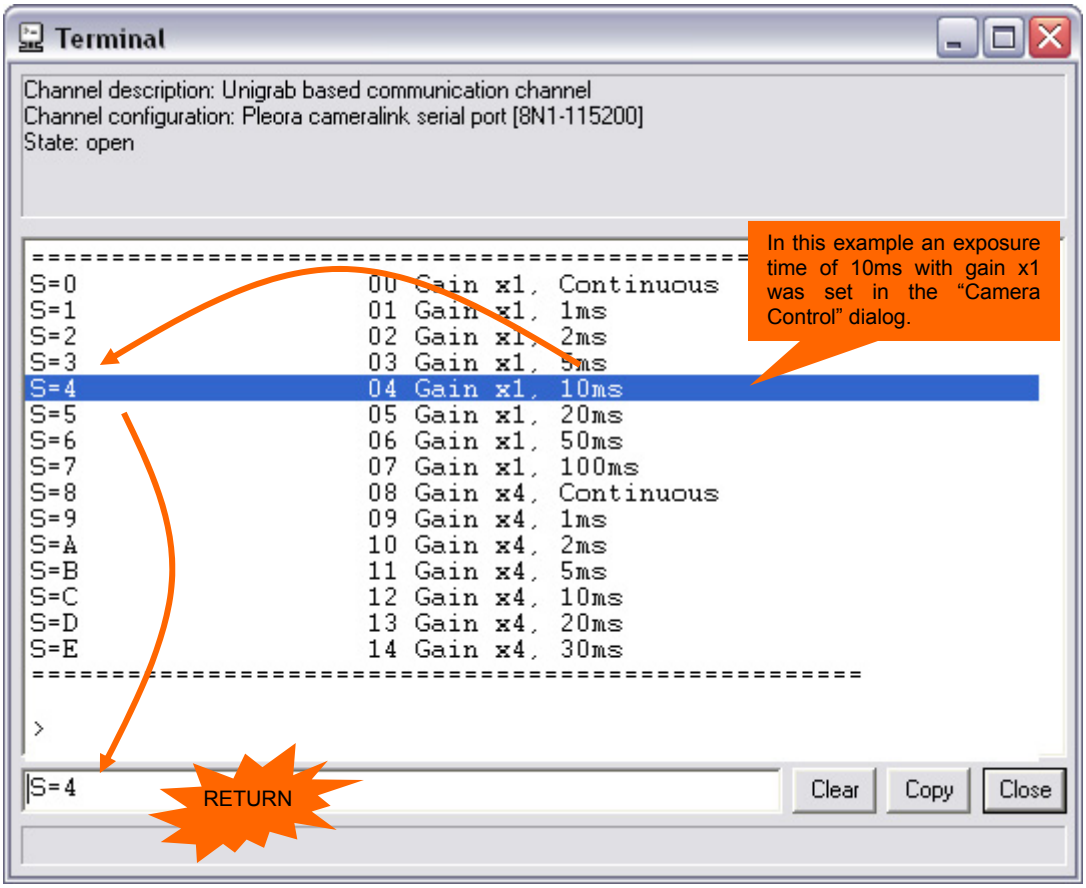
NIR cameras have an internal non uniformity correction and bad pixel correction. The non-uniformity depends on the exposure time and the gain, so you have to change the correction in case of changing the exposure-time or gain.
To get a good image quality, we have made different correction sets inside the camera. So it is very easy to change the correction when changing the exposure time or gain.

To adjust the exposure time, you always have to process two steps:

- **Adjust the Exposure time or Continuous mode and Gain setting like described in *chapter 6.2.1.1, CCD & CMOS Cameras.***
- **Select the corresponding correction data set as follows:**



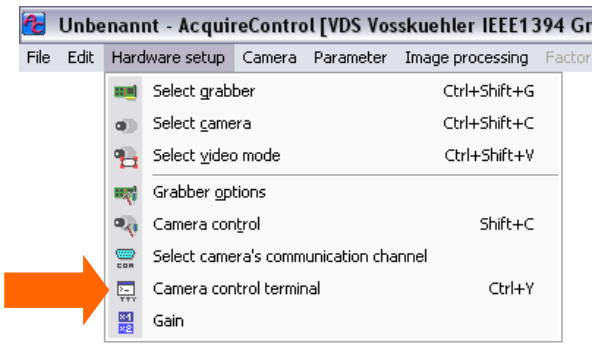


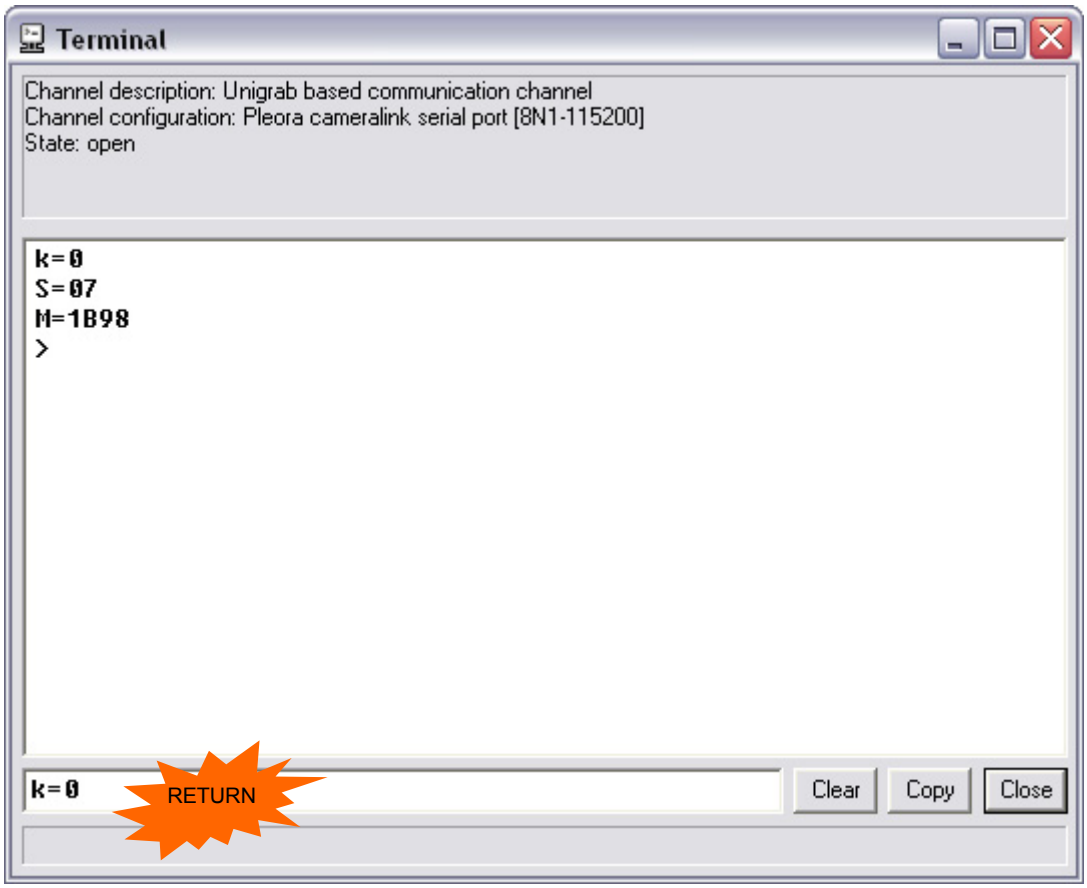


<u>Note:</u> Please note that "V" and "S" are upper case letters!

6.2.1.3 IRC Cameras

For IRC cameras it is not possible the change the exposure time. IRC cameras work always in Continuous mode.
The internal image correction in the camera should be calibrated from time to time and some minutes after the camera has switched on.



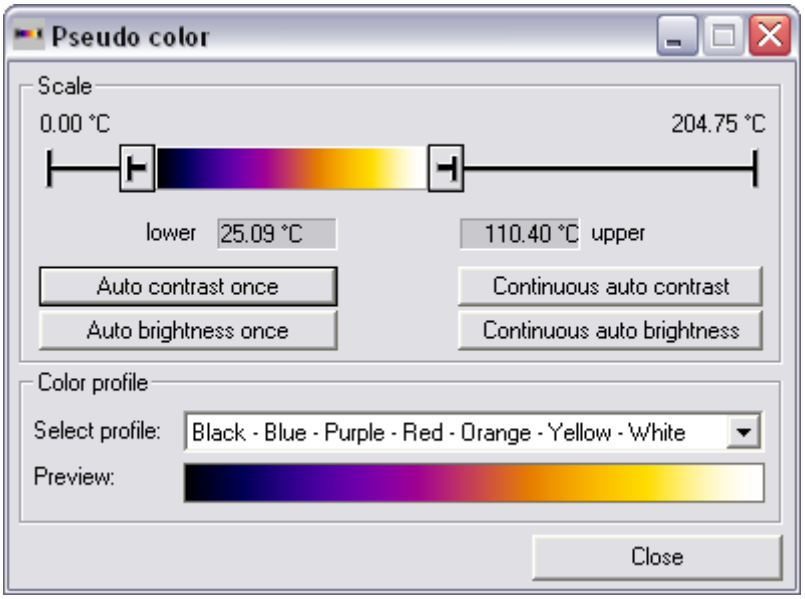


The calibration can be started by the command “k=0”. After some seconds the camera is calibrated.

<u>Note:</u> Please note that “k” is a lower case letter!

6.2.2 Pseudo Color & Contrast Enhancement

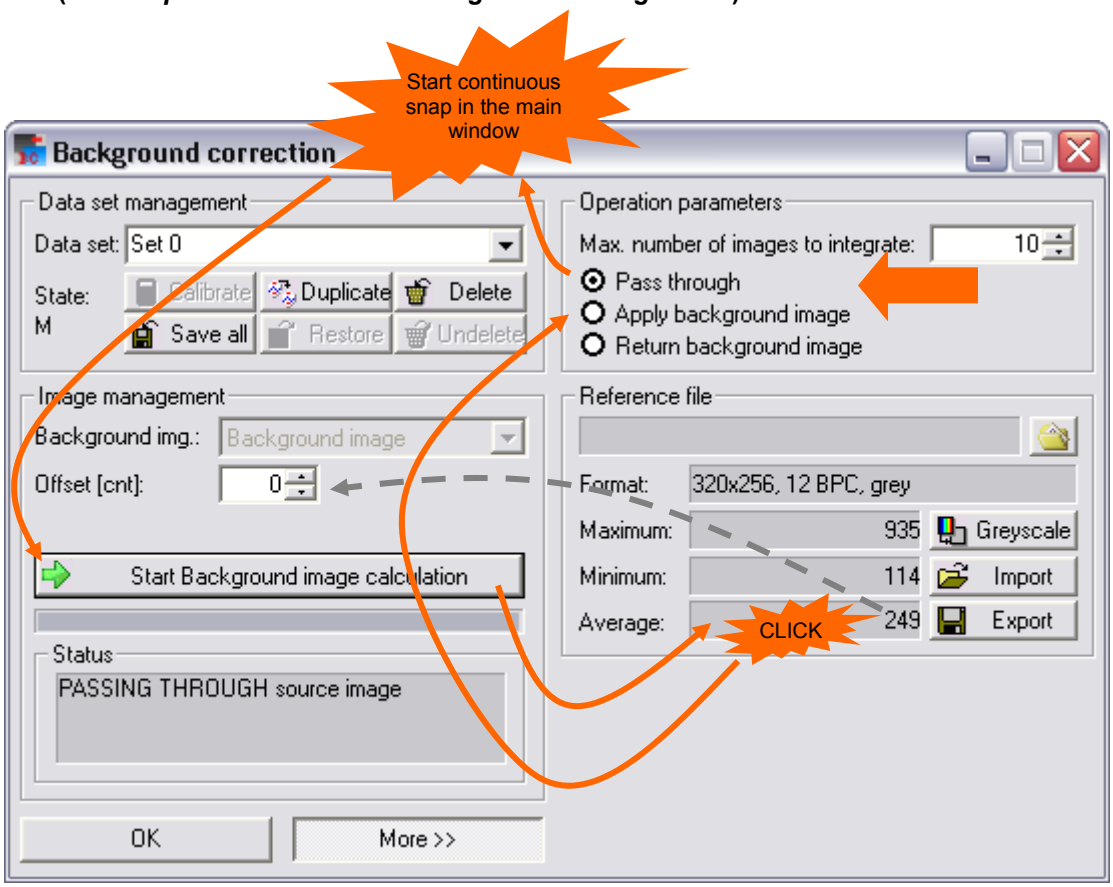
With the help of the “Pseudo color” dialog you can change the display of an image. Also you have the possibility to change the contrast of the displayed image to see more details of the 12 bit values.
Please don’t scramble this with the camera parameters. The contrast slider only changes the displayed values of the 12 bit camera image and not the camera data itself!



Note: Please note that the availability of this dialog depends on the chosen image process chain (see *chapter 6.1.4 Select the Image Processing Chain*).

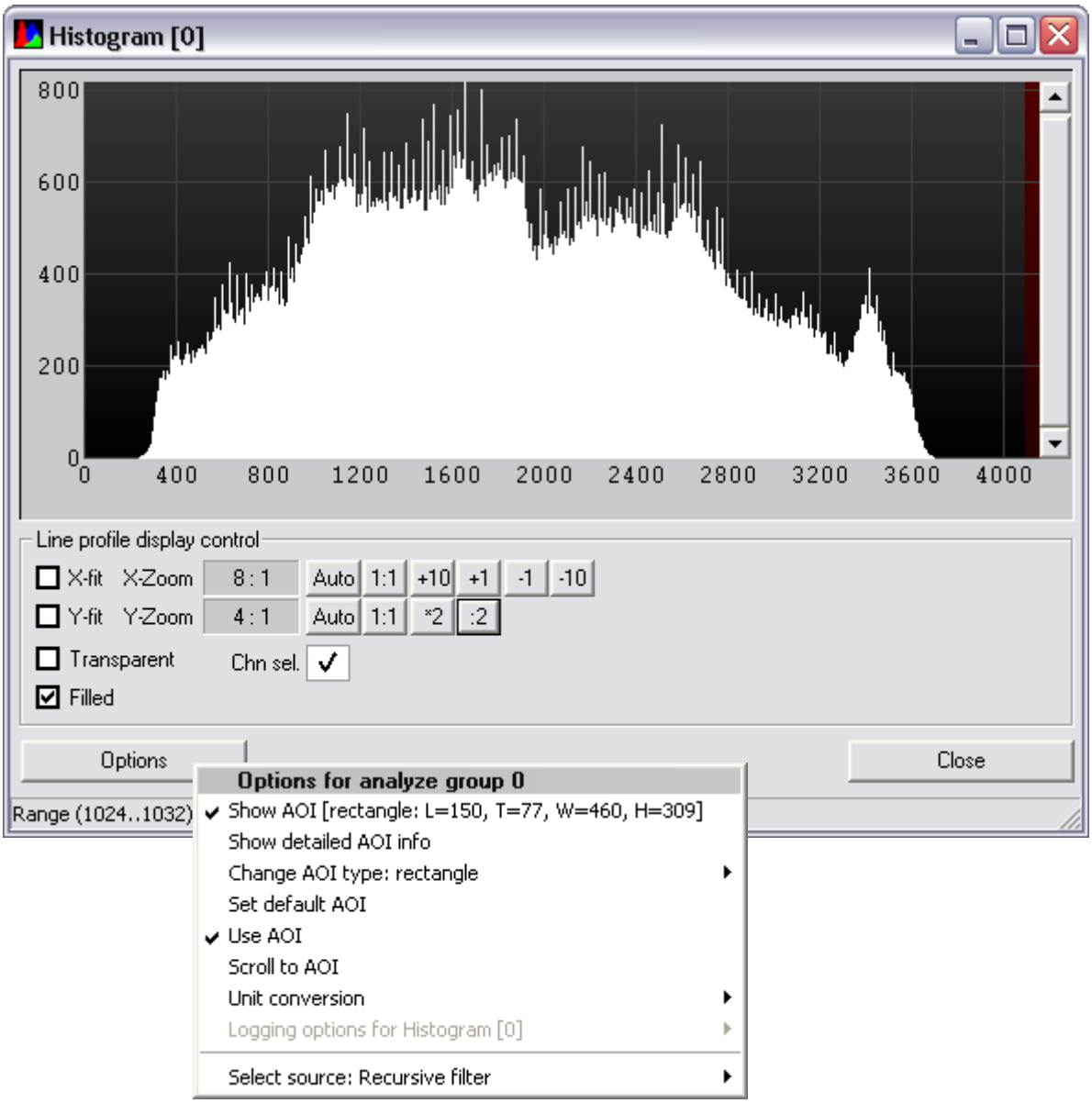
6.2.3 Background Correction

You can add an additional background correction (see “Image processing” menu) in the AcquireControl to get a better image quality. Therefore you have first record a homogeneous image and than set the average value and switch on this correction.
Note: Please note that the availability of this dialog depends on the chosen image process chain (see *chapter 6.1.4 Select the Image Processing Chain*).



6.2.4 Statistics & Histogram

It can be very useful to take a look to the statistic / histogram values to be sure that the light conditions are OK (see “Image processing” menu).
For a good light condition of the scene, the histogram of the image is balanced to the middle of the 12 bit (2048) like the following screenshot.



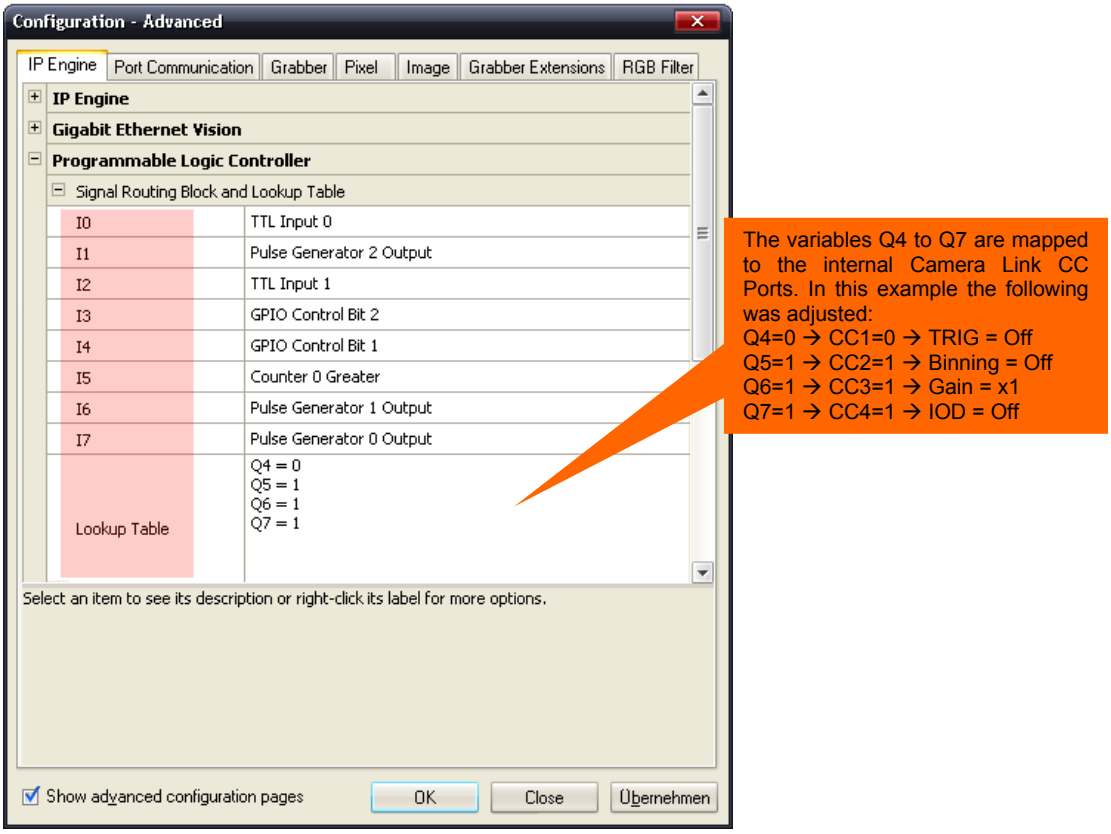
By clicking on the Options button you can decide to calculate the histogram for the whole image or only for an AOI.

6.3 Using Pleora Coyote

- Install the "**GigE VDS Camera Integration DLL**" available as download from the VDS website.
- Start Coyote.
- Select the camera by clicking on "**Detect…**" and set IP (if necessary).
- Select the camera type.
- Click on "**Connect**".
- Go to the "**Acquisition**" tab and click on "**Start**".

If the "**GigE VDS Camera Integration DLL**" is not installed, the Programmable Logic Controller of the IP Engine and the image format has to be setup manually:

- After connecting to the camera click on "**Configure**".
- Adjust the settings for **I0 … I7** and the **Lookup Table** as follows:



- Click on the "**Pixel**" tab and select the correct "**Color space**" and "**Pixel depth**".
- Click on the "**Image**" tab and adjust the image size corresponding to the used camera.

6.4 Using Pleora GEV Player

The Pleora GEV Player is an application which can grab images from a camera with GEV (GigE Vision) configuration.

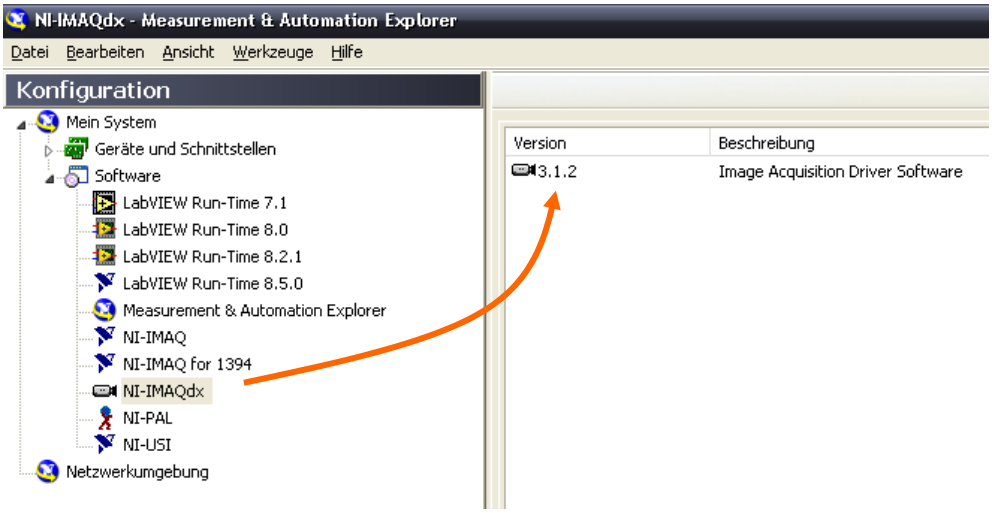
Note: In order to work with a GigE Vision compatible GIP-1000 interface it is necessary to use at least Pleora driver version 2.3.3.

- Start GEV Player.
- Select the camera by clicking on "**Select / Connect**" and set IP (if necessary).
- Click "**Play**".
- If you want to switch between a GigE Vision application (e.g. GEV Player) and an iPORT application (e.g. Coyote), it is necessary to power cycle the camera.

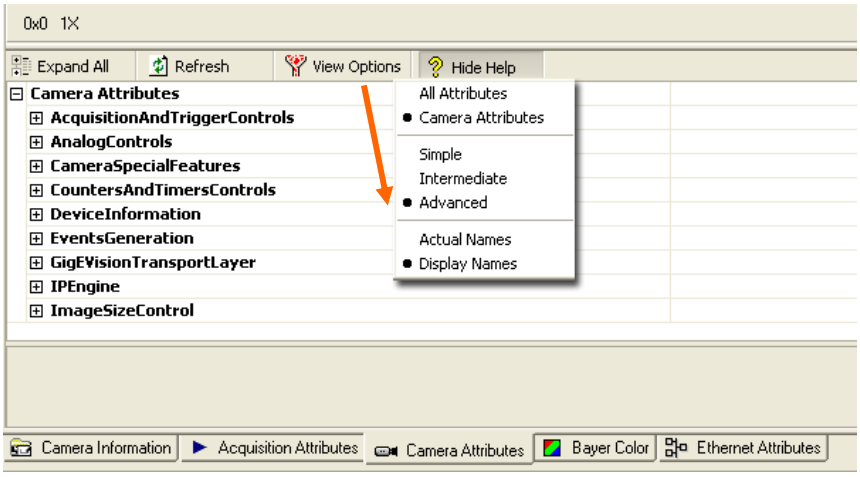
6.5 Using National Instruments Software

In order to work with LabView or compatible applications, it is necessary to have the NI IMAQdx driver installed. Without this driver it is not possible to access a GigE Vision camera!
To test the camera, start the MAX (Measurement & Automation Explorer) software.

- Whether the IMAQdx driver is installed correctly can be verified in the "**Software**" branch:



- Open the "**Devices and Interfaces**" branch. After a few seconds the camera should appear.
- Click once on the camera entry. Now every register of the camera is read which can take a few seconds.
- In the lower pane of the MAX software now several controls appear for accessing the camera parameters. Please also refer to *chapter 10, Appendix* for more information regarding the registers.

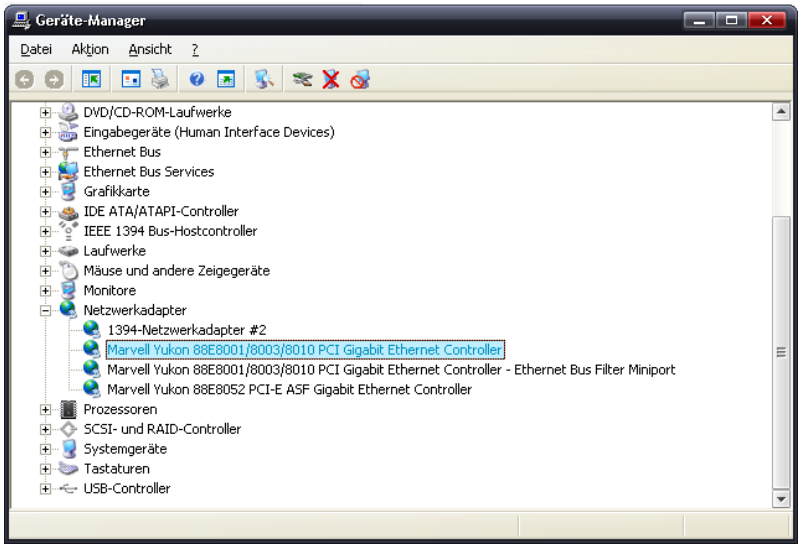


- Click on the "**Grab**" button to start continuous grab.
- In some situations the software can't access the camera correctly anymore. Here it may help to reset the device cache of the NI software. Quit all NI applications and delete all files and folders within the following directory:
  `C:\Documents and Settings\All Users\Documents\National Instruments\NI-IMAQdx\Data`
- When you want to switch between a GigE Vision application (e.g. NI MAX) and an iPORT application (e.g. Coyote), it is necessary to power cycle the camera.
- In some situations the MAX software is not able to confirm the used pixel format. In this case open the "**Acquisition Attributes**" tab and reselect the desired "**Pixel Format**".

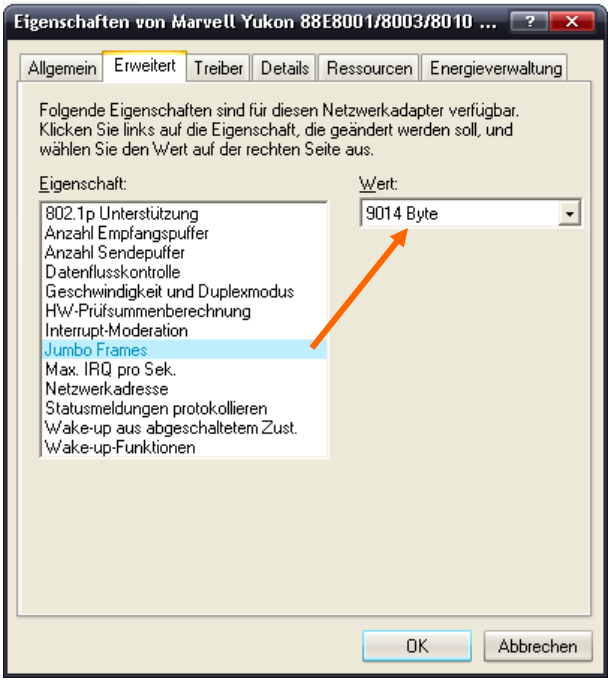
7 Performance Optimization

The video data from the camera is (like all other data in the network) transferred in packets. The default value for this packet size is 1440 bytes. In some cases it can be an advantage to increase this packet size because then fewer packets are needed to transfer the image data. This results in less overhead and better performance. But these oversized packets are not standardized so not every network card / device supports it. To determine if your network card supports it follow these steps:

- Open the device manager

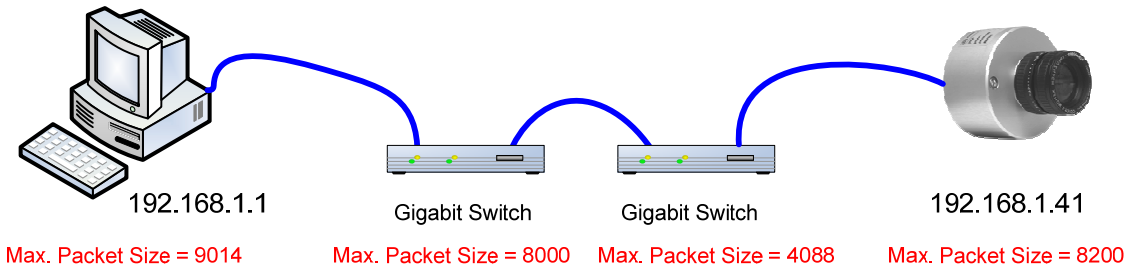


- Open the properties of the network card. Try to find a value called "**Jumbo Fames**", "**Jumbo Packets**" or "**Packet Size**" and change it to the maximum, e.g. 9014 Bytes.



If the camera is not connected directly to the PC but over a switched network, it is important to know that also the **Switches must support Jumbo Frames**.

The following illustration shows an example for a network with several switches. The maximum packet size between the PC and the camera in this example is 4088 bytes.



Refer to the technical data of the used switches to determine if Jumbo Frames are supported.

If you have determined the maximum size of a packet you can modify the used packet size in your application.

Please note that the maximum packet size the iPORT protocol can use is 8128 bytes.

7.1 Using AcquireControl

- Close AcquireControl.
  Go to the installation directory , e.g. `C:\Program Files\VDS Vosskuehler GmbH\AcquireControl V3.5.4`
- Open the file `UniGrab.ini` with a text editor.
- Find the "GRABBER_" section with the description **Gigabit Ethernet (Pleora iPORT)**
- Find the value **PacketSize** and enter the determined Jumbo Frame size – 72 bytes.
- Save the file and start AcquireControl again.

7.2 Using Pleora Coyote

- Start Coyote.
- Open the "**Options**" dialog in the "**Tools**" menu.
- Enter the determined Jumbo Frame size – 72 bytes.

7.3 Using Pleora GEV Player

- Packet Size is determined automatically.

7.4 Using National Instruments Software

- Start MAX
- Open the camera.
- In the lower pane open the "**Acquisition Attributes**" tab, find the "**packet size**" value and enter the determined Jumbo Frame size – 72 bytes.

8 Adjusting Firewall Settings

- For the first test all firewalls and antivirus solutions should be disabled. Only when the camera can be accessed properly without any firewall one can try to adjust firewall settings step by step.
- The communication from and to the camera is done in the UDP protocol.
- A global rule for incoming and outgoing traffic should be created

  Rule: **Pleora outgoing (Allow)**
  - Protocol: UDP
  - Direction: Outgoing, Packet type: Local
  - Remote Host: 255.255.255.255
    xxx.xxx.xxx.xxx ← IP range the camera is in, e.g. 169.254.*.*
  - Remote Port: 4
    68
    3956
    20200
    20201
    20202

  Rule: **Pleora incoming (Allow)**
  - Protocol: UDP
  - Direction: Incoming
  - Remote Host: xxx.xxx.xxx.xxx ← IP range the camera is in, e.g. 169.254.*.*

9 Troubleshooting & Support

- If the camera can be detected but no images can be grabbed, verify the camera operation mode. Basically every VDS camera can work in three modes:
  - **Continuous Mode** – The camera generates the images with a constant exposure time independently. This exposure time cannot be adjusted.
  - **Image On Demand (IOD) Trigger mode** – The camera produces no image until an external trigger impulse reaches the trigger input pin of the camera.
  - **Image On Demand (IOD) Timer mode** – The trigger impulses are generated internally by a timer which can be adjusted in the software.

  Sometimes the camera was adjusted to an IOD mode by a mistake. Verify the following settings:
  - AcquireControl:
    - Open the "**Camera control**" dialog
    - Check if in the "**Misc**" group either "**Continuous (IOD = Off)**" with disabled "**Timer**" or "**IOD = On**" with enabled "**Timer**" was chosen.
    - Remember that the settings within the "**Shutter time**" group and the "**Interval time**" group are only used when "**IOD = On**" with enabled "**Timer**" was chosen.
  - Coyote:
    - Make sure that the "**GigE VDS Camera Integration DLL**" was installed.
    - Open the "**Configuration – Advanced**" dialog and select the "**Camera Properties**" tab.
    - Verify the settings of "**Timer Mode**", "**Image On Demand**", "**Exposure Time ms**" and "**Dark Time ms**"
  - GEV Player & NI MAX:
    - Go to the "**AcquisitionAndTriggerControls**" branch
    - Check state of "**TriggerMode**"
    - Check state of "**StartExposureTimer**"
    - Verify the values of "**DarkTimeAbs**" and "**ExposureTimeAbs**"
- If the camera cannot be detected, verify all settings from the driver installation description. Make sure that no third party network filter driver conflicts with the Pleora driver. Disable all Firewalls and antivirus solutions. Power cycle the camera.
- Restart the computer.
- Do you have Jumbo Packets enabled? Ensure that every network device supports the adjusted packet size. Try setting to the default packet size of 1440 bytes.
- Launch the "**Information Gathering Tool**" which was installed with the Pleora driver package. A shortcut to this program can be found in the "Pleora Technologies Inc" folder of the Start menu. Save the generated output to a file.
- Make screenshots of the problem and the network connection dialogs of windows.
- Write down the state of the LED's on the backside of the GIP-1000 camera module.
- Mail all the files to the VDS support support@vdsvossk.de with a detailed description of the problem including:
  - Camera model name.
  - Camera serial number.
  - GIP-1000 model number (if label is available).
  - GIP-1000 serial number (if label is available).
  - Type of Power Supply used (VDS or own).
  - Used operating system, 32 or 64 bit edition.
  - Used Pleora driver/SDK version.
  - Used application version (AcquireControl, …).
  - If possible, open the terminal window in AcquireControl for the following commands (please note the capital letters for the commands!). Enter "Y=1". Press RETURN. Enter "V=1". Press RETURN. Press the COPY button and paste the output into a text file.

10 Appendix

10.1 GEV Register Description

DeviceInformation	
Feature	**Description**
DeviceModeName	Name of the attached camera model.
DeviceID	Unique 32 bit device ID of the VDS camera model.
DeviceUserID	User ID field. This field can be accessed (R/W) by the user to store an additional device identifier.
DeviceScanType	This feature specifies the scan type of the sensor (Areascan or Linescan).

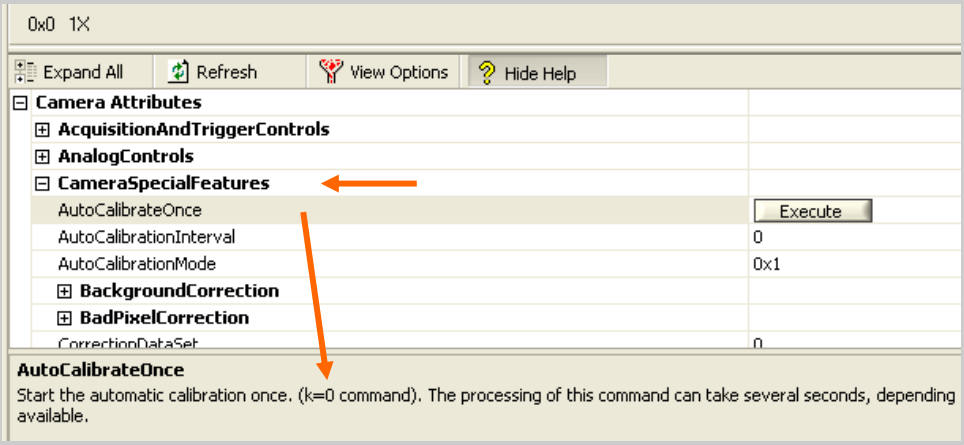
ImageSizeControl	
Feature	**Description**
SensorWidth	Maximum width of the sensor in pixels.
SensorHeight	Maximum height of the sensor in pixels.
WidthMax	This feature represents the maximum width (in pixels) of the image after horizontal binning, decimation or any other function changing the horizontal dimensions of the image.
HeightMax	This feature represents the maximum height (in pixels) of the image after vertical binning, decimation or any other function changing the vertical dimensions of the image.
Width	This feature represents the actual image width expelled by the camera (in pixels).
Height	This feature represents the actual image height expelled by the camera (in pixels).
OffsetX	This feature represents the horizontal offset from the origin to the AOI (in pixels).
OffsetY	This feature represents the vertical offset from the origin to the AOI (in pixels).
DecimationHorizontal	Unused.
DecimationVertical	Unused.
PixelFormat	List with all available pixel formats of the camera, e.g. MONO12.
TestImageSelector	Enables or disables the internal test image generator of the camera.

AcquisitionAndTriggerControls	
Feature	**Description**
AcquisitionMode	This feature controls the acquisition mode of the software. This feature works independently (!) of the chosen camera mode (Continuous, IOD hardware trigger, IOD hardware timer). It describes how many frames should be acquired.
AcquisitionStart	Starts the image acquisition of the camera.
AcquisitionStop	Stops the image acquisition of the camera.
TriggerMode	Modifies the trigger mode of the camera. When the trigger mode is “Off”, the camera will generate frames independently. When the trigger mode is “On” the camera is switched to the so called IOD (Image On Demand) mode. In this mode the camera waits for an external trigger signal or an timer pulse generated by the GIP-1000 module. To control exposure and dark time trigger mode must be switched to “On”.
StartExposureTimer	Start or stop the internal exposure signal timer.
ExposureTimeAbs	This feature is used to set the Exposure time (in microseconds).
ExposureTimeGranularity	Exposure time granularity
ExposureTimeAbsMs	This feature is used to set the Exposure time (in milliseconds).
DarkTimeAbs	This feature is used to set the Dark time (in microseconds).
DarkTimeGranularity	Dark time granularity
DarkTimeAbsMs	This feature is used to set the Dark time (in milliseconds).

AnalogControls	
Feature	**Description**
`GainRaw`	This feature controls the selected gain as a raw integer value.

CameraSpecialFeatures

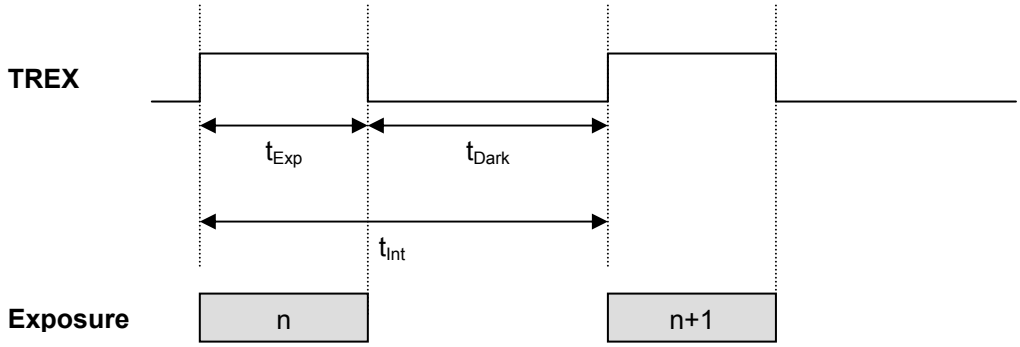
This section contains camera depending commands like serial commands (if available). For each command within this branch you will find a description text in your GigE Vision software.



The description contains a reference to the serial command which can be found in the base manual of the camera for further information.

10.2 GEV Timer Calculations

The following graphic shows how an exposure signal is generated.



t_{Exp} = Exposure time
t_{Dark} = Dark time
t_{Int} = Interval time = 1 / Frame rate

In order to adjust t_{Exp} and t_{Dark} of the TREX pulse in each case two parameters are available:

- **ExposureTimeAbs** & **ExposureTimeGranularity**
- **DarkTimeAbs** & **DarkTimeGranularity**

The granularities are integer values in the range from 0…65535 which define the minimum and maximum pulse widths. The minimum pulse width is equal to the time granularity.

$$t_{Exp\,MIN}(\mu s) = \frac{(ExposureTimeGranularity + 1) \times 30ns}{1000}$$

$$t_{Exp\,MAX}(\mu s) = \frac{(ExposureTimeGranularity + 1) \times 30ns \times 65535}{1000}$$

10.3 Feature Mapping

This table shows the mapping of the camera features to the corresponding features in the GEV naming convention.

VDS Vosskuehler Camera Feature	Camera Link CC Port	GigE Vision Feature Names
TREX	CC1	**StartExposureTimer**, **ExposureTimeAbs**, **DarkTimeAbs**
BIN	CC2	**BinningVertical**. If the camera has 2x2 binning implemented, the **BinningHorizontal** feature is set automatically.
SV2	CC3	**GainRaw**
IOD	CC4	**TriggerMode**