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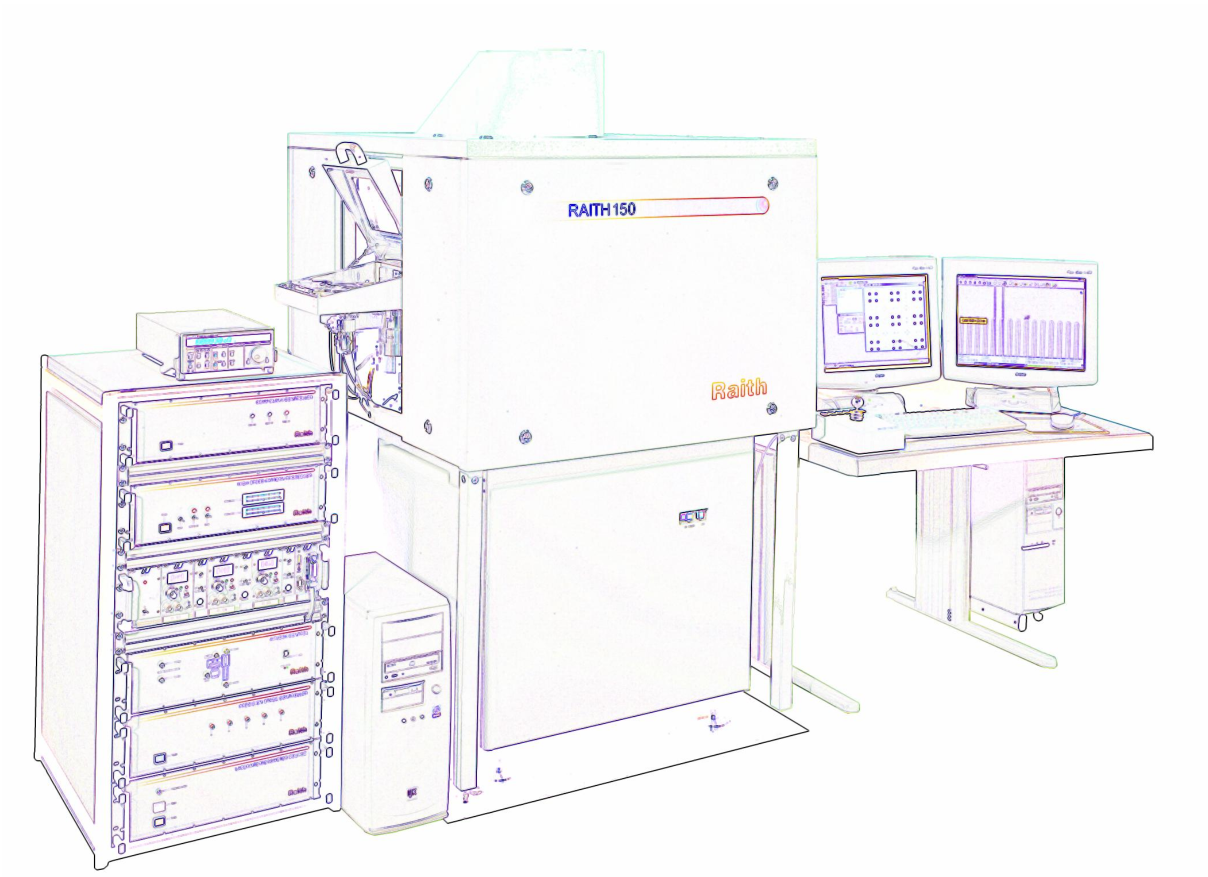

Operation Manual

Height Sensing

Product:	RAITH150 Sample holder
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1 Laser Height Sensing

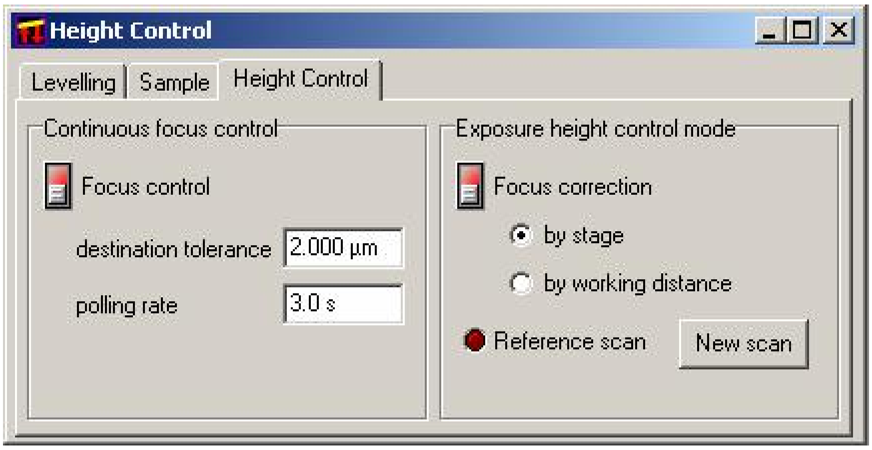
1.1 Controlling height during exposure

The exposure height control mode corrects the working distance during an exposure in order to keep the electron beam in focus. At a single field exposure this correction will be executed after driving to the destination directly before starting the exposure. At a multi field exposure this correction will be executed in front of every stitch field.

When using the exposure height control mode the working distance must to be in the range of W = 6.5 mm to W = 8.5 mm.

STEP 1 ► Open the Height Control window and switch to the Height Control tab and choose Focus correction.

Figure 1 Dialog Height Control, tab Height Control.

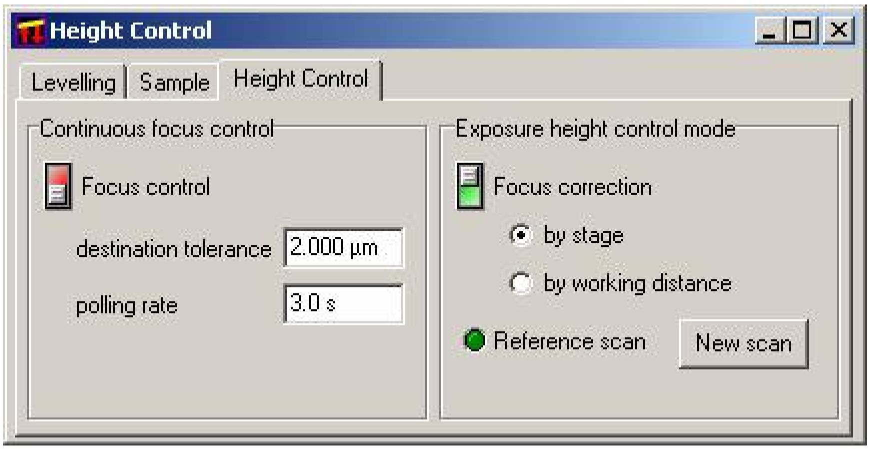


STEP 2 ► Select the desired mode. When using by stage the system will adjust the Z level of the stage. When using by working distance the system will adjust the working distance of the SEM.

STEP 3 ► Drive nearby a characteristic exposure position and open the CCD control window and check the peak detection. If necessary active the automatic peak control and adjust the threshold (see section 1.5).

STEP 4 ► Go back to the Height Control tab and start the exposure height control mode by using the switch Focus correction. Green indicates an enabled exposure height control mode.

Figure 2 Dialog Height Control controlling the height during an exposure.



STEP 5 ► Focus the electron beam at the desired height. Take care not to exposure any position where an exposure will be placed later on.

STEP 6 ► Take a reference scan by pressing the button New Scan. After that the corresponding LED should be lighted to indicate an active reference scan.

STEP 7 ► Start the exposure, if every necessary alignment is done.

1.2 Using continuous focus correction

The continuous focus correction adjusts the working distance during the operation in order to stay in focus.

When using the continuous focus correction mode the working distance should be in the range of W = 6.5 mm to W = 8.5 mm.

STEP 1 ► Open the Height Control window and switch to the Height Control tab.

STEP 2 ► Adjust the destination tolerance and the polling rate as desired.

A selected polling rate of 3 seconds results in a focus correction after every 3 seconds. Minimum time period and increment is 1 second.

A destination tolerance of 2.0 µm results in a focus correction after a W deviation larger than 2 µm. Minimum destination tolerance and increment is 1 µm.

STEP 3 ► Focus the electron beam anywhere on your sample. Take care the working distance of the microscope is in the range of the CCD calibration (see section 1.5).

STEP 4 ► Check the peak detection at the CCD Control window.

STEP 5 ►

Go back to the Height Control tab and start the continuous focus control by using the switch. Green indicates an enabled continuous focus control.

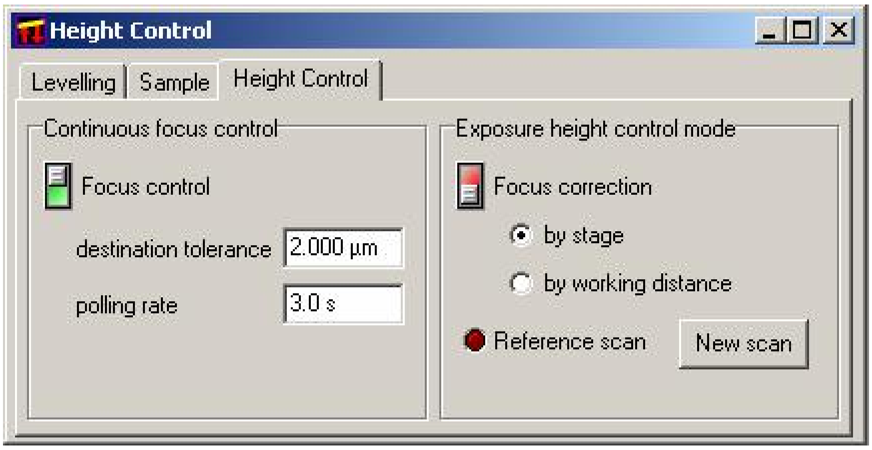


Figure 3 Dialog Height Control controlling the height continuously.

From now the focus of the microscope will be adjusted continuously during any operation like stage movement via joystick. During an exposure the continuous focus correction will be automatically disabled.

1.3 Leveling the sample surface

For flat surfaces like a mask or wafer the working distance may vary with the XY coordinates of the stage due to a non parallelism between the surface of the sample and the linear XY bearings. The leveling procedure gives the possibility to make the sample surface parallel to the XY movement. This method is realized by the fine positioning of three vertical piezos, which are situated under the sample holder.

HINT

This procedure is only useful in case of real flat surfaces like a mask or a high quality wafer on an electrostatic chuck. Otherwise the calculation of the sample surface can differ significantly from the actually sample surface.

STEP 1 ►

Open the Height Control window and choose the Sample tab.

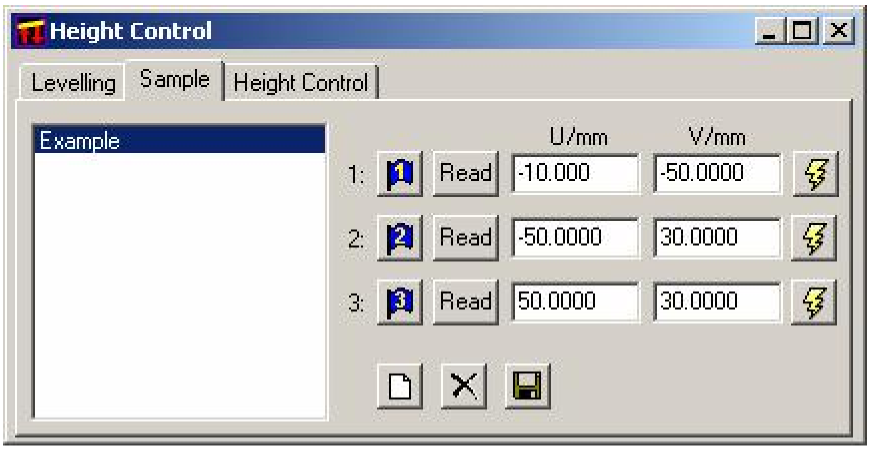
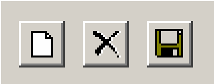


Figure 4 Dialog Height Control, tab Sample.

STEP 2 ►

Define three different points on your sample, which should be used for the leveling procedure. To create a new point triple press the new button.



Type a name for this point triple by using a significant name for your sample or application.

Enter the position of three points where to leveling the sample. There are three possibilities to enter these values.

- Drag and Drop one blue flag in any UV-window, e.g. an image, GDSII viewer or editor.
- Drive to the considering position and read the actual UV coordinates by pressing the Read button.
- Enter the UV coordinates in the corresponding input fields.

The higher the distance between the three user-defined points, the higher is the accuracy of the leveling procedure. Further it is recommended to choose positions without high topography to guaranty a high quality of the peak detection.

Save these settings by pressing corresponding button.

STEP 3 ►

Change to Leveling tab.

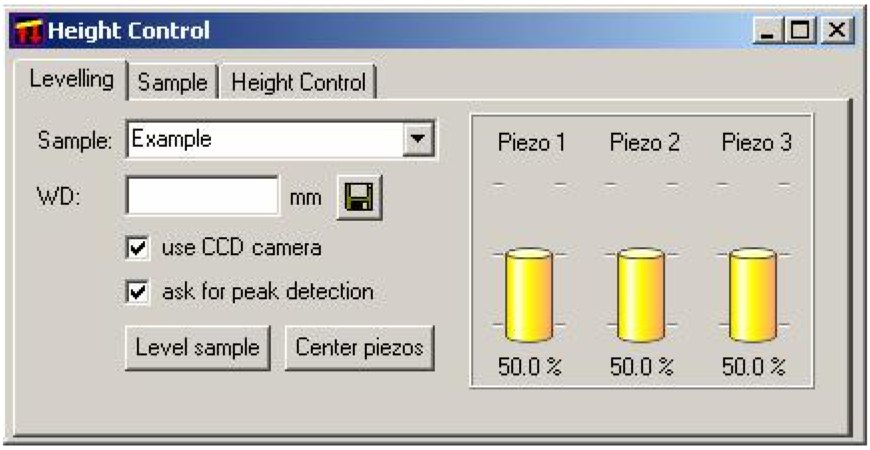


Figure 5 Dialog Height Control, tab Levelling.

STEP 4 ►

Select your point triple at Sample.

STEP 5 ►

Enter the working distance you want to use after the leveling procedure. After finishing the leveling procedure the stage will automatically adjust the Z axis. If no working distance is selected, the Z axis will not move after the leveling procedure.

By pressing the Save button the entered working distance will be stored to the corresponding point triple.

STEP 6 ► Make sure the option use CCD camera is enabled. Otherwise the operator will be asked to focus the microscope in order to read out the working distance instead of getting the height information form the laser height sensing.

STEP 7 ► If it is not sure whether the CCD peak detection will work reliable at the three leveling point, enable ask for peak detection. If it is safe leave it disabled and the leveling procedure will run without any further user interaction.

STEP 8 ► Press Level sample and the leveling procedure will start.

1.4 Calibrating the piezos

Three piezos are mounted on the LASER stage and provide the only connection between the stage and the sample holder. Each piezo has a travel range of 100µm. The piezo calibration procedure can be used to recalibrate the piezos, which means a redefinition of the relationship between the control voltage and the resulting piezo movement. A repetition is recommended every six month or in case of misalignment.

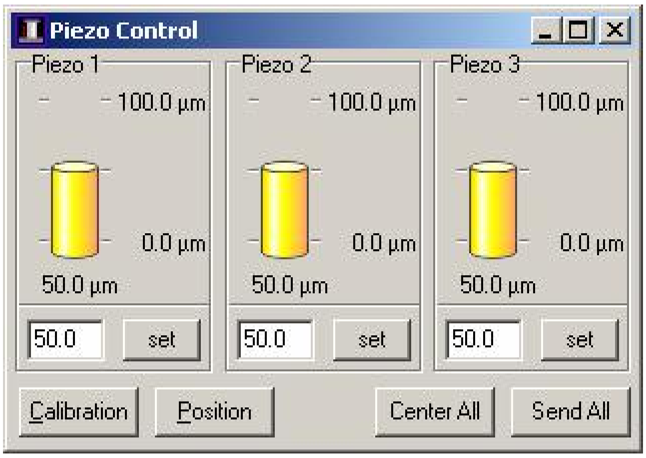
HINT This calibration procedure is only available for the supervisor and should only be done by an advanced user.

HINT Using the height sensing, this calibration procedure should only be carried out with valid calibration data for the height sensing camera. Further the peak detection should have been checked.

STEP 1 ► The piezo calibration procedure needs a flat and reflective surface above each piezo position. For that load 6 inch wafer or a 6 inch mask for example.

Open the Piezo Control window.

Figure 6 Dialog Piezo Control.

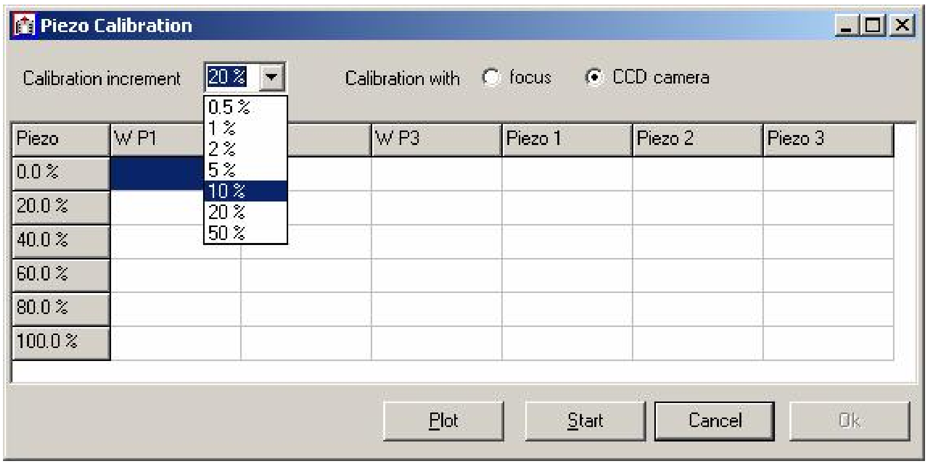


To check that the correct position of the piezo are stored press Position in the Piezo Control window. By pressing the flash buttons the stage will drive to the corresponding position.

STEP 2 ► Choose the Calibration button.

STEP 3 ► Define the Calibration increment. The relationship of the piezo control voltage and the piezo elongation is not linear. Therefore a higher amount of calibration points increases the accuracy of this calibration. At least an increment in the range of 10% is recommended.

Figure 7 Dialog Piezo Calibration.



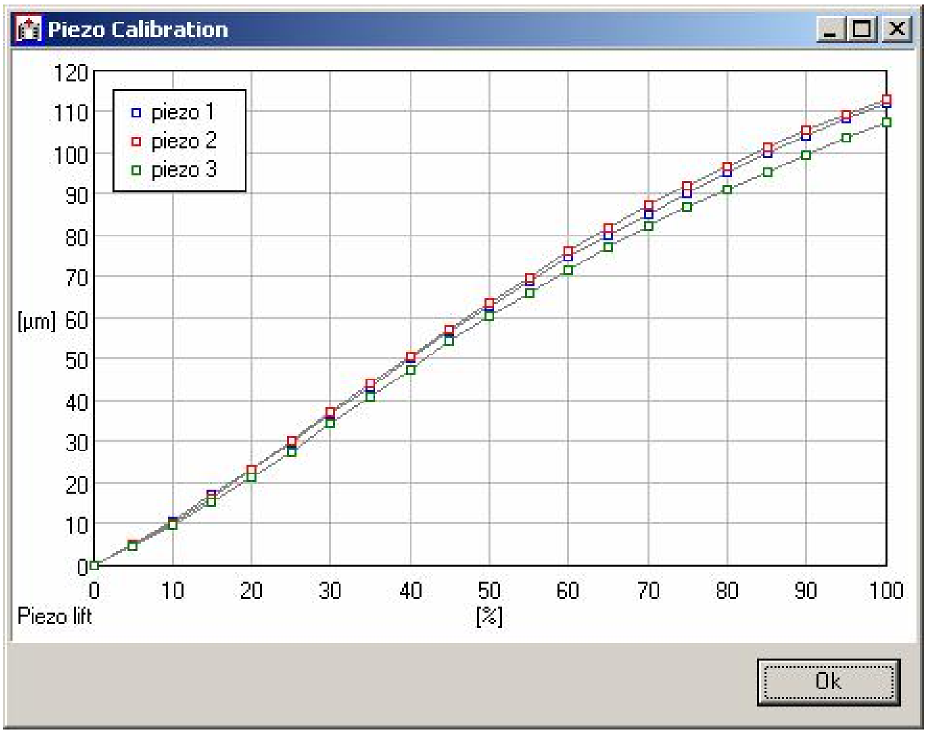
STEP 4 ► Choose the CCD camera calibration mode. During the calibration procedure the piezo movement will be detected by the automated height sensing.

STEP 5 ► Press the Start button. The calibration procedure is running fully automatically.

STEP 6 ► At the end of piezo calibration procedure press the Plot button to check the result.

The piezo elongation as a function of the piezo control voltage will be displayed. The maximum elongation of each piezo should be in the range of 105µm +/- 10%. Observe the smoothness of the cures. If there are significant jumps or peaks repeat the calibration procedure.

Figure 8 Piezo Calibration plot showing the calibration of three piezos.



Close the piezo calibration plot.

STEP 7 ► Press the OK button at the Piezo Calibration window to store the calibration data. By pressing the Cancel button the calibration will be ignored.

1.5 Calibrating the camera

The CCD calibration procedure can be used to recalibrate the interpretation of the CCD peak position shifting, which means a redefinition of the relationship between the peak position shifting and the corresponding height changing.

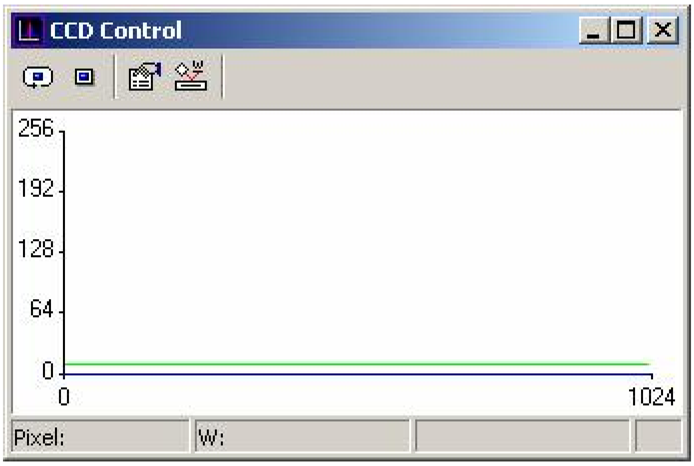
HINT This calibration procedure is only available for the supervisor and should only be done by an advanced user.

STEP 1 ► Load in a flat and reflective sample mounted somewhere on the stage. The sample should be leveled. A tilt would influence the result of this calibration.

The height variation of the sample surface must be less than 10 µm when driving 5 mm in any XY direction.

STEP 2 ► Open the CCD Control window and activate the continuous CCD polling by pressing the .

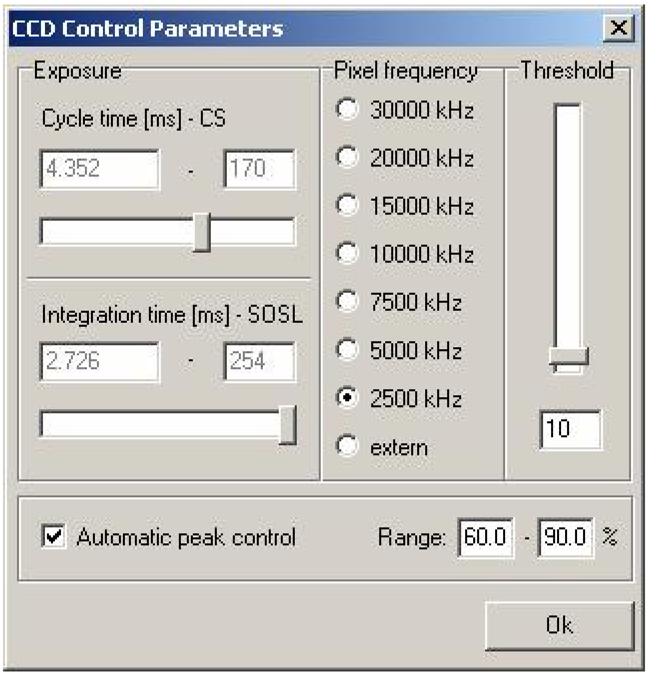
Figure 9 CCD Control plot.



STEP 3 ►

Press the property icon  and enable the Automatic peak control. Specify the intensity Range. Useful limits are from 60 up to 90 %. The hardware settings like pixel frequency, cycle and integration time will be adjusted automatically in order to get a peak with an optimized intensity between the selected limits.

Figure 10 Dialog CCD Control Parameters.



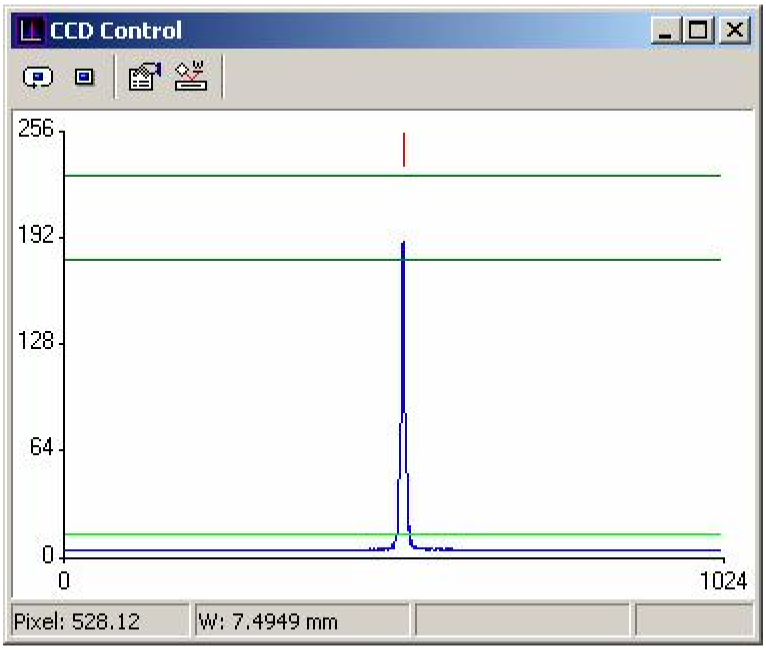
The limits are indicated as a dark green line within the CCD Control window.

STEP 4 ►

Adjust the Threshold to cut off the ground noise of the signal. Only the distribution above this threshold will be used for the peak detection.

The threshold is indicated as a light green line within the CCD Control window.

Figure 11 CCD Control plot showing a signal.



STEP 5 ▶ After the adjustment of the peak detection close the property dialog and press the Calibration button.

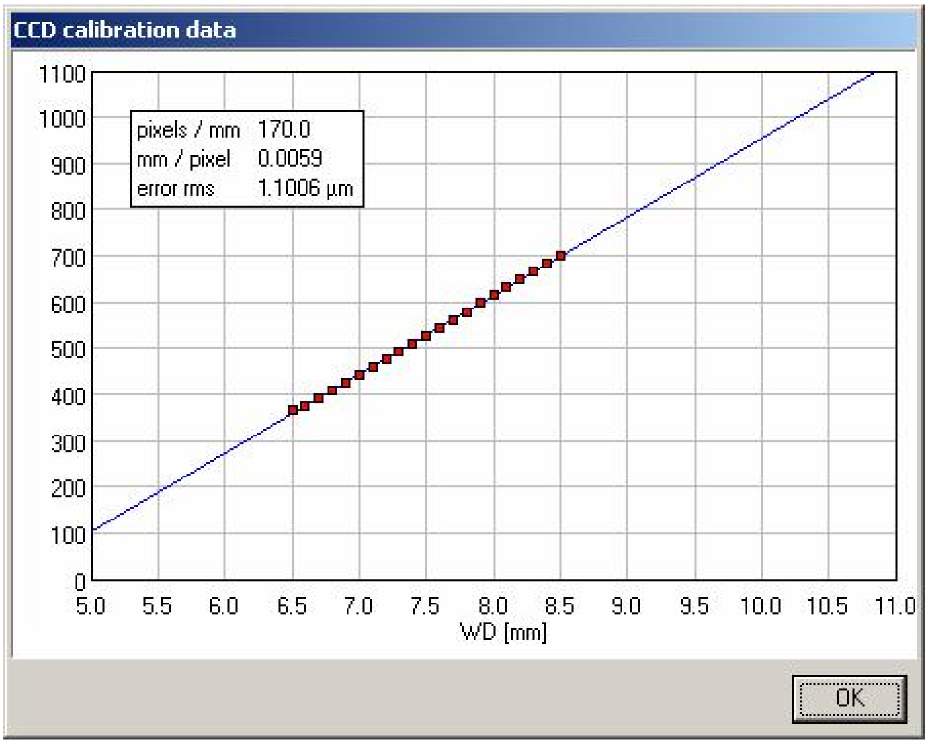
STEP 6 ▶ Define the New range of the calibration procedure from W = 6.5 mm up to W = 8.5 mm.

STEP 7 ▶ The relationship of the peak position and real height of the surface is a linear function. Therefore a higher amount of calibration points increases the accuracy of the linear fit. At least a step size of 100 µm is recommended.

STEP 8 ▶ Press the Start button. The calibration procedure will run fully automatically. The stage will drive to the lower W limit of the calibration range. Successive the stage will move down by using the selected increment as step size. At each level the height of the surface will be detected by the laser height sensing.

STEP 9 ▶ At the end of CCD calibration procedure press the Plot button to check the result. The detected peak position as a function of the stage level will be displayed. If there are significant deviation from a linear function or any peaks repeat the calibration procedure.

Figure 12 CCD calibration data plot.



Close the piezo calibration plot.

STEP 10 ► Press the OK button at the CCD Calibration window to store the calibration data. Press Cancel to discard the calibration.