EE2000

Automatic Image and Data Acquisition for Windows 95/98/ME and Windows NT/2000/XP

Operating Manual

EE 2000 is a program of
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I. Starting of EE 2000

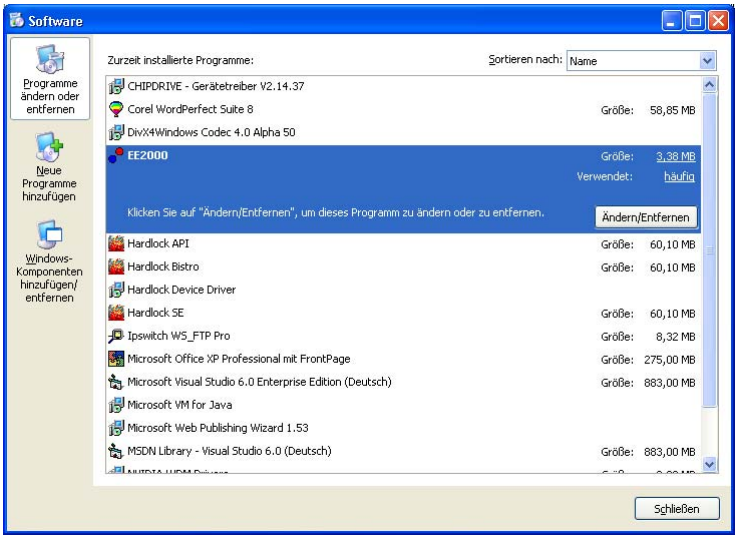
De-Installing the software

Before you can install the new software, you must remove any older version of this software.

1. Click on *Start* in the task bar and choose menu *Einstellungen*[1] and click on *Systemsteuerung*

2. Double click on the icon *Software*

3. Select the icon *Programme ändern oder entfernen* and select the list entry of this software: EE2000



4. Choose command button *Ändern/Entfernen*

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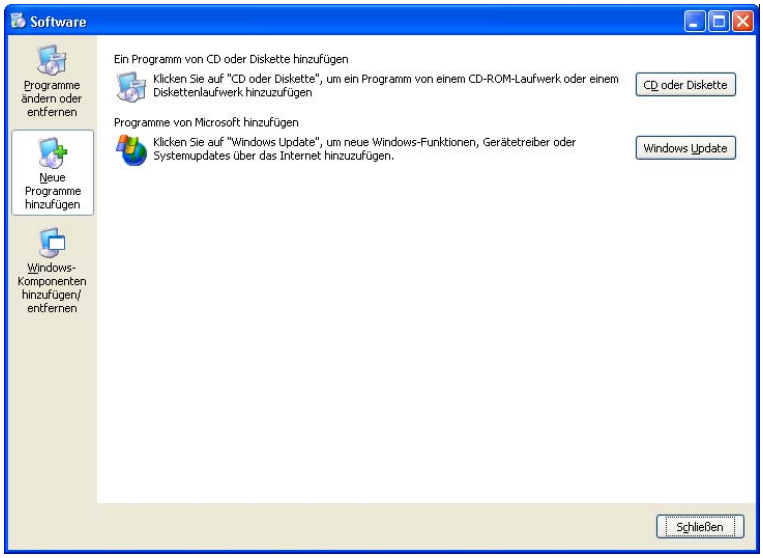
[1] This Document and the software are created on a German version of Windows XP. All windows messages in this document are written as they appear on the screen and are not translated to the English language.

During the de-install procedure you will be asked whether to de-install some shared files or not. You can delete all files.

Installing the software

To install the new software follow the steps 1 to 2 as described above.

Choose command icon *Neue Programme hinzufügen*



3. Insert the EE2000 CD-ROM into your CD-ROM drive and press *CD oder Diskette*.

A setup boot program starts and temporary installs some necessary files to continue with the real setup program. The setup program asks you for the path, where the software files are written to.

By default this is C:\Programme\EE2000.

Hardlock Driver Installation

After finishing the setup program, you have to install the Hardlock. The Hardlock (also called a *Dongle*) is a small device, which can be plugged on any parallel port of your computer. Optional the Hardlock is a small device which can be connected to an USB port. If the Hardlock driver is successfully installed, a red LED at the USB Hardlock will light on.

Run [CD]:\Driver\Hardlock\Hldrv32.exe on your EE2000 CD-ROM.

Follow the instructions on the screen.

Starting EE 2000

EE 2000 includes all of the programs: **bioScan 2000**, **eeScan 2000**, **eeScan 2000 (Henkel)**, **eeScan 2000-RL**, **AIDA 2000**, **PyroScan 2000**, and **Riss 2000**.

To start **EE 2000**

1. Click on *Start* in the task bar and choose menu *Alle Programme* and sub menu *EE2000*
2. Double click on the menu entry EE2000 

The following picture is shown during the start-up procedure to indicate the activated program version:

Error message during start up:

You didn't plugged the Hardlock to your computer or the Hardlock is plugged to a port, which address isn't declared in the SET HL_SEARCH= statement in your AUTOEXEC.BAT file.

A printer, who is connected to the same parallel port as the Hardlock, may produce problems, if the printer is powered off. (for example Hewlett Packard HP5MP) Disconnect the printer, or power on the printer. Or use another port for the Hardlock.

If you have any problems, call Mr. Michael F. Opheys: +49-171-6918844 or send an e-mail to: DrOpheys@EE2000.de.

If you click on *Nein* / *No*, the software starts in 'Demo Mode'. The Demo version is limited: no hardware support (only 'dummy hardware'), images and worksheets can not be saved, opening film and worksheets is limited to max. 20 frames resp. 20 rows.

Hardware Installation

To use all functions of **EE 2000**, it is necessary to install the required hardware:

- video capture card (grabber interface) or digital camera
- digital I/O interface
- D/A converter interface
- A/D converter interface

To install an interface card follow the instructions in the ReadMe.txt file on the driver disk, coming with the interface. Normally you have to run Setup.exe from the driver disk. In some cases it is necessary to reboot the computer after installing of the driver. Select the interface in the Setup menu of the **EE 2000** program.

Table of supported hardware:

Video Capture Cards			
Interface Name	**Bus Type**	**Driver Model**	**OS**
Video 1000 S/W	ISA16	WinRT Device #0	all
SensiCam	PCI	Driver from the manufactory, PNP	all
PixelFly	PCI	Driver from the manufactory, PNP	all
Video for Windows compatible capture cards: e.g. Bt848, Win TV (Hauppauge), ELSA Winner 2000/Office, Asus, etc.	PCI or AGP	Driver from the manufactory, PNP, Control via AVI API-functions	see the manual of the interface
USB 2.0 Digital Camera	USB	Driver from the manufactory, PNP	WIN2000, XP, Vista

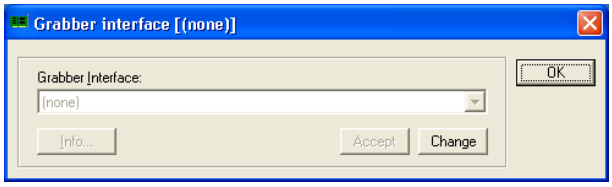
Digital I/O interfaces			
Interface Name	**Bus Type**	**Driver Model**	**OS**
Fpc-024	ISA8	WinRT Device #1	All
Rtx-02d	ISA8	WinRT Device #1	All
PCI-DIO24, PCI-DIO24H	PCI	WinRT Device #1, PNP	All

Digital to Analogue Converter			
Interface Name	**Bus Type**	**Driver Model**	**OS**
FPC-011	ISA8	WinRT Device #2	All
RTX-03B	ISA8	WinRT Device #2	All
AX-5621	ISA8	WinRT Device #2	All
ISODAC 16	-	Uses a Digital I/O interface	All

Analogue to Digital Converter			
Interface Name	**Bus Type**	**Driver Model**	**OS**
FPC-011	ISA8	WinRT Device #3	All
RTX-03B	ISA8	WinRT Device #3	All
AX-5621	ISA8	WinRT Device #3	All
LTC1290	COM	WinRT Device #3	All

Multi I/O Cards			
Interface Name	**Bus Type**	**Driver Model**	**OS**
BMC PciBase50/300/1000 (including A/D and D/A modules)	PCI	Driver and ActiveX control from the manufactory, PNP	see the manual of the interface
BMC USB AD16f (Digital I/O not supported)	USB	Driver and ActiveX control from the manufactory, PNP	see the manual of the interface

Setup the Grabber interface

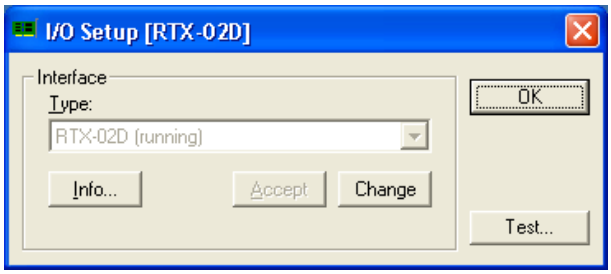


After installing the video capture card into the Windows system, you must tell the **EE 2000** program, which of the installed capture cards it should use. Click on the command *Grabber* in the *Setup* menu.

Select your video capture card and press *OK*.

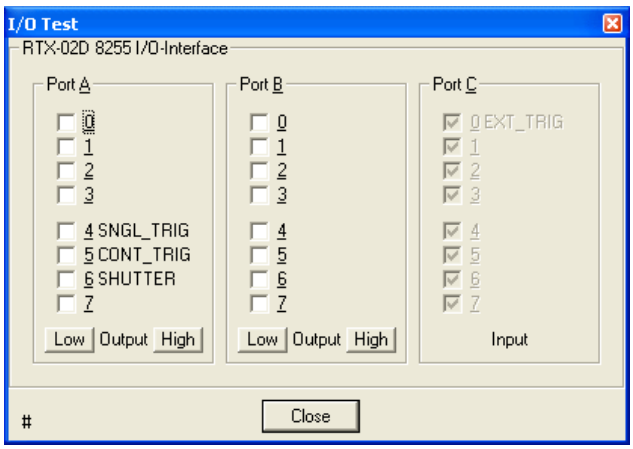
Setup the Digital I/O interface

After installing the digital I/O interface into the Windows system, you must tell the **EE 2000** program, which of the installed I/O cards it should use. Click on the command *Digital I/O* in the *Setup* menu.



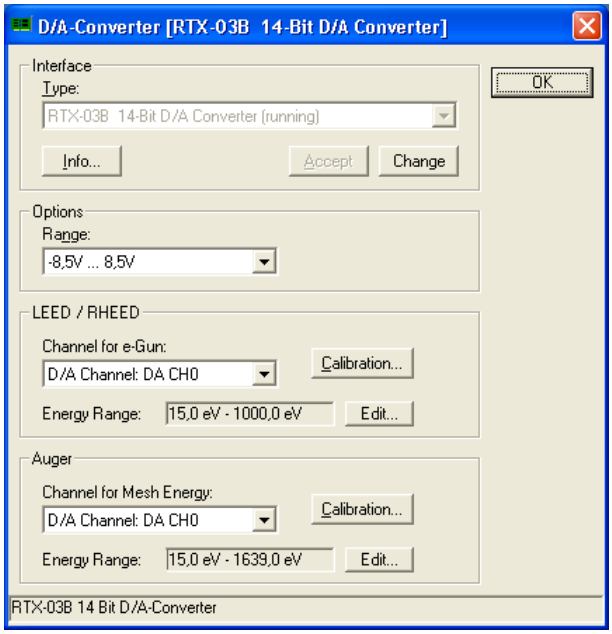
Select your digital I/O card and press *Accept* or *OK*.

The *Test* button will open a new dialog box which shows you the status of the digital input/output lines.



Port A and Port B are programmed for output, Port C is programmed for input.

Setup the D/A-converter interface



Choose the command *D/A-converter* in the menu *Setup*.

Select the D/A-converter interface. For more details about the selected D/A-converter interface press the *Info* button.

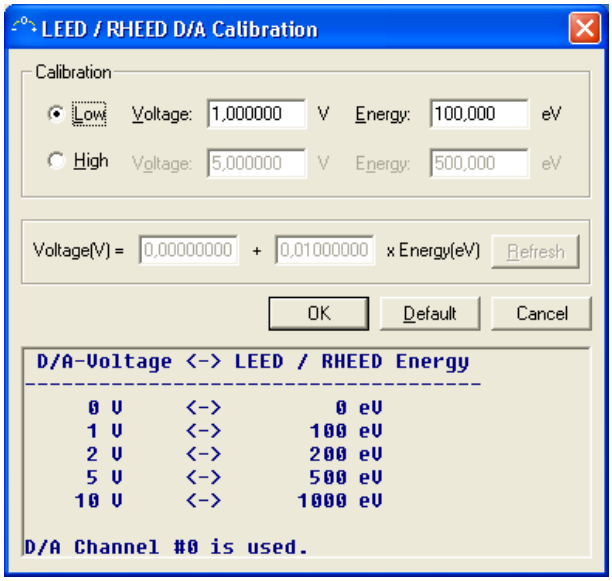
A digital I/O interface must be installed, if you use the external D/A-converter ISODAC10.

The number of available ranges depends on the interface model. Normally you have to select the range by setting of jumpers and/or dip switches on the interface. Some interfaces have the second D/A-converter channel as an option only.

Hint: *The enumeration of the D/A-channels starts with 1, independent from the selected interface model. Some manufactories use a 0 as the first D/A-channel. Keep this in mind, if you check the pin assignment of the connector. The Info text within the program gives you a correct pin assignment which is compatible with the enumeration within this program.*

Calibration of the D/A-converter

External power supplies can be controlled with an analogues voltage signal of the D/A-converter. Because you set the electron energy in this program directly in units of eV, you have to calibrate the D/A-converter to produce the correct voltage when setting the electron energy.



Calibration can be done for the RHEED/LEED and Auger mode separately with one of the command buttons *Calibration* from the setup window.

Typically a RHEED/LEED power supply can generate electron energies up to 1000 eV. Therefore they need normally a driving voltage of about 10 V.

The calibration is done with a two point adjustment, by calibrating at a low energy and at a higher energy.

! WARNING !

Be careful when handling with high voltages.

1. Select Option *Low*. Enter a low voltage, for example 0.5 V and click on the *Refresh* button.

2. Enter the correct energy value which is produced by the low voltage of the D/A-converter. Simply read the energy value displayed on your power supply or measure the high voltage produced by the power supply.

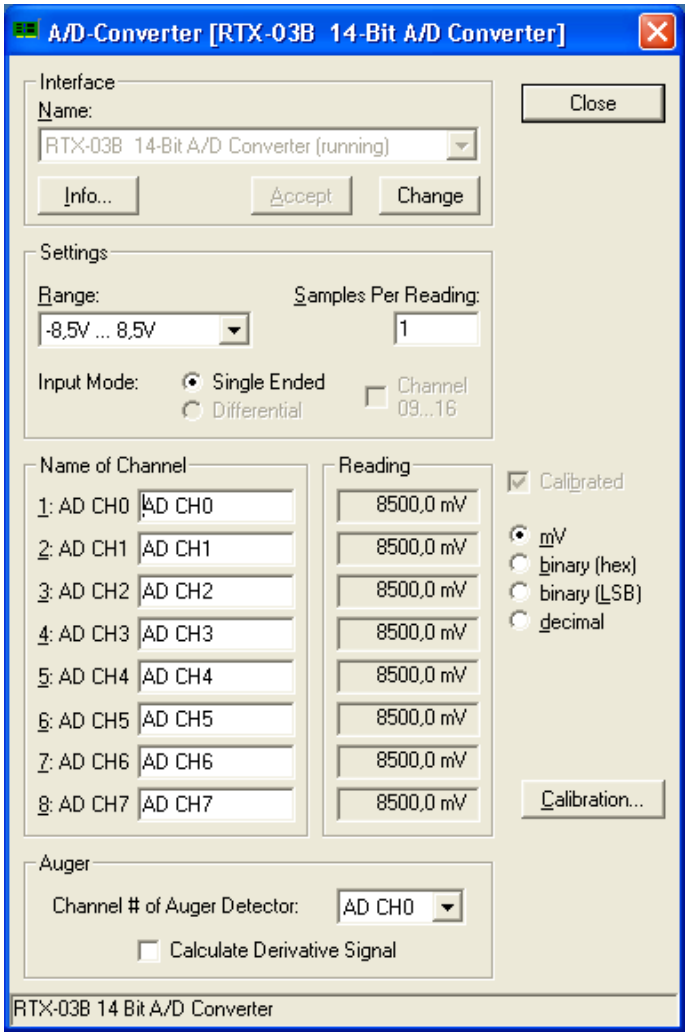
3. Select option *High*. Enter a high voltage, for example 8 V and click on the *Refresh* button.

4. Enter the correct energy value which is produced by the low voltage of the D/A-converter. Simply read the energy value displayed on your power supply or measure the high voltage produced by the power supply.

5. Click again on the *Refresh* button to update the calibration formula

Typical values for *Offset* are about 0 and for *Gain* about 0.01 (10 V = 1000 eV).

Setup the A/D-converter interface



Choose the command *A/D-converter* in the menu *Setup*.

Select the A/D-converter interface. For more details about the selected A/D-converter interface press the *Info* button.

Hint: *The enumeration of the D/A-channels starts with 1, independent from the selected interface model. Some manufactories use a 0 as the first D/A-channel. Keep this in mind, if you check the pin assignment of the connector. The Info text within the program gives you a correct pin assignment which is compatible with the enumeration within this program.*

Many interfaces have A/D and D/A-converter integrated. Normally you select the same interface model for A/D and D/A conversion. An exception is the use of external D/A-converters like the ISODAC10 model.

During setup you see the values of the first eight A/D-channels of the interface. Changes of interface model, port address and range are taken into consideration after pressing the *Accept* button. The *Accept* button is disabled, if the current selection matches the current hardware setting.

To reduce noise, the program can calculate the average value of multiple readings. Valid values for *Samples per Reading* are between 1 (default) and 1000. Keep in mind, that higher values will take considerable conversion time.

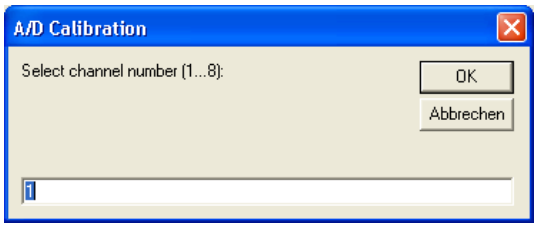
In the example shown in the above window, A/D-channel 2 is shorted to ground and A/D-channel 3 is connected to D/A-channel 1 of the same interface. The D/A-converter was set to nominal 5 V (= 500 eV not calibrated). All other A/D-channels are open. Because of the high impedance, open A/D-channels can sense voltages much greater than 0 V. You can avoid this affect by connecting a resistor of 10 to 100 kOhms parallel to every A/D-channel.

Be careful when connecting voltages to the A/D-channels. Consult the manual of the manufactory for more details.

Calibration of the A/D-converter

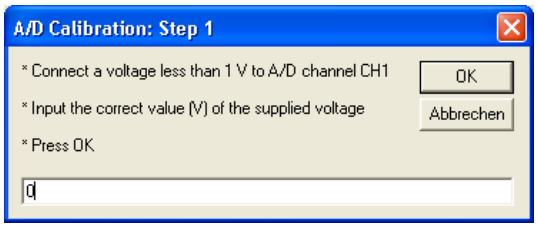
For accurate measurements it is necessary to calibrate the A/D-converter very carefully. Press the *Calibration* button from the setup window.

Calibration procedure:

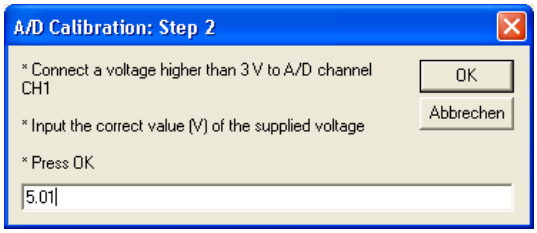


1. Enter the channel number for calibration. Known test voltages are feeded to this channel. (In the shown figure this is A/D-channel 3.)

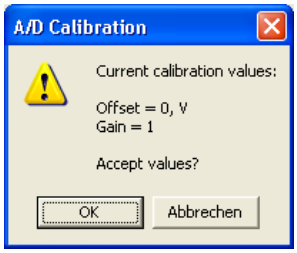
Hint: *The calibration is valid for all A/D-channels.*



2. Connect a known voltage less than 1 V to the A/D-channel defined in calibration step 1. (For example, short this channel to ground.) Enter the exact value of the test voltage. Use a DVM which is accurate enough. The default value is the non-calibrated value measured when this dialog window was opened. Press the *OK* button.



3. Connect a known voltage higher than 3 V to the A/D-channel defined in calibration step 1. Enter the exact value of the test voltage. Use a DVM which is accurate enough. The default value is the not calibrated value measured when this dialog window was opened. Press the *OK* button.
4. At the end of the calibration procedure you see this dialog window:



The program uses this calibration formula:

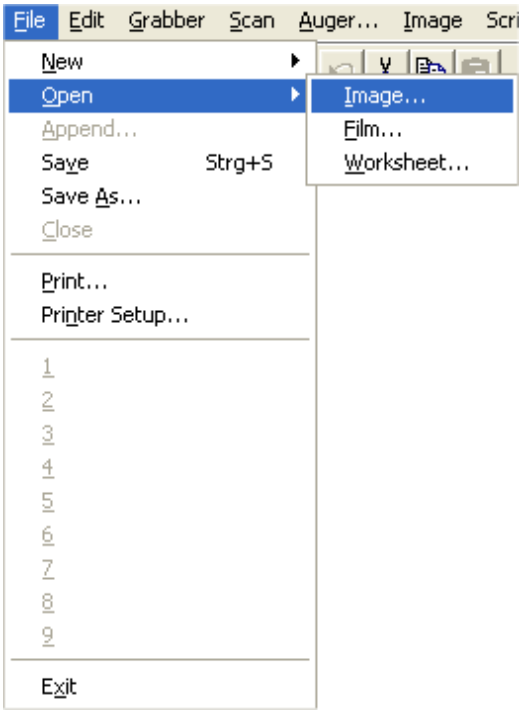
$$Voltage_{Cal.} = Offset + Gain \cdot Voltage$$

The default values are *Offset* = 0 and *Gain* = 1.

We recommend increasing temporary the *Samples Per Reading* value to 10 for best results. Don't forget to enter the old value after calibration.

II. Working with EE 2000

The File Menu



Open Image

With this command you can load an image from the HDD or FDD for further analysis. Note, that this command always creates a new window. The *Open Image* command button in an image window replaces any existing image in that window. The following graphic file formats are supported and automatically detected by **EE 2000**:

- TIFF - 8 Bit (*.TIF)
  Mini Color, Grey Scale and True Color (uncompressed)
- Windows Bitmap Format - 8 Bit (*.BMP)
  Mini Color, Grey Scale and True Color (uncompressed)
- ITEX - 8 Bit (*.IMG)
- TIFF - 16 Bit (*.T16)
- Windows Bitmap Format - 16 Bit (*.B16)
- ITEX - 16 Bit (*.IMG)

Images are always stored in the computer memory as 16 bit grayscale images. The internal 16 bit image will be converted into an 8 bit image for displaying. The program uses a look up table for conversion.

If an image file includes a comment text, this text appears in the comment edit field of the image window.

Save Image As

Any image shown in the image window can be saved in various graphic file formats:

- TIFF - 8 Bit (*.TIF)
  Mini Color, Grey Scale and True Color (uncompressed)

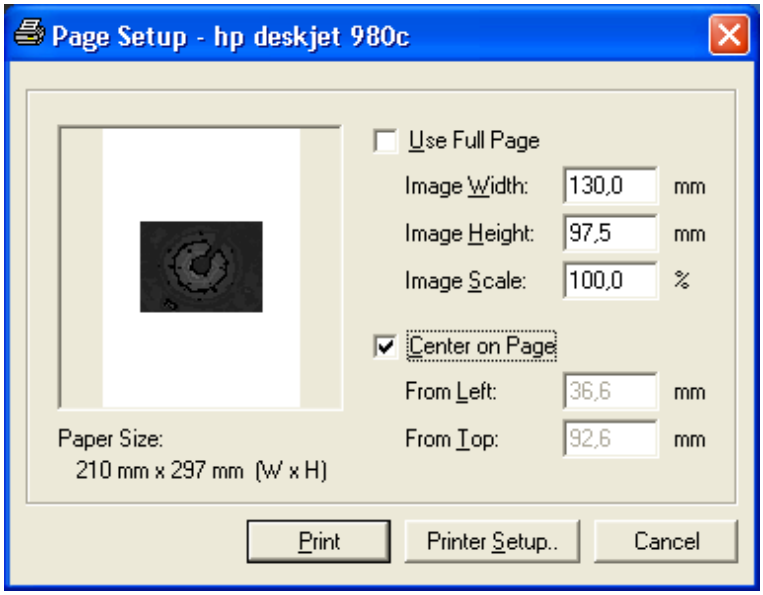
- Windows Bitmap Format - 8 Bit (*.BMP)
  Mini Color, Grey Scale and True Color (uncompressed)
- ITEX - 8 Bit (*.IMG)
- TIFF - 16 Bit (*.T16)
- Windows Bitmap Format - 16 Bit (*.B16)
- ITEX - 16 Bit (*.IMG)
- FTS - 16 Bit (*.FTS)

EE 2000 writes always the complete image into the image file.

Hint: *The 16bBit formats are only available, if the image has a dynamic greater than 8 bit per pixel.*

Print Image

The image can be printed with the *Print Image* command from the *File* menu. First you must activate the image window. The *Page Setup* window appears:



In the window there will appear a sample showing how the print will look like.

The desired size can be created with *Image Width*, *Image Height* and *Image Scale*. Only one input is necessary. All others are given by the height/width ratio of the image. *From Left* and *From Top* give the position of image in the page. The printable size is dependent from the actual paper size of your standard windows printer. The unprintable margins are taken into consideration.

With *Print* you can start printing.

Printer Setup

With the command button *Printer Setup* you can select a printer and define printer parameters specifically to the selected printer. The printer setup window is dependent from the printer driver.

Worksheet

This command starts the worksheet module. See chapter *The Worksheet Module* for a complete description.

Exit

Quit the program with this command. All parameters are saved in a configuration file.

The Grabber Menu

The Grabber menu includes all commands to control image capturing.

Preview

The Preview command sets the program into preview mode. The software will permanently digitize and display images as fast as possible. The maximum frame rate depends strongly from the hardware (grabber interface and computer).

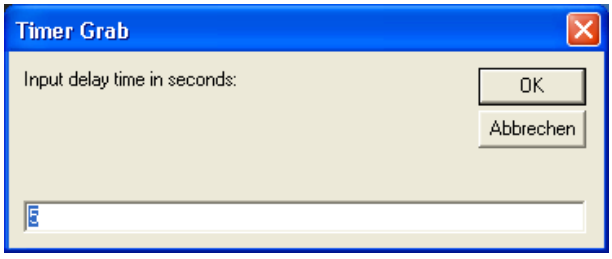
Overlay

Many, but not all video capture cards have an overlay capability. In overlay mode, the video capture card will permanently digitize an image and display the digitized image on the display. Because of special hardware capabilities, the data are directly moved to the video memory without read by the CPU.

Grab

The *Grab* command will digitize and display one image.

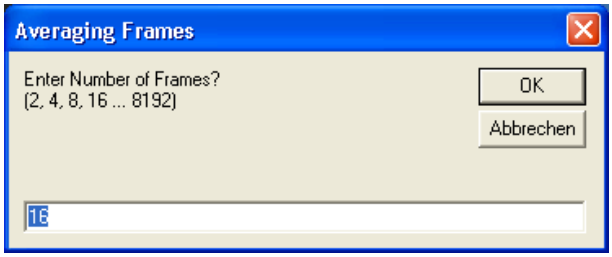
Grab (Timer)



With *Grab (Timer)* you can digitize a new image with a delay. Enter the delay time in seconds and press *OK*.

Hint: *If no video signal is connected to the grabber interface, the message "(No sync)" will appear in the comment text field.*

Averaging



To reduce image noise you can average over multiple images using the full dynamic range of 16 bit. The averaging factor must be a power of 2. The maximum average factor is 8192. The dynamic range increases with higher averaging values. The averaged image is temporary stored as an 32 bit image. After the averaging process finishes, the 32 bit image is converted to an 16 bit image. The dynamic range is decreased if necessary.

Video Source

The *Video Source* function will display a control window for setting some parameters of the video capture card. The design and functions depends on the installed video capture card, because this dialog box is part of the capture driver and not of the **EE 2000** software.

Video Format

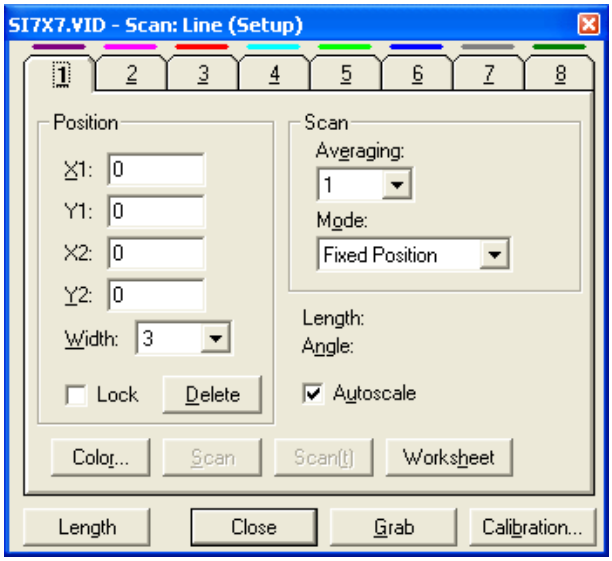
The *Video Format* function will display a control window for setting the size of the captured image. The design and functions depends on the installed video capture card, because this dialog box is part of the capture driver and not of the **EE 2000** software.

The Scan Menu

All functions necessary for experiments are summarized in the *Scan* menu.

Line (Setup)

With the *Line (Setup)* function you can get intensity profiles of a static image and can define up to eight lines for time or energy dependent experiments.



The following dialog box appears. All intensity profiles correspond to the image window, which was active when the dialog box appears.

Definition of a line

All currently defined lines are drawn on the image. The currently selected line is plotted as a solid line. The unselected lines are plotted with dots.

A line is defined by a starting point (X1, Y1) and ending point (X2, Y2).

1. Select a register card for your line definition.

2. Click on the desired starting point in your image and hold down the left mouse button while moving to the ending point.

3. Release the mouse button. The line co-ordinates are shown in the co-ordinate text boxes.

4. You can edit your line definition by clicking on the line. Watch the mouse cursor when moving the mouse over line.

5. Set the *Width* of the line with the *Width* combo box.

6. Choose a color for the line with the *Color* button. The program will open the standard windows dialog box for choosing a color.

7. Set the *Averaging* value. If the averaging value is 1, the intensity profile is plotted in a separate intensity profile window. The profile is automatically updated when you change one of the definition parameters (position, length, orientation, width)

8. For time and energy dependent experiments you can set a *Tracking* mode. In the *Fixed Position* mode the position of the line remains unchanged during an experiment. (Other modes will be implemented in the future.)

9. To avoid inadvertently changes to your line definition, you can lock the definition of a line with the *Lock* check button.

10. Repeat step 1 to 7 for other line register cards.

Scan

Use the *Scan* button to get intensity profiles for a line with an averaging value greater than 1. This command is only available in the *Camera Image* window and not in a standard image window.

Scan(t)

When the *Scan(t)* button is pressed, the program will permanently digitize new intensity profiles from the camera image. The caption of the button is changed to *Stop*. The result of any changes to a line definition parameter is taken into account. For higher averaging values the reaction speed of the program decreases. You stop this *Live* mode with a click on the *Stop* button.

Autoscale

By default the width of the intensity profile window is calculated by the program, to match the length in pixel of the current line. If the *Autoscale* checkbox is off, the current profile window width remains unchanged, even if you change the length of the line.

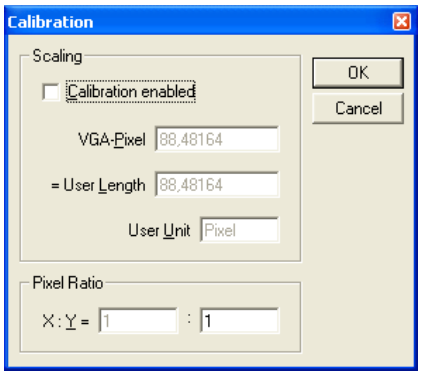
Grab

You can digitize a new image from the camera by pressing the *Grab* button. This function is only available in the *Camera Image* window and not in a standard image window.

Worksheet

If you want to save the profile data or to analyze the data press the *Worksheet* button. The program will open a new data sheet and fill it with the data of the current intensity profile. See chapter *The Worksheet Module* for a description of available functions.

Calibration



For length measurements you can define a calibration factor for converting a length values expressed in image pixel into user defined units. A new dialog box will appear.

Calibration procedure

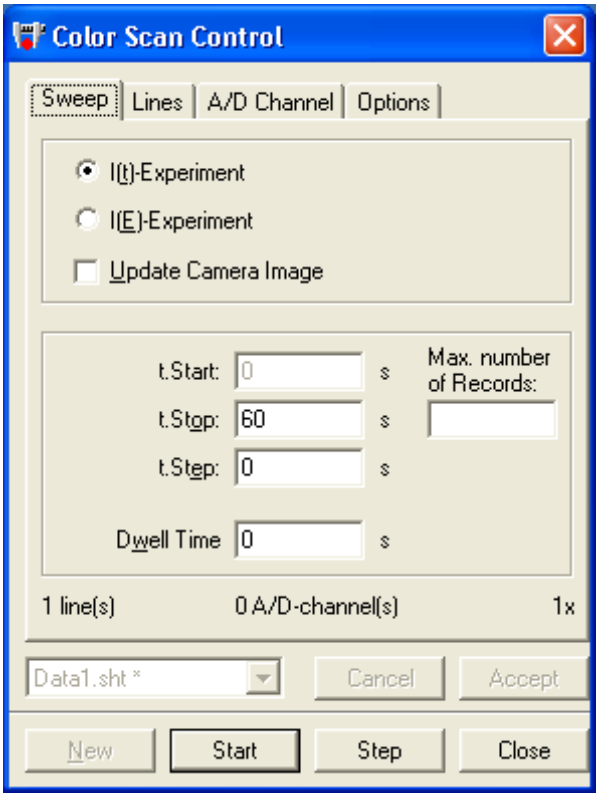
1. Define a line between two points of a known distance.
2. Click on the *Calibration* button.
3. Enable the calibration factor.
4. Enter the known distance for the defined line in the *User Length* text field.
5. Enter the unit of the user length in the *User Unit* text field.

If necessary specify the X/Y aspect ratio of the image.

Click on *OK*.

All length values are now shown in user units.

Color Scan



Recording intensity profiles as a function of time (or energy) will produce a large amount of data. To simplify data handling, the *Color Scan* experiment offers a method to save and visualize profile data as an image. The intensity values of the image correspond to the profile intensity values. A horizontal scan line in the Color Scan image corresponds to the profile data of a fixed time value (or energy value). The vertical axis of the Color Image is the time (or energy) axis.

Save

You save the Color Scan experiment data by saving the Color Scan image with the *Save Image As* command in the *File* menu. We recommend using a 16 bit file format to avoid loss of information.

Analysis

To analyze the experimental data use the *Line (Setup)* command in the *Scan* menu.

Color Scan Control

The *Color Scan Control* dialog box gives you access to all important experiment parameters.

Sweep

All sweep parameters are summarized in the *Sweep* register card.

1. Set the kind of experiment: *I(t)-Experiment* or *I(E)* dependent.
2. I(t)-Experiment

   The parameters *t.Start* and *t.Stop* define the beginning and the end time of the time dependent experiment. The time scale starts with pressing the *Start* button. By default the parameter *t.Start* is zero. If you enter a non-zero value, recording of data will be suppressed for this duration.

   With *t.Step* you can slow down the experiment to decrease the number of data records and/or to acquire data in fixed intervals. If this value is zero, data acquisition is done as fast as possible.

   or

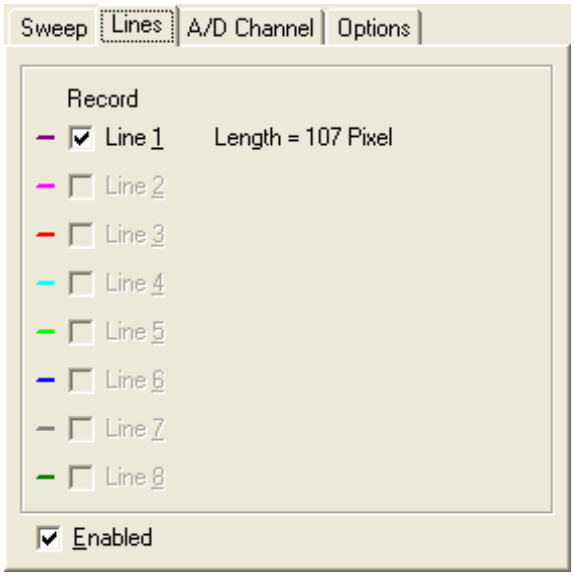
   I(E)-Experiment

   The parameters *E.Start* and *E.Stop* define the first and last energy value of the energy dependent experiment. *E.Start* may be greater than *E.Stop* to run the experiment from higher to lower energy values.

   With *E.Step* you define the energy increment/decrement. The sign of *E.Step* is ignored.
3. The experiment will wait for a time of *t.Dwell* seconds between two data acquisition steps.

   Use a non-zero value in I(E)-Experiments, if your e-gun power supply does not output the required voltage fast enough.
4. Select (already defined) lines for the experiment.

   Click on the register card *Lines*

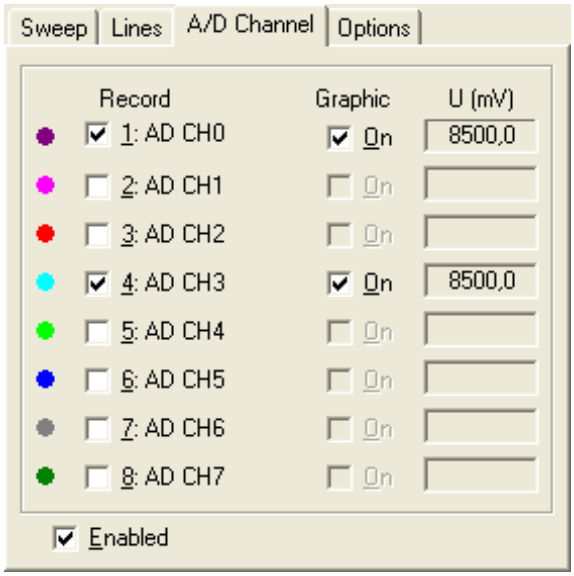


The register card shows you all lines, which are defined in a previous step with the *Line (Setup)* function in the *Scan* menu.

Select at least one line.

The *Enabled* check box enables or disables all selected lines for the experiment.

5. Select A/D-channels

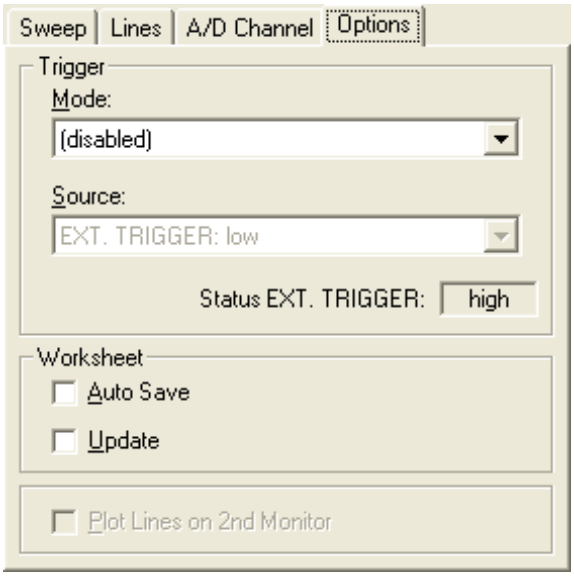


This register card is only available, if an A/D-converter interface is installed.

All selected A/D-channels are monitored during the experiment. Their data are stored in the experiments worksheet. If the *Graphic* checkbox is on, the data are plotted in a separate plot window. The current voltages at the selected A/D-channels are displayed if this register card is selected.

The *Enabled* check box enables or disables all selected A/D-channels for the experiment.

6. Set Options



An experiment can by synchronized with other events.

Select one of the trigger modes with the *Mode* combo box:

(disabled)

The program ignores trigger events.

Test on Start of Sweep

The beginning of the experiment is synchronized with a trigger event.

Test on every Step of Sweep

Every data acquisition is triggered.

Select the trigger source with the *Source* combo box. A trigger event can be the status of the EXT. TRIGGER I/O line or a manual press of a key.

The current level of the EXT. TRIGGER line is shown in a status field.

External trigger requires a digital I/O interface.

Auto Save

All experiment data are stored in the computers memory. If the *Auto Save* check box is on, the data are automatically saved when the experiment is stopped. The program uses the default filename ~Cscan the default filename extension. The file(s) are saved in the windows directory for temporary files. Existing files are overwritten without notice.

Plot Lines on 2nd Monitor

If the grabber interface and driver supports overlay technique, the program shows the actual position of the analyzed line(s) on a second video monitor. This will decrease the maximum data acquisition rate.

Most of the parameters take effect after pressing the *Accept* button. Some parameter changes require a restart of the experiment.

New

The *New* command initializes the experiment worksheet and all associated plot windows.

Start - Continue - Stop

The *Start* button starts an experiment. Data are stored in the worksheet from Row 1. The caption of the button changes to *Stop*.

Pressing the *Stop* button - click with the mouse or pressing the Esc key (window must have the focus)- will stop the experiment. The experiment worksheet is updated. The caption of the button changes to *Continue*.

You can continue an interrupted experiment with the *Continue* button. The caption of the button changes to *Stop*.

Most of the controls are disabled during a running experiment.

A running experiment is indicated in the title bar of the program.

The program distinguishes two different experiment modes:

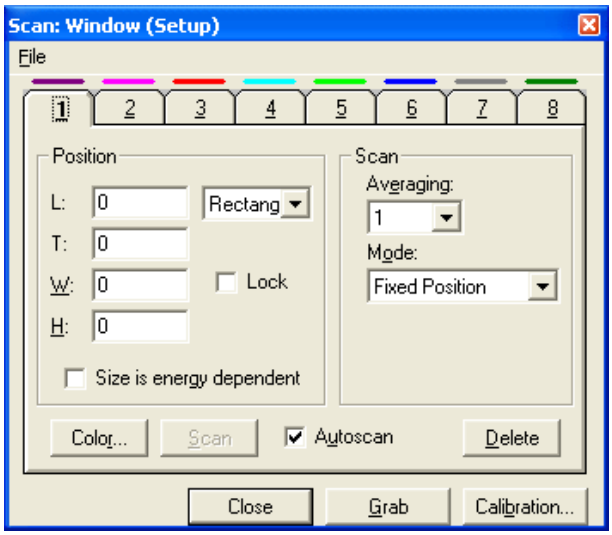
Normal Mode: The *monitor* function in the *Grab* menu is disabled and the Soft VTR control window is closed.

VTR Mode: The Soft VTR control window is opened and a video file is loaded. Instead of grabbing a new image from the camera, the program will read the next frame of the video file. With this powerful tool you can reproduce experiments. Using the same experiment data will exactly result in the same data values. There is no need to use a hardware VTR (VTR = Video Tape Recorder).

Hint: *All experiment data are stored only in the computers memory. You have to save your data on hard disk drive with the Save command within the experiment worksheet window and with the Save Image command within the Color Scan window.*

Window (Setup)

With the *Window (Setup)* function you can get intensity information of a static image and can define up to eight windows (rectangular regions) for time or energy dependent experiments.



The following dialog box appears. All definitions correspond to that image window, which was active when the dialog box appears.

Definition of a window

All currently defined windows are drawn on the image. The currently selected window is plotted with a solid borderline. The unselected windows are plotted with dots.

A window is defined by a starting point (L, T) - left and top position - and the size (W, H) - width and height -.

1. Select a register card for your window definition.
2. Click on the desired starting point in your image and hold down the left mouse button while moving to the ending point.
3. Release the mouse button. The window co-ordinates are shown in the co-ordinate text boxes.
4. You can edit your window definition by clicking on the borderline or inside the window. Watch the mouse cursor when moving the mouse over the rectangular.

5. Choose a color for the window with the *Color* button. The program will open the standard windows dialog box for choosing a color.
6. Set the *Averaging* value. If the averaging value is 1, the intensity information are automatically updated when you change one of the definition parameters (position, length, orientation, width)
7. For time and energy dependent experiments you can set a *Tracking* mode:

Mode	Description
Fixed Position	The position of the window remains unchanged during an experiment.
Stop Mode ABS	The window will be centered to the pixel with the maximum intensity value, if the maximum intensity is greater than the *Threshold* value ($I_{\max} \geq Threshold$). Otherwise the position remains unchanged.
Stop Mode REL	The window will be centered to the pixel with the maximum intensity value, if the difference between the maximum intensity value and the average value of all intensity values of the pixel lying on the borderline is greater than the *Threshold* value ($I_{\max} - I_{border} \geq Threshold$). Otherwise the position remains unchanged.
Follow Mode	The window will be centered to the pixel with the maximum intensity value, if the difference between the maximum intensity value and the average value of all intensity values of the pixel lying on the borderline is greater than the *Threshold* value ($I_{\max} - I_{border} \geq Threshold$). Otherwise the new position is extrapolated from the previously position and energy values. This mode requires, that an I(E) experiment will start with a good visible spot for the first energy values. The track parameters are automatically saved.
Repeat Mode	The windows centre position will always be calculated from the previously saved Follow Mode track parameters. In this mode, you can start the I(E) experiment with invisible spots. Another advantage is that the window track is a straight line.

In Repeat Mode you have access to two additional buttons: Σ=0 and Σ+.

Σ=0 clears the track parameter.

$$n = 0, \sum \frac{1}{\sqrt{E}} = 0, \sum \frac{1}{E} = 0, \sum x = 0, \sum \frac{x}{\sqrt{E}} = 0, \sum y = 0, \sum \frac{y}{\sqrt{E}} = 0$$

Σ+ adds the co-ordinates X_{max}, Y_{max} of the pixel with the maximum intensity value together with the energy value E to the track parameter memory.

The center position X_c, Y_c of the window at a given energy value E will be calculated during an $I(E)$ experiment by the following formulas:

$$X_c = m_x \frac{1}{\sqrt{E}} + t_x, Y_c = m_y \frac{1}{\sqrt{E}} + t_y$$

with

$$m_x = \frac{n\sum \frac{x}{\sqrt{E}} - \sum x \sum \frac{1}{\sqrt{E}}}{n\sum \frac{1}{E} - \left(\sum \frac{1}{\sqrt{E}}\right)^2}, m_y = \frac{n\sum \frac{y}{\sqrt{E}} - \sum y \sum \frac{1}{\sqrt{E}}}{n\sum \frac{1}{E} - \left(\sum \frac{1}{\sqrt{E}}\right)^2},$$

and

$$t_x = \frac{\sum x \sum \frac{1}{E} - \sum \frac{x}{\sqrt{E}} \sum \frac{1}{\sqrt{E}}}{n \sum \frac{1}{E} - \left(\sum \frac{1}{\sqrt{E}} \right)^2}, t_y = \frac{\sum y \sum \frac{1}{E} - \sum \frac{y}{\sqrt{E}} \sum \frac{1}{\sqrt{E}}}{n \sum \frac{1}{E} - \left(\sum \frac{1}{\sqrt{E}} \right)^2}.$$

8. To avoid inadvertently changes to your window definition, you can lock the definition of a window with the *Lock* check button.

9. Repeat step ∈ to ™ for other line register cards.

Scan

Use the *Scan* button to get intensity profiles for a line with an averaging value greater than 1. This command is only available in the *Camera Image* window and not in a standard image window.

Scan(t)

When the *Scan(t)* button is pressed, the program will permanently digitize new intensity profiles from the camera image. The caption of the button is changed to *Stop*. The result of any changes to a line definition parameter is taken into account. For higher averaging values the reaction speed of the program decreases. You stop this *Live* mode with a click on the *Stop* button.

Autoscale

By default the width of the intensity profile window is calculated by the program, to match the length in pixel of the current line. If the *Autoscale* checkbox is off, the current profile window width remains unchanged, even if you change the length of the line.

Grab

You can digitize a new image from the camera by pressing the *Grab* button. This function is only available in the *Camera Image* window and not in a standard image window.

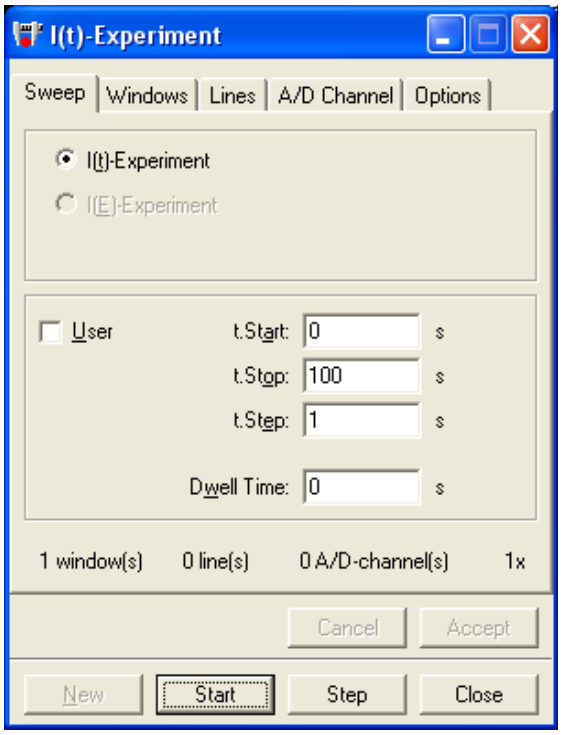
Worksheet

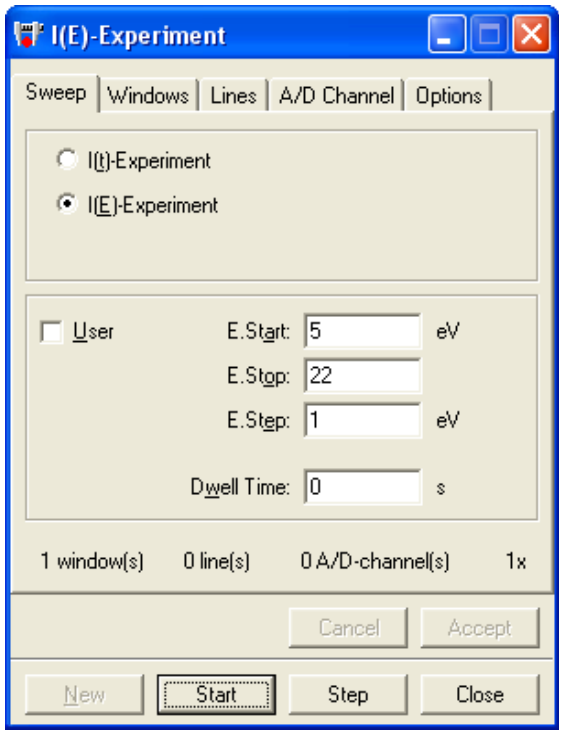
If you want to save the profile data or to analyze the data press the *Worksheet* button. The program will open a new data sheet and fill it with the data of the current intensity profile. See chapter *The Worksheet Module* for a description of available functions.

I(t)-Experiment… / I(E)-Experiment

With the *I(t)-Experiment* resp. *I(E)-Experiment* function an experiment is performed. All Lines and Windows defined with the Line (Setup)… resp. Window (Setup)… function can be selected for an experiment. The intensity profile resp. intensity values are recorded as a function of time resp. as a function of energy.

The I(E)-Experiment is also known as I(V)-Experiment.





The I(E)-Experiment can only selected, if a D/A-converter is installed.

The Sweep Tab

I(t)-Experiment

t.Start: Defines the beginning of an experiment. This value works as a delay. Normally it is set to 0 s.

t.Stop: Defines the end of the experiment. If this value is set to zero, the experiment runs infinite (until the user stops the experiment or an error occurred (e.g. disc full).

t.Step: This value defines the time interval between grabbing an image. A value of 0 will define the fastest recording rate. Depending on the hardware and parameters, the software cannot guarantee the interval time defined by *t.Step* (especially for small values).

I(E)-Experiment

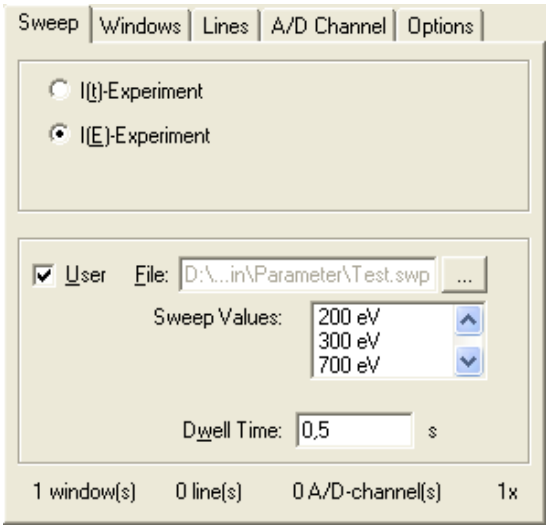
E.Start: Defines the first energy value of an experiment.

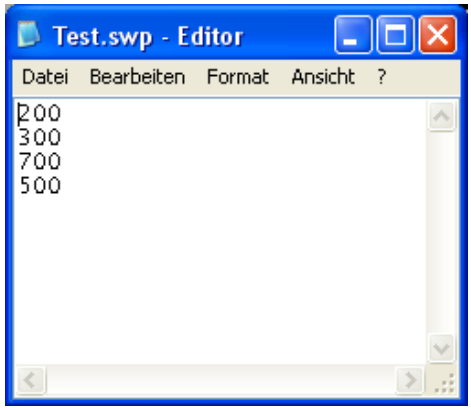
E.Stop: Defines the last energy value of an experiment. *E.Stop* can be less than *E.Start*.

E.Step: This value defines the energy step between grabbing an image. This value is always positive.

I(t)-Experiment / I(E)-Experiment

User: If this check box is enabled, all *.Start*, *.Stop*, and *.Step* values are ignored. Instead, user defined time resp. energy values are used. These values are read from a sweep file. This is an Ascii file containing the time resp. energy values in seconds resp. in eV. The sweep filename is shown in textbox File. The user defined sweep values allow non-equidistant step values. Energy sweeps are possible in a non-monotonic order. Time values must be in an ascending order and in the range of 0…86400 (0 s … 24 h). Energy values must be in the range of 0…3000 (eV).





Dwell Time: If a new time value defined by *t.Step* is reached, a delay defined by the *Dwell Time* occurs, before the image is grabbed. For I(E)-Experiments this is useful, if the power supply of the energy gun needs some time until the energy is set to the correct value.

Cancel: A click on the *Cancel* button will reset the parameters to the last valid values.

Accept: will accept all changed parameter values

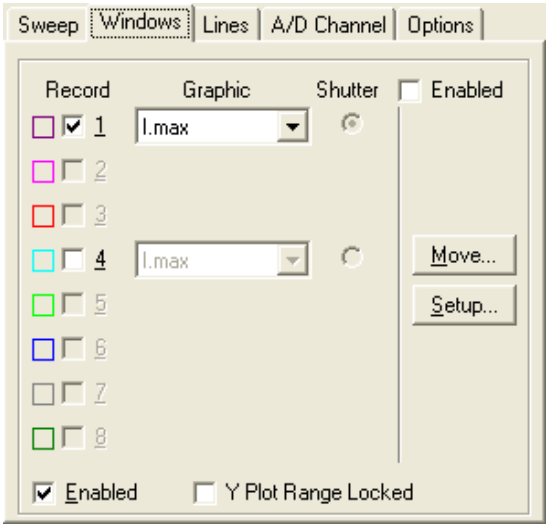
New: Resets the experiment.

Start: Starts an experiment, beginning with *t.Start* resp. *E.Start*.

Continue: Continues an experiment after a stop.

Stop: This stops the experiment.

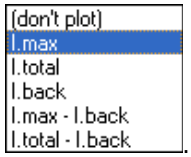
The Windows Tab



All Windows defined with the Window (Setup)… function can be selected for the experiment. In this example, window #1 and window #4 are defined, but only window #1 is selected for the experiment.

Record: With *Record* you can define whether an intensity parameter is recorded or not. (See also the commands to *Enabled*.)

Graphic: With *Graphic* you can define whether an intensity parameter is plotted or not.

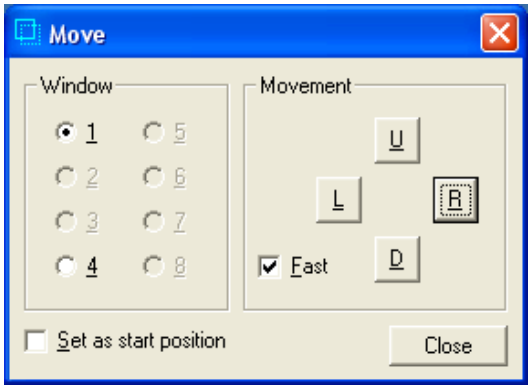


Shutter: The checkbox *Shutter Enabled* activates a shutter control function. If it is activated, you can select one of the windows used in the experiment to feed the shutter control algorithm with intensity data by clicking on the appropriated option box.

Enabled: if the checkbox *Enabled* is checked, all windows selected with the *Record* checkbox will be used in the experiment. If it is disabled, all entries on this tab are ignored.

Y Plot Range Locked: All plotted intensity values are shown in a separate plot window. The Y-axis is automatically set to the correct range. If the user changes Y-scale, these changes will be used as a default scaling, when this checkbox is checked.

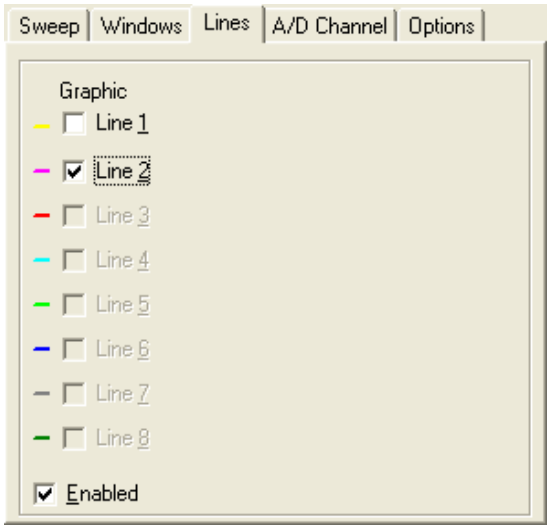
Move… With this command you can move the window position for the next scan step(s).



- Select the *Window* you want to move
- The check box *Fast* defines the movement step: 1 pixel of 8 pixel
- Use the *Movement* buttons to move the selected window: the current position is used for the next scan step.
- With the check box *Set as start position* marked, the current position is used for the Start of the scan.

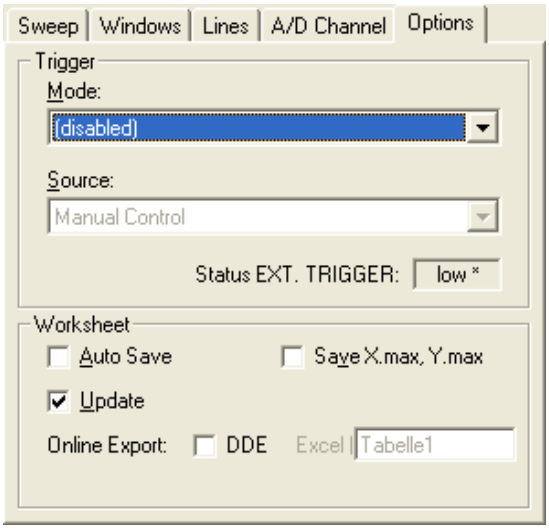
Setup… This calls the *Window (Setup)…* dialog box. The experiment dialog box will be closed.

The Lines Tab



All Lines defined with the *Line (Setup)…* function can be selected for the experiment. The intensity profiles of all selected lines will be plotted during the experiment. Note: the profile data are NOT recorded. Use the *Color Scan…* function in the Scan menu for recording intensity profiles.

The Options Tab

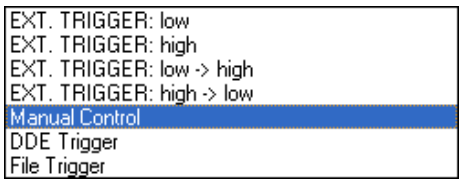


On the *Options Tab* you can define the trigger parameters and how to handle the online data.

Trigger

Mode: Select one of the trigger modes:

Source: Select the trigger source:



If a digital I/O card is installed, the digital input line EXT. TRIGGER can be used as a trigger source. The software can react on static signals (low or high) or on signal changes (low to high or high to low). The current signal of the EXT. TRIGGER line is shown in the *Status EXT. TRIGGER* field.

With *Manual Control* the software asks the user for a manual trigger input.

DDE Trigger and *File Trigger* are special trigger sources. Asks the programmer for more details.

Worksheet: The parameters collected during an experiment are displayed in a worksheet.

Auto Save: If checked, the worksheet is automatically saved at the end of an experiment. The filename is automatically generated by the software.

Save X.max, Y.max: If checked, the coordinates of the pixel with the highest intensity value is also written to the worksheet.

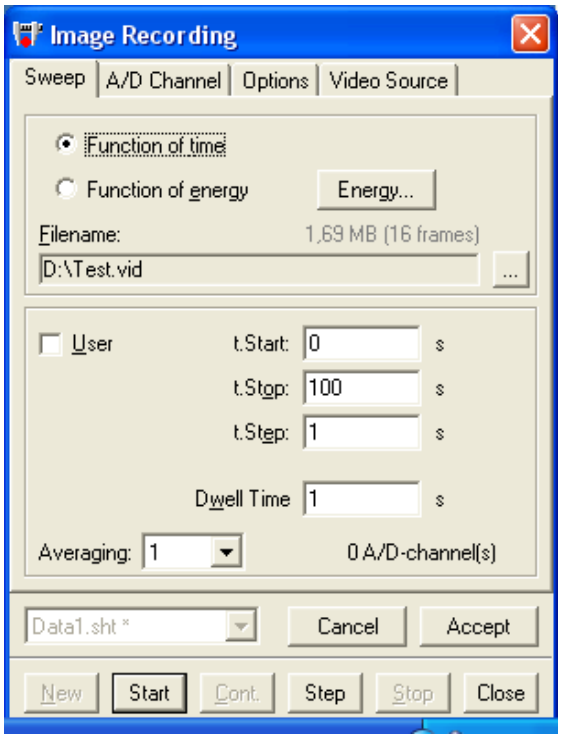
Update If checked, the collected experiment data are immediately displayed in the worksheet. If unchecked, the maximum acquisition rate can be realized. The data are displayed to the worksheet when the experiment is stopped.

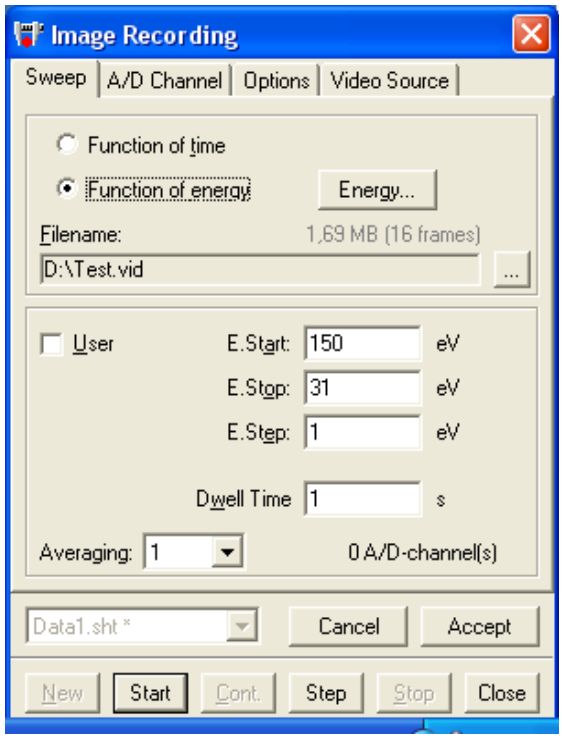
Online Export: The worksheet data can be exported to a Microsoft Excel sheet during an experiment, if this checkbox is checked. The name of the Excel sheet is defined in the *Excel* field.

Image Recorder…

A sequence of images can be recorded to the hard drive and can be used later as the image source for experiments. The sequence can be a function of time or energy.

The Sweep Tab





Most of the parameters are equal to the parameters described in the *I(t)-Experiment…* resp. *I(E)-Experiment…* function in the *Scan* menu.

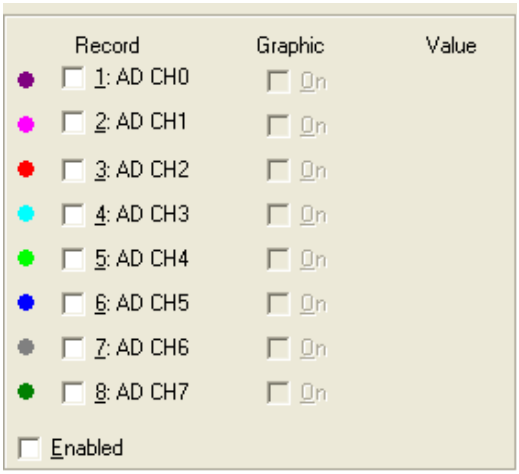
Filename: Enter the complete filename (including path and extension) of the video file.

Use the ... button.

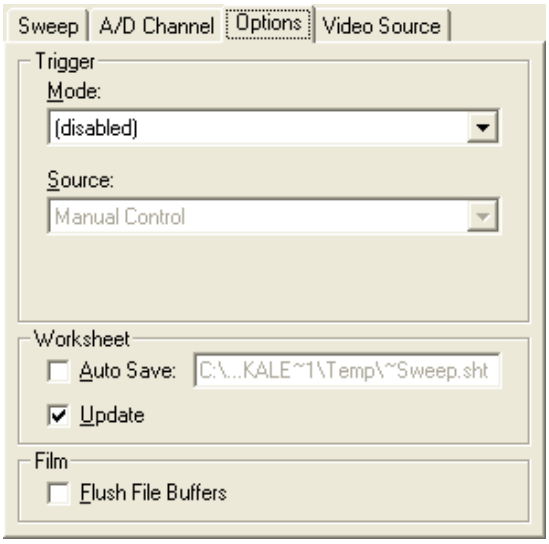
Averaging: Before recording to the file, a sequence of images can be averaged. This will decrease the noise in the images but slow down the experiment.

The A/D Channel Tab

The A/D Channel Tab is described in the I(t)-Experiment.



The Options Tab



Trigger — The Trigger options are as described in the I(t)-Experiment.

Worksheet — The experiment data (time, energy, A/D-channels) are saved to a worksheet.

Auto Save: If checked, the worksheet data are automatically saved to the file ~Sweep.sht in the directory of temporary files of the current user when the experiment is stopped.

Film: The film data are saved to the hard drive. The operating system uses a file buffer to speed up writing to the hard drive. If the buffer is full, the data are written to the hard drive.

Flush File Buffer: If checked, the file buffer is written to the hard drive after every image. This is recommended for experiments with many images and if the image rate should be as constant as possible.

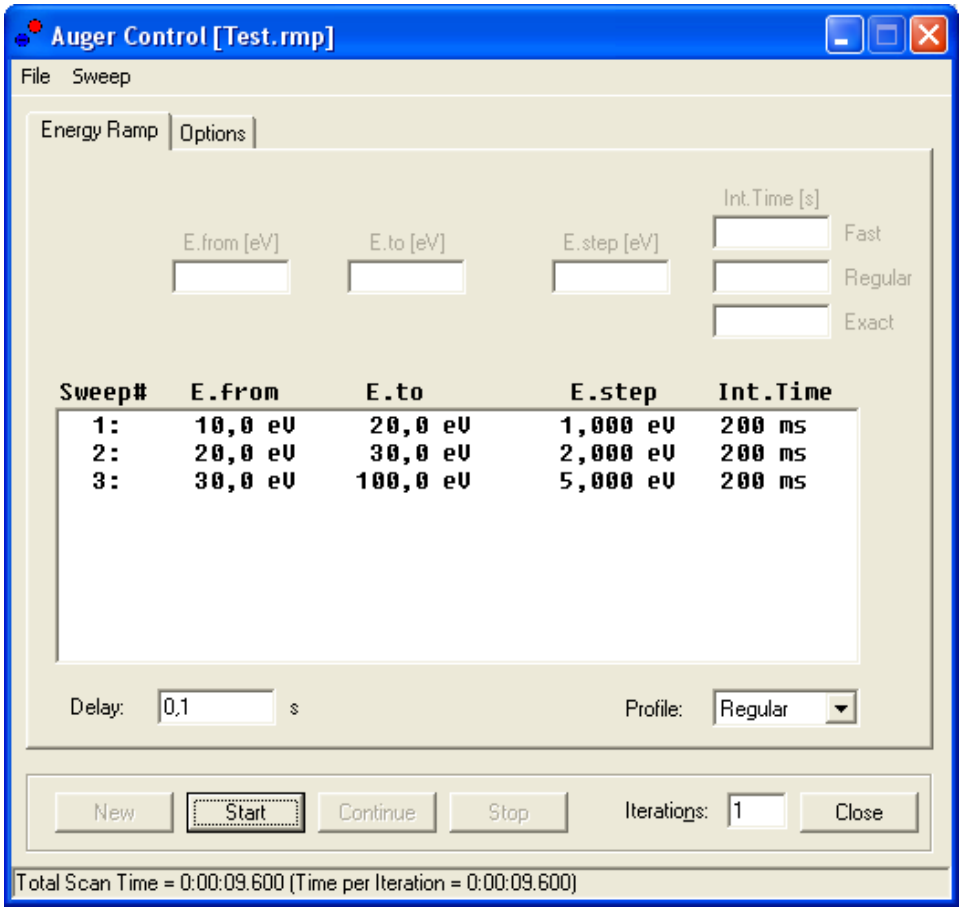
The Video Source Tab

If the grabber interfaces driver supports multiple video inputs or if more than one single digital camera is connected, you can define in which sequence the inputs/cameras should be used for the experiment. The input/camera is changed after every step of the experiment. A file for each input/camera is generated.

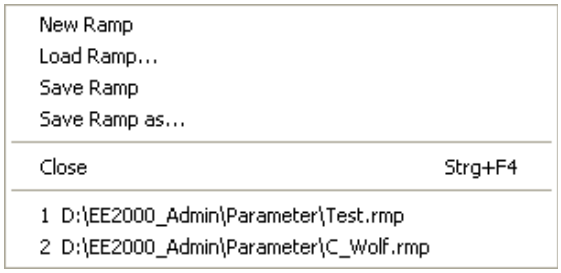
The Auger… Menu

The Auger experiment can be performed with this function.

A 2nd D/A channel is used to control the mesh energy during the Auger experiment.

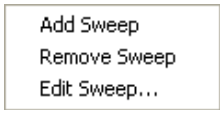


The File Menu



New Ramp	Creates a new (empty) energy ramp
Load Ramp…	Load and opens a file containing ramp data
Save Ramp	Saves the current energy ramp using the existing filename
Save Ramp as…	Saves the current energy ramp using a new filename
Close	Closes the Auger Control window.

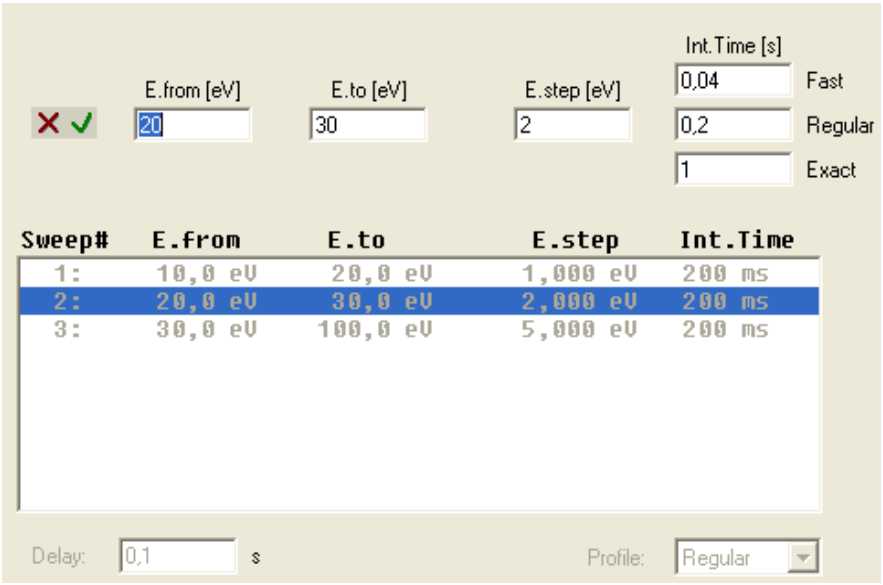
The Sweep Menu



Add Sweep — Adds a new sweep before or behind the marked sweep depending on the energy values: if the E.to value of the previous sweep is equal then the E.from value of the marked sweep, the new sweep is added behind the marked sweep.

Remove Sweep — Removes the selected sweep from the list.

Edit Sweep — Editing of the sweep parameters



Each sweep is defined by an energy range (*E.from* and *E.to*) and the energy step value (*E.step*). *E.from* can be less then *E.to*. *E.step* is always a positive value. For each sweep you can define 3 integration time values (*Int.Time*) for the 3 *Profile* modes (Fast, Regular, and Exact).

The Energy Ramp Tab

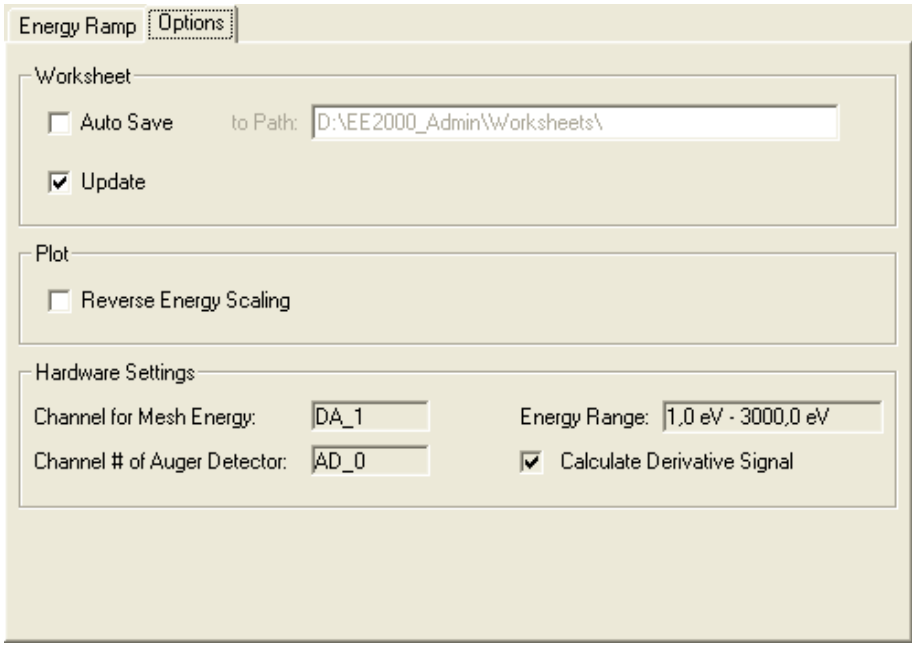
The *Energy Ramp* tab shows all parameters defining the energy ramp. In this example, the experiment the energy ramp has 3 energy sweeps. An experiment can be repeated depending on the value of *Iterations*.

The Auger experiment is explained in the following simplified flow diagrams:

```
START:
        IterationIndex = 0
FIRST_SWEEP:
        SweepIndex = 0 : DataIndex = 0 : MeshEnergy = E.from[SweepIndex]
CONTINUE:
        SetMeshEnergy(MeshEnergy)
        Wait(Delay)
        ACQUISITION       // see flow diagram below
        MeshEnergy = MeshEnergy + E.step[SweepIndex]
        MeshEnergy > E.to[SweepIndex] ?
                YES:  SweepIndex = SweepIndex +1
                      SweepIndex >= NumberOfSweeps ?
                            YES:  IterationIndex = IterationIndex +1
                                  IterationIndex >= Iterations ?
                                        YES:  Goto END
                                        NO:   Goto FIRST_SWEEP
                            NO:   MeshEnergy = E.from[SweepIndex]
        Goto CONTINUE
END:
```

```
ACQUISITION:
        E[DataIndex] = MeshEnergy
        U[DataIndex] = Intgerate AugerVoltage, Int.Time[SweepIndex]
        Derivative ?
                YES:  DataIndex > 0 ?
                            YES:  E2 = E[DataIndex] : E1 = E[DataIndex - 1]
                                  U2 = U[DataIndex] : U1 = U[DataIndex - 1]
                                  E1 <> E2 ?
                                        YES:  AES_Energy = (E1 + E2) / 2
                                              AES_Signal = (U2 – U1) ( E2 – E1)
                                              UpdateWorksheet…
                NO:   AES_Energy = E[DataIndex]
                      AES_Signal = U[DataIndex]
                      UpdateWorksheet…
        DataIndex = DataIndex + 1
Return
```

The Options Tab



Worksheet

Auto Save — The worksheet is automatically saved at the end of the experiment in the default path for worksheets. The Filename is generated by the software: AES_<date>_<time>.sht.

Update — If checked, the worksheet is updated during the experiment. Otherwise the worksheet is updated only if the experiment is stopped.

Plot

Reverse Energy Scaling — If checked, the energy scale in the plot is reversed, going from higher energy values to lower energy values.

Experiment Control

New — The experiment is reset.

Start — The experiment starts with the 1st sweep of the 1st iteration.

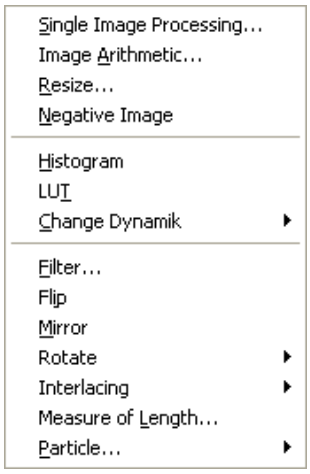
Continue — The experiment continues at that point, where it was stopped before.

Stop — Will stop the experiment.

Iterations — The energy ramp can be repeated by the number of *Iterations*.

Close — This command closes the Auger control window.

The Image Menu

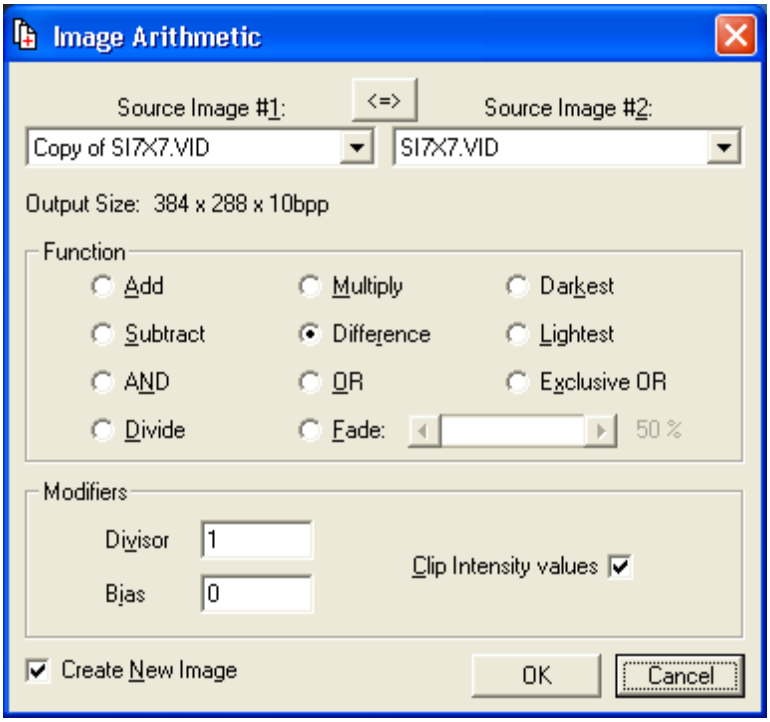


All image editing functions are summarized in the *Image* menu of the main window.

Single Image Processing

You can modify image data with the *Single Image Processing* command. A new dialog box appears.

1. Select the image



Use the drop down box labeled "Source Image" to select the image that you want to modify.

2. Enter the constant value *const*.

   const may be any long integer value.

3. Select the Function

   Click on a function in the Function Group Box. Function processing is performed as follows:

   - A copy of the source image is made. The original image is used for the *Undo* function.

- The intensity data from the source image is combined with the *const* value according to the formulas detailed below.

Function	New Color Value Equals
Add	Source Image Value + *Const*
Multiply	Source Image Value * *Const*
Subtract	Source Image Value – *Const*
Darkest	Minimum of (Source Image Value, *Const*)
Difference	Absolute Value of (Source Image Value - *Const*)
Lightest	Maximum of (Source Image Value, *Const*)
AND	Source Image Value & *Const*
OR	Source Image Value | *Const*
Exclusive OR	Source Image Value ^ *Const*
Divide	Source Image Value / *Const*

4. Set the Modifiers

   The modifiers are applied to the intensity values produced by the function formula.

   Divisor

   The intensity value produced by the function formula is divided by the value selected in the *Divisor* text field. This allows you to reduce the effects of the other selections.

   Bias

   You use the bias to shift each intensity value by a fixed amount. The value selected in the *Bias* text field is added to the intensity value produced by the function formula and divisor selections.

   Clip Intensity Values

   The *Clip Intensity Values* checkbox determines how the program handles final intensity values that are greater than the maximum valid intensity value (dependent of the dynamic range) or less than zero.

Setting	X < 0	X > MAX
On	X = 0	X = MAX
Off	X = X MOD (MAX + 1)	X = X MOD (MAX + 1)

5. Select the *OK* button

   Click on the *OK* button. The program will close the dialog box and modifies the source image.

Image Arithmetic

The *Image Arithmetic* function combines data from two images. The function accepts any two images as input, and produces a third image (or changes source image #1) that is the product of the source images' intensity data.

1. Open the images

   The *Image Arithmetic* function is only available if at least two images are visible. Use the *Open Image* command from the *File* menu to load an image into a new image window.

2. Select *Image Arithmetic* from the *Edit* menu

   The program will open the *Image Arithmetic* dialog box.

3. Select the images

   Use the drop down boxes labeled *Source Image #1* and *Source Image #2* to select the images that you want to combine. The size and dynamic of the resulting image is determined by source image #1.

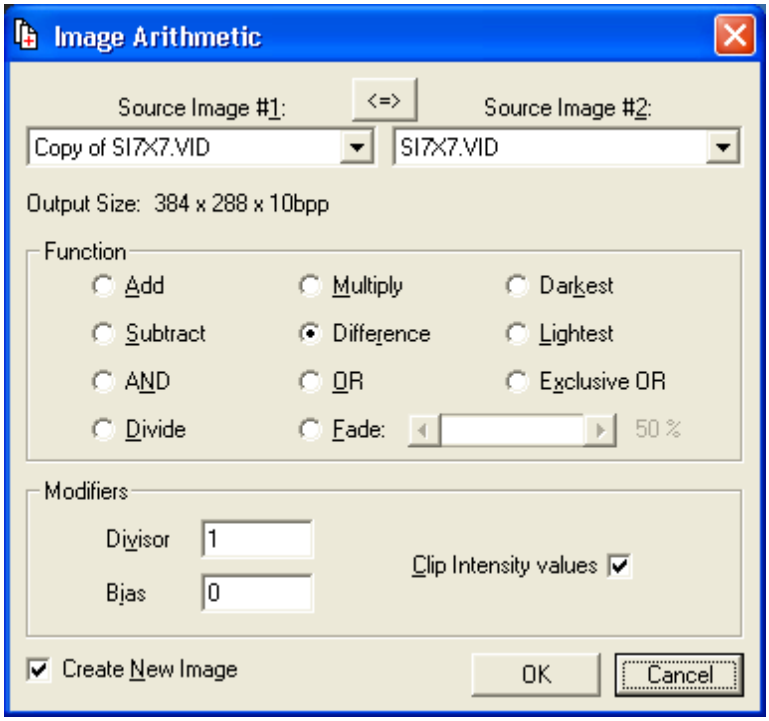
4. Select the function

   Click on a function in the *Function* group box. Function processing is performed as follows:

   - A copy of source image #2 is resized to match source image #1. The resized copy is used in the function processing. It resides in temporary memory and is not displayed.

   - The dynamic of the copied image is changed to match the dynamic range of source image #1.

   - The intensity data from the two images is combined on a pixel-by-pixel basis according to the formulas detailed below.



Function	New Color Value Equals
Add	Image 1 Value + Image 2 Value
Multiply	Image 1 Value x Image 2 Value
Darkest	Minimum of (Image 1 Value, Image 2 Value)
Subtract	Image 1 Value - Image 2 Value
Difference	Value of (Image 1 Value - Image 2 Value)
Lightest	Maximum of (Image 1 Value, Image 2 Value)
AND	Image 1 Value & Image 2 Value
OR	Image 1 Value | Image 2 Value
Exclusive OR	Image 1 Value ^ Image 2 Value
Fade	*X* * Image 1 Value + (1 - *X*) * Image 2 Value, *X* = 0 ... 1

5. Set the modifiers

   The modifiers are applied to the intensity values produced by the function formula.

   Divisor

   The intensity value produced by the function formula is divided by the value selected in the *Divisor* text edit field. This allows you to reduce the effects of the other selections.

   Bias

   You use the *Bias* to shift each intensity value by a fixed amount. The value selected in the *Bias* text edit field is added to the intensity value produced by the function formula and divisor selections.

   Clip Color Values

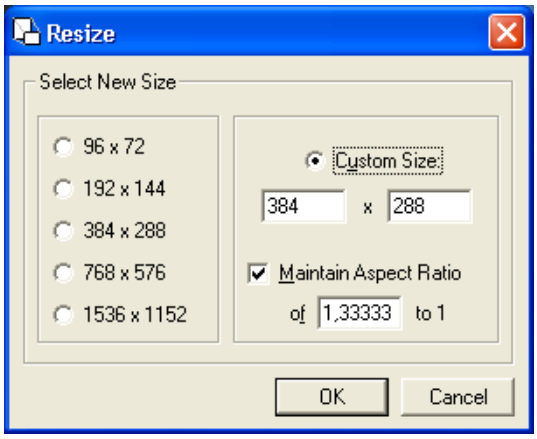
   The *Clip Color Values* checkbox determines how the program handles final intensity values that are greater than the maximum valid intensity value or less than 0.

Setting	X < 0	X > MAX
On	X = 0	X = MAX
Off	X = X MOD (MAX + 1)	X = X MOD (MAX + 1)

6. Select the *OK* Button

   Click on the *OK* button. The program will close the dialog box and calculate the new image from the combined intensity data.

Resize



You can select one of up to five standard image sizes, a custom size by width and height, or a custom size by aspect ratio.

Standard Sizes

The five standard image sizes are listed in the group box on the left. To select one of the standard sizes, click on the option's button or its text. Standard image sizes are equivalent to the first five available resolutions of the current frame grabber / digital camera.

Custom Size by Width and Height

To specify a custom size by width and height in pixels:

1. Click on the *Custom Size* option.
2. Empty the *Maintain Aspect Ratio* checkbox.
3. Type the new width into the first text box.
4. Press <Tab>.
5. Type the new height into the second text box.

Custom Size by Aspect Ratio

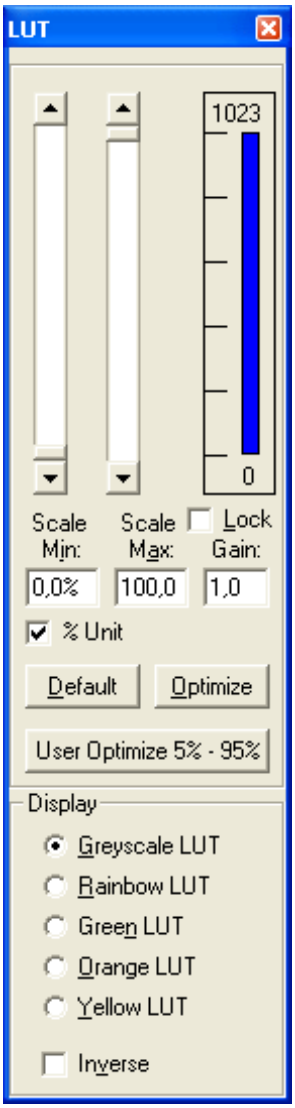
The aspect ratio is the relationship between the image's two dimensions, expressed as width divided by height. To specify a custom size using the aspect ratio:

1. Click on the *Custom Size* option.
2. Mark the *Maintain Aspect Ratio* checkbox.
3. The *Aspect Ratio* text box will display the image's current aspect ratio. If you want to change the ratio, click in the text box, and then type the new ratio.
4. Enter the setting for the dimension that you want to fix. For example, if you want to fix the width and let the height be determined by the aspect ratio, click in the *Width* text box and type the new width. The remaining field will update when you either (a) exit the current field, or (b) select the *OK* Button.

Negative Image

The *Negative Image* function replaces each intensity with its opposite. The effect is similar to a photographic negative.

VGA Display LUT



All images are stored in memory with a maximum of 16 bit dynamic range. Before an image is displayed on the VGA screen, it is converted into an image with 8 bit resolution by using a LUT (= *L*ook *U*p *T*able). With this function you can dramatically increase the contrast of an image.

In the *Display* group you can select one of five basic LUTs:

- Grayscale LUT

  This is the default palette.

- Rainbow LUT

  The rainbow LUT produces a false colors image.

- Green LUT

  This LUT displays the image similar to an image on a green phosphor screen.

- Orange LUT

  This LUT displays the image similar to an image on an orange phosphor screen.

- Yellow LUT

  This LUT displays the image similar to an image on a yellow phosphor screen.

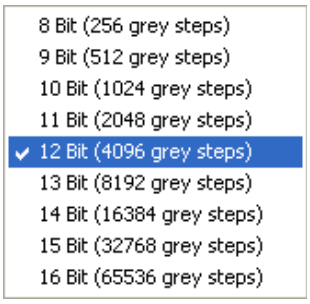
The *Inverse* checkbox inverts the intensity values.

All settings will only affect the displayed (8 bit) image. The internal 16 bit image data remain unchanged.

The *LUT* dialog box corresponds only to that image window, which was active when the dialog box was opened. The LUT for other image windows remain unchanged.

Hint: *On VGA display with 256 colors, changing the LUT of one image window will change the appearance of other image windows. Windows also gives only 236 palette entries to the user (Windows itself uses 20 reserved colors), which can produce some pixel with wrong colors.*

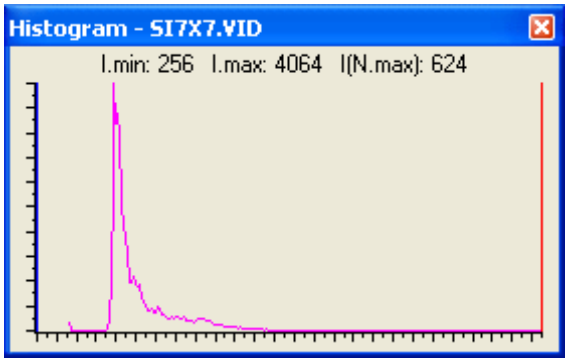
We recommend using 32 bit true color display mode to achieve best results.



Change Dynamic

You can simply change the dynamic of the active image window with the *Change Dynamic* command. A second menu will appear where you can select one of nine different dynamic ranges. The current dynamic is marked.

Histogram



The *Histogram* function gives you an overview about the distribution of intensity values in the active image window. The X-axis is the intensity axis scaled from intensity value 0 to the maximum possible intensity value. The maximum possible intensity value is equal to the dynamic range minus 1.

The histogram window shows also the minimum and maximum intensity value of the image.

A blue and red line mark the lower and upper limit of the LUT, if the LUT dialog box is simultaneously opened.

Filter

You can create and apply your own filters.

How Filters Work

A filter alters each pixel's intensity based on its current intensity and the intensities of any neighboring pixels. The heart of a filter is an array of coefficients called a filter matrix.

A filter processes an image pixel-by-pixel: each pixel's intensity value is multiplied by the coefficient in the matrix centre, and any pixels within the matrix are multiplied by the corresponding coefficients.

The sum of the products becomes the target pixel's new value. The new value is saved in a separate bitmap so that it does not affect the remaining pixels.

The formula for this calculation is:

$$F = \sum_{i=1}^{49} P_i C_i$$

Where *F* is the filtered value of the target pixel, *P* is a pixel in the grid, and *C* is a coefficient in the matrix.

Applying a filter

1 Select *Filter* from the *Edit* menu. The program will open the *Filter* dialog box.

2 Click on the filter in the *Filter Name* list box.

3 Click on the *Apply* button. The program will close the dialog box and apply the filter.

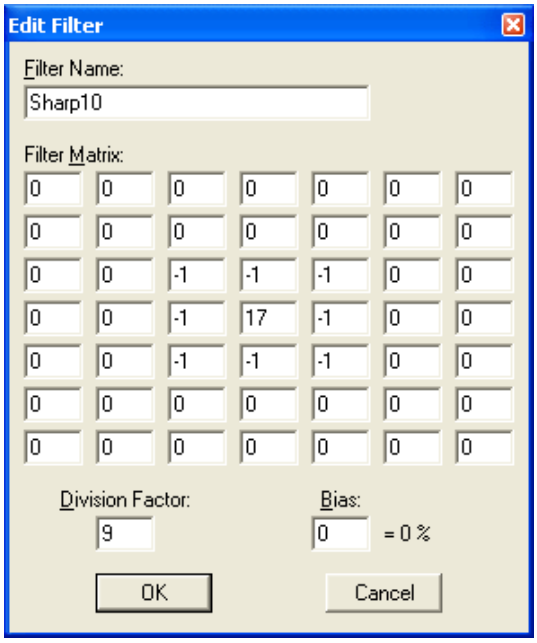
Creating a user defined filter

1. Open the Define New Filter Dialog Box
2. Select *Filter* from the Edit menu. The program will open the *Filter* dialog box.
3. Click on the *New* button. The program will open the *Edit Filter* dialog box.
4. Enter the *Filter Name*

Type the new filter's name into the *Filter Name* text box.

5. Enter the *Filter Matrix* values

Enter the filter matrix values into the table in the centre of the dialog box. Non-integers will be truncated. See the next step for help achieving the same effect as decimal coefficients.



6. Set the Division Factor

   You can think of the division factor as the coefficient denominator: each coefficient in the filter matrix is divided by the division factor before being applied to a pixel. In actuality, the division factor is applied to the product of the matrix calculation. The division factor changes the filter formula to:

$$F = \frac{\sum_{i=1}^{49} P_i C_i}{D}$$

   Where *F* is the filtered value of the target pixel, *P* is a pixel in the grid, *C* is a coefficient in the matrix, and *D* is the division factor.

   The division factor allows you to achieve effects that would otherwise require decimal coefficients. The advantage of requiring non-decimal coefficients is execution speed: the program can accelerate the filtering process by perform the math using integers.

   Using the Division Factor

- Raise the decimal coefficients to integers by multiplying them by the division factor (typically 10, 100, or 1000).
- Enter the "integer-ized" coefficients in the matrix.
- Enter the division factor in the *Division Factor* text box. Non-integers will be truncated.

7. Set the *Bias*

   The *Bias* is added to the product of the matrix calculation and the division factor. You use the bias to shift the value of each pixel by a fixed amount. Bias adjustments are particularly useful for creating embossing effects. The bias changes the filter formula to:

$$F = \frac{\sum_{i=1}^{49} P_i C_i}{D} + B$$

   Where *F* is the filtered value of the target pixel, *P* is a pixel in the grid, *C* is a coefficient in the matrix, *D* is the division factor, and *B* is the bias.

   Using the Bias

   Non-integers will be truncated.

   Integers outside of the range of 0 to the maximum valid intensity value will be clipped to fall within the range.

8. Select the *OK* Button

When you've finished entering the filter's settings, click on the *OK* button. The program will save the filter and return to the *Filter* dialog box. To apply your new filter to the active image:

- Click on it on the *Filter Name* list box.
- Click on the *Apply* button. The program will close the dialog box and apply the filter.

Flip, Mirror

The *Flip* and *Mirror* commands reverse an image orientation along the vertical and horizontal axes:

Flip command

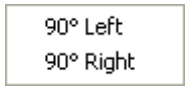
The *Flip* command reverses the image vertically, so that what was the top becomes the bottom, and vice-versa. To use the command, select *Flip* from the *Edit* menu.

Mirror command

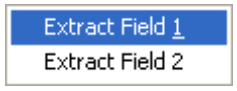
The *Mirror* command reverses the image horizontally, so that what was the left side becomes the right side, and vice-versa. To use the command, select *Mirror* from the *Edit* menu.

Rotate

The *Rotate* command rotates an image 90 degree to the left or to the right.

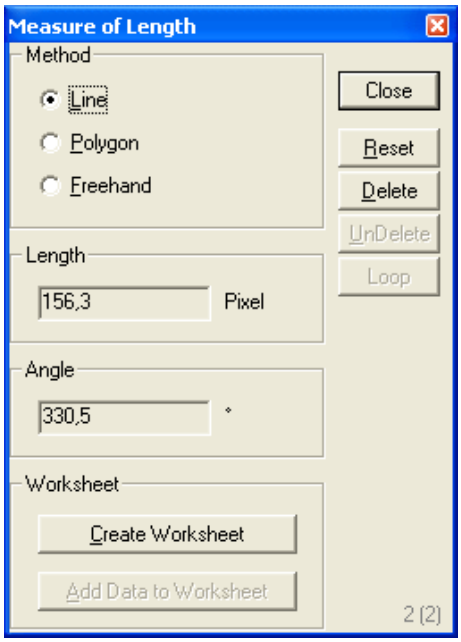


Interlacing



Normal video cameras digitize an image which consists of two interlacing pictures containing the odd and the even lines of the whole image. The complete image with all lines is called a frame. The two interlacing pictures with only the odd or even lines are called a filed. The first field contains the odd lines (1, 3, 5,...) where the second field contains the even lines (2, 4, 6, ...). The time between capturing both fields is 20 ms (50 Hz) or 16.7 ms (60 Hz) depending on the video system. A rapidly changing image will produce interlacing effects in the frame. With the *Interlacing* function you can extract a field from the frame. The aspect ratio will be maintained by drawing every line twice.

Measure of Length



The *Measure of Length* function gives you the capability to measure distances and angles in an image. There are three options how to measure lengths:

Line

Click with the moue on the image where the line should start. Hold down the mouse button and move the mouse pointer to the end point of the line and release the mouse button.

Polygon

Define every polygon point by clicking with the mouse at the required position in the image. The point co-ordinates are accepted, when the mouse button is released. You can delete the last point definition with the *Delete* command. You can un-delete a point by clicking on the *Un-Delete* button.

Freehand

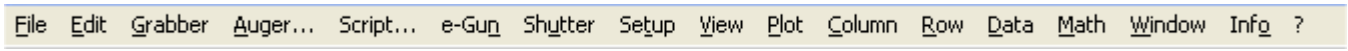
Click at the starting point of a freehand curve. Hold down the mouse button and move the mouse pointer. The length of the mouse movement will be measured. You can also delete and un-delete the curve definition points.

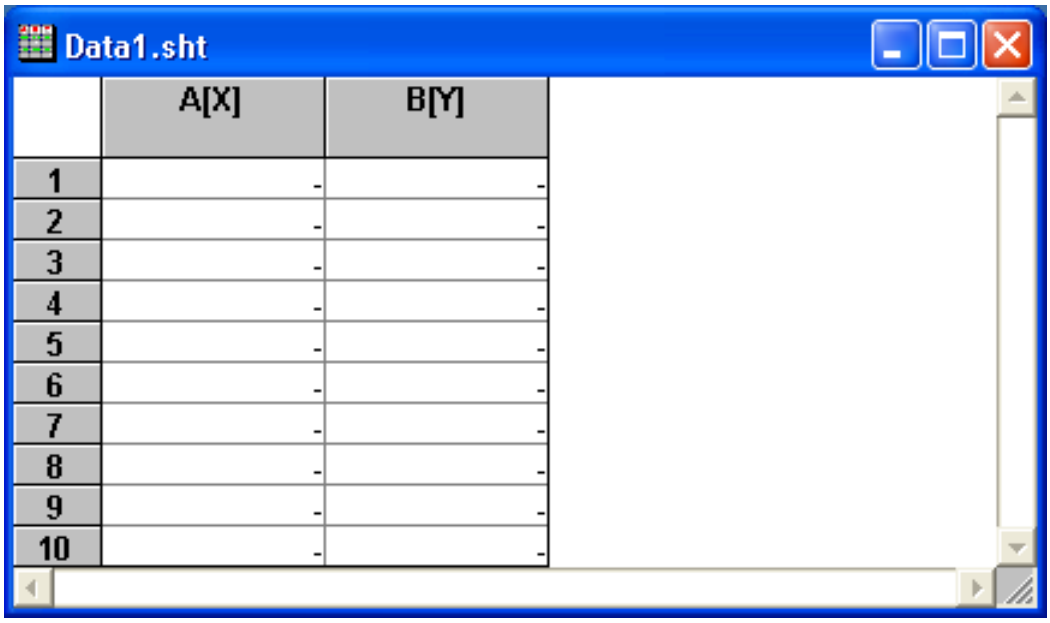
The *Reset* command clears all curve definitions and set the length to zero. The measured length will be in the units defined with the *Calibration* command in the *Line (Setup)* dialog window.

The angle of the last defined curve segment is also displayed. The direction starts with 0° at a line from the left to the right and increases counter clockwise.

III. The Worksheet Module

The worksheet module starts with an empty sheet (*worksheet*) on the screen. Pay attention to the alteration of the menu line.





All experiment data are stored in a worksheet file format compatible to the DOS programs eeScan, eeScan-RL, AIDA-PC and bioScan.

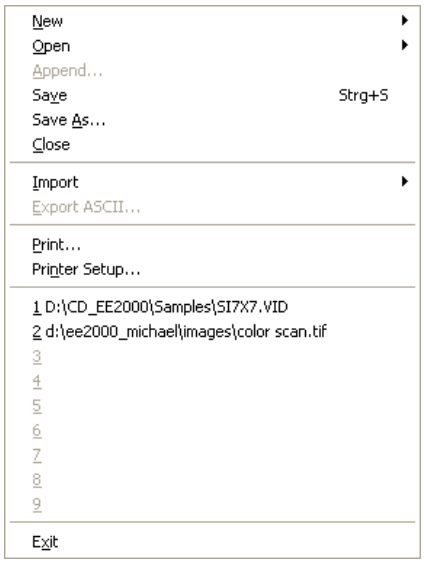
With **EE 2000** this file format includes additional information for plot parameters. The DOS programs will ignore these data.

A worksheet consists of at least 3 columns and 2 rows (including the fixed header row, and the fixed row column).

The column headers show the name of a column - by default a new column gets an unique letter -, the type of data for calculations and plots (X or Y interpreted data), and an optional column label. A column is always referenced by the column name (because he is guaranteed to be unique). A legend of a plot will show the column label if it is defined, else the column name is shown.

The row number appears on the left side.

The Worksheet File Menu



New

Use the *New* Command to create a new empty

Open

With *Open* you can load a previously save worksheet.

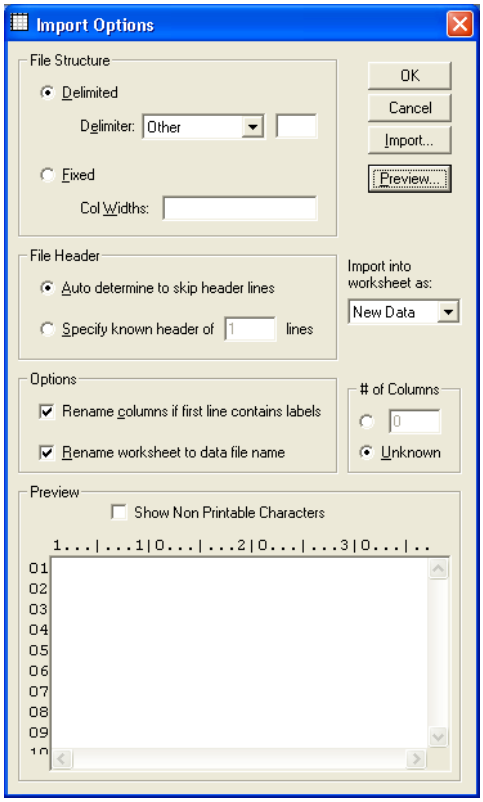
Save, Save As

The command *Save* will save the worksheet with the same filename as the worksheet was opened. If no filename is defined, a file selection window will appear.

Use *Save As* to save the worksheet into a new file.

Import

You can import ASCII data files into an existing worksheet with *Import* | *ASCII* in the *File* menu. The default filename extension is *.DAT. How the ASCII data are imported is depended from the import option settings. *Import* | *Options* will show this window:



File Structure

A *carriage return* (0x0D) and/or *line feed* (0x0A) separates different rows. Columns can delimit by a special character or they have a fixed column width.

Most windows programs use a *tab* character (0x09) as a delimiter. Some FORTRAN programs often export the data with a fixed column width.

File Header

ASCII files can include non numeric header lines. **EE 2000** can automatically detect these header lines or you can directly specify the number of header lines. The header lines are not saved in the worksheet.

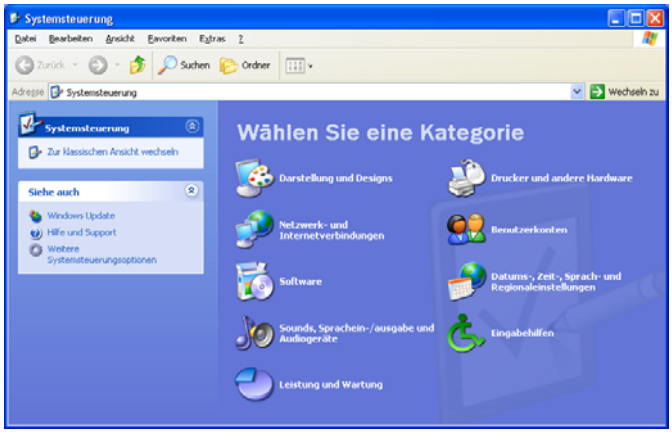
# of Columns

All columns are loaded from the ASCII file if the option button *Unknown* is selected. However, you can define that only subsets of columns are imported. Enter the number of columns to import in the edit field. If this value is greater than the number of columns in the ASCII file, he will be ignored.

Import into worksheet as

With this combo box you can define, how the ASCII data are imported:

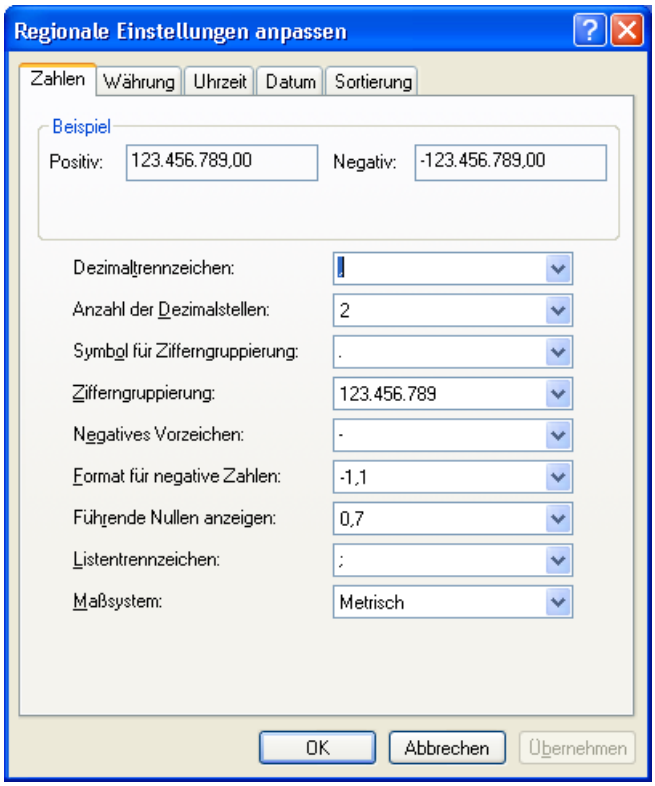
1. *New Data* Before the data are imported, a new worksheet is created.
2. *New Columns* The data are merged to the existing worksheet by adding new columns to the right of last column. The number of rows will be increased if necessary.
3. *New Rows* The data are appended to the existing worksheet after the last row. The number of columns will be increased if necessary.



The decimal 'point' character depends from your windows language settings. In Germany the decimal point is represented by a comma: the value one thousand and a half is written as 1000,5 (or 1.000,5).

You can define the decimal point character by calling the *Systemsteuerung* and then clicking on the icon *Datums-, Zeit-, Sprach- und Regionaleinstellungen*.

In the new dialog box click on 



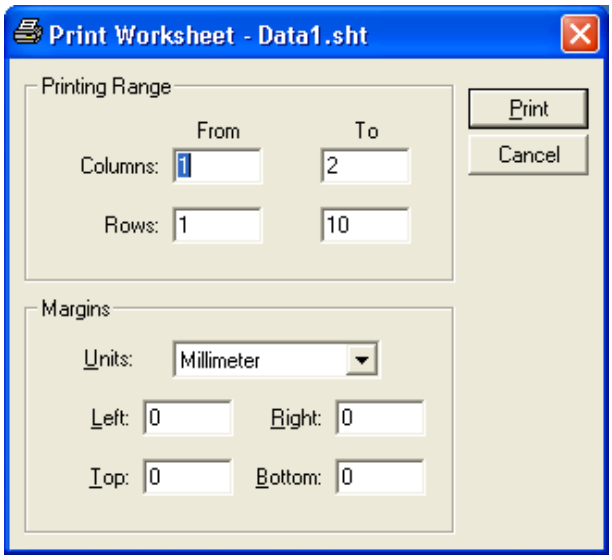
Select register card *Regionale Einstellungen* and click on *Anpassen*.

Define your decimal point in the combo box *Dezimaltrennzeichen*. Check, that your decimal point is unique.

Export ASCII

The *Export* function save the worksheet in ASCII-format, so that other programs can access the data. The program uses a *tabulator* for separate data. Each data record ends with a *carriage return + line feed* sequence. The decimal 'point' character depends from your windows language settings.

Print



You can print the complete worksheet or only a part on a printer with the *Print* command in the *File* menu.

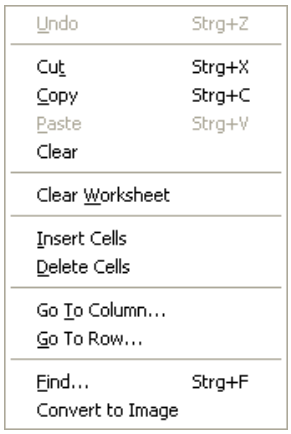
Printer Setup

Use this command to select a printer or to change printer parameters.

Close

With the *Close* command you exit the worksheet module. All plot windows based on the worksheet are closed. A warning appears, if changes to the worksheet are not saved.

The Worksheet Edit Menu



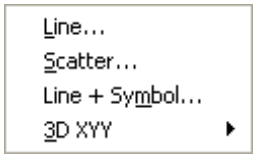
The commands *Cut*, *Copy*, *Paste* and *Clear* are normal clipboard functions and apply to the selected region of the worksheet..

Clear Worksheet will clear all data in the worksheet. The dimensions of the worksheet and the columns properties remain unchanged.

Use the *Insert* and *Delete* command to insert resp. delete columns or rows of the worksheet.

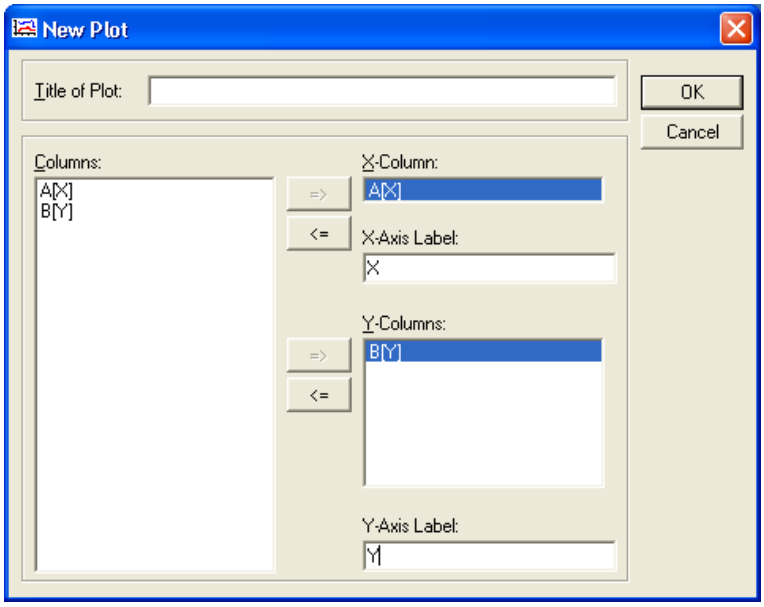
The *Go To Column* and *Go To Row* commands are useful to navigate in a large worksheet. Both commands accept the keyword *last* instead of a column name resp. row number to move to the last column resp. row.

The Worksheet Plot Menu



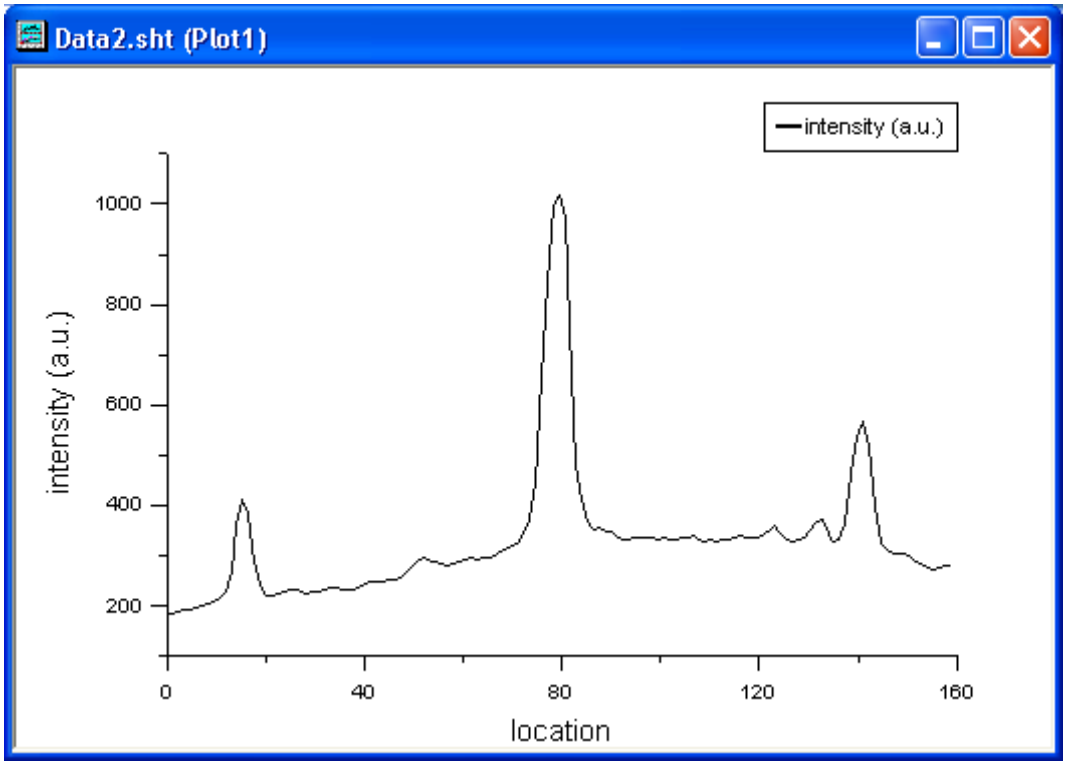
To create a new plot window use one of the commands in the *Plot* menu.

The *Line* command will create a line plot: all data points are connected with a solid line. With the *Scatter* command all data points are plotted as a symbol. To draw a symbol at every data point and connect all data point with a solid line use the *Line + Symbol* command. If you have not selected any column, the following window appears; otherwise the selected data are plotted immediately.



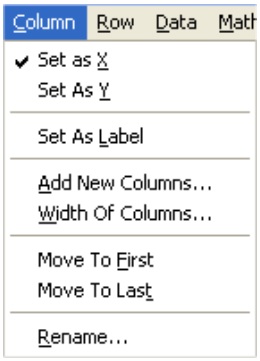
Select any column as X-data and at least one column as Y-data. Enter a title for the plot and axis labels if you want. The data can also be changed later.

Press the *OK* button to plot the data.



You can create multiple plot windows. Pay attention to the changes in the menu line if you make a plot window the active window. See chapter *Plot Module* for more details.

The Worksheet Column Menu



Set as X, Set as Y, Set as Label

Define the column type with the *Set as X*, *Set as Y* or *Set as Label* command. Some functions need X-data for calculation. The nearest X-column left to a specified Y-column is used as a source for X-data.

Hint: *The Row column is always of type X.*

Add New Columns

To add new columns to the worksheet use command *Add New Columns* and enter the number of columns to be added.

Width Of Columns

The width of columns in the window can be changed width the *Width Of Columns* command. Enter the new width in units of characters. A width of 13 characters will guarantee that the complete number is displayed.

Move To First, Move To Last

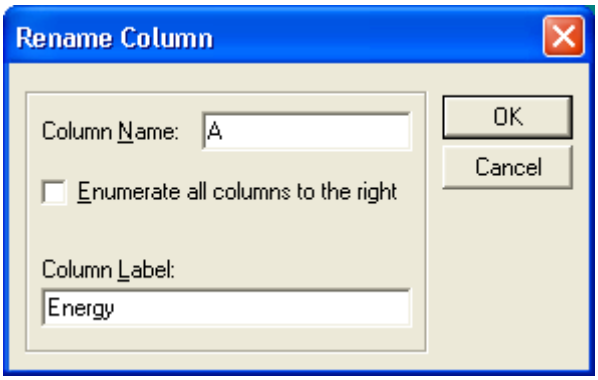
To move the leftmost selected column before the first column use the *Move To First* command. *Move To Last* moves the leftmost selected column behind the last column.

Rename Column

You can edit some column parameter as the column name with the *Rename* command. The *Rename Column* dialog window appears.

Column name

The column name must be unique in the worksheet. Mark the checkbox *Enumerate all columns to the right* to append a number to existing column names beginning with the currently selected column.



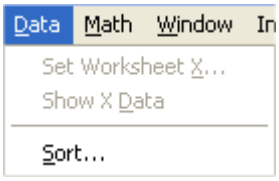
Column Label

Enter any text to this edit field. This text will appear in the column header line and in the legend of a plot.

Write Protection

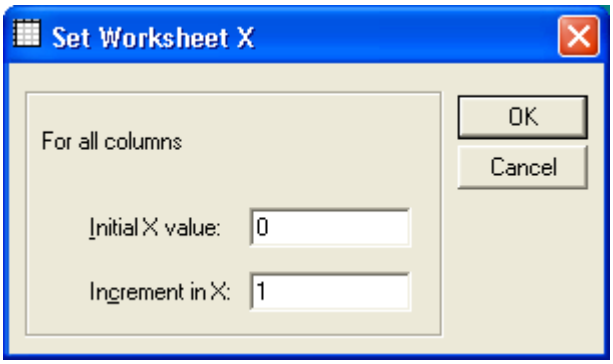
Use this checkbox to guarantee, that the column data remain unchanged during a worksheet session. Worksheet columns crated by any experiment are write protected by default. Normally you should not disable write protection for original experiment data.

The Worksheet Data Menu



Set Worksheet X

If your worksheet does not include a X-column, the program will use the row number as X-data. In some cases you may want to generate your own X-column. Use command *Set Worksheet X* to generate a new X-column.



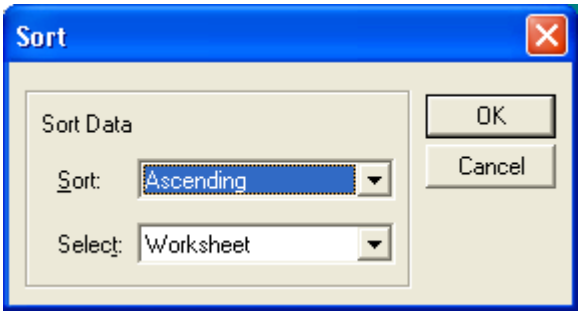
A new column is created but not visible. The value in row 1 of this column contains the *Initial X value*. All following values are incremented by the *Increment in X* value with every row. The formula is:

$$X(row) = X_{init} + (row - 1)X_{inc}$$

Show X Data

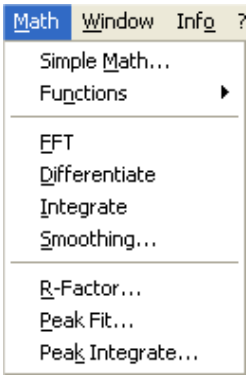
With the command *Show X Data* in the *Data* menu the new created X-column will be displayed.

Sort



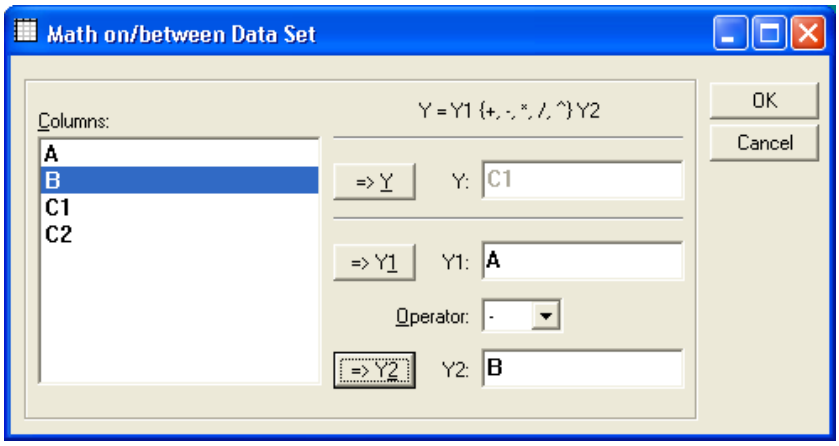
All column data can be sorted in ascending or descending order with the *Sort* command.

The Worksheet Math Menu



Many analysis functions are implemented in the worksheet module. Some of them are only available if exactly 1 column is selected.

Simple Math



Basic operations can be performed with this function. A new window appears.

The basic operation is:

Y an existing column where the result of the operation is written to. If you want to write the result of the operation into a new column, please first insert a new column with the *Insert Column* command in the *Edit* menu. A new column is inserted directly left to the currently selected columns.

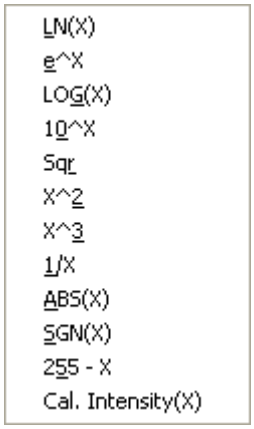
Y1 an existing column or a numeric value.

Operator	**basic operation**
+	Add
-	Subtract
X	Multiply
/	Divide
^	Powered by

If *Operator* is empty, the *Y2* parameter will be ignored.

Y2: an existing column or a numeric value.

Functions



Some functions can be directly applied to a selected column. These functions are available:

LN(X)	natural logarithm, base *e*
e^X	exponential function, base *e*
LOG(X)	decade logarithm, base 10
10^X	10 powered by X
Sqr(X)	square root of X
X^2	quadrate function
X^3	cube function
1/X	reciprocal function
ABS(X)	absolute function
SGN(X)	sign function
255 - X	inverse intensity data

FFT

B_FFT *

	Freq[X]	Real[Y]	Imag[Y]	Ampl[Y]
1	0	0,0353544	0	0,0353544
2	1,677857E-02	-3,962243E-03	2,09546E-03	8,964446E-03
3	3,355714E-02	1,120419E-03	-5,051088E-03	1,034772E-02
4	5,033571E-02	3,115848E-03	4,46984E-03	1,089733E-02
5	6,711428E-02	-6,019653E-03	-4,048051E-04	0,0120665
6	8,389285E-02	3,507621E-03	-4,651322E-03	0,0116513
7	0,1006714	1,779164E-03	5,018855E-03	1,064976E-02
8	0,11745	-4,625358E-03	-8,086398E-04	9,391024E-03
9	0,1342286	2,201001E-03	-2,969858E-03	7,393096E-03
10	0,1510071	1,213006E-03	2,72653E-03	5,968366E-03

This command performs a fast Fourier transformation of the selected column. If the number *N* of data values cannot be represented by

$$N = 2^i, i = 2,3,4,5,...$$

additional data values are calculated by interpolating. The data of the X-column are interpreted as time values. The imaginary part is assumed to be zero. The result of the FFT is written into two new created columns containing the

frequency and amplitude values. These two columns are added behind the last column, because the frequency column is a new X-column and should not affect existing Y-columns.

Differentiate, Integrate

These commands will differentiate resp. integrate the selected column.

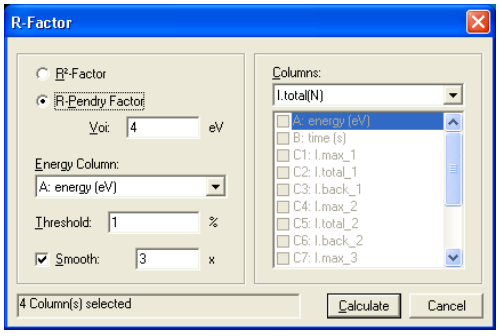
Smoothing

To smooth data values use the *Smoothing* command. You can enter the degree of smoothing. The program uses following formula:

$$Y_{new}(i) = \frac{Y(i-1) + 2Y(i) + Y(i+1)}{4}$$

The first and the last Y value remain unchanged. This calculation will be repeated corresponding to the degree of smoothing.

R-Factor



You can use the Pendry-R-Factor for quantitative comparison of *I*(*E*) spectra:

$$R_{Pendry} = \frac{\sum (Y_1 - Y_2)^2}{\sum (Y_1 + Y_2)^2}$$

$$Y_j = \frac{L_j}{1 + (V_{0i} L_j)^2}, L_j = \frac{1}{I_j} \frac{\partial I_j}{\partial E}, j = 1,2$$

L is the logarithmic derivative of intensity by energy. For very low intensity values *I* the logarithmic derivative can get unphysical singularities. To avoid this, you can define a threshold value as a percentage of the maximum intensity value. All intensity values below the threshold will be ignored for the calculation of R_{Pendry}.

Out of experience of LEED-experiments it is known that the electron suppression limited the steepness of intensity variation by energy. For that intensity peaks can have minimal energy width of 2 * V_{0i} and obtains a maximum gradient of I_{Peak}/V_{0i} (V_{0i} = imaginary part of the inner potential). Unphysical values for the logarithmic derivative *L* are limited with the *Y*-function and 'normal' values are barely altered. The Pendry-*R*-Factor is the medium quadratic derivative between the *Y*-functions of the compared spectra.

The value of R_{Pendry} is zero for identical spectra, 1 for two statistically independent spectra and 2 as a maximum for two anti correlate spectra. Two good matching *I*(*E*) spectra will result in a value of typical 0.1 to 0.3 for the Pendry-*R*-factor. With the comparison of the gradient of the spectra the Pendry-*R*-factor is more sensitive for peak positions than for peak heights.

Another scale to compare different spectres is the *R*-factor:

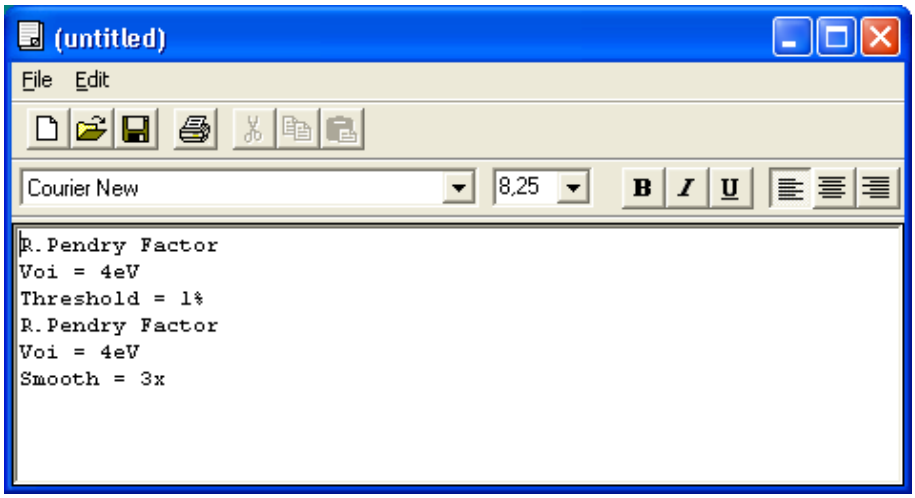
$$R = \frac{\sum (I_1 - I_2)^2}{\sum (I_1 + I_2)^2}$$

This factor can be used to compare two *I*(*t*)-spectra with unknown energy.

You can select more than one column for calculation. In the shown example the calculation will be performed for 4 columns. **EE 2000** automatically looks for a column label *Energy*. If a column with this label is found, it becomes the energy column by default. The program also looks for columns with the label *I.total...* and automatically selects these columns.

Of course you can overwrite the default settings. The default values are: V_{oi} = 4 eV and *threshold* = 1%.

The result of the calculation is written into a new text edit window.



Peak Fit

With **EE 2000** you can simply fit a combination from multiple Gauss and Lorenzian peaks to any column data.

$$y(x) = y_0 + mx + \sum_{i=1}^{n} F_i(x)$$

n 0 number of peaks (*n* = 0, 1, 2, 3,...). $F_i(x)$ is one of the following peak functions:

$$L(x) = \frac{hw^2}{w^2 + 4(x - x_c)^2}, Lorenzian$$

$$G(x) = h\exp\left(-2\frac{(x - x_c)^2}{w^2}\right), Gaussian$$

The coefficients are (the program uses the notation shown in brackets):

x_c = peak position [xc1, xc2, ...]

h = height of peak [h1, h2, ...]

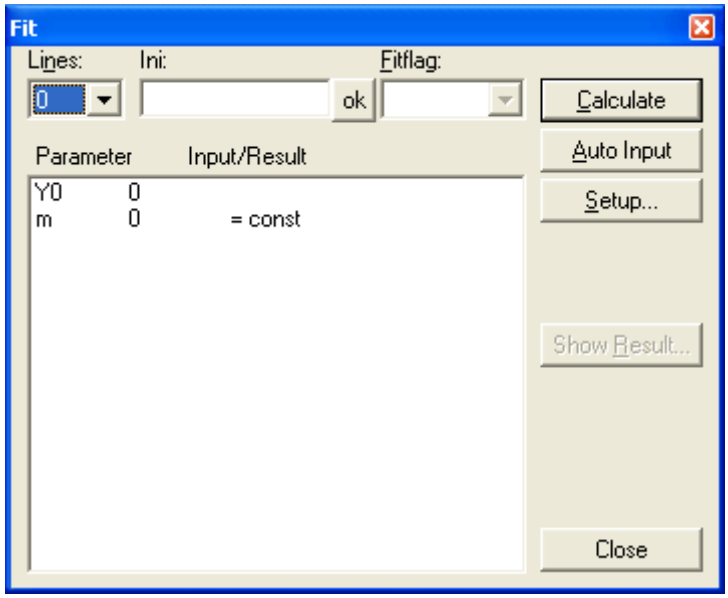
w = width of peak [w1, w2, ...]

y_0 = offset [y0]

m = slope [m]

Executing a peak fit

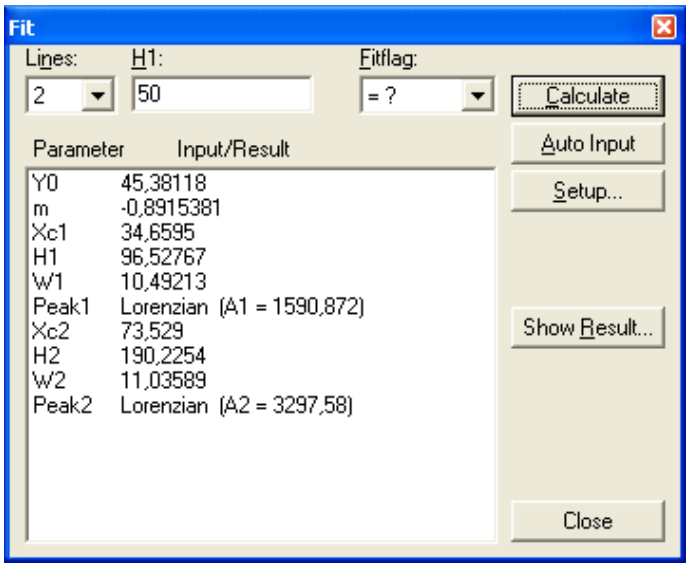
Select a column to fit and choose command *Peak Fit* from the *Math* menu.



A new column will be automatically created to hold the estimated value of the fit. Also a new plot window will appear which shows the original data (black line + symbols) and the estimated values (red line). At least a fit control dialog window appears. In the fit control box you can define and edit fit parameters and start the fit.

If you call the fit module the first time, all fit coefficients are zero (offset, slope, number of peaks).

To start the fit, you must first define the initial coefficient values. This can be done with the *Auto Input* command button in the fit control box.



In this example the software detects two peaks. The shape and width of the peaks are predefined with the *Fit Setup* command.

The list field shows all fit coefficients. Every entry in the list starts with the symbolic name of the coefficient followed by the initial coefficient value. The parameter *A* behind the peak type shows the area under this single peak: $A_i = h_i w_i \frac{\pi}{2}$

for Lorenzian peaks and: $A_i = h_i w_i \sqrt{\frac{\pi}{2}}$ for Gaussian peaks.

You can edit all coefficient data of a selected list entry in the first line in the fit control window. We distinguish three types of coefficients:

1. independent coefficient

The value in the *Input* edit field is the initial value for the fit algorithm. The combo box *FF* (*FF* = *F*it *F*lag) shows = ?.

2. constant

   The fit algorithm will use the value of the *Input* edit field. This value remains unchanged during the fit procedure. The combo box *FF* shows = const.

3. dependent coefficient

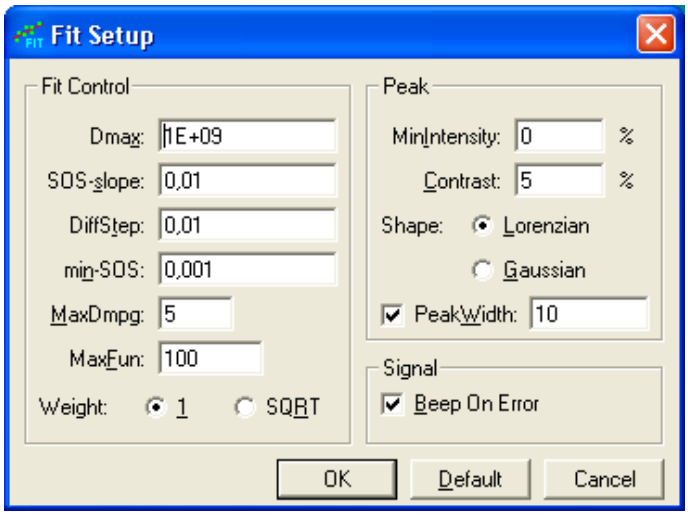
   The value of this coefficient will be set to the value of a different fit coefficient after each iteration step. The link must be done to a fit coefficient of the same type and must have a lower index. The combo box *FF* shows the name of the linked coefficient.

Auto Input

This function detects the number of peaks and calculates the initial fit coefficient values. The *Auto Input* routine uses following procedures:

- original data are filtered with a despecle filter (spikes are removed)
- smoothing the data by averaging over five points
- searching for minima and maxima. Data points less than the *MinIntensity* value (see *Filter Setup*) are ignored. A maximum is detected, if the difference between a local maximum and the next minima is greater than the *Contrast* value (see *Filter Setup*).
- the shape of each peak is defined in the *Filter Setup* window.
- the width of a peak is a predefined constant value or can be estimated by the program (see *Filter Setup*)

Fit Setup



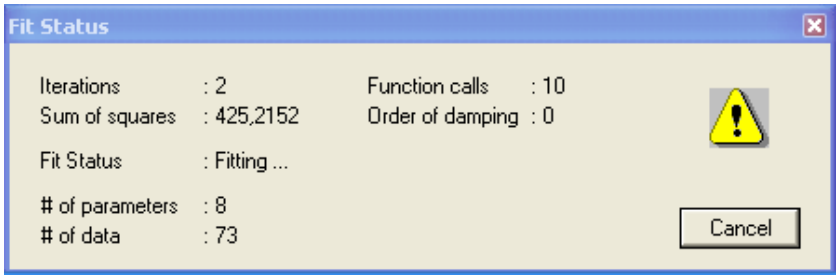
The fit setup window lets you define all important fit parameters.

Parameter	Range	Comment
Dmax	0 < *Dmax* (1E+09)	Search radius of the fit coefficient. The fit algorithm will be stopped with an error message if the difference between current fit coefficient value and initial value is greater than *Dmax*
SOS-slope	0 < *SOS-slope* (0.01)	Convergence criterion for the *S*um *O*f *S*quares. Convergence is achieved, if the relative alteration of *SOS* between two consecutive iterations is less than *SOS-slope*
DiffStep	0 < *DiffStep* (0.01)	Relative change of the fit coefficient for calculating the partial derivative of the fit function
min-SOS	0 < *min-SOS* (0.001)	Convergence criterion for *SOS*. Convergence is achieved, if *SOS* is less than *min-SOS*
maxDmpg	0 < *maxDmpg* (5)	Maximum degree of damping for the fit algorithm
MaxFun	1 < *maxFun* (100)	Maximum number of calls to the fit function. If the number of fit function call becomes greater than *MaxFun*, the fit algorithm stops with an error message
Fit-Wght	1, SQRT(Y) (1)	This parameter controls the weighting of the data points. You can select either 1 no weighting or SQRT(Y) intensity weighting (every data point is weighted with the value of the square root)
MinIntensity	0 # MinIntensity # 100	The *Auto Input* function will ignore all data points less than *MinIntensity*. *MinIntensity* is given in units of percentage of Y_{max} - Y_{min}
Contrast	0 < *Contrast* # 100	This parameters controls the detection of a peak by the *Auto Input* function. A peak is detected, if the difference between a local maximum and the next minima is greater than *Contrast*. *Contrast* is given in units of percentage of Y_{max} - Y_{min}
Shape	Lorenzian, Gaussian	The shape of (all) peaks (used by the *Auto Input* function)
PeakWidth	0 < *PeakWidth*, auto	Initial value for the peak width. In *auto* mode, the *Auto Input* function will estimate the initial peak width from the intensity slope.
Beep On Error		A fit error will be indicated by a beep signal if this check box is marked.

With the *Default* command you can reset all parameters to default values.

Calculating Fit

The fit algorithm is started with the *Calculate* command button in the fit control window. During the calculating process the *Fit Status* window is displayed.



Following status and error messages are possible:

Fitting

The calculating is active.

Fit converged due to slope criteria

The calculation was successfully finished. The relative change of the sum of squares between two iteration steps is less than *SOS-slope*.

Fit converged since sum of squares small enough

The calculation was successfully finished. The sum of squares is less than *min-SOS*

Fit unsuccessful, sum of squares no longer decreases

The calculation was cancelled, because any variation of the fit coefficients does not decrease the sum of squares. Increasing parameter *DiffStep* can solve those problem.

Fit unsuccessful, too many function calls

The calculation was canceled, because the algorithm needs more than *MaxFun* fit function calls to achieve the convergence criterion. The *MaxFun* parameter works as a time out criteron. If a convergence is recognizable in the plot window, you should increase the *MaxFun* value. If you see no convergence, please check your initial fit coefficient values.

Fit unsuccessful, no solution within given convergence radius

At least one of the calculated fit coefficients is outside a certain range (*Dmax*) around the initial value. With *Dmax* you can restrict the range for a fit coefficient to avoid nonsensical values.

Fit unsuccessful, Jacobian matrix is singular

No calculation possible. Check your initial values. There must be more data points than fit coefficients.

Fit unsuccessful, there is no parameter to fit

No calculation possible. The number of fit coefficients is zero or they are declared as constants.

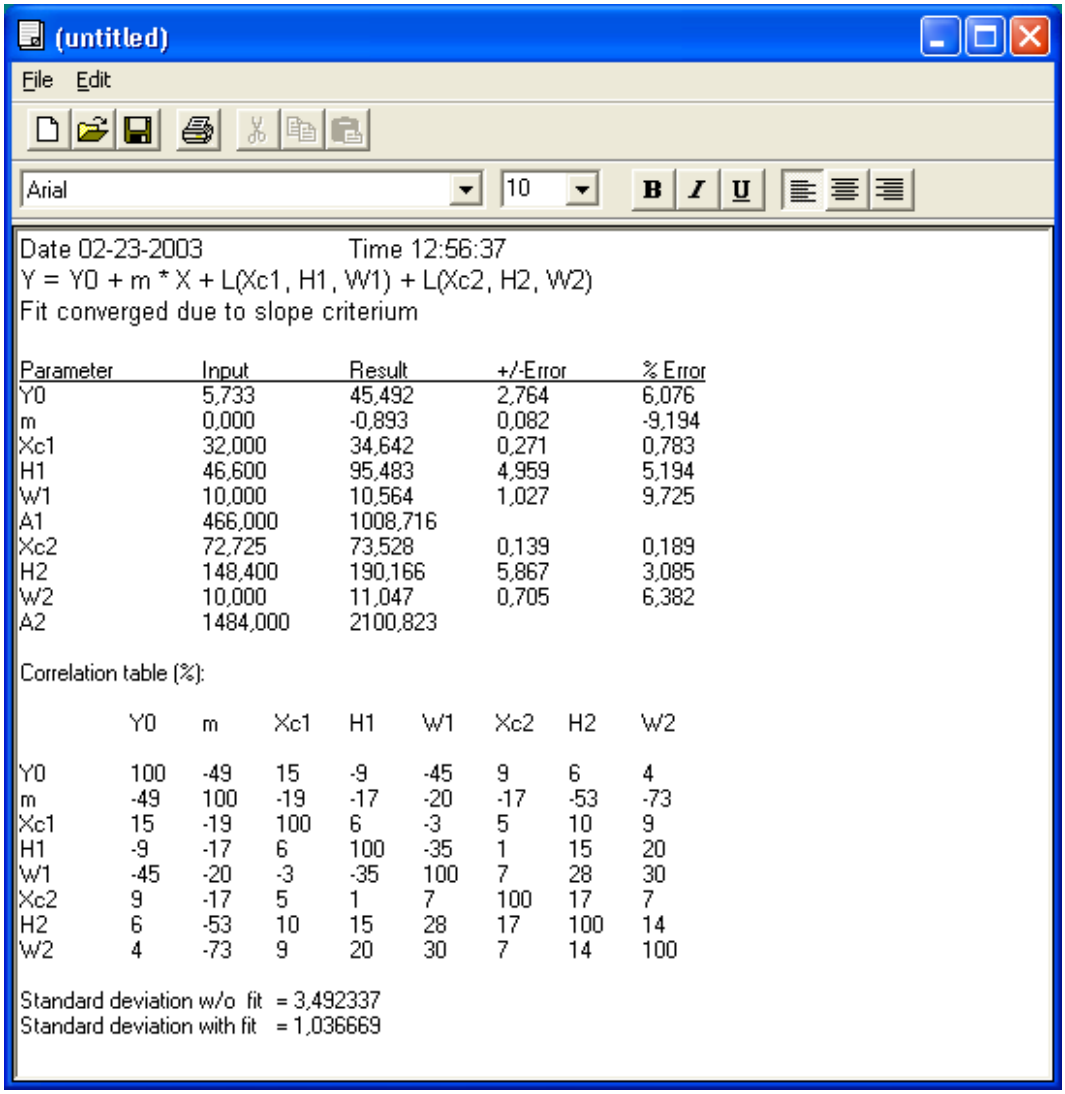
Fit unsuccessful, there is no data to fit

There are no selected data points to fit.

Fit Result

The result of the fit can be shown graphically in the plot window. The calculated fit coefficients are listed in the list field of the fit control window. The estimated fit values are written to the worksheet. By pressing the *Show Result* command button the program creates a summary in a text window. The summary can be saved or printed out or copied to the clipboard within the text edit window.

A summary from the example shown above is listed here:



(untitled)

File Edit

Arial 10 **B** *I* U

Date 02-23-2003 Time 12:56:37
Y = Y0 + m * X + L(Xc1, H1, W1) + L(Xc2, H2, W2)
Fit converged due to slope criterium

Parameter	Input	Result	+/-Error	% Error
Y0	5,733	45,492	2,764	6,076
m	0,000	-0,893	0,082	-9,194
Xc1	32,000	34,642	0,271	0,783
H1	46,600	95,483	4,959	5,194
W1	10,000	10,564	1,027	9,725
A1	466,000	1008,716		
Xc2	72,725	73,528	0,139	0,189
H2	148,400	190,166	5,867	3,085
W2	10,000	11,047	0,705	6,382
A2	1484,000	2100,823		

Correlation table (%):

	Y0	m	Xc1	H1	W1	Xc2	H2	W2
Y0	100	-49	15	-9	-45	9	6	4
m	-49	100	-19	-17	-20	-17	-53	-73
Xc1	15	-19	100	6	-3	5	10	9
H1	-9	-17	6	100	-35	1	15	20
W1	-45	-20	-3	-35	100	7	28	30
Xc2	9	-17	5	1	7	100	17	7
H2	6	-53	10	15	28	17	100	14
W2	4	-73	9	20	30	7	14	100

Standard deviation w/o fit = 3,492337
Standard deviation with fit = 1,036669

Peak Integrate

This function calculates the area under a curve between two selectable data points.

1. Select a single data column for this function
2. Click on command *Peak Integrate* in the worksheet *Math* menu

A new plot window is created, showing the selected column data as a line plot. The *Result* window is also opened, showing an empty text box. You can recognize the *Peak Integrate* mode by the pressed toolbar button:

The Mouse cursor is changed to a red cross.

3. Select the integration range

- Move the mouse to the starting point of the curve, from where the integration should begin and clock and hold the left mouse button. The program will calculate the data point (*Row1*, *X1*, *Y1*), which is next to the mouse position. A red line is shown as a guideline.
- Drag the mouse to the end of the integration range and release the mouse button. The program again calculates the next data point (*Row2*, *X2*, *Y2*)

The area A_0 between the curve and the X-axis is calculated with the formula:

$$A_0 = \sum_{Row=Row_1}^{Row_2-1} \frac{1}{2} \frac{Y_{Row} + Y_{Row+1}}{X_{Row+1} - X_{Row}}$$

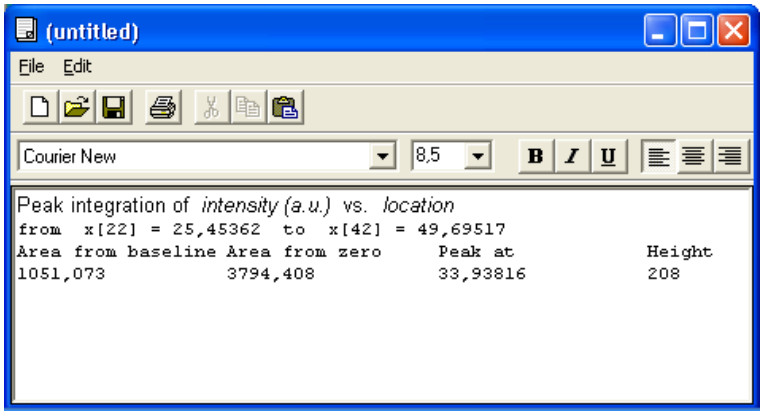
The area *A* between the curve and the baseline from (*X1*, *Y1*) to (*X2*, *Y2*) - is calculated with formula:

$$A = \sum_{Row=Row_1}^{Row_2-1} \frac{1}{2} \frac{Y_{Row} + Y_{Row+1}}{X_{Row+1} - X_{Row}} - \frac{1}{2} \frac{Y_{Row_1} + Y_{Row_2}}{X_{Row_2} - X_{Row_1}}$$

The value of area *A* is written into the data column *Area* next to the right side of the source data column. If the *Area* column does not exist, the program will create this column. This column is automatically set as a *Label* column. When a *Label* column is plotted, the program uses the left data column - which must be set as a *Y* column - and the *X* column to calculate the position of the label. The contents of a *Label* column is interpreted as a text rather than a (possible valid) number.

The *Area* column is plotted into the plot window.

A detailed description of the performed peak integration is written into the *Result* window.



4. Continue with step 3 for additional calculations.

5. If you are finished with calculations, press the

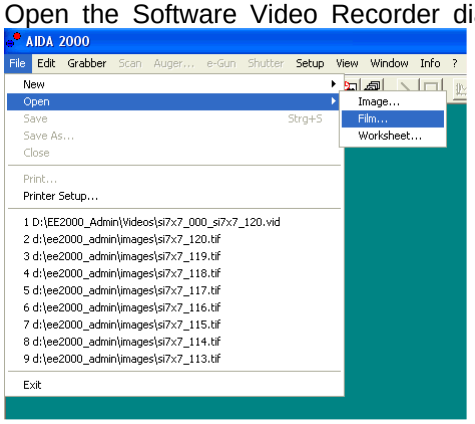
 button.

Hint: *It is possible to invoke the Peak Integrate function directly from a plot window by clicking on the Peak Integrate button in the toolbar. The info line shows the name of the source data column. The source data column is the leftmost selected column in the worksheet associated with the plot window. If no column is selected or the selected column is not plotted within the active plot window, the program will use the data column of the first plotted curve.*

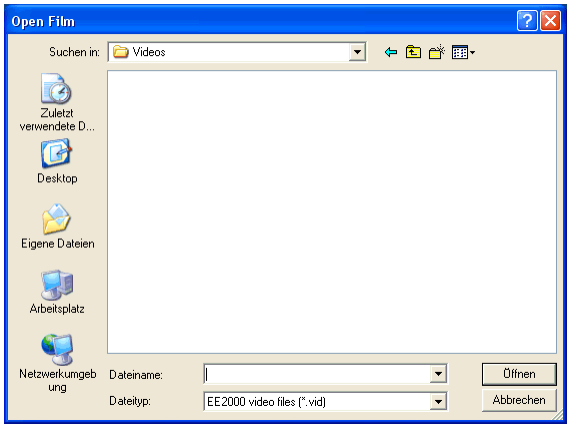
IV. Creating a video file from a sequence of single images

With EE2000 you are able to create a video file (“Film”) from a sequence of single images. To do this, follow these steps:

Open the Software Video Recorder dialog box by clicking click on the *Open Film* command in the *File* menu

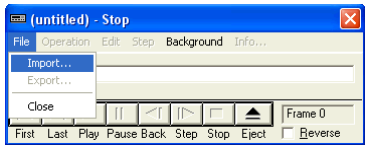


A file open box appears. Close this dialog box without selecting a file by clicking on the *Cancel* (*Abbrechen*) command button.

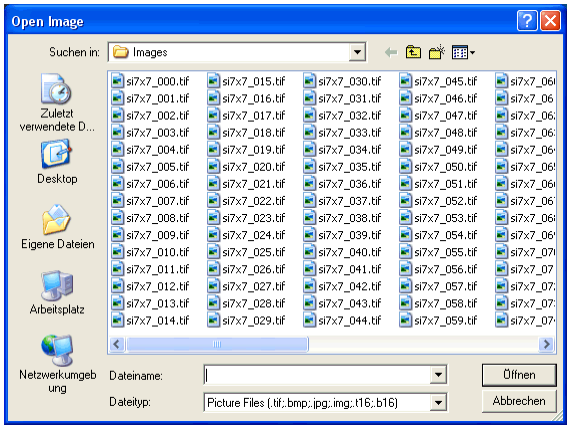


The Software Video Recorder window is displayed without loading a file.

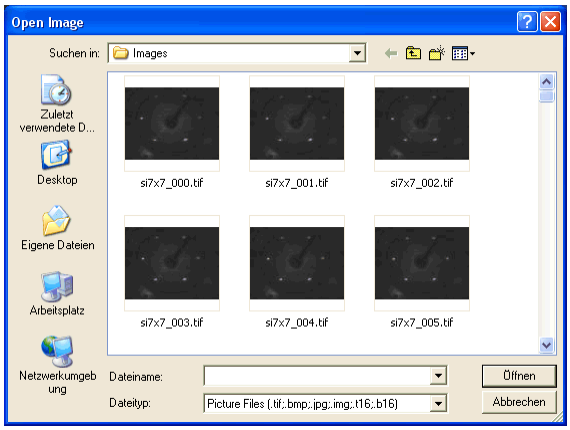
From the *File* menu in the Software Video Recorder call the *Import* command.



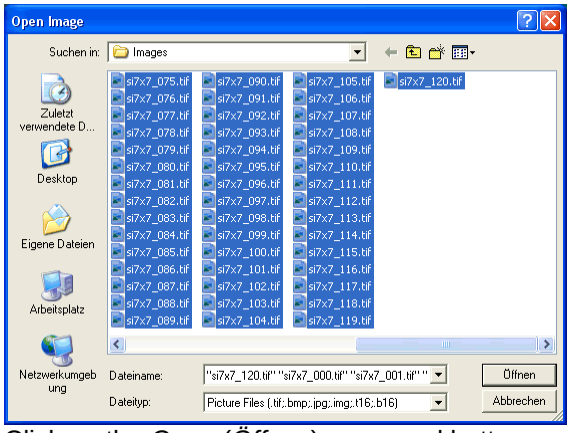
A file open box for selecting an image files is shown.



In this example you see image files, which were exported from the sample video file coming with this software. You can also list the files by displaying a thumb nail of every image in the file open box.



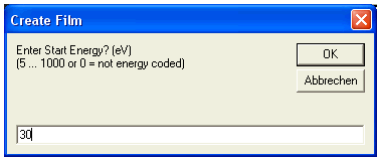
Select all image files, which you want to have in the video file. In the example select from file si7x7_000.tif to si77x7_120.tif as shown in the next figure.



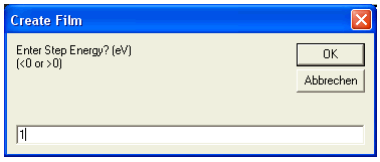
Click on the *Open* (*Öffnen*) command button.

In this example, the image sequence was recorded with a starting energy value of 30eV. The energy value was increased by 1eV with every recorded image. The image sequence can be saved by adding the energy information into the video file (only possible when using the .vid file format).

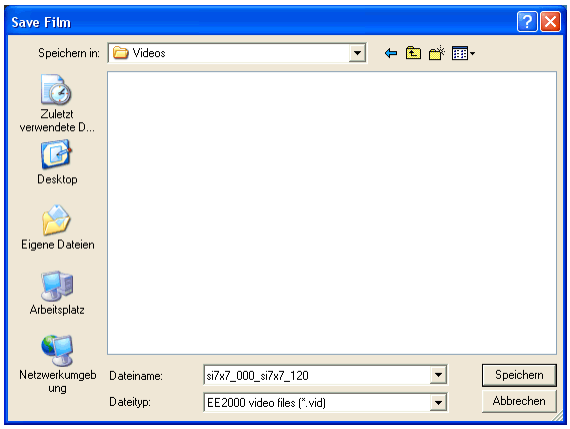
Enter the energy vale of the first image and click on *OK*:



Enter the energy step value and click on *OK*:

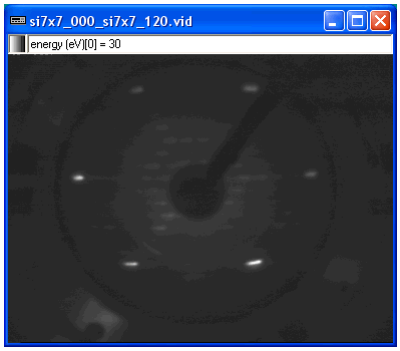


In the next safe file box you must enter the file name of the video file. Use the *.vid file format, if you want to add the energy information to the video file.

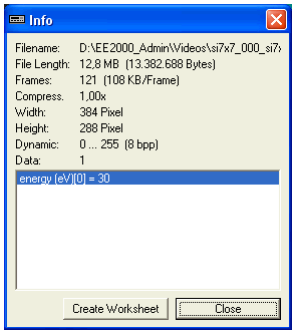


Click on *Save* (*Speichern*).

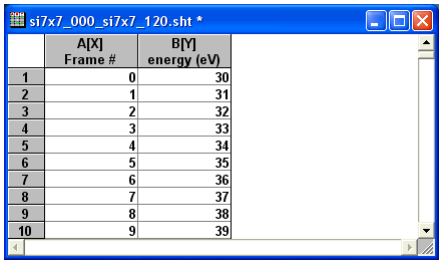
The EE2000 software loads one image file after another and save the image data to the video file. Note, that the image sequence is sorted alphabetically. So, image file “pic_3.tif” is loaded after image file “pic_10.tif”. Keep this in mind and use leading zeros for small image numbers: “pic_003.tif” and “pic_010.tif”. Depending on the image size and number of image files this process can take some time. When finished, the created video file is opened and the first image is shown.



With the Info menu command you can get some information regarding the current image of the vide file.



From this dialog box you can create a work sheet with all the data information additionally saved in the video file:



si7x7_000_si7x7_120.sht *

	A[X] Frame #	B[Y] energy (eV)
1	0	30
2	1	31
3	2	32
4	3	33
5	4	34
6	5	35
7	6	36
8	7	37
9	8	38
10	9	39

With a video file open, you can do experiments (like measuring I(V) curves), as if the image data came from the grabber and the energy value were measured with an ADC-interface board. Note: if a video file is opened, the grabber is not used as an image source for experiments. Instead the video file is the image source.

V. Das Stresscounter Modul (Riss 2000)

Das Stresscounter Modul generiert ein Trigger Signal in Abhängigkeit des gemessenen Spannungsverlaufs einer Analogspannung. Üblicherweise ist die Analogspannung proportional zur mechanischen Zugspannung (*Stress*), die auf die Probe einwirkt. Da die mechanische Belastung auf die Probe zyklisch wiederholt wird, ist das Stresscounter Modul auch in der Lage, die Zahl der Belastungszyklen zu registrieren.

Das Stresscounter Modul ist ein separates Programm, so dass die Belastungszyklen auch dann registriert werden, wenn das Bilderfassungsprogramm **EE 2000** gerade nicht läuft. Der Datenaustausch mit **EE 2000** erfolgt über DDE (*D*ynamic *D*ata *E*xchange).

Installation

Falls **EE 2000** noch nicht installiert ist, tun Sie dies jetzt.

Kopieren Sie alle Dateien aus dem Stresscounter Verzeichnis der **EE 2000** CD in das Verzeichnis von **EE 2000** (üblicherweise C:\Programme\Ee2000\

Installieren Sie den Treiber für die mitgelieferte A/D-Wandlerkarte. (Siehe die Datei ReadMe.txt auf der Treiberdiskette)

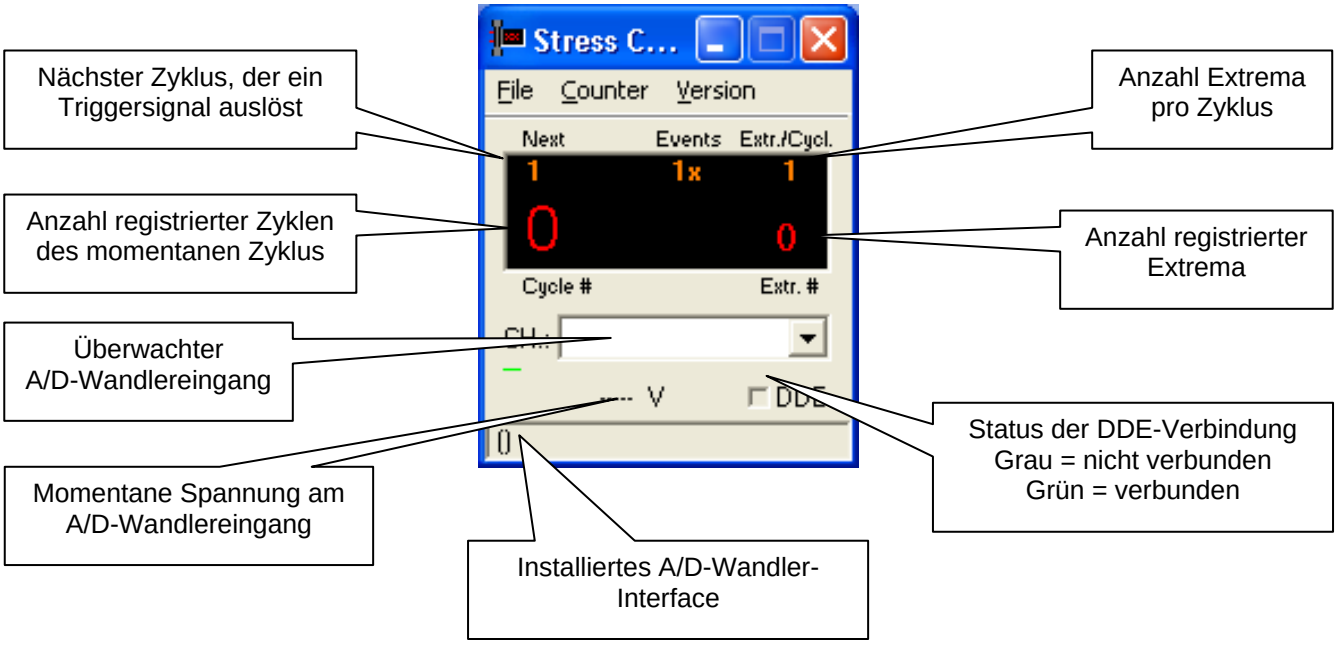
Starten Sie das Programm **EE 2000**

Führen Sie den Befehl *A/D-Converter* im Menü *Setup* aus und wählen Sie als A/D-Interface *ADCFile*.

Klicken Sie auf *OK*.

Beenden Sie **EE 2000** und starten Sie **EE 2000** erneut.

Starten Sie jetzt das Programm StressCounter.exe. Sie sehen das Programmfenster von StressCounter.exe:



Rufen Sie den Befehl *Setup* im Menü *File* auf:

In der angezeigten Dialogbox wählen Sie Ihr Interfacemodell aus und klicken auf *Accept*. In der Statuszeile wird der Name des Interfaces angezeigt. Erscheint der Name in Klammern, so konnte das Interface wegen eines Fehlers nicht initialisiert werden.

Wählen Sie jetzt den A/D-Wandlereingang, an dem die zu messende Spannung anliegt. Klicken Sie hierzu auf die Combo-Auswahlbox und wählen den entsprechenden Kanal.

Die momentan an dem ausgewählten Kanal gemessene Analogspannung wird unterhalb der Combo-Auswahlbox angezeigt.

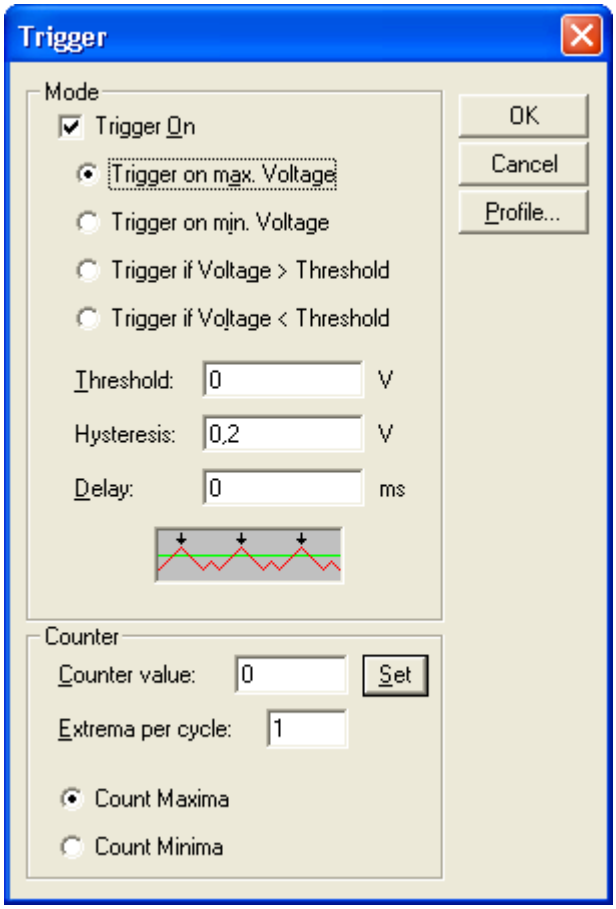
Hinweis: *Die Setup-Funktionen sind nur verfügbar, wenn keine DDE-Verbindung vorhanden ist. Beenden Sie also ggfls. das Programm* **EE 2000**. Bei bestehender DDE-Verbindung kann das Programm nicht beendet werden.

Beenden Sie nun *StressCounter.exe* damit die Einstellungen gespeichert werden.

StressCounter.exe muss manuell zusätzlich zu **EE 2000** gestartet werden. Durch den Start von **EE 2000** wird StressCounter.exe nicht automatisch gestartet.

Triggerung

Mit dem Befehl *Trigger* im Menü *Counter* wird nachstehende Dialogbox angezeigt.



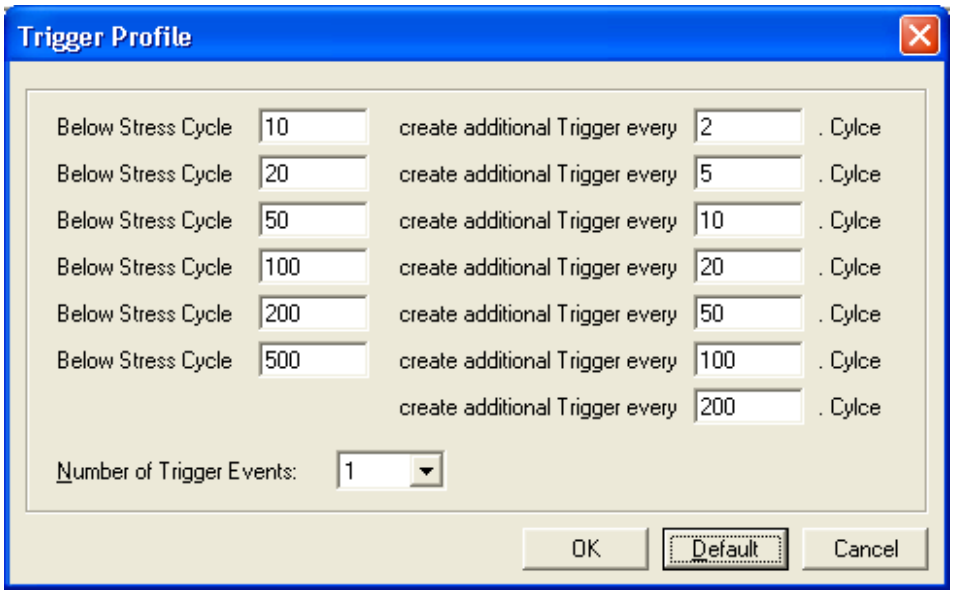
Die Stresscounter-Software erkennt einen Zyklus an Hand von Extrema im zeitabhängigen Verlauf der gemessenen Analogspannung. Sie können auf Maxima oder auf Minima in der Analogspannung triggern. Ein Extremum wird als solches jedoch nur dann erkannt, wenn der Analogspannungswert oberhalb (bei *Trigger on max. voltage*) bzw. unterhalb (bei *Trigger on min. voltage*) des *Threshold* Spannungswertes liegt.

Ein Zyklus kann mehrere gleichartige Extrema enthalten. Damit der Zykluszähler nicht falsch zählt (nämlich zu schnell), können Sie im Eingabefeld *Extrema per cycle* die Anzahl der Extrema pro Zyklus angeben. Dieser Zahlenwert erscheint in der rechten oberen Ecke des Displays.

Der Zykluszähler kann jederzeit auf einen beliebigen (positiven) Wert gesetzt werden. Geben Sie hierzu den neuen Zählerwert im Eingabefeld *Counter value* ein und drücken Sie *Set*. Der Zählerwert wird nicht durch drücken von *OK* gesetzt. Der augenblickliche Zählerwert wird links im Display in großen Zahlen angegeben. Die bereits registrierten Extrema des folgenden Zyklus werden rechts davon im Display angezeigt. Wird der Zählerwert neu gesetzt, so berechnet StressCounter.exe automatisch die Zyklusnummer, bei das nächste Triggersignal ausgelöst wird. Es werden hierzu die Einstellungen unter *Profile* benutzt.

Profile

Mit dem Befehl *Profile* im Dialog *Trigger* wird nachstehende Dialogbox angezeigt.



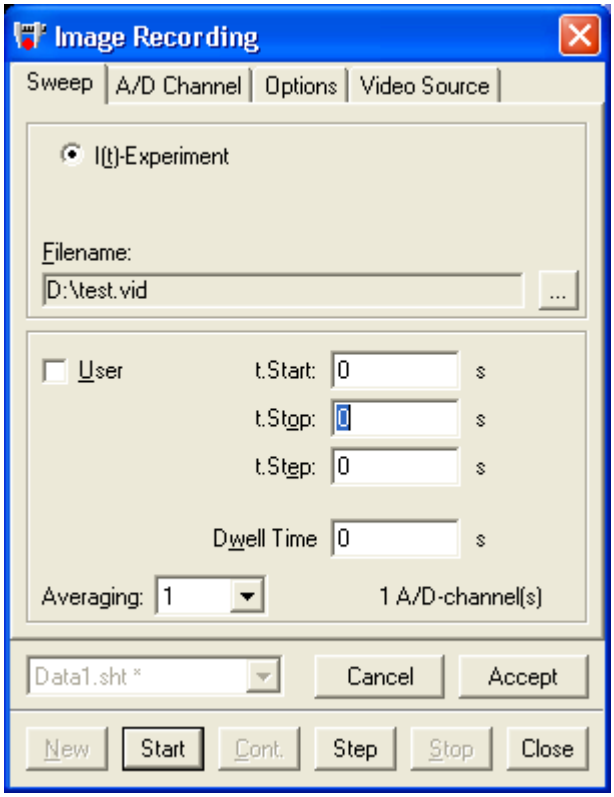
Um die Zahl der Triggersignale vor allem bei lang andauernden Experimenten gering zu halten, können Sie in dieser Dialogbox definieren, in welchen Abständen (ausgedrückt in Anzahl Zyklen) ein Triggersignal erzeugt werden soll. Mit *Default* wird ein (fast) logarithmischer Abstand zwischen den Triggersignalen definiert.

Tipps bei der Aufzeichnung von Risswachstum mit der EE2000

Die folgende Beschreibung geht davon aus, dass die EE2000 Software nebst Hardware installiert sind.

Die Aufzeichnung eines Risswachstumsexperiments erfolgt mit der Funktion *Image Recorder* im Menü *Scan*.

Einstellungen auf der Registerkarte *Sweep*:



Geben Sie einen Dateinamen an. Wählen Sie ein Verzeichnis auf einem Laufwerk mit genügend Speicherkapazität.

Deaktivieren Sie das *User* Kontrollkästchen.

Setzen Sie *t.Start* auf 0 s. (Es sei denn, Sie wollen das Experiment verzögert starten.)

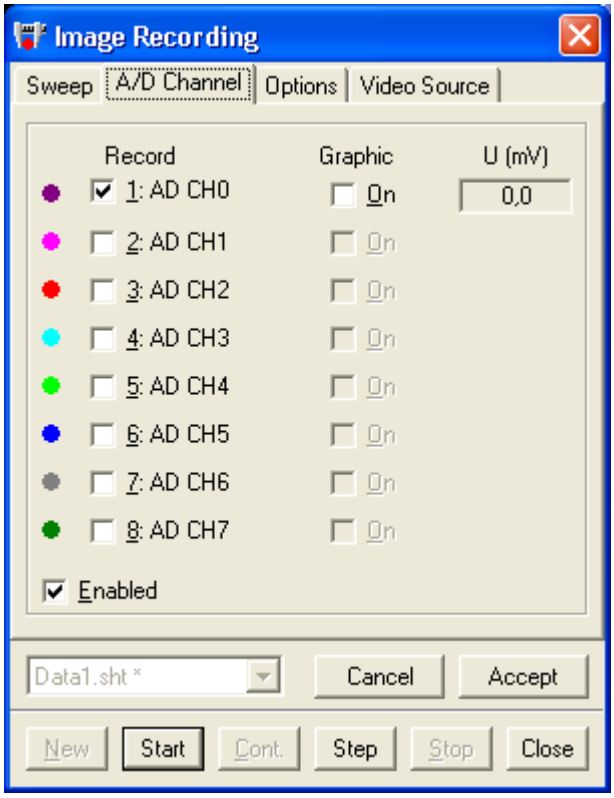
Setzen Sie *t.Stop* auf 0 s, wenn Sie das Experiment beliebig lange laufen lassen wollen (Abbruch erfolgt dann nur manuell oder bei einem Fehler.), oder geben Sie die Laufzeit des Experiments in Sekunden an. (1 Tag = 86400 s).

Setzen Sie *t.Step* auf 0 s.

Setzen Sie *Dwell Time* auf 0 s.

Setzen Sie *Averaging* auf 1.

Einstellungen auf der Registerkarte *A/D Channel*:

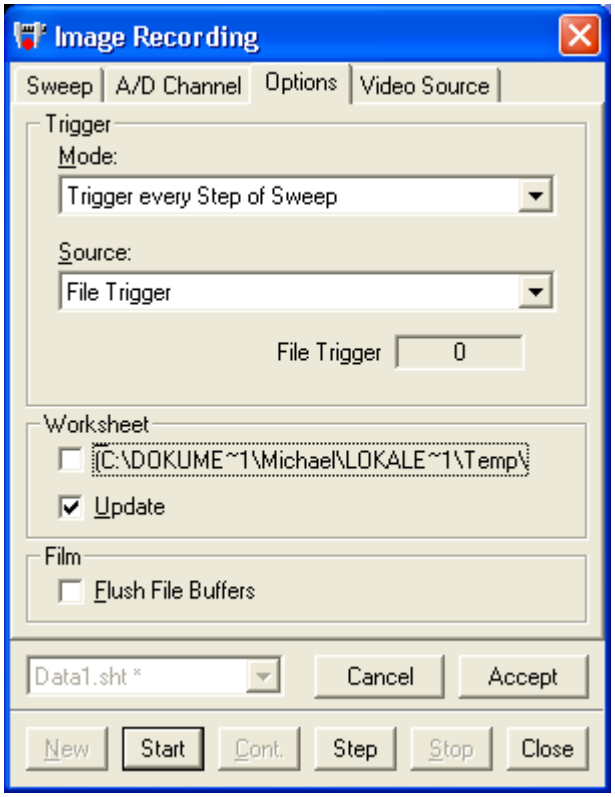


Aktivieren Sie das 1. Kontrollkästchen unter *Record*. (Die Nummer des aktuellen Zyklus wird wie eine Analogspannung behandelt.)

Deaktivieren Sie das Kontrollkästchen unter *Graphic*

Aktivieren Sie das Kontrollkästchen *Enabled*.

Einstellungen auf der Registerkarte *Options*:

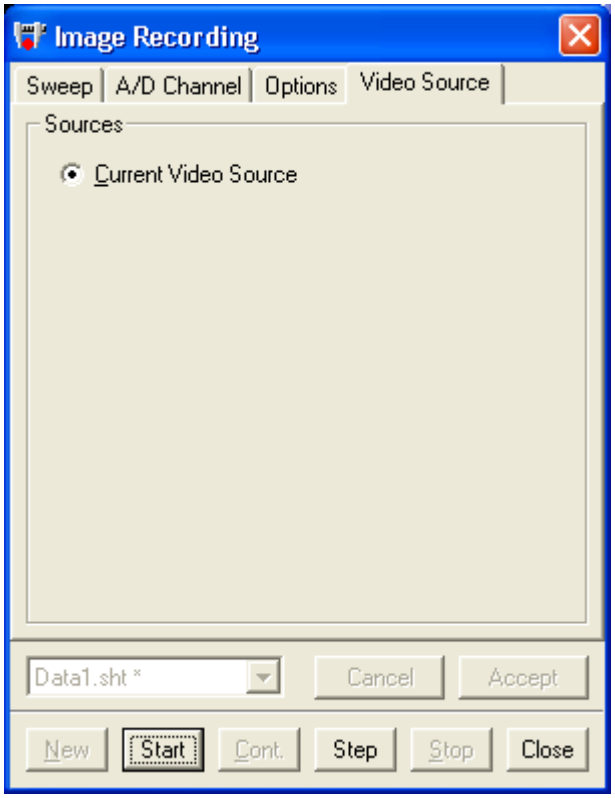


Wählen Sie als Trigger Mode: *Trigger every Step of Sweep*.

Wählen Sie als Trigger Source: *File Trigger*.

Markieren Sie das Kontrollkästchen *Update*.

Einstellungen auf der Registerkarte *Video Source*:



Wählen Sie die Videoquellen, die Sie aufzeichnen wollen. Diese Registerkarte ist abhängig vom verwendeten Video Grabber. Falls der Framegrabber nur einen Videoeingang hat oder der Treiber eine programmgesteuerte Umschaltung nicht unterstützt, erscheint nur die Optionsschaltfläche *Current Video Source*.

Stehen mehrere Videoeingänge zur Verfügung (2 oder 3), so können Sie wählen, ob nur der momentan aktive Videoeingang als Videoquelle dient, oder ob nach jedem Triggersignal zu einem anderen Videoeingang umgeschaltet werden soll (z.B. Betrieb von 2 Kameras).

Klicken Sie zuletzt auf *Accept*.

Bevor Sie das Experiment mit *Start* starten, überprüfen Sie die Einstellungen in StressCounter.exe.