# CamWare

Operating Instructions



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## Operating Instructions CamWare Version 05/2003

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## CamWare

CamWare is a 32 bit Windows application for the operating systems Windows 9x/ME/2000/NT/XP.

CamWare is a camera control software for the PCO camera series SensiCam, SensiCam QE, PixelFly, DiCAM-PRO and HSFC-PRO.

With CamWare all camera parameter can be set. The images will be displayed on the monitor and can be saved, e.g. on hard disk. The Recorder function allows you to record image sequences and display them as "movies". This function allocates a memory space into which the images are written. The maximum memory space for the recorded images depends solely on the RAM size of your computer.

When starting the program, the software automatically recognizes the camera type.

Before starting CamWare, the PCI-Board, the PCI-Board driver, the camera and CamWare must be installed according to the camera manual.

While installation of CamWare, the default directory is ... Programme\Digital Camera ToolBox

After starting CamWare you can see the main window as follows (may vary slightly):



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## 1. Quick Overview

Brief description of the buttons. On the following pages find a detailed description of the features.

<b>3</b>	Print
	Display
	Camera Setting
$\leftrightarrow$ $\leftrightarrow$	Auto Convert Routines
×	White Balance (only for Color Cameras)
_ <b>⊠</b> ₹	Preview / Acquire
-+	Master Gain
● ► Ⅲ	Play & Record
	Recorder- and Play-Options
	ecorder Navigation
王	Browser
RefAct.+Offs 💌 🗮 0 🥰	Mathematical Functions

## 2. CameraControl

This chapter informs about the main functions of this software, the camera control.

Depending of the camera type different functions are available.

The CameraControl Window can be opened by pressing the following button:

-	4
3	
-	

CamWare automatically identifies the connected camera and starts the corresponding window.

#### Which is your camera?

Camera Series SensiCam

<ul> <li>SensiCam LongExposure</li> </ul>	see next page
<ul> <li>SensiCam FastShutter</li> </ul>	see page 10
SensiCam DoubleShutter	see page 15
<ul> <li>SensiCam QE</li> </ul>	see page 17
<ul> <li>SensiCam SensiMod</li> </ul>	see page 20
Camera Series <b>PixelFly</b> <ul> <li>PixelFly</li> </ul>	see page 22
Camera Series <b>DiCAM-PRO</b>	

## 2.1 SensiCam LongExposure

In the following Camera Control Window all camera parameter can be set.



## SensiCam LongExposure

Region of Interest (ROI)	Selection of the exposed CCD area. The minimum is 32 x 32 pixels
	Input by keyboard or mouse (press left mouse key and move). By pressing the STRG key and the left mouse button simulta- neously, a ROI can be defined with the mouse pointing in the original displayed image. By pressing simultaneously the STRG key and double-clicking with the left mouse button in the original displayed image, the ROI will be reset to its maximum. The non-exposed lines will be readout approximately four times faster thus increasing the image repetition rate. The image data will be reduced, too.
Analog Gain	Gain Normal (standard setting) Gain –6dB Useful only in binning mode. The gain will be reduced by factor 2.
Info	<ul> <li>The following information will be shown by repeatedly pressing the Info button.</li> <li>type of SensiCam (this code is important for queries about the camera)</li> <li>sensor type (b/w, color, VGA, SVGA)</li> <li>CCD- and electronics temperature</li> <li>delay- / exposure time</li> <li>readout time, frames per second (fps)</li> <li>trigger options</li> </ul>
Trigger Settings	With the button ,Set Trigger' a new window will be opened and the following settings can be done:
Sequence Start	The exposure sequence is started internally (Auto Start) or by an external trigger signal (Triggered) at the BNC connector of the PCI-Board.
Frame Start	The exposure will be started (sequential or simultaneous) or by an external trigger signal (Triggered). For further details on trig- gering see the camera manual.
Trigger Edge	Setting of the falling or rising edge trigger signal by external trigger
Signal Out	The BNC socket can be also used for control output signals. For more details please see the camera manual.

Please continue on page 30!

## 2.2 SensiCam FastShutter

The SensiCam FastShutter can be operated in the Standard Mode and in the Fast Cycles Mode. In the field 'Options' you can select the desired mode.

For each mode you will get a separate Camera Control window.

#### 2.2.1 SensiCam FastShutter in Standard Mode

In the following Camera Control Window all camera parameter can be set.



**Delay Time** 

0 ... 1ms, selectable in 100ns-steps

**Exposure Time** 

100ns ... 1ms, selectable in 100ns-steps

A maximum of 10 pairs (delay + exposure) can be programmed. If you need a single exposure you have to set the nine not used

pairs to 0000.000.

⊢Del./Exp. ti	me
Delay [µs]	Exposure [µs]
0020.000	0005.000
1000.000	0000.000
1000.000	1000.000
0001.000	1000.000
0000.000	0100.000
0000.000	0000.000
0000.000	0000.000
0000.000	0000.000
0000.000	0000.000
0000.000	0000.000

Binning

## SensiCam FastShutter (Standard Mode)

Example for a multiple exposure operation

Shot 1: Delay 20 $\mu s,$  Exposure 5 $\mu s$ 

Shot 2: Delay 1ms, Exposure 0

Shot 3: Delay 1ms, Exposure 1ms

Shot 4: Delay 1µs, Exposure 1ms

Shot 5: Delay 0, Exposure 100µs

#### Remarks:

- At shot 2 exposure time has been set to 0. This way a delay of >1ms is achieved.
- Shot 4 has a true duration of 1.1ms, since the delay of shot 5 is zero, i. e. the shot 5 follows shot 4 without interruption. This way exposures of >1ms are achieved.

Lines (vertical) and columns (horizontal) will be combined generating so called 'super pixels'. Please note that the resolution will be reduced and the image repetition rate will rise (only by vertical binning).

Horizontal Binning: Factor 1, 2, 4, 8 Vertical Binning: Factor 1, 2, 4, 8, 16, 32

Region of Interest (ROI)	Selection of the exposed CCD area. The minimum is 32 x 32 pixels. Input by keyboard or mouse (press left mouse key and move). By pressing the STRG key and the left mouse button simulta- neously, a ROI can be defined with the mouse pointing in the original displayed image. By pressing simultaneously the STRG key and double-clicking with the left mouse button in the original displayed image, the ROI will be reset to its maximum. The non-exposed lines will be readout approximately four times faster thus increasing the image repetition rate. The image data will be reduced, too.
Trigger Settings	Auto Sequential (only in Standard Mode) External falling Edge External rising Edge
Options	<ul><li>Selection of the two operating modes</li><li>FastShutter Standard</li><li>FastShutter Fast Cycles</li></ul>
Analog Gain	Gain Normal (standard setting) Gain –6dB Useful only in binning mode. The gain will be reduced by factor 2.

#### SensiCam FastShutter (Fast Cycles Mode)

The following information will be shown by repeatedly pressing the Info button.

- type of SensiCam (this code is important for queries about the camera)
- sensor type (b/w, color, VGA, SVGA)
- CCD- and electronics temperature
- delay- / exposure time
- readout time, frames per second (fps)
- trigger options

## 2.2.2 SensiCam FastShutter in Cycles Mode

In the following Camera Control Window all camera parameter can be set.



Info

12

Del./Exp. Time

Cycles

Cycles

Cycles

Cycles

Cycles

Exposure [µs]

0012

1000.000

0001

0500.000

0003

0060.000

0005

1000.000

0000

0000.000

Delay [µs]

0000.800

0002.000

0000.400

0001.000

0000.000

## SensiCam FastShutter (Fast Cycles Mode)

In this window you can select the delay time, exposure time and the number of cycles. Altogether five time blocks are available.



Within each block the delay- and exposure time will be repeated according to the cycle number, before the exposures of the following block begin.

When cycles = 0 the block will be skipped.

The block (delay + exposure) may not be  $<1\mu$ s.

#### Example for a multiple exposure operation

Shot 1: Delay 800ns, Exposure 1ms, Cycles 12

- Shot 2: Delay 2µs, Exposure 500µs, Cycles 1
- Shot 3: Delay 400ns, Exposure 60µs, Cycles 3
- Shot 4: Delay 1µs, Exposure 1ms, Cycles 5

Shot 5: Delay 0, Exposure 0, Cycles 0

#### Each cycle must be triggered separately!

First you have 12 exposures with 1ms exposure time and 800ns delay time each.

Then there is a delay of  $2\mu s$  and an exposure of  $500\mu s$ .

Now in block three you have three times an exposure of 60µs with 400ns delay between.

Then you have a  $1\mu$ s delay and an 1ms exposure. This pair will be repeated five times.

The last block is disregarded because all settings are zero.

#### Binning

Lines (vertical) and columns (horizontal) will be combined generating so called 'super pixels'. Please note that the resolution will be reduced and the image repetition rate will rise (only by vertical binning).

Horizontal Binning: Factor 1, 2, 4, 8 Vertical Binning: Factor 1, 2, 4, 8, 16, 32

## SensiCam FastShutter (Fast Cycles Mode)

Region of Interest (ROI)	Selection of the exposed CCD area. The minimum is 32 x 32 pixels.
	Input by keyboard or mouse (press left mouse key and move). By pressing the STRG key and the left mouse button simulta- neously, a ROI can be defined with the mouse pointing in the original displayed image. By pressing simultaneously the STRG key and double-clicking with the left mouse button in the original displayed image, the ROI will be reset to its maximum. The non-exposed lines will be readout approximately four times faster thus increasing the image repetition rate. The image data will be reduced, too.
Trigger Settings	Auto Sequential (only in Standard Mode) External falling Edge External rising Edge
Options	<ul><li>Selection of the two operating modes</li><li>FastShutter Standard</li><li>FastShutter Fast Cycles</li></ul>
Analog Gain	<b>Gain Normal</b> (standard setting) <b>Gain –6dB</b> Useful only in binning mode. The gain will be reduced by factor 2.
Info	<ul> <li>The following information will be shown by repeatedly pressing the Info button.</li> <li>type of SensiCam (this code is important for queries about the camera)</li> <li>sensor type (b/w, color, VGA, SVGA)</li> <li>CCD- and electronics temperature</li> <li>delay- / exposure time</li> <li>readout time, frames per second (fps)</li> <li>trigger options</li> </ul>
	Please continue on page 30!

## 2.3 SensiCam DoubleShutter

In the following Camera Control Window all camera parameter can be set.



With the SensiCam DoubleShutter no delay and exposure settings in the camera control window are possible. These fields are grey and inactive. The exposure time can only be controlled via the TRIG IN socket at the PCI-Board.

To control the TRIG IN socket, please see manual "SensiCam / SensiCam QE".

Lines (vertical) and columns (horizontal) will be combined generating so called 'super pixels'. Please note that the resolution will be reduced and the image repetition rate will rise (only by vertical binning).

Horizontal Binning: Factor 1, 2, 4, 8 Vertical Binning: Factor 1, 2, 4, 8, 16, 32

Binning

## SensiCam DoubleShutter

Region of Interest (ROI)	Selection of the exposed CCD area. The minimum is 32 x 32 pixels.
	Input by keyboard or mouse (press left mouse key and move). By pressing the STRG key and the left mouse button simulta- neously, a ROI can be defined with the mouse pointing in the original displayed image. By pressing simultaneously the STRG key and double-clicking with the left mouse button in the original displayed image, the ROI will be reset to its maximum. The non-exposed lines will be readout approximately four times faster thus increasing the image repetition rate. The image data will be reduced, too.
Trigger Settings	External falling Edge External rising Edge
	For detailed information about trigger control , please see Chapter 2.7 Trigger Control
Options	<ul> <li>Two available <b>DoubleShutter</b> modes</li> <li>Double Short (dead time 200ns)</li> <li>Double Long (dead time 1µs)</li> <li>Two available <b>FastShutter</b> modes</li> <li>Standard</li> <li>Fast Cycles</li> </ul>
	The two operation modes 'Double Short' and 'Double Long' re- fer to the dead time between the first and the second picture. During this period, no exposure must be started. In operation mode <b>DOUBLE short</b> , the dead time is <b>200 nanoseconds</b> . In operation mode <b>DOUBLE long</b> , the dead time is <b>1µs</b> . The inte- gration time of image 1 should not exceed 10ms. An enhanced anti-blooming effect is given.
Analog Gain	Gain Normal (standard setting) Gain –6dB
	2.
Info	<ul> <li>The following information will be shown by repeatedly pressing the Info button.</li> <li>type of SensiCam (this code is important for queries about the camera)</li> <li>sensor type (b/w, color, VGA, SVGA)</li> <li>CCD- and electronics temperature</li> <li>delay- / exposure time</li> <li>readout time, frames per second (fps)</li> <li>trigger options</li> </ul>

Please continue on page 28!

## 2.4 SensiCam QE





\*) The selection of the exposure time is internally generated in 156,25ns steps. The true value for short exposure times is only an approximation of the selected exposure time value

## SensiCam QE

Binning	Lines (vertical) and columns (horizontal) will be combined gen- erating so called 'super pixels'. Please note that the resolution will be reduced and the image repetition rate will rise (only by vertical binning). <b>Horizontal Binning:</b> Factor 1, 2, 4, 8 <b>Vertical Binning:</b> Factor 1, 2, 4, 8, 16	
Region of Interest (ROI)	Selection of the exposed CCD area. The minimum is 32 x 32 pixels. Input by keyboard or mouse (press left mouse key and move). By pressing the STRG key and the left mouse button simulta- neously, a ROI can be defined with the mouse pointing in the original displayed image. By pressing simultaneously the STRG key and double-clicking with the left mouse button in the original displayed image, the ROI will be reset to its maximum. The non-exposed lines will be readout approximately four times faster thus increasing the image repetition rate. The image data will be reduced, too.	
Analog Gain	Gain Normal (standard setting) Gain High The gain will be increased by factor 2. Useful in binning mode.	
Low Light Mode	Two different modes are available. The main difference is in the antiblooming feature and the quantum efficiency.	
	<ul> <li>Default</li> <li>This 'Standard Light Mode' is useful for all exposure times up to 1000s. The antiblooming function is maximum.</li> <li>On</li> <li>The 'Low Light Mode' is useful for exposure times between 1ms 10s. The antiblooming function is limited to fourfold overexposure. The quantum efficiency is maximum.</li> </ul>	
	Q.E.[%]	



## SensiCam QE

Info	<ul> <li>The following information will be shown by repeatedly pressing the Info button.</li> <li>type of SensiCam (this code is important for queries about the camera)</li> <li>sensor type (b/w, color, VGA, SVGA)</li> <li>CCD- and electronics temperature</li> <li>delay- / exposure time</li> <li>readout time, frames per second (fps)</li> <li>trigger options</li> </ul>
Frame Control	Selection of the operating mode and trigger settings.
	<ul> <li>Operating Mode</li> <li>"LongExp" for exposures between 1ms1000s</li> <li>"Fast" for exposures between chen 500ns10ms</li> <li>"Double" for exposure of two images</li> </ul>
	<b>Trigger Settings</b> With the button ,Set Trigger' a new window will be opened and the following settings can be done:
	Sequence Start       Frame Start         C Triggered       Sequential         Triggered       Simultaneous         Trigger Edge       Signal Out         C Faling       Fising
Sequence Start	The exposure sequence is started internally (Auto Start) or by an external trigger signal (Triggered) at the BNC connector of the PCI-Board.
Frame Start	The exposure will be started (sequential or simultaneous) or by an external trigger signal (Triggered). For further details on trig- gering see the camera manual.
Trigger Edge	Setting of the falling or rising edge trigger signal by external trigger.
Signal Out	The BNC socket can be also used for control output signals. For more details see the camera manual.

Please continue on page 30!

## 2.5 SensiCam SensiMod

In the following Camera Control Window all camera parameter can be set.



Info Window

#### Integration Time Window



Setting of the integration time window. Within this window the modulation takes place. 100µs ... 1s, selectable in 1µs steps

The modulated input signal will be input via the BNC socket MOD IN at the camera rear panel.

The integration time window can be output as control signal via the BNC socket TRIG IN at the PCI-board.

While this signal is high, modulation signal input is accepted. Out of this time window, pulses fed in do not generate any exposure or clearing process. However, they may interfere in the CCD's readout, resulting in distortions or disturbances of the image.

PCI-Interface-Board

The BNC socket TRIG IN has only output function and not trigger input function!

## SensiCam SensiMod

	MOD INThe BNC socket marked MOD IN at the camera's rear panel is the input for external modulation signals (TTL level).0V= expose 5V= clear
1 kΩ	The input has a $1k\Omega$ pull-down resistor, i. e. an exposure is made while no external signal is applied.
	$T_{off} \ge 500$ ns $T_{on} \ge 500$ ns $f_{max} = 1$ MHz
	There is an intrinsic delay of approx. 30 ns between feeding in of an external signal and its optical repercussion.
Binning	Lines (vertical) and columns (horizontal) will be combined gen- erating so called 'super pixels'. Please note that the resolution will be reduced and the image repetition rate will rise (only by vertical binning). <b>Horizontal Binning:</b> Factor 1, 2, 4, 8 <b>Vertical Binning:</b> Factor 1, 2, 4, 8, 16
Region of Interest (ROI)	Selection of the exposed CCD area. The minimum is 32 x 32 pixels. Input by keyboard or mouse (press left mouse key and move). By pressing the STRG key and the left mouse button simulta- neously, a ROI can be defined with the mouse pointing in the original displayed image. By pressing simultaneously the STRG key and double-clicking with the left mouse button in the original displayed image, the ROI will be reset to its maximum. The non-exposed lines will be readout approximately four times faster thus increasing the image repetition rate. The image data will be reduced, too.

Please continue on page 30!

## 2.6 PixelFly

In the following Camera Control Window all camera parameter can be set.



## PixelFly

Binning	Lines (vertical) and columns (horizontal) will be combined gen- erating so called 'super pixels'. Please note that the resolution will be reduced and the image repetition rate will rise (only by vertical binning). <b>Horizontal Binning:</b> Factor 1, 2 <b>Vertical Binning:</b> Factor 1, 2 (VGA sensors: 1, 2, 4)
	Please note that with color cameras, the color information will be lost in binning mode!
Info	<ul> <li>The following information will be shown by pressing the Info button several times.</li> <li>type of PixelFly (this code is important for queries about the camera)</li> <li>sensor type (b/w, color, VGA, SVGA)</li> <li>CCD- and electronics temperature</li> <li>delay- / exposure time</li> <li>readout time, frames per second (fps)</li> <li>trigger options</li> </ul>
Analog Values	There are two gain levels possible: normal and high.
Trigger Mode	<b>Intern:</b> Pressing the Preview or Acquire button starts an exposure. <b>Extern:</b> A hardware trigger is generated by an external trigger pulse at the BNC socket (PCI board).
	Please continue on page 30!

## 2.7 DiCAM-PRO

#### 2.7.1 DiCAM-PRO in Single Trigger Mode

In the following Camera Control Window all camera parameter can be set.



## **DiCAM-PRO (Single Trigger Mode)**

The selectable gain ranges from 0 ... 100%, while reasonably a gain of 80 ... 100% should be set. Less than 50% of an intensifier gain are already achieved by state of the art, bare CCD cameras. Caution The image intensifier is the most delicate part of the whole camera system. Its lifetime is decisively influenced by the photocathode current (photoeffect). The photocathode is best preserved by setting a high gain, since a small amount of input light generates a low photocathode current but produces a high light output to yield a perfect image on the CCD. But the lifetime also depends on the number of shots and its repetition rate. If your image is overexposed, do not lower the image intensifier gain but attenuate the light impinging on the photocathode by, e. g. closing the lens iris or adding a grey filter to it. Trigger Choice between external trigger (Extern) and internal (software) trigger (Auto). For detailed trigger information, please see the separate camera manual. Lines (vertical) and columns (horizontal) will be combined gen-Binning erating so called 'super pixels'. Please note that the resolution will be reduced and the image repetition rate will rise (only by vertical binning). Horizontal Binning: Factor 1, 2, 4, 8 Vertical Binning: Factor 1, 2, 4, 8, 16, 32 **Region of Interest (ROI)** Selection of the exposed CCD area. The minimum is 32 x 32 pixels. Input by keyboard or mouse (press left mouse key and move). By pressing the STRG key and the left mouse button simultaneously, a ROI can be defined with the mouse pointing in the original displayed image. By pressing simultaneously the STRG key and double-clicking with the left mouse button in the original displayed image, the ROI will be reset to its maximum. The non-exposed lines will be readout approximately four times faster thus increasing the image repetition rate. The image data will be reduced, too. Analog Gain Gain Normal (standard setting) Gain –6dB Useful only in binning mode. The gain will be reduced by factor 2. Info The following information will be shown by pressing the Info button several times. type of DiCAM-PRO (this code is important for queries about the camera) sensor type (b/w, VGA, SVGA) CCD- and electronics temperature delay- / exposure time readout time, frames per second (fps) trigger options

## 2.7.2 DiCAM-PRO in Multi Trigger Mode

In the following Camera Control Window all camera parameter can be set.



## DiCAM-PRO (Multi Trigger Mode)

The selectable gain ranges from 0 ... 100%, while reasonably a gain of 80 ... 100% should be set. Less than 50% of an intensifier gain are already achieved by state of the art, bare CCD cameras. Caution The image intensifier is the most delicate part of the whole camera system. Its lifetime is decisively influenced by the photocathode current (photoeffect). The photocathode is best preserved by setting a high gain, since a small amount of input light generates a low photocathode current but produces a high light output to yield a perfect image on the CCD. But the lifetime also depends on the number of shots and its repetition rate. If your image is overexposed, do not lower the image intensifier gain but attenuate the light impinging on the photocathode by, e. g. closing the lens iris or adding a grey filter to it. Trigger Choice between external trigger (Extern) and internal (software) trigger (Auto). For detailed trigger information, please see the separate camera manual. Lines (vertical) and columns (horizontal) will be combined gen-Binning erating so called 'super pixels'. Please note that the resolution will be reduced and the image repetition rate will rise (only by vertical binning). Horizontal Binning: Factor 1, 2, 4, 8 Vertical Binning: Factor 1, 2, 4, 8, 16, 32 **Region of Interest (ROI)** Selection of the exposed CCD area. The minimum is 32 x 32 pixels. Input by keyboard or mouse (press left mouse key and move). By pressing the STRG key and the left mouse button simultaneously, a ROI can be defined with the mouse pointing in the original displayed image. By pressing simultaneously the STRG key and double-clicking with the left mouse button in the original displayed image, the ROI will be reset to its maximum. The non-exposed lines will be readout approximately four times faster thus increasing the image repetition rate. The image data will be reduced, too. Analog Gain Gain Normal (standard setting) Gain –6dB Useful only in binning mode. The gain will be reduced by factor 2. Info The following information will be shown by pressing the Info button several times. type of DiCAM-PRO (this code is important for queries about the camera) sensor type (b/w, VGA, SVGA) CCD- and electronics temperature delay- / exposure time readout time, frames per second (fps) trigger options

## 2.7.3 DiCAM-PRO in Double Trigger Mode

In the following Camera Control Window all camera parameter can be set.



## DiCAM-PRO (Double Trigger Mode)

Caution	The image intensifier is the most delicate part of the whole camera system. Its lifetime is decisively influenced by the photocathode current (photoeffect). The photocathode is best preserved by setting a high gain, since a small amount of input light generates a low photocathode current but produces a high light output to yield a perfect image on the CCD. But the lifetime also depends on the number of shots and its repetition rate. If your image is overexposed, do not lower the image intensifier gain but attenuate the light impinging on the photocathode by, e. g. closing the lens iris or adding a grey filter to it.			
Trigger	Choice between external trigger (Extern) and internal (software) trigger (Auto). For detailed trigger information, please see the separate camera manual.			
Binning	Lines (vertical) and columns (horizontal) will be combined gen- erating so called 'super pixels'. Please note that the resolution will be reduced and the image repetition rate will rise (only by vertical binning). Horizontal Binning: Factor 1, 2, 4, 8 Vertical Binning: Factor 1, 2, 4, 8, 16, 32			
Region of Interest (ROI)	<ul> <li>Selection of the exposed CCD area. The minimum is 32 x 32 pixels.</li> <li>Input by keyboard or mouse (press left mouse key and move).</li> <li>By pressing the STRG key and the left mouse button simultaneously, a ROI can be defined with the mouse pointing in the original displayed image. By pressing simultaneously the STRG key and double-clicking with the left mouse button in the original displayed image, the ROI will be reset to its maximum.</li> <li>The non-exposed lines will be readout approximately four times faster thus increasing the image repetition rate.</li> <li>The image data will be reduced, too.</li> </ul>			
Analog Gain	Gain Normal (standard setting) Gain –6dB Useful only in binning mode. The gain will be reduced by factor 2.			
Info	<ul> <li>The following information will be shown by pressing the Info button several times.</li> <li>type of DiCAM-PRO (this code is important for queries about the camera)</li> <li>sensor type (b/w, VGA, SVGA)</li> <li>CCD- and electronics temperature</li> <li>delay- / exposure time</li> <li>readout time, frames per second (fps)</li> <li>trigger options</li> </ul>			

	3. Functions
	3.1 Menu Bar
	3.1.1 Menu File
Print Setup	Printer selection and printer setup
Print	Prints the active window at the printer installed in Windows. The image size is optimized to the paper size.
Load Camera Settings	The camera settings, saved with ,Save Camera Settings', will be imported.
Save Camera Settings	The actual used camera settings can be saved. When several people work with the same camera, an individual setting is advantageous.
Exit	Exit the program.

## 3.1.2 Menu Image

#### Import

12 Bit single images in the B16 or TIF format can be imported.

Import Image					<u>?</u> ×
Search in:	🔁 CamWare		•	← 🗈 💣 🔳-	
Verlauf Desktop Arbeitsplatz	color checker P     bgo.b16     test_image_bw     test_image_col	F215X5.b16 or.b16			
	Filename:	test_image_bw.b16		•	Load
	Filetype:	12bit B16-File (*.b16)		•	Cancel

In case the recorder is activated, the image will be insert automatically to the existing format (picture width and height). In case the recorder is deactivated, the software will be set automatically to the new format (picture width and height).

**Remark** If a camera with VGA sensor (640x480) is attached and a SVGA image has to be imported, the edges will be cut off.

Black/white Look Up Tables (LUTs) and Color LUTs are imported by the B16 file as they where exported the last time.

Import SetImports a set of images which were exported with the ,Export<br/>Set' command. A set contains at the most the number of im-<br/>ages as number of cameras are operated at the same time in<br/>one computer. If e.g. 3 cameras run in one computer, an ex-<br/>ported set can save at the most 3 images. These three images<br/>can be imported again with the 'Import Set' command.<br/>Condition: To import these three images, all three cameras<br/>must be connected to the computer.

#### **Import Recorder**

A complete sequence or parts of it can be imported. The number of imported images depends of the allocated recorder memory.

Select an arbitrary file of the sequence to the field 'Filename'. In case of importing the complete sequence, the field 'Whole sequence' must be activated, otherwise you have to select the image numbers.

If not specified, the first image of the sequence will be imported to the first memory place of the buffer.

Import Recorder				<u>? ×</u>
Search in:	🔁 Experiment		- 🔁 🖻	<b>Ⅲ</b> ▼
Verlauf Desktop Lesktop Arbeitsplatz	bubbles_0001.b16     bubbles_0002.b16     bubbles_0003.b16     bubbles_0004.b16     bubbles_0006.b16     bubbles_0006.b16     bubbles_0007.b16     bubbles_0009.b16     bubbles_0009.b16     bubbles_0010.b16     bubbles_0011.b16	bubbles_0012.b16     bubbles_0013.b16     bubbles_0014.b16     bubbles_0015.b16     bubbles_0015.b16     bubbles_0017.b16     bubbles_0017.b16     bubbles_0019.b16     bubbles_0020.b16     bubbles_0021.b16     bubbles_0022.b16	bubbles_0023.b16     bubbles_0024.b16     bubbles_0025.b16     bubbles_0026.b16     bubbles_0026.b16     bubbles_0028.b16     bubbles_0029.b16     bubbles_0030.b16     bubbles_0031.b16     bubbles_0032.b16     bubbles_0033.b16	bubbles_0034.b     bubbles_0035.b     bubbles_0036.b     bubbles_0037.b     bubbles_0038.b     bubbles_0039.b     bubbles_0040.b     bubbles_0041.b     bubbles_0042.b     bubbles_0043.b     bubbles_0044.b
Netzwerkumg	•			Þ
	Filename:		•	Load
	Filetype: 12t	oit B16-File (*.b16)	•	Cancel
🔽 Whole sequen	ice First Image 1	Last Image 101		
Load first image to	buffer number: 1			

The recorder is automatically set to the new imported format (picture width and height).

Black/white LUTs and Color LUTs are imported by the B16 and TIF file as they were exported last time.

#### Export

With export you can save single images. They can be exported in following formats:

- "b16" 12 Bit PCO format
- "tif" 16 Bit and 8 Bit TIFF format (b/w and color)
- "fts" 16 Bit FITS format (NASA definition)
- "asc" 16 Bit ASCII format
- "bmp" 8 Bit b/w- and 3x8 Bit color format

Export Image					<u>? ×</u>
Search in:	🔁 Test		•	⇐ 🗈 💣 🎟-	
Verlauf Desktop Arbeitsplatz					
	Filename: Filetype:	testimage 12bit B16-File (*.b16)		•	Save Cancel
Use and increr	ment current number es (BW) 🔲 BW+C	ol			

In case of exporting single images with ascendant numbers the field 'Use and increment current number' must be activated. The file name must terminate with 3 digits.

**Example:** You select the file name test023

When exporting again, the default file name will be test024, then test025, ...

When working with several cameras in one computer, the single images of all used cameras can be saved at the same time. The field 'Export all images (BW)' must be active. Another possibility to save them is the 'Export Set' command.

**Example:** You work with three cameras in one computer and select the file name TEST. Three files will be generated with the names TESTC1, TESTC2 and TESTC3, whereby C means channel and the number corresponds to the camera.

In case a b/w and a color window are opened at the same time, you can also export both at the same time. The field ,BW+Col' must be activated.

Example: You select the file name TEST.

The b/w image will be saved as TESTBW, the color image as TESTCOL.

#### Export Set

When operating several cameras in one computer, a complete set of images from all cameras can be exported. A set contains at the most the number of images as number of cameras are operated at the same time in one computer. If e.g. 3 cameras run in one computer, an exported set can save at the most 3 images. The export set command will generate one set file and three B16 files.

**Example:** You work with 4 cameras in one computer and select the filename TEST. The following five files will be generated: TEST.set, TEST1.b16, TEST2.b16, TEST3.b16 and TEST4.b16 The set file contains all camera settings of each camera and an

additional info text which can be input by a dialog box.

**Export Recorder** With ,Export Recorder' a complete **sequence** can be exported. The file format has to be selected in the field ,Filetype'.

Export Image					? ×
Search in: 🧲	🔁 Test		•	🗢 🗈 💣 🎟	-
Verlauf Desktop Arbeitsplatz Netzwerkumg					
Fi	lename: letype:	testimage 12bit B16-File (*.b16)		• •	Save Cancel
☑ Save All Images File numbering starts v	First Image 1	Last Image 101			

You can save all images of the sequence or only parts of them. When exporting only parts of the images, the first and the last images have to be defined. The image number corresponds to the number of the memory place within the sequence.

To the selected file names, a 4-digit number will be added automatically, beginning with 0001.

Example: You select the file name TEST.

The exported sequence will be saved as TEST\_0001, TEST\_0002, TEST\_0003, TEST\_0004, ...

The start number can be selected individually.

#### **Direct Record to File**

Images can be stored directly to hard disk.

Direct Record To Fi	ile			<u>? ×</u>
Search in:	🔁 Test	<u> </u>	🗢 🗈 💣 🎟 •	
Verlauf Desktop Arbeitsplatz				
	Filename:	testimage	•	Start
	Filetype:	12bit B16-File (*.b16)	<b>•</b>	Cancel
No. of images to st	ore: 1			

With ,No. of images to store' you select the total number of images you want to save. Pressing the Record button starts the recording.

Please note that with this direct record to hard disk the maximum recording speed of the camera cannot be achieved. It depends of the computer system speed (hard disk, hard disk controller, ...).

Load Lookup Table By clicking the 'Load' button, look-up-tables for your b/w images are available. With these look-up-tables (LUT) the 12 bit grey values get a color information (false colors).

Beside the predefined LUTs (see below) you can also define your own one.

Load Pseudo LU	Г				<u>?</u> ×
Search in:	🔁 CamWare		•	🗢 🗈 💣 🎟•	
Verlauf Verlauf Desktop Lesktop Arbeitsplatz	LUT_BGRsoft.lt     LUT_compresse     LUT_compresse     LUT_expanded     LUT_expanded     LUT_exponentil     LUT_invertent     LUT_ISO7_cold     LUT_linear.lt1     LUT_logarithmin     LUT_logarithmin     LUT_noverexpos     LUT_quantized	:1 .lt1 al.lt1 :1 r.lt1 c.lt1 drant_bw.lt1 sed.lt1 16_color.lt1	LUT_quantized8,     LUT_quantized8,     LUT_rainbow.lt1     Lut_rgb.lt1     Lut_rgb.lt1     LUT_RGBsoft.lt1	_bw.lt1 soft_color.lt1	
	Filename:			•	Load
	Filetype:	ASCII 256xr 2	56xg 256xb (*.LT1)	•	Cancel

The following predefined LUTs can be loaded:

LT1-Tabellen	Files with 3x256 ASCII-characters, consisting of 256x red, followed by 256x green, followed by 256x blue.				
	LUT_BGRsoft LUT_compressed LUT_expanded LUT_exponential LUT_inverted LUT_ISO7_color	LUT_linear LUT_logarithmic LUT_middlequadrant_bw LUT_overexposed LUT_quantized16_color LUT_quantized8_bw	LUT_quantized8soft_color LUT_rainbow LUT_RGB LUT_RGBsoft		
LT2-Tabellen	Files with 768 ASCII- characters, consisting of 256x rgb rgb rgb rgb (r=red, g=green, b=blue)				
	LUT_green				
LT3-Tabellen	Files with 3x256 256x red, followe	binary values, consistined by 256x green, follow	g of ed by 256x blue.		
	LUT_green_invers				
LT4-Tabellen	Files with 768 binary values, consisting of 256x rgb rgb rgb rgb (r=red, g=green, b=blue)				
	LUT_blue LUT_green	LUT_linear LUT_red			

**Create Hot Pixel List** 

Hot Pixels are oversensitive pixels and therefore get saturated faster than others.

This command allows to select the hot pixels for correction. The hot pixel list can be saved.

Furthermore each hot pixel can be selected individually, which will be corrected later when acquiring new images. This selection will be done by setting each pixel active.

To make a hot pixel list, the camera must acquire a dark image (close the lens) with an exposure time of at least 5 seconds.

ei H	otpixel				? X
Ni pi	Nr. of hot- pixels in list			lot Pixel	Close
A	verage Val.	61.47	9	Save HOT-Fi	e
PI pr be	lease verify ess aquire I e longer tha	that the ap to get a ne in 5s.	perture is clos w image. Exp	sed. You can posure time m	ust
	×	у	∇ Value	d [%]	
	1078	0560	436	609.3	
	1028	0110	335	445.0	
	0405	0767	215	249.8	
	1204	0702	175	184.7	
	0344	0658	162	163.5	_
	0040	0089	160	160.3	-

A hot pixel correction is possible only for SensiCam LongExposure, SensiCam QE, PixelFly and DiCAM-PRO.

Hot Pixel Correction

With the hot pixel correction, the last acquired image will be corrected according to the correction table.

## 3.1.3 Menu Settings

The Menu Settings is only visible when more than one camera is operated from one computer.

Camera 1 Camera 2 Camera 3	
Camera 4	According to the number of installed cameras in one computer (maximum 4), the cameras can be enabled individually.
B/W Window	Activates or deactivates the b/w display window of the selected camera.
Color Window	The color display window of the selected camera will be activated or deactivated.
Set to all Cameras	One or several settings, made in one of the camera control windows, can be transferred to all other camera control windows, depending of the settings in the ,Setup Set to' window (see below). A camera control window must be opened which is used as source for the other cameras.
Setup Set to	Selection of the settings which should be updated with the 'Set to all Cameras' command (see above).
	Analog Values

## 3.1.4 Menu View

- **B/W Window** Activates or deactivates the b/w display window. Cameras with double shutter function allow to toggle between image A, B or A+B. When operating several cameras from one computer, each one can be individually chosen.
  - Activates or deactivates the color display window. Cameras with double shutter function allow to toggle between image A, B or A+B. When operating several cameras from one computer, each one can be individually chosen.

**Histogram Window** Histogram of the intensity distribution over the entire image.



The two green markers define the 12 Bit area which is currently displayed on the monitor.

A red line at 4095 (on the right side) appears when the image is overexposed. The histogram is a useful tool for camera setting.

**Camera Control** The Camera Control window differs for the various camera types. For more details see description of the Camera Control function in Chapter 2.

**Color Window** 

**Convert Control BW** When converting 12 Bit data into 8 bit black/white data, 256 grey levels are displayed on your PC monitor. By using the three scroll bars, you can freely set the minimum and maximum values for this range of 256 values or you can move the setting altogether.

The values may also be set via the keyboard or changed with the mouse via the cursor keys. Pressing the Shift key and the left mouse key simultaneously, a window is generated in the original image with maximum contrast.

When exporting images in 8 bit formats, the displayed image with the set convert control values will be saved.

By selecting the checkbox "inv." the image will be displayed with an inverse scaling [for 8 Bit display: new image = 255 + (old image - 255)].

Beside the linear presentation, one often needs the logarithmic display with gamma = 0.45.





Algorithm for gamma function:

 $f(g) = n^{(1-\gamma)} \cdot g^{\gamma}$  (standardized to n = 0...255)

**Convert Control Color** When converting the 12 Bit data into 3x8 color data, 256 values for each of the colors red, green and blue are displayed on the PC monitor. By using the three scroll bars, you can freely set the minimum and maximum values for each color or you can move the setting altogether.

The values may also be set via the keyboard or changed with the mouse via the cursor keys.

When exporting images in 8 bit formats, the displayed image with the set convert control values will be saved.

Beside the linear presentation, one often needs the logarithmic display with gamma = 0.45.



The selection of the color can be done by the Red, Green or Blue button or by simply clicking to the marker position.

#### **Memory Settings**

When starting CamWare parts of the computer memory RAM will be allocated. The user may change the allocation value (% value) at any time by moving the pointer. With the 'Allocate!' button the new allocation can be saved.

A proper allocation can be saved by pressing OK. It is possible to allocate an individual memory to each camera, when operating several ones from one computer.

Memory Allocation Dialog	<u>? ×</u>
Allocate xx% of available memory	ок
Allocate!	Cancel
10 go 60 MB allocated	Manual distribution
Manual distribution of allocated memory	
сі 🔳 м	emory in kB No. of Images
C1 [	60535 94
C2 [	0 0
C3 [	0 0
100.0%	0 0

When using several cameras in one computer, the memory can be allocated individually for each camera.



#### Browser

Overview of all exposures in the allocated memory.



By clicking onto the desired image it will be displayed in the main window.

In the browser window up to 40 images can be shown at the same time. With a double click in the lower part of the window the next page will be displayed, a double click in the upper part of the window the previous page will be displayed. A right mouse click opens a context menu which can also command the next or previous page. Different zoom factors are

command the next or previous page. Different zoom factors are possible, too.

- Multi Window This function makes only sense when several cameras are operated from one computer. The images of all used cameras can be displayed in one common window. The sort sequence can be selected in the window 'Options': displaying in the sequence of the cameras or displaying in the time sequence of the exposed images.
- Live PreviewLive Preview allows easy focusing of the camera. The display is<br/>black/white or colored. The trigger mode is always set to inter-<br/>nal.<br/>When the Live Preview has finished, the actual displayed image<br/>will be reset to the actual active image in the recorder.Acquire PictureA single image will be exposed.

Marker ColorThe color of the cross hair will change. For setting the cross<br/>hair active, please see the 'Options' field (see below).

#### Embedded Image Info

Selection of the text parameter for the overlaid text. (see also 'Options' field)

Embedded Image Info		? ×
The embedded image info fi writes image data. If you do image data to be overwritter use this feature. See 'Option	eld over- not want n do not ns' dialog.	OK Cancel
Settings Show inverted Show date Show Camera Numb	Use In case big font	e big font of color CCD is standard. ow time
Image Info Text (max. 30 ( experiment	Characters	

#### Options

In this window many useful features can be activated or deactivated.

Options		? 🛛
Color Conversion	Image Browser	Scroll Mode
Toolbar Main	Marker View Marker	Embedded Image Info View Image Info
Cursor Display	Select Color	Select Info
Recorder	Infotext Show At Startup	Multi Win Picture Order
DoubleShutter	ASCII file separator	C Image time stamp
Paint both images	SLASH /	Cancel OK

#### **Color Conversion**

There are two algorithm to generate the color information.

A detailed description of these algorithm can be found in the camera manual. The selection of the algorithm is done in the 'Options' field.

The smooth color conversion algorithm optimises the color resolution. Disabling optimises the spatial resolution.

As standard the algorithm with optimised spatial resolution is used.

#### Image Browser

Selects the Browser mode for color or b/w display. Please note that the refreshing time in the b/w mode is faster than in the color mode.

#### **Scroll Mode**

When operating several cameras (maximum 4) from one computer you get one image from each camera. The four images are displayed on the monitor at the same time. Each window has a horizontal and a vertical scroll bar. They can be moved individually or synchronously altogether. For the synchronous move the field 'Synchronous' must be active.

#### Toolbar

The following button lines toggle between visible and hidden in the CamWare main window:

- Main
- Cursor Display
- Math. Functions
- Recorder (switches the recorder on or off)

#### Marker

A cross hair will be visible in the center of the image. Its color may be chosen by ,Select Color'.

#### **Embedded Image Info**

A text overlay with maximum 30 characters is added to the image at its lower right corner. This field becomes an invariable part of the image! It is part of the image contents!

Attention: Any image information in this area will be overwritten!

The text overlay will be done while exposing.

With the ,Select Info' button another window will be opened where the text parameter can be chosen as follows:

- fade in of date
- fade in of time
- fade in of camera number
- inverted display
- text size

Embedded Image Info	<u>? ×</u>
The embedded image info field writes image data. If you do not image data to be overwritten do use this feature. See 'Options' d	over- want OK p not dialog. Cancel
Settings	
Show inverted	🔲 Use big font
☐ Show date	In case of color CCD big font is standard.
Show Camera Number	Show time
Image Info Text (max. 30 Cha	aracters)
experiment	

#### Infotext

When starting CamWare, an image window shows up.

#### **Multi Win Picture Order**

Definition of the displaying sequence in the 'MultiWin' window: displaying in the sequence of the cameras (Camera Order) or in temporal recording (Image Time Stamp). The MultiWin function is only useful when operating several cameras, which record the same object, in one computer.

#### **DoubleShutter**

By activating this checkbox both images will be refreshed (painted) if a SensiCam DoubleShutter camera is connected. Without activation of the checkbox only the active image is refreshed.

**ASCII** file separator

The type of separator for ASCII storage of the images can be selected here by a drop down list.

## 3.1.5 Menu Window

Cascade	Open windows will be displayed one after the other.
Tile	Open windows will be displayed side by side.
Arrange Icons	The icons of the minimized windows will be grouped.
Close All	All open windows will be closed.

## 3.1.6 Menu ?

Contents	Opens the help menu of CamWare. Overview of the help topics.
Search for Help	Opens the help menu of CamWare. Input of the search topic.
About	Version number of the used software.

	3.2 Buttons
<b>-</b>	
-	Print
	Prints the active window at the printer installed in Windows. The image size is optimised to the paper size.
	Display
	B/W Window, see chapter 3.1.4 Menu View
	Color Window, see chapter 3.1.4 Menu View
	Histogram Window, see chapter 3.1.4 Menu View
	Camera Settings
<b>3</b>	Camera Control, see chapter 2. Camera Control
	Convert Control BW, see chapter 3.1.4 Menu View
2	Convert Control Color, see chapter 3.1.4 Menu View
₩ ₩	Auto Convert Routines
<b>€</b> →	Auto Range Peak Display of the image within the maximum and minimum inten- sity values.
	Auto Range Crop 10% of the extremely bright or dark intensities (e.g. lamps, re- flections, etc.) are ignored for the image display
	White Balance (only for color cameras)
	When using with a color camera, a white balance is necessary at the beginning of the experiment. The camera has to 'learn' the definition of the color white. Depending of the incoming light the color white can be very different. Each time when working under new light conditions, the white balance has to b done anew. The white balance will be done always with the actual image in the memory. To do it, place a white sheet of paper in the centre of the object and acquire one single image. Then press the white balance button. Now the white balance is done.

643	
0	Auto Exposure
	To get the optimum exposure time you can predefine it with the Auto Exposure function. This function is available only for the cameras SensiCam Long Exposure, SensiCam QE and PixelFly.
3	Preview / Acquire
<u>s</u>	Live Preview, see chapter 3.1.4 Menu View Acquire Picture, see chapter 3.1.4 Menu View
-+	Master Gain
	Changes the gain of an image. The Convert Control curve will move. Each mouse click changes the gain by +/- 2dB.
	Play & Record
	In this field you can control record and display. Clicking to the values in "Option (Start, End)" determine the number of pictures which are taken (●). The display is started with the green arrow symbol (>). The re-
	corded sequence is played once, or, in the case of "Wrap", repeatedly. You can stop record or play at any time by striking the Stop (■) key
Hint	Close all display windows (black/white, color, browser, histo- gram) for a maximum recording speed. No mathematical func- tion or text overlay should be active.
	When exposing while displaying, the recording speed will de- crease. It also depends of the processor used in the computer.
	Maximum recording speed in fps(fps = frames per second)With VGA Sensors (640x480 Pixel):30 fpsWith SVGA Sensors (1280x1024):8 fps

## 

#### **Record- and Play Options**



Here you can define the number of the first (Start) and the last (End) image. In case of 'Set to all' is selected, the image numbers for all cameras are equal (only valid when operating several cameras in one computer).

"Average" leads to averaging over the images in the computer. Setting a factor of 16, this number of images is taken and averaged in the computer. The noise will be improved by the square root of the average factor.

You can set the display speed with the pointer, where pointer towards left means slow and pointer towards right means fast. pointer left = slow pointer right = fast

Seq.Wrap Rec. A sequence of images is stored in the allocated memory (RAM) of the PC. When the memory is full, it will be overwritten (wrap). This endless loop can only be stopped with the Stop button. In case the field is not activated **one sequence** of images will be written to the allocated memory (RAM). When using the Display button, the sequence in the allocated memory will be displayed only once.

**Seq.Wrap Play** When using the Display button, the sequence in the allocated memory will be displayed endlessly. The memory is read out continuously and always repeated.

<b> 4 44 4</b>	11	►	►	M	
----------------	----	---	---	---	--

#### **Recorder Navigation**

This function selects an image to be displayed in the output window. Its number is shown in the box.

By striking the "<" and ">" keys, the previous and next picture, respectively, are displayed. By typing "<<" or ">>" you can skip the previous or next picture and get the following picture accordingly (10% step).

You can reach the first and last image by striking the "I<" and "I>" key, respectively.

囲	Browser
	See chapter 3.1.4 Menu View
	Multi Win
	This function makes only sense when several cameras are op- erated from one computer. The images of all used cameras can be displayed in one common window. The sort sequence can be selected in the window 'Options': displaying in the sequence of the cameras or displaying in the time sequence of the ex- posed images.
RefAct.+Offs	Mathematical Functions

See chapter 3.4 Mathematical Functions

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## **3.3 Different Functions**

With a right mouse click **within** a displayed image, the following menu will be opened.

<u>H</u> istogram
C <u>a</u> mera Control
Convert Control BW
Convert Control Color
Zoom <u>x</u> 0,25
Zoom x <u>0</u> ,5
✓ Zoom x <u>1</u> ,0
Zoom x <u>2</u> ,0
Auto Range <u>P</u> eak
Auto Range <u>C</u> rop
Auto <u>B</u> alance Color
Auto E <u>x</u> posure
<u>E</u> lip
<u>M</u> irror

Histogram Camera Control Convert Control BW Convert Control Color	See chapter <b>3.1.4 Menu View</b> See chapter <b>2. Camera Control</b> See chapter <b>3.1.4 Menu View</b> See chapter <b>3.1.4 Menu View</b>
Zoom	Zooming the displayed image.
Auto Range Peak Auto Range Crop	See chapter <b>3.2 Buttons</b> See chapter <b>3.2 Buttons</b>
Auto Balance Color	See chapter 3.2 Buttons
Auto Exposure	To get the optimum exposure time you can predefine it with the Auto Exposure function. This function is available only for the cameras SensiCam Long Exposure, SensiCam QE and PixelFly.
Flip	The image will be mirrored horizontally. Flip and Mirror can be combined at any time.
Mirror	The image will be mirrored vertically. Flip and Mirror can be combined at any time.

Status Line	The status line is placed at the bottom of the main window.		
Open Camera Control dialog.	Rec. Info 67MB 109 Images	Cursor B/W x: 20 y: 6 Value: 33	
	The left field shows the comm The center field shows the m maximum available RAM) in pictures which can be writh shown. This number of image space, for this number also de The right field shows the coo the pixel onto which the mous	The left field shows the command short description. The center field shows the maximum available recorder size (= maximum available RAM) in Mbytes. Right to it, the number of pictures which can be written into this memory space are shown. This number of images may vary for the same memory space, for this number also depends on ROI, binning, etc. The right field shows the coordinates and the intensity value of the pixel onto which the mouse points.	
	In the display window "Blac Cursor B/W x: 262 y: 202 Value:26 The current x-y-coordinates a 4095) of the pixel onto which	<b>:k/white"</b> i37 and the 12 Bit intensity value (0 mouse points, is displayed.	

#### In the display window "Color"

Cursor Col. x: 442 y: 272 R:255 G:255 B: 69

The current x-y-coordinates and the respective 8 Bit intensity values (0 ... 256) for each of the colors red, green, and blue virtual pixel onto which the mouse points, is displayed.

## **3.4 Mathematical Functions**

With CamWare you can make an online subtraction of a reference image and an offset addition. The menu bar 'Math. Functions' must be visible (see menu View/Options).



|--|

Acquiring of the reference image

The last acquired or via 'Load Image' imported image which is in the memory and is displayed will be declared as reference image and put into the reference image memory.

Ref.-Act.+Offs 💌

Mathematical operation

- Toggles between two operations:
  - reference image current image + offset
  - current image reference image + offset

The reference image will be subtracted from the current image and vice versa. To the resulting (new image) an offset can be added.



Offset setting Selectable offset: 0 ... 4095 counts

With the following button, the mathematical operation can be activated or deactivated:



In case the green checkmark is visible, the mathematical procedure will be done each time an image or a sequence is acquired. The displayed image is the result of the mathematical operation.



In case the red cross is visible, the mathematical procedure is not active.

## 4. Memory Functions

#### 4.1 File Formats

There are four possible file formats for saving camera images:

- **BMP** Windows Bitmap Format, b/w or color 8 bit format Images which have been saved in BMP format can later only be loaded as 8 bit images, i.e. part of the original 12 bit information is lost.
  - **TIF** <u>Tag Image File Format, version 6.0 and lower</u> 16 bit format
- FTSElexible Image Transport System, Version 3.116 bit formatThis format has been defined by the NASA/Science Office of<br/>Standards and Technology (NOST). Some programs use the<br/>FIT extension for this format.
- ASCII 16 bit format Some mathematical programs prefer ASCII data. Listing of intensities (0...4095) of all pixels as follows: x1 <TAB> x2 ... xn x12 ... xm (with n = number of columns = image width, m = number of lines =

(with n = number of columns = image width, m = number of lines = image height)

B16 16 bit format

The B16 format is similar to the BMP format. However, 16 bit pixel values are used instead of 8 Bit pixel values. The 16 bit pixel values represent "unsigned integer values", where the camera (12 bit values) sets the higher 4 bits to zero. The file format consists either of a "Basic Header" (6 Longparameter) or of an "Extended Header" (32 Long-parameter), the latter of which for optionally additional information. There might follow a variable comment field (ASCII code). Finally, there is the actual data set which is saved linearly (as in the case of BMP files).

**Remark:** With the exception of the first value, all parameters are "Long Integers" (4 Byte). The first 6 parameters must always exist. The rest of the parameters, as well as the comment field, are optional.

	Parameter	Function
1	"PCO-"	the first 4 byte are the characters "PCO-"
2	file size	file size in byte
3	header length	header size + comment filed in byte
4	image width	image width in pixel (4 1280)
5	image height	image height in pixel (1 2048)
6	extended header	-1 (true), extended header follows
7	color mode	0 = black/white camera, 1 = color camera
8	b/w min	black/white LUT-setting, minimum value (0 4094)
9	b/w max	black/white LUT-setting, maximum value (1 4095)
10	b/w linlog	black/white LUT-setting, linear respect. logarithmic, 0 = lin, 1 = log
11	red min	red LUT-setting, minimum value (0 4094)
12	red max	red LUT-setting, maximum value (1 4095)
13	green min	green LUT-setting, minimum value (0 4094)
14	green max	green LUT-setting, maximum value (1 4095)
15	blue min	blue LUT-setting, minimum value (0 4094)
16	blue max	blue LUT-setting, maximum value (1 4095)
17	color linlog	color LUT-setting, linear respect. logarithmic, 0 = lin, 1 = log
18		
	internal use	
255		
Comm	ent file in ASCII char	acters with variable length of 0 XX.
The length of the comment filed must be documented in the 'header length' field.		
		16 bit pixel data
line 1, pixel 1		value of the first pixel
line 1,	pixel 2	value of the second pixel

**Remark** We recommend to save (export) all images first in the B16 or TIF format.

The advantage is to have the B16 or TIF images available all the time. You will always have the maximum 12 bit information.

Please note that not all image analysing programs can handle 16 bit data.

The 8 bit format saves only the information, seen on the monitor screen. The 12 bit information will be lost and cannot displayed later.

## 4.2 Conversion of File Formats

To convert file formats you should use the program **'Image Converter'** which is installed automatically when installing the CamWare software. You will find it in the 'Programs\Digital Camera Toolbox' (or in the directory you have chosen at the installation).

Image Converter 1.3			
Select Source Path and Files		Select Target Path	
test_0001.b16 image 0001.b16 test_0002.b16 test_0002.b16 test_0003.b16 test_0006.b16 test_0006.b16 test_0006.b16 test_0008.b16 test_0008.b16 test_0008.b16 test_0009.b16	C.\ Test	image         0001.b16           test_0001.asc         test_0001.b16           test_0001.b16         test_0001.b16           test_0002.b16         test_0002.b16           test_0005.b16         test_0005.b16           test_0007.b16         test_0007.b16           test_0007.b16         test_0007.b16           test_0007.b16         test_0007.b16           test_0007.b16         test_0007.b16	C:\ Temp Test c: [FESTPLATTE] V Refresh Boxes
C Convert B16 to TIFF (16Bit) C Convert TIFF (16Bit) to B16	C Convert B16 to FITS C Convert B16 to ASCI	Split B16 Double Shutter	Help Exit

B16 images can be converted in 16 bit TIFF, 16 bit FITS or 16 bit ASCII formats. 16 bit TIFF images can be converted to B16 files.

When using a camera in the DoubleShutter mode, both full frame images will be displayed and saved as one big image to avoid confusion. To separate the two images you should use the function 'Split B16 Double Shutter' in the Image Converter program. The selected B16 images will be separated in two images with the same name but the suffix sign 'a' and 'b'. (e.g. *test.b16* will be separated to *testa.b16* and *testb.b16*).

In above picture the originally image test\_0001.b16 was converted to the ASCII format test\_0001.asc.

The image test\_0001.b16 was splitted in test\_0001a.b16 and test\_0001b.b16.

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# 5. Additional Functions in CamWare for HSFC-PRO

When operating HSFC-PRO you have to use 'CamWare for HSFC-PRO' which has some additional features.

#### **Common Control**

Common Control is a control function for the selected delay and exposure times. All active channels are displayed (maximum 4 channels). Depending of the selected trigger mode, there are different Camera Control windows.

After pressing the Camera Control button, the following window will be displayed:

Opening	Common Control Dialog		×
•	Select a common trigger mode.	Single Trigger	ОК
ч	This trigger mode will be set to all channels.	C Multi Trigger C Double Shutter	Cancel

Please select the desired trigger mode.

Single Trigger ModeIn the following example, four channels are active.<br/>Use the mouse to shift the red marker on the sliding bars or the<br/>+/- button.<br/>In the +/- Timebase window you can select the time steps.<br/>Please note the different scaling!

Common Control Dialog	×
Channel 1	ОК
Delay: 0.000015ms         Exposure: 0.00005ms           Image: Delay: 0.000015ms         Image: Delay: 0.000015ms           Image: Delay: 0.000015ms         Image: Delay: 0.000015ms </td <td>Cancel +/- Timebase: default</td>	Cancel +/- Timebase: default
Channel 2	
Delay: 0.000030ms         Exposure: 0.000005ms           0ms         50ms	
Channel 3	
Delay: 0.000045ms         Exposure: 0.000005ms           Image: Construction of the second	
Channel 4	
Delay: 0.000060ms         Exposure: 0.00005ms           Image: Comparison of the second sec	

#### Multi Trigger Mode

In the following example, four channels are active.

Common Contra	l Dialog					×
Channel 1	1	2	2	4	5	
Delay [mS]	0.300000	0.500000	0.500000	0.500000	0.500000	OK
Exposure [mS]	0.000060	0.000060	0.000060	0.000060	0.000060	Cancel
Channel 2						
_	1	2	3	4	5	
Delay [mS]	0.420000	0.500000	0.500000	0.500000	0.500000	
Exposure [mS]	0.000060	0.000060	0.000060	0.000060	0.000060	
- Channel 2-						
Channel 5	1	2	3	4	5	
Delay [mS]	0.540000	0.500000	0.500000	0.500000	0.500000	
Exposure [mS]	0.000060	0.000060	0.000060	0.000060	0.000060	
- Channel 4						
Criamier (	1	2	3	4	5	
Delay [mS]	0.660000	0.500000	0.500000	0.500000	0.500000	
Exposure [mS]	0.000060	0.000060	0.000060	0.000060	0.000060	
1						

**Double Trigger Mode** In the following example, four channels are active. Because of the double exposure there are two delay and exposure times each.

The first image (image A): Delay A, Exposure A The second image (image B): Delay B, Exposure B

Use the mouse to shift the red marker on the sliding bars or the +/- button.

In the +/- Timebase window you can select the time steps. Please note the different scaling!

Com	mon Cont	rol Dialog					×
	hannel 1 —						ОК
		Delay A: 0.020000ms	Exposure A: 0.010000ms	Delay B: 0.300000ms	Exposure B: 0.010000ms	<b>-</b>	Cancel
	0ms	<u> </u>	0.5ms			hms 🚽	+/- Timebase:
						<u></u>	
	nannei 2—	D. J	<b>T</b>			•	
		Delay A: 0.100000ms	Exposure A: 0.010000ms	Delay B: 0.300000ms	Exposure B: 0.010000ms	<b>•</b>	
	0ms		0.5ms	1 1 1 1	1 1 1	hms 🔂	
	⊣ hannel 3						
Ē		Delay A: 0.180000ms	Exposure A: 0.010000ms	Delay B: 0.300000ms	Exposure B: 0.010000ms	•	
	╢╞══╧			<b>-</b> · · · ·		<u> </u>	
	Oms		0.5ms			tms 😳	
	— hannel 4 —						
		Delay A: 0.260000ms	Exposure A: 0.010000ms		Exposure B: 0.010000ms	<u> </u>	
		<b>•</b>	· · · · · · ·			🛃	
	0ms		0.5ms			tms 📑	

#### Dear Customer,

We hope CamWare will be an always valuable tool for your scientific day in, day out work.

Comments, suggestions or any new idea on our system are welcome.

We are at your disposal at any time, also after your buying of this camera.

Your PCO Team



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