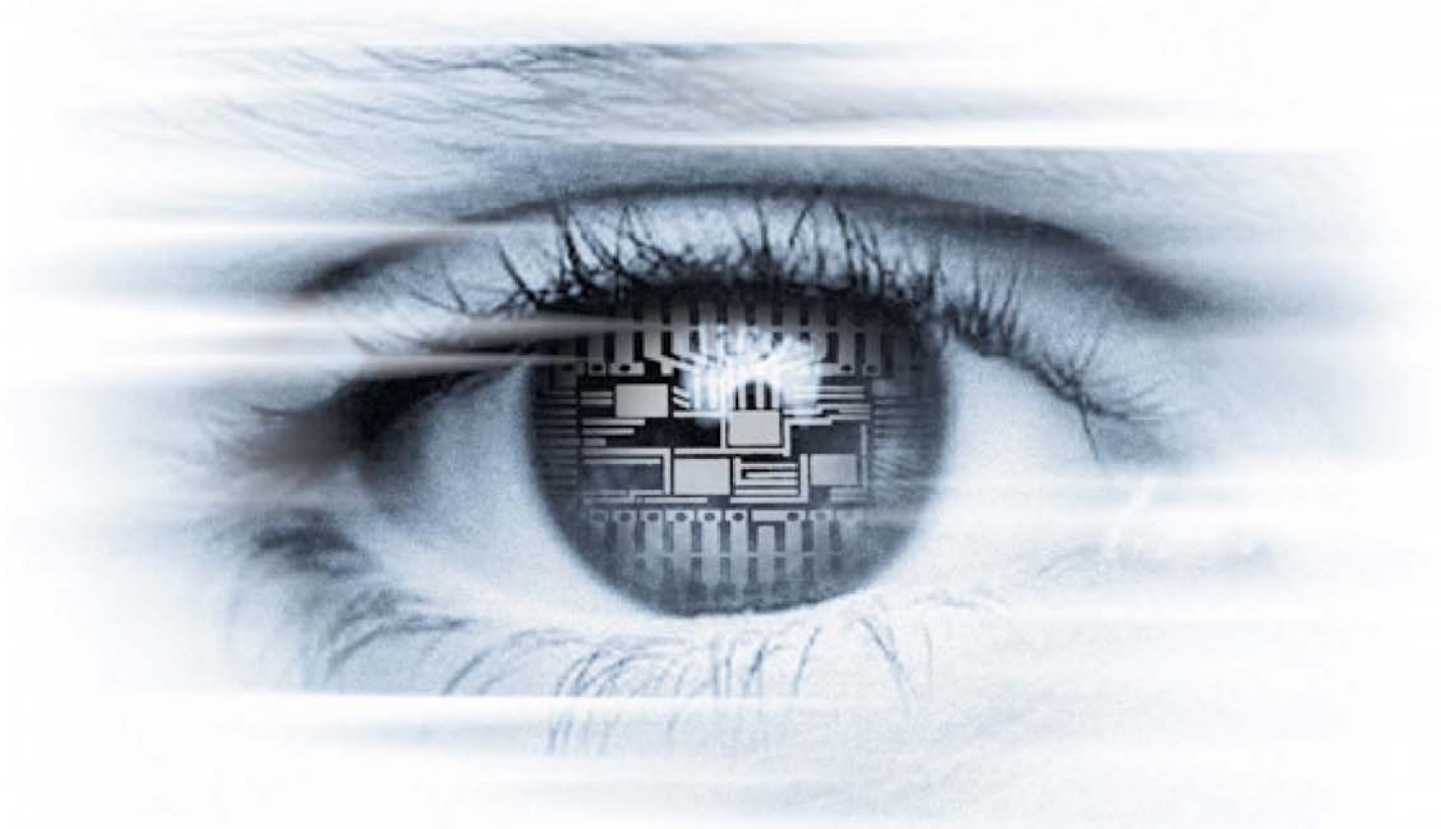


User Manual
microDisplay USB2.0
For Photonfocus cameras with USB2.0 interface



THE PERFECT EYE

microDisplay USB2.0

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The Swiss company Photonfocus is one of the leading specialists in the development of CMOS image sensors and corresponding industrial cameras for machine vision, security & surveillance and automotive markets.

Photonfocus is dedicated to making the latest generation of CMOS technology commercially available. Active Pixel Sensor (APS) and global shutter technologies enable high speed and high dynamic range (120 dB) applications, while avoiding disadvantages, like image lag, blooming and smear.

Photonfocus has proven that the image quality of modern CMOS sensors is now appropriate for demanding applications. Photonfocus' product range is complemented by custom design solutions in the area of camera electronics and CMOS image sensors.

Photonfocus is ISO 9001 certified. All products are produced with the latest techniques in order to ensure the highest degree of quality.

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1 Basic Configuration

1.1 Quick start of microDisplay

1. Ensure that a camera is connected to the USB port.
2. Select the camera hardware applet from the Camera selection menu (see section 1.2).
3. If required, change the parameters of the applet, such as ROI size (see section 2.1).
4. Activate grabbing (see 3.1).

1.2 Select a hardware applet

A hardware applet contains the USB firmware for the Photonfocus camera. When starting microDisplay, the first step is to select the correct hardware applet.

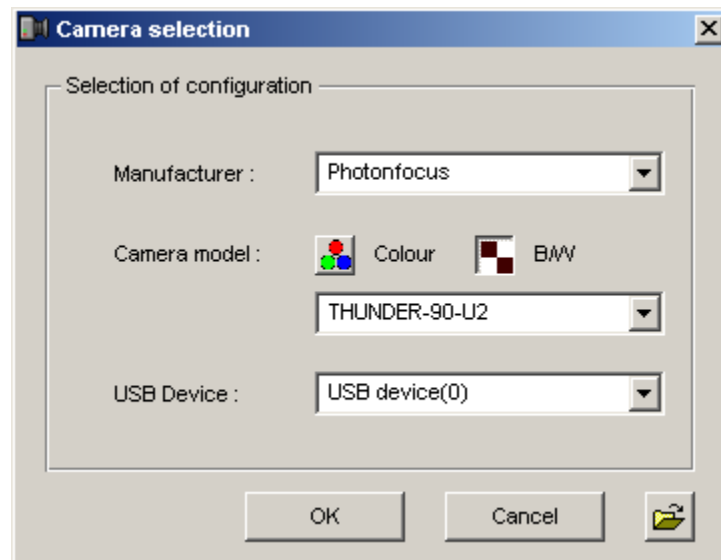


Figure 1: Hardware applet selection

There are three input fields:

- **Manufacturer:** choose Photonfocus
- in **Camera model** choose the name of the camera. You can make a preselection by using the buttons **Colour** or **B/W**.
- **USB Device:** choose USB device(0).

By pressing OK, the selected hardware applet (USB firmware) will be loaded into the camera.

If you are frequently working with *microDisplay*, it might be useful to save a configuration file that contains the complete configuration of the applet. The configuration file can be directly loaded in the camera selection windows with the button:



You also can execute the camera selection in the main menu or by the menu entry **Setup → Camera selection** (Shortcut **Ctrl-K**).

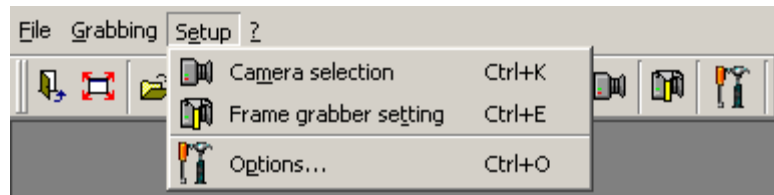


Figure 2: Camera selection with main menu

1.3 Main menu

The main menu allows quick access to all functions of *microDisplay*. All functions are available via the menu or via buttons.

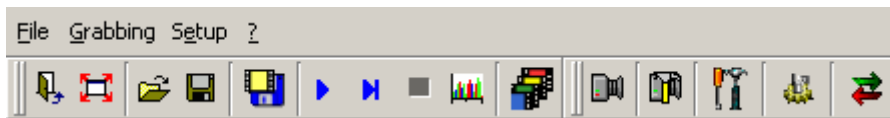















Figure 3: Main menu

Table 1: Overview of the functions and shortcuts of *microDisplay* buttons

<i>Symbol</i>	<i>Shortcut</i>	<i>Function</i>
	Alt-F4	Quit <i>microDisplay</i>
	n/a	Maximise the main window without menu and status bar, return by ESC
	Ctrl-L	Load a configuration file with <i>microDisplay</i> parameterisation
	Ctrl-S	Save a configuration file with <i>microDisplay</i> parameterisation
	n/a	Save the actual image in bitmap format
	Ctrl-G	Start continuous acquisition of images
	Ctrl-N	Start acquisition of a single image
	Ctrl-T	Stop the continuous acquisition of images
	n/a	Display the histogram of the current image
	Ctrl-Q	Acquisition of sequences, access to submenu
	Ctrl-K	Load a hardware applet
	Ctrl-E	Parameterise the hardware applet
	Ctrl-O	Options (i.e. number of frame buffers, language version, folders)

1.4 Status bar

The status bar provides a short overview of the status of the USB frame grabber and the image acquisition.



Figure 4: Status bar

The most important indication is the red or green field on the right side of the status bar, that shows directly the status of the camera port. A green field means that *microDisplay* has detected an active camera that is ready for grabbing. Figure 4 shows an active camera on port A.

Note: For Photonfocus USB cameras, only Port A is used. Port B is not active.

The port status display carries three letters indicating if the camera outputs any frames (**F** is displayed bold) and lines (**L** is displayed bold). If **E** is marked bold, the hardware applet generates a camera trigger or an external trigger signal is applied.

At the right side of the port status field the port activity is displayed. The activity state of a Port A can be *Not Selected* (grey circle), *Selected without Acquisition* (orange circle), and *Selected with Acquisition* (blue circle). Port B will always be Not Selected.

On the left side of the port indicator the frame rate is displayed. The number of images acquired by *microDisplay* is measured. This number can differ with the number of displayed images in the window.

On the very left side of the status bar there is some information on the loaded hardware applet (camera name).

1.5 Selection of Camera Configuration

A Camera Configuration is the collection of all parameters of an applet. The current configuration of *microDisplay* can be saved into a file. A configuration file is stored as a text file with the extension *.mcf.

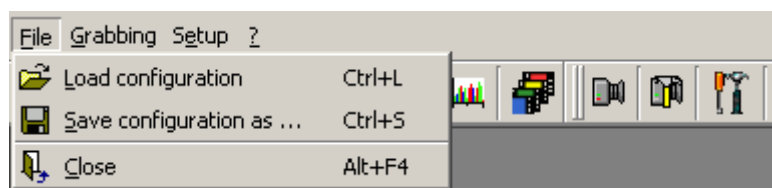




Figure 5: Camera configuration

You will find this function in the menu entry **File** → **Load configuration** (Shortcut **Ctrl-L**) respectively **File** → **Save configuration as ...** (Shortcut **Ctrl-S**) or with the buttons

 to load and  to save a configuration.

1.6 Options

In the **Options** menu, the basic settings of *microDisplay* can be accessed. This menu function is also available as a button in the main menu bar:



You can also activate the **Options** menu in the main menu in **Setup** → **Options** (Shortcut **Ctrl-O**):

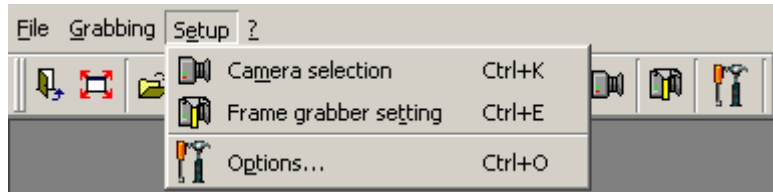


Figure 6: Options

In the options menu you will find three registers:

1. Basic settings
2. Folder settings
3. Specific settings of the output of AVI files.

1.6.1 Basic configuration

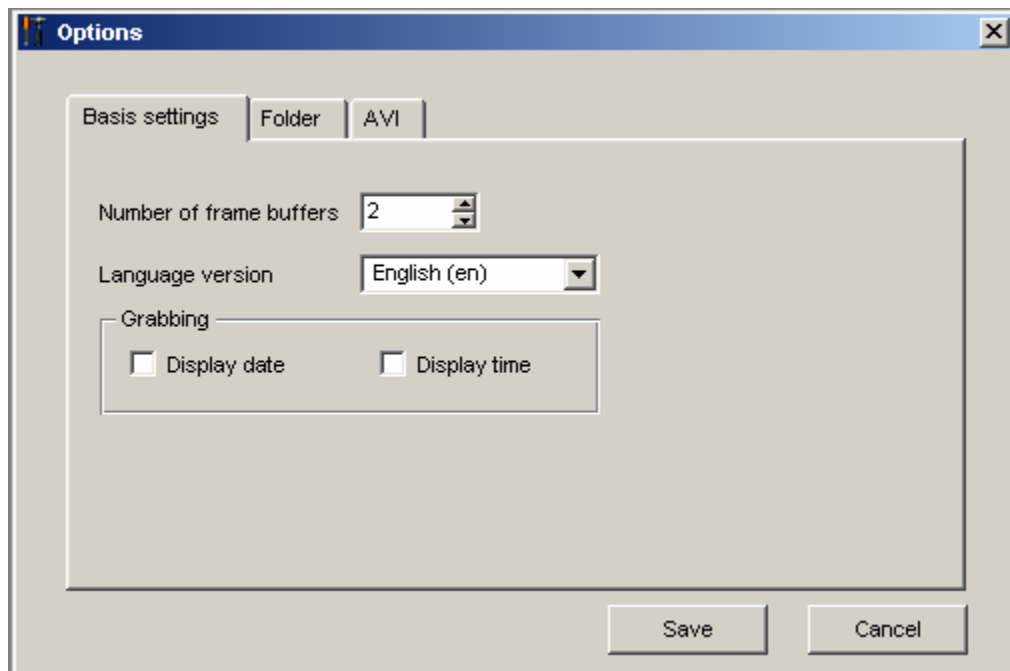


Figure 7: Basic configurations

The most important entry in the basic settings is the configuration of **number of frame buffers**, which are allocated for image acquisition by *microDisplay*. This parameter defines the number of frame buffers which are allocated as a ring buffer by *microDisplay* and cyclically get replaced by new images. A minimum of 2 frame buffers needs to be allocated, since the grabbing and displaying do not use the same frame buffer. Please pay attention to allocate sufficient RAM memory for each frame buffer, at least as large as the maximum size of the camera image.

When grabbing an image sequence, the number of frame buffers limits the maximum number of images that can be acquired in the sequence. Before starting to grab, you should configure the parameter to a size, which is large enough for the sequence.

Below the frame buffers the **Language version** can be selected. Here you can choose the language of menu entries and text outputs of *microDisplay*.

Enabling the **Display date** and **Display time** activates a time stamp and displays the date and time on every grabbed image.

1.6.2 Folder settings

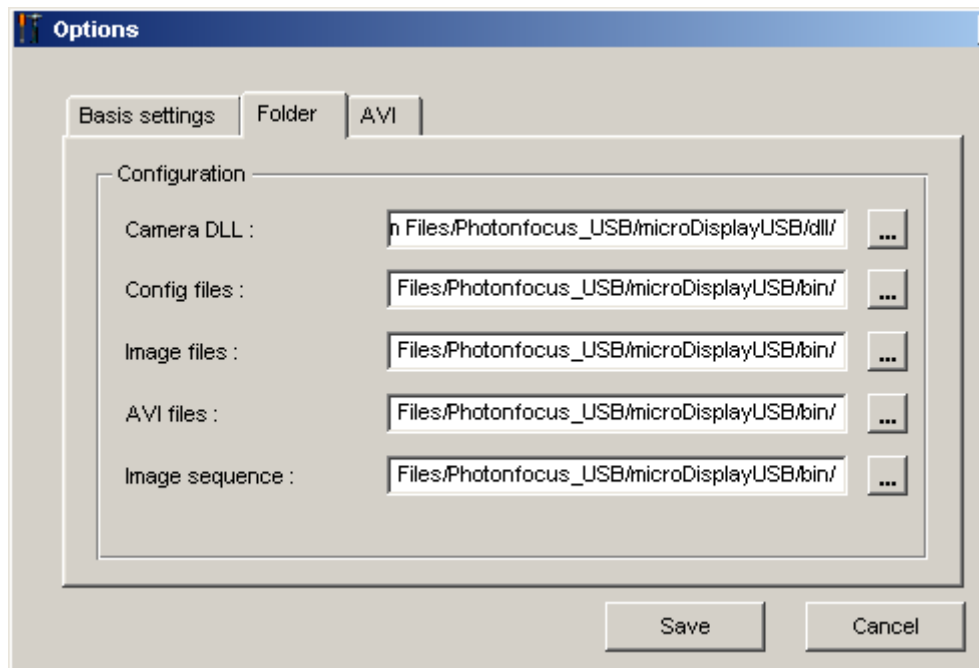


Figure 8: Folder settings

In this menu you can configure the folders, where *microDisplay* reads, writes and saves files.

1.6.3 AVI settings

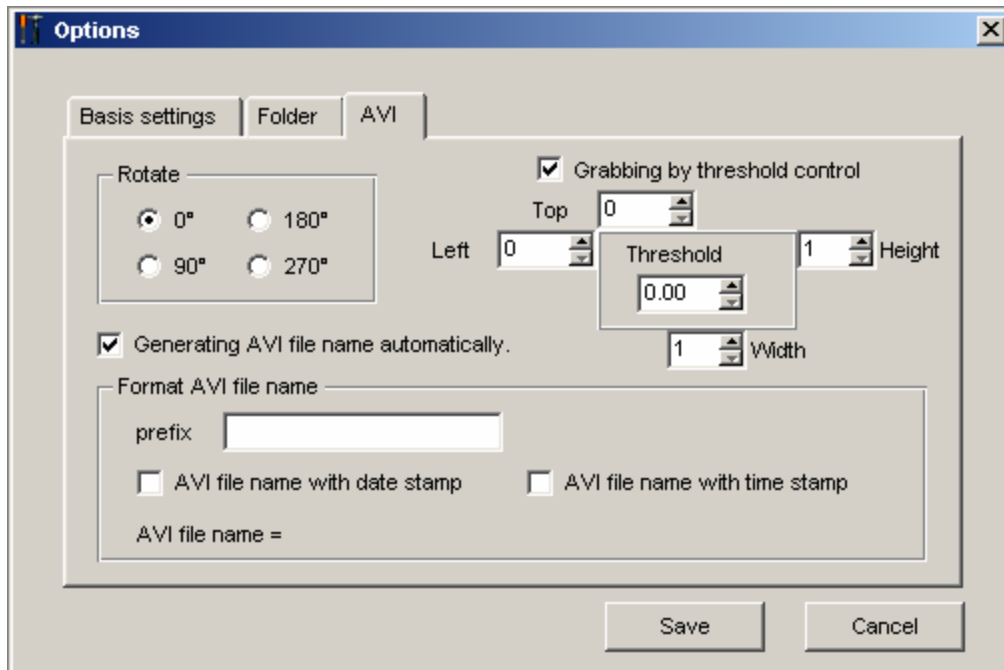


Figure 9: AVI settings

There are special settings for storing image sequences in AVI format. All operations are calculated in software and therefore need corresponding CPU power.

As first option (**Rotate**) images will be rotated in 90°-steps before saving.

Note: Rotate does only work when the configured height and width of the display windows is modulo 8.

The second option (**Grabbing by threshold control**) activates a software trigger for image acquisition. If the content of an image in an area of the window (can set by the sliders **Top**, **Left**, **Height** and **Width**) exceeds the configured **Threshold** value, the saving of the images in AVI format begins.

The last option (**Generating AVI file name automatically**) extends the file name of the stored AVI file. According to the options, a date stamp and/or a time stamp is added to the file name. This feature allows an unique assignment of the grabbed sequence by time and prevents an accidentally overwriting of previous AVI sequences at the same time, in case that the same file name is reused.

The AVI file format is limited to a maximum size of 2 GBytes.

2 Applet Parameters

2.1 Configuration of Hardware Applets

The applet configuration is available in a separate menu entry. You will find this menu in **Setup → Frame grabber setting** (Shortcut **Ctrl-E**).

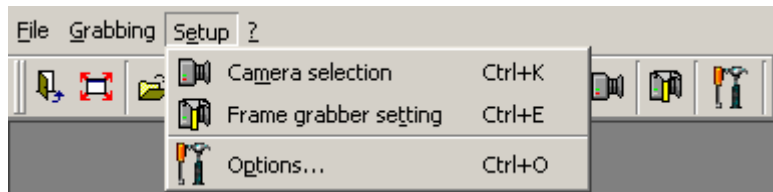


Figure 10: Frame grabber setting

The function is also available as button in the main menu bar.



2.2 Parameter menu

Following settings are accessible by the parameter menu:

- USB Setup of different camera formats
- Bayer Bayer settings (only available for colour cameras)
- Display Setup of image size and position
- Trigger Trigger and strobe
- Exposure Trigger frequency and trigger pulse width
- I/O Signals Internally used signals

2.2.1 Menu USB

The USB menu configures the hardware applet to the camera format. The number of taps is automatically configured for the connected camera.

Depending on the camera, the grey level resolution can be changed here.

If the camera supports the DecimationX function, the DVAL check box has to be activated so that the USB frame grabber module evaluates the data valid (DVAL) signal.

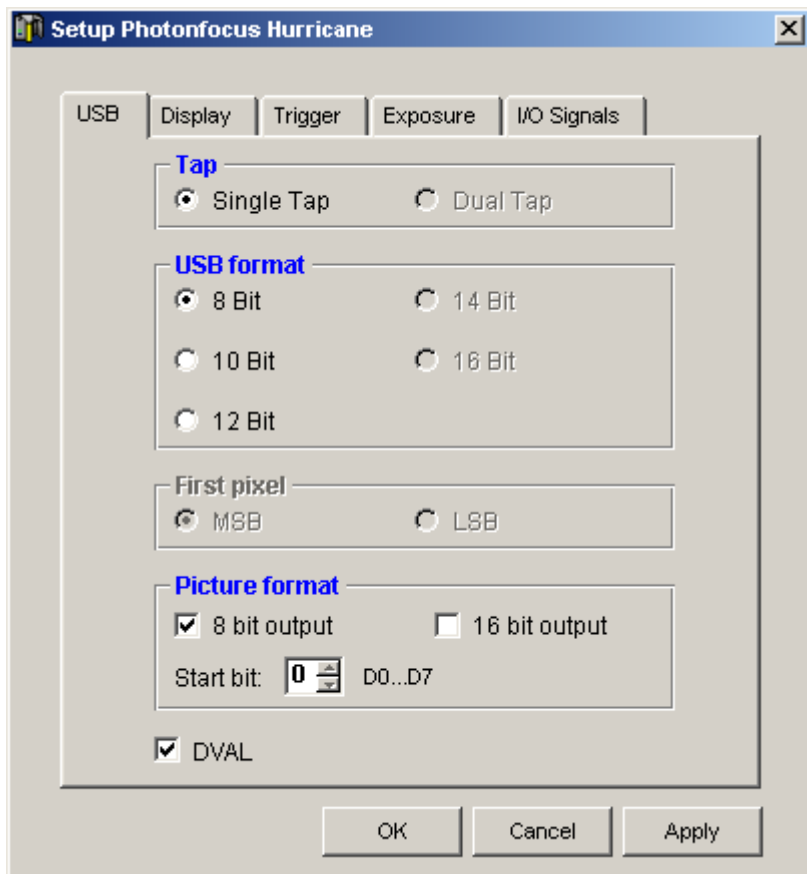


Figure 11: General image format settings

Picture Format

By default, the USB grabber module is configured for 8 bit pixel data (**8 bit output** is checked).

Some Photonfocus USB cameras exhibit a grey level resolution of more than 8 bit. To transfer 10 bit or 12 bit values via the USB interface, the USB grabber module must be configured in the **16 bit output** mode. However, this will halve the maximum frame rate, since 2 bytes per pixel are transferred via the USB interface.

If the camera is configured in 10 or 12 bit output mode by PFRremote and the USB grabber module is configured for **8 bit output**, the **Start bit** value defines the bit of the 10 or 12 bit value that corresponds to the LSB of the resulting 8 bit value.

Example: If the camera is configured in 12 bit output mode and the Start bit set to 3, the upper 8 bit of the 12 bit value will be transferred via the USB interface. If Start bit is set to 0, the lower 8 bit of the 12 bit value will be transferred.

Note: After applying picture format settings, it may be necessary to stop and restart grabbing for the changes to take effect.

2.2.2 Menu Display

This dialog menu enables the configuration of the image size and the position of the region of interest (ROI). An ROI is defined by the four parameters Width, Height, xOffset and yOffset.

Note: xOffset and yOffset are typically not used, since this does not change the camera offset. Instead it is an additional offset on the image that is read out from the sensor. Use the offset parameters on the camera (PFRemote) to position an ROI.

The point of origin (0,0) is in the top left corner. The width must be a modulo of four.

Important: The width and height of the ROI must be identical in the USB frame grabber (microDisplay) and the sensor (PFRemote) settings. **The width must be a multiple of four.**

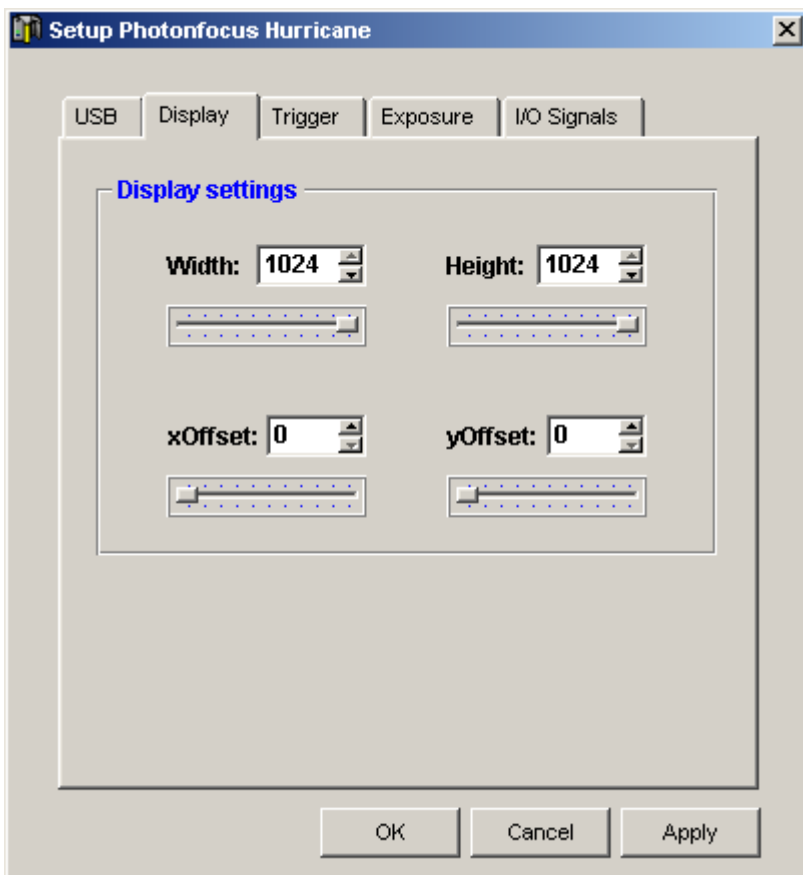


Figure 12: Display settings. Width and Height must correspond to the configured ROI in PFRemote.

Note: When using the MROI camera feature, the width and height must correspond to the resulting MROI image size.

2.2.3 Menu Trigger

By default the camera and the USB frame grabber are configured in free running mode. If necessary, the acquisition of an image can be synchronised to a trigger event. The trigger event can be applied from different sources:

- It can be an external signal that is fed to the camera via the trigger I/O on the power connector (**External trigger controlled**).
- The USB frame grabber can generate a periodic trigger signal to trigger an image (**Grabber controlled**). This mode makes sense in particular if there is no 'Constant Frame Rate' mode on the camera available.
- When using the USB Grab Module SDK, a software trigger can be generated.

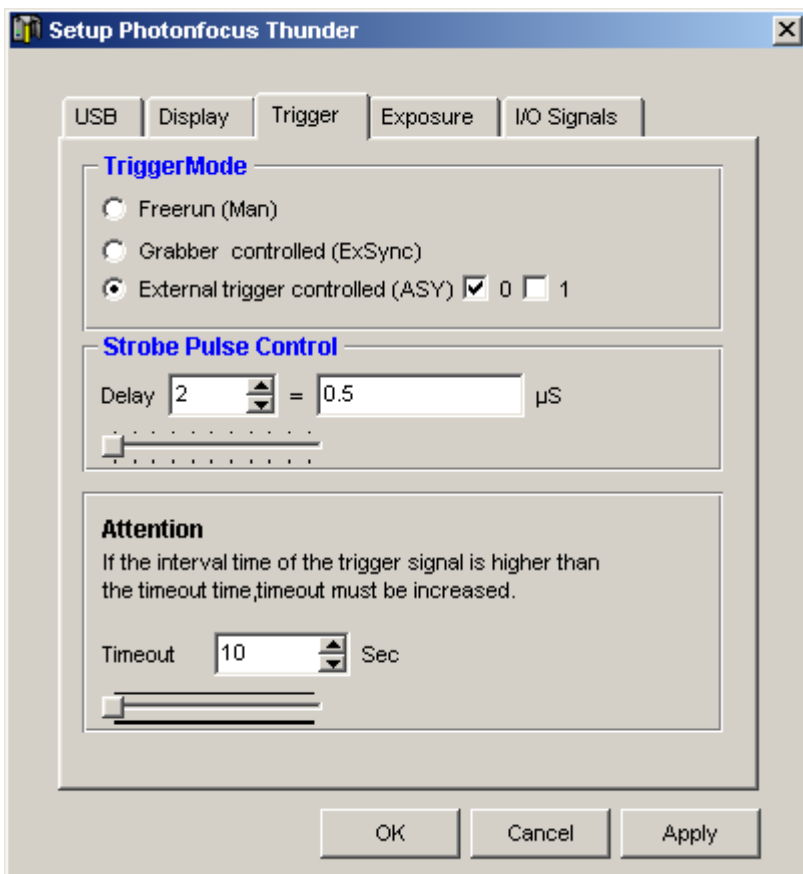


Figure 13: Trigger configuration

Triggering the HURRICANE/THUNDER USB Models

The Hurricane and Thunder USB cameras differ between Interface trigger and I/O trigger. The I/O trigger signal is provided directly to the camera via the power supply connector. The Interface trigger is mainly used for the Hurricane/Thunder CameraLink models in order to trigger the camera through the frame grabber. For the USB models, this trigger mode is less useful since the USB frame grabber is located in the camera.

When using an external trigger with a Hurricane/Thunder USB camera, always use the I/O trigger. The table below shows the configuration of the frame grabber software microDisplay and the camera software PFRremote.

Table 1: Trigger configuration summary for HURRICANE/THUNDER cameras

Mode	microDisplay	PFRemote
Free Running	Free running (Man)	Free running
USB Frame grabber generates periodic trigger signal (not recommended)	Grabber controlled (ExSync)	Interface Trigger
External Trigger signal	External trigger controlled	I/O Trigger
Software Trigger	Only with Grab Module SDK	Interface Trigger

Table 2: Strobe configuration summary for HURRICANE/THUNDER cameras

Mode	microDisplay	PFRemote
Strobe off	Does not matter.	Strobe Pulse Width = 0
Strobe on	Does not matter.	Strobe Pulse Width > 0
Change Strobe Delay	Does not matter.	Strobe Delay

Triggering all other Photonfocus USB Models

For all other USB cameras, there is only an interface trigger available, i.e. the trigger signal is always routed through the USB frame grabber module.

The Grabber controlled trigger mode can be useful for the MV-D640 camera, since there is no constant frame rate mode available. In this trigger mode, the USB frame grabber module can trigger an image and thus dictate the frame rate.

The table below shows the configuration of the frame grabber software microDisplay and the camera software PFRemote.

Table 3: Trigger configuration summary for all other Photonfocus USB cameras

Mode	microDisplay	PFRemote
Free Running	Free running (Man)	Free running
USB Frame grabber generates periodic trigger signal (not recommended)	Grabber controlled (ExSync)	External Trigger
External Trigger signal	External trigger controlled	External Trigger
Software Trigger	Only with Grab Module SDK	External Trigger

Important notes regarding the microDisplay "exposure time" parameter:

- The 'exposure time' parameter in the exposure menu (see Figure 14) limits the maximum external trigger frequency that can be applied.
Take care that $1/\text{'exposure time'} \geq \text{trigger frequency!}$
- However, if the 'exposure time' parameter is too small, no image might be output.
Take care that $\text{'exposure time' (microDisplay)} \geq [\text{'exposure time' (PFRemote)} + 50\mu\text{s}]$.
- Summary:
 $\text{trigger period} > \text{'exposure time' (microDisplay)} \geq [\text{'exposure time' (PFRemote)} + 50\mu\text{s}]$
- The maximum exposure time (PFRemote) in external trigger mode is < 50ms.

In the same way as the trigger signal, the strobe output is also routed through the USB frame grabber module.

Table 4: Strobe configuration summary for all other Photonfocus USB cameras

Mode	microDisplay	PFRremote
Strobe off	Strobe pulse control = 0	-
Strobe on	Strobe pulse control > 0	-
Change Strobe Delay	Delay in lines (configure in μs).	-
Change Strobe Pulse Width	'Exposure time' parameter in the exposure menu tab (configure in μs)	-

Note: The strobe signal is always active low.

2.2.4 Menu Exposure

The menu Exposure provides the configuration for the trigger signal that is generated in the Grabber controlled mode. The trigger signal can be configured to be **active high** or **active low**. The **Exposure time** defines the pulse width of the trigger pulse in μs .

Note: The exposure time that is configured in microDisplay does not configure the exposure time of the camera! It just defines the pulse width of the generated trigger signal.

On some cameras there is a trigger mode available where the exposure time is defined by the pulse width of the trigger signal.

The **Frequency** parameter defines the frequency of the generated trigger signal. The **HD Sync** parameter does not need to be changed.

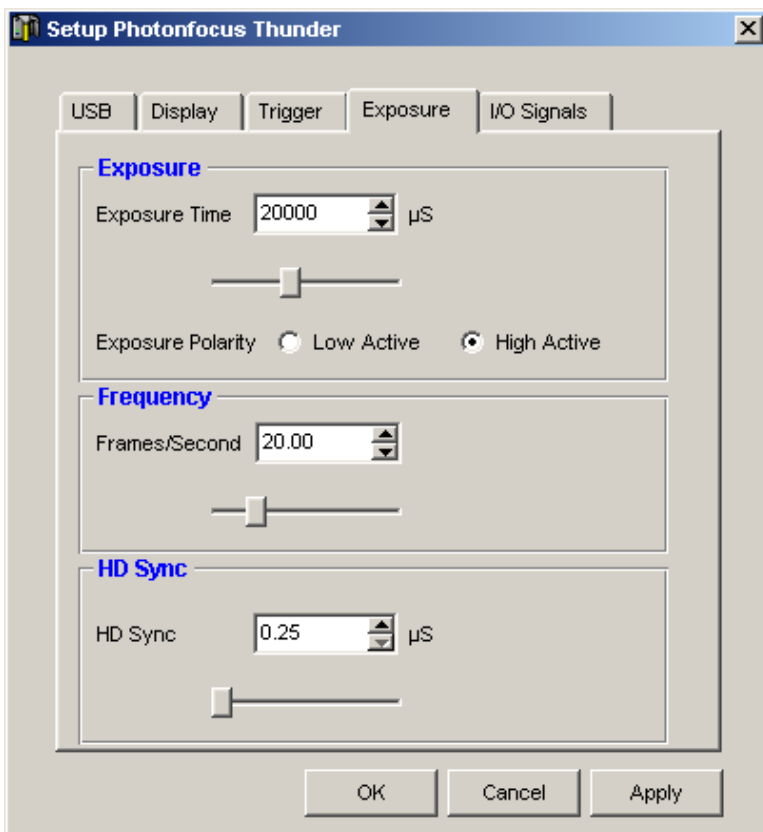


Figure 14: Configuration of the grabber-controlled trigger signal

2.2.5 Menu I/O Signals

The I/O menu provides information about internally used signals.

Note: Do not change any of the default settings here.

The **Input** in the **Dig I/O** section is connected to the trigger input. The box is ticked when a trigger signal was received.

Note: There are no digital I/Os available except trigger input and strobe output.

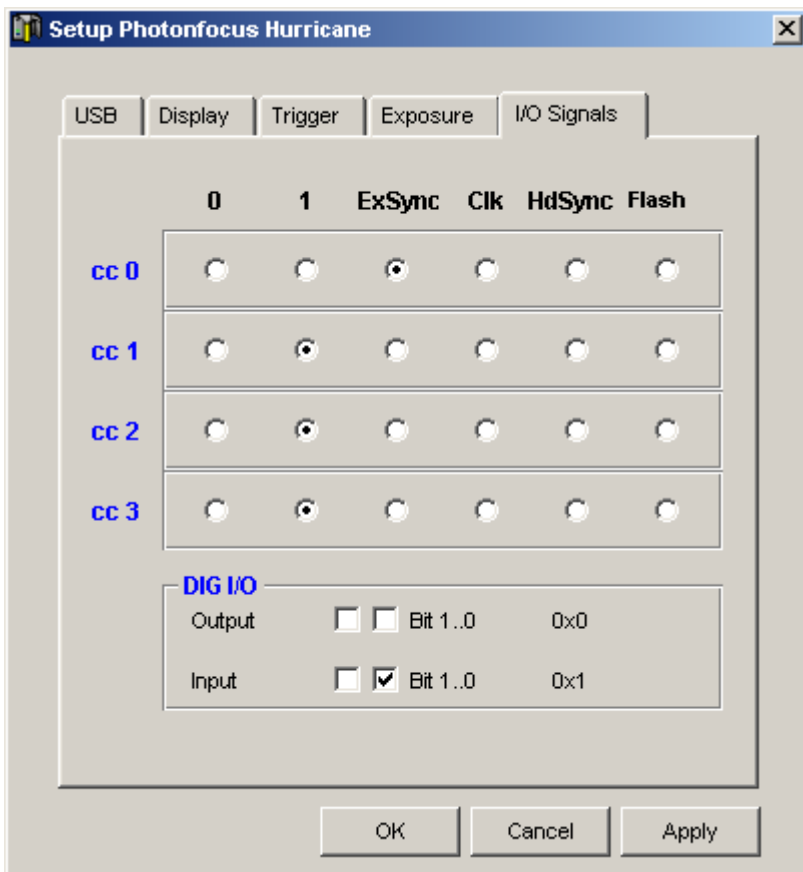


Figure 15: I/O Signals. Do not change any settings here.

2.2.6 Menu Bayer (colour cameras only)

This menu is available for colour cameras only and allows adjustment of the Bayer parameters. With the **Bayerfilter initialisation** the correct starting point must be configured. A wrong initialisation coefficient leads to false colours, e.g. actually red objects will be green.

The **Scaling RED** and **Scaling BLUE** parameters are used to white balance the image. There is also an automatic **White Balance** available. To perform white balancing, take an image of a white, flat surface which is properly illuminated but not oversaturated, stop grabbing and then press the White Balance button. The Scaling RED and Scaling BLUE parameters will be automatically adjusted.

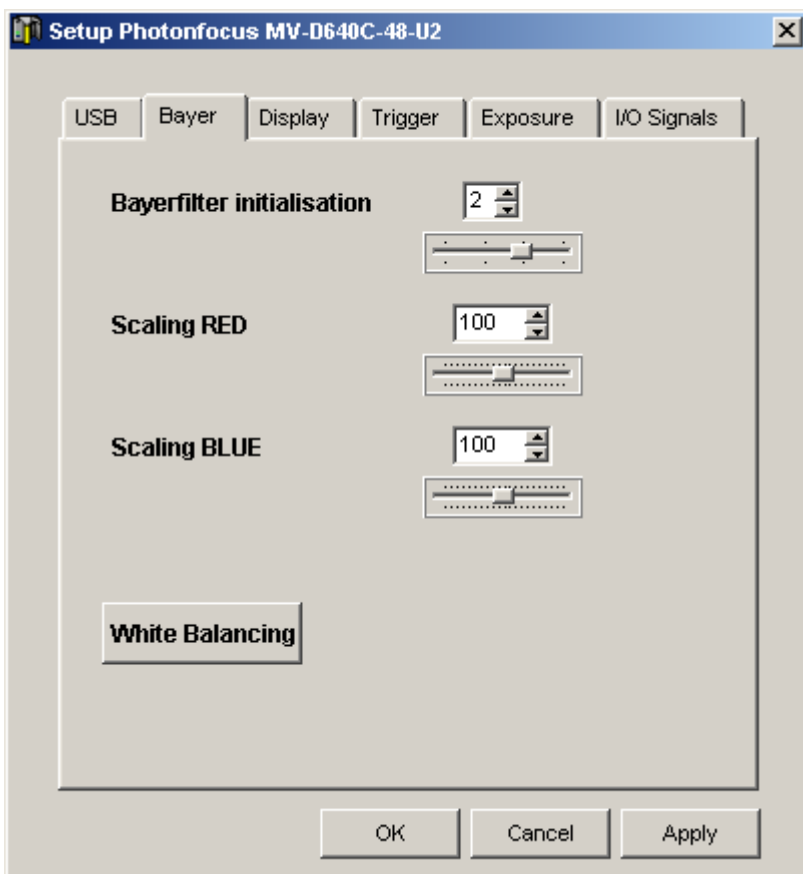


Figure 16: Bayer parameters

3 *microDisplay* image acquisition

3.1 Continuous image acquisition

The acquisition of images is controlled in the menu entry **Grabbing** → **Grab** (Shortcut **Ctrl-G**) of the menu bar.

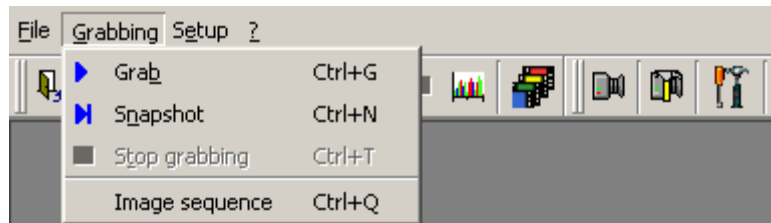


Figure 17: Grabbing menu

Alternatively, the following button in the main menu bar can be used:



To stop the continuous image acquisition, choose **Stop** in the main menu **Grabbing** → **Stop Grabbing** (Shortcut **Ctrl-T**).

Alternatively, use the following button in the main menu bar:



Changes of the hardware applet configuration cannot be done during active image acquisition.

3.2 Single image acquisition

The symbol underneath the **Grab** symbol allows the acquisition of a single image (**Grabbing** → **Snapshot** or Shortcut **Ctrl-N** in menu bar).

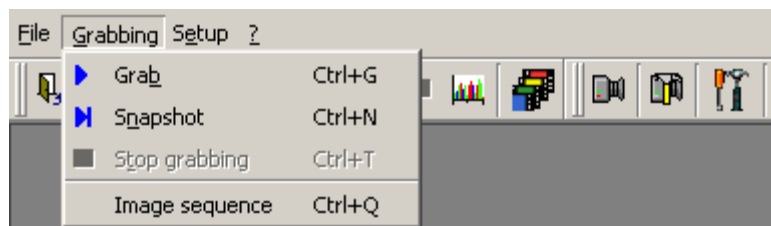


Figure 18: Single acquisition

Alternatively, press the following button:



3.3 Saving images

When the image acquisition is stopped, the currently displayed image can be saved in Windows Bitmap format. Therefore press the following button :



A menu will be displayed, where you can specify the file name and the destination folder for the file. The default folder can be specified in the menu **Options** (see chapter 1.6.2).

3.4 Sequence acquisition

Besides the continuous acquisition you can record an image sequence. The sequence grabbing is a separate submenu, which is accessible via the entry **Grabbing** → **Image sequence** (Shortcut **Ctrl-Q**) in the main menu.

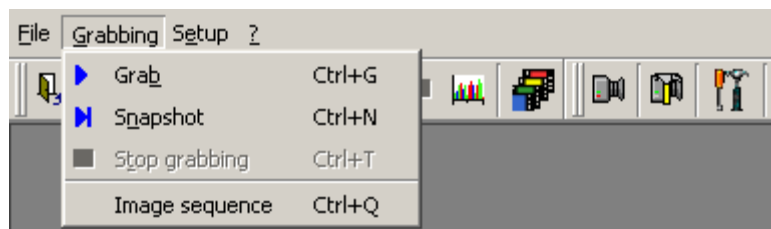


Figure 19: Sequence acquisition

Alternatively activate the symbol:



The main menu will be extended by the submenu of the sequence grabbing, from where you get access to all further options of the sequence grabbing.



Three steps are required to acquire and replay an image sequence:

















1. Configure the length of the sequence and the number of images that you want to acquire in the sequence ("Duration of sequence"). This number must not exceed the number of frame buffers that are currently allocated (see chapter 1.6.1).
2. Start the sequence grabbing with the red **Grab** button:



3. Replay the sequence.

The table below lists all functions of the menu of sequence grabbing.

Table 2: List of the submenu sequence grabbing

Symbol	Function
	Show or hide the submenu sequence grabbing
	Play an acquired sequence
	Pause the replay of the acquired sequence
	Stop the replay of the acquired sequence
	Acquire a new image sequence
	Play continuously the acquired sequence
	Jump to the first image of the acquired sequence
	Jump to the previous image of the acquired sequence
	Select an image of the acquired sequence with the slider
	Jump to the next image of the acquired sequence
	Jump to the last image of the acquired sequence
Duration of sequence 2 	Configure the number of images of a sequence
Delay 100 	Configure the delay between two images when a sequence is replayed
	Load a stored image sequence (see chapter 3.5)
	Save the current image sequence (see chapter 3.5)
	AVI grabbing (see chapter 3.6)

3.5 Saving Image Sequences

An acquired image sequence can be stored on a hard disk as single bitmaps. A stored sequence can also be reloaded again. Activate therefore the button:



In the dialog box enter file name and destination folder. *microDisplay* will save the sequence into this folder with a running number.

Saved image sequences can be reloaded with the following button:



In the dialog box, choose one of the images of the sequence. All files that contain the same name except the running number will be loaded into the sequence buffer. Take care that a sufficient number of image buffers is allocated before a sequence is loaded (see chapter 1.6.1).

3.6 AVI Grabbing

The AVI grabbing is a special form of the sequence grabbing. The above mentioned default form of sequence grabbing writes into a prepared image buffer of the PC memory. Therefore the function works very fast, but it is limited to the size of available memory of the PC.

For the grabbing of very long image sequences, you can write directly on the hard disk. Therefore it is possible to save distinctly longer sequences. The grabbing is strongly dependent of the performance of the hard disk system.

Since the hard disc access time may jitter from image to image, it is recommended that a minimum number of 16 image buffers are allocated.

The AVI grabbing can be activated by the following button:



Enter the name of the AVI file and the destination folder in the dialog box. The AVI configuration settings can be changed in the **Options** menu (see chapter 1.6.3).

Once you have prepared the AVI grabbing as described above, you can start the grabbing with the following button:



All acquired images will be directly written in an AVI file of the defined name and location. To finish the grabbing, use the button



Each restart of the sequence grabbing will overwrite the existing AVI file, except if the automatic generation of file names is active in the AVI options or if you explicitly stop the AVI mode. To cancel the AVI mode, click again on the following button:



4 microDisplay Status

4.1 Histogram

With *microDisplay*, a histogram of the currently grabbed image can be displayed. The histogram is calculated concurrent to the process of grabbing and therefore consumes some computer processing power. The display of the histogram possibly may reduce the number of displayed images.

To activate the histogram function, use the following button:



The histogram can also be displayed while image acquisition is active. The histogram output can be chosen to be displayed either in contour mode or in area mode. Click within the histogram to get the number of grey levels displayed on the right side.

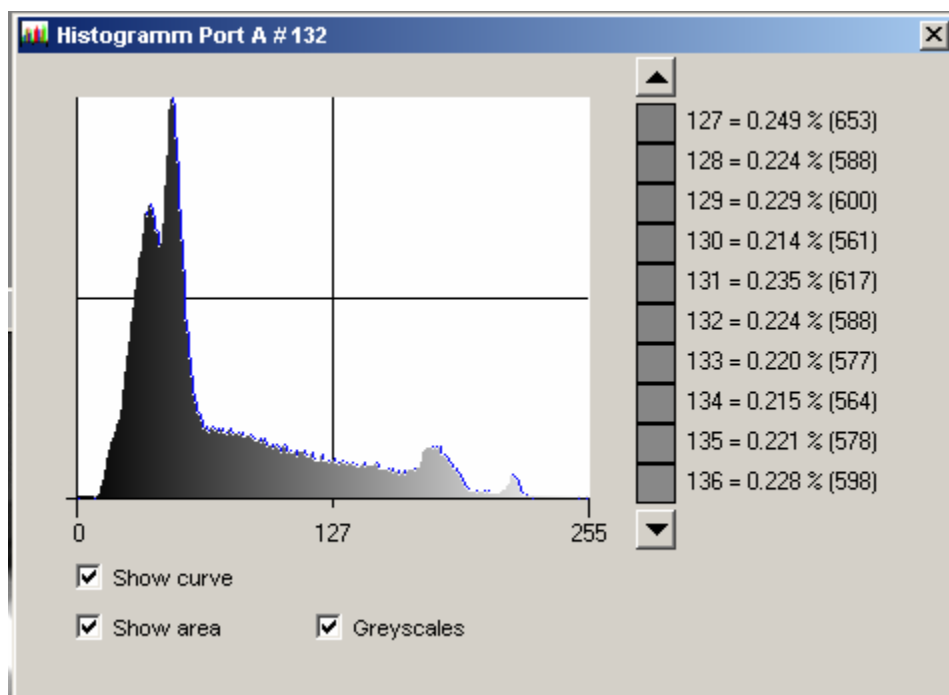


Figure 20: Histogram

4.2 Magnifier

The magnifier is an additional tool for image evaluation, which allows zooming in an image to receive information of single pixels.

The magnifier can only be used when grabbing mode is inactive. To activate the magnifier, mark an area-of-interest by dragging the mouse while keeping the right mouse button pressed. The selected area will be displayed in a separate window. When moving with the mouse in the new window, the content (R,G,B) of each pixel is displayed. Additionally the panel bar of the window gives the absolute coordinates of the pixel to which the mouse pointer currently points to.

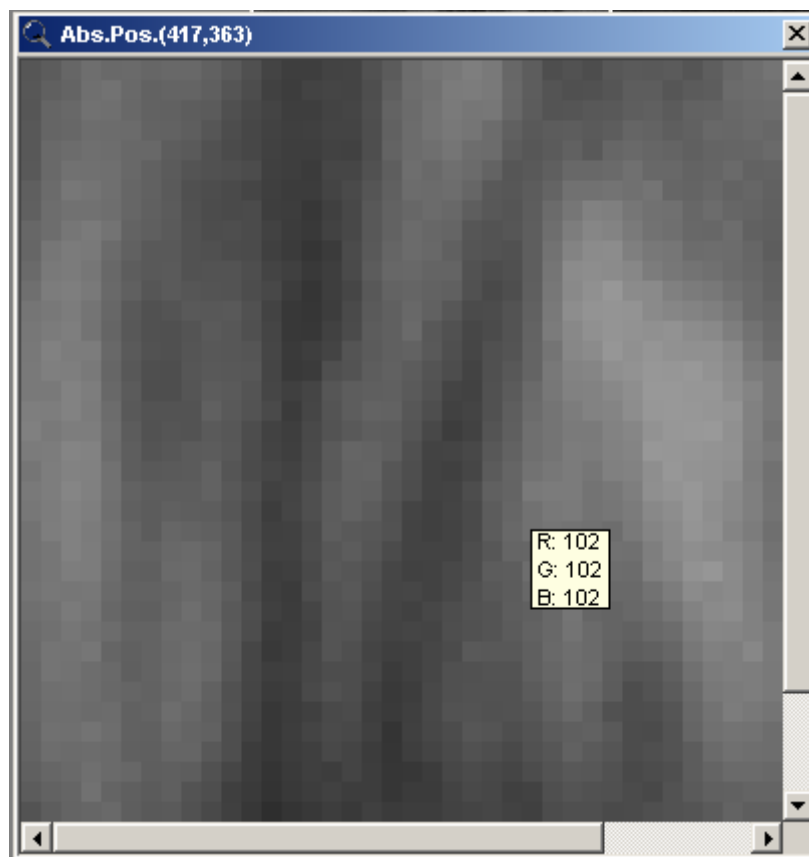


Figure 21: Magnifier

4.3 Info display

Information about the version of *microDisplay* is displayed in the menu entry → **Info** (Shortcut **Ctrl-I**)

5 Common Pitfalls with microDisplay and PFRemote

Message "mEnable not found" appears after microDisplay USB was started.

- The camera is not powered on or not connected to the USB interface.
- The USB driver is not installed correctly. Try reinstalling PFInstaller.
- When the camera is connected to the USB bus and powered on, check if there is a "Multifunction adapter" with the entry "Silicon Software GmbH microUSB2" in the Windows device manager.
- Reinstall the driver manually (see Camera User Manual).

PFRemote cannot communicate.

- microDisplay USB must always be started before PFRemote, because it downloads the USB firmware to the camera.

No image is displayed.

- Check if the camera is outputting images (check if the LED2 is green). Maybe the camera is in external trigger mode and does not receive a trigger signal.
- The camera USB interface or power supply has been disconnected since the last start of microDisplay USB. Restart microDisplay USB.
- Due to the minimum data frame size that can be transferred by USB, choose a minimum ROI of Width x Height > 1024 pixels, e.g. an ROI of 750x2. Important: This restriction comes from the USB interface and not from the sensor. If the USB interface is not used, the restriction does not apply.
- If there is already an earlier USB driver installed on your PC and you have problems installing the new PFInstaller, please contact the Photonfocus support at support@photonfocus.com.

Message "Camera clock on port A is inactive".

- A wrong hardware applet was downloaded to the camera when starting microDisplay USB.
- The USB interface or power supply has been disconnected since the last start of microDisplay USB. Restart microDisplay USB.

6 Revision History

Table 3: Document Revisions

REV	Changes	Date
1.0	First release	07/11/04
2.0	Second Release, completely revised	02/11/05

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