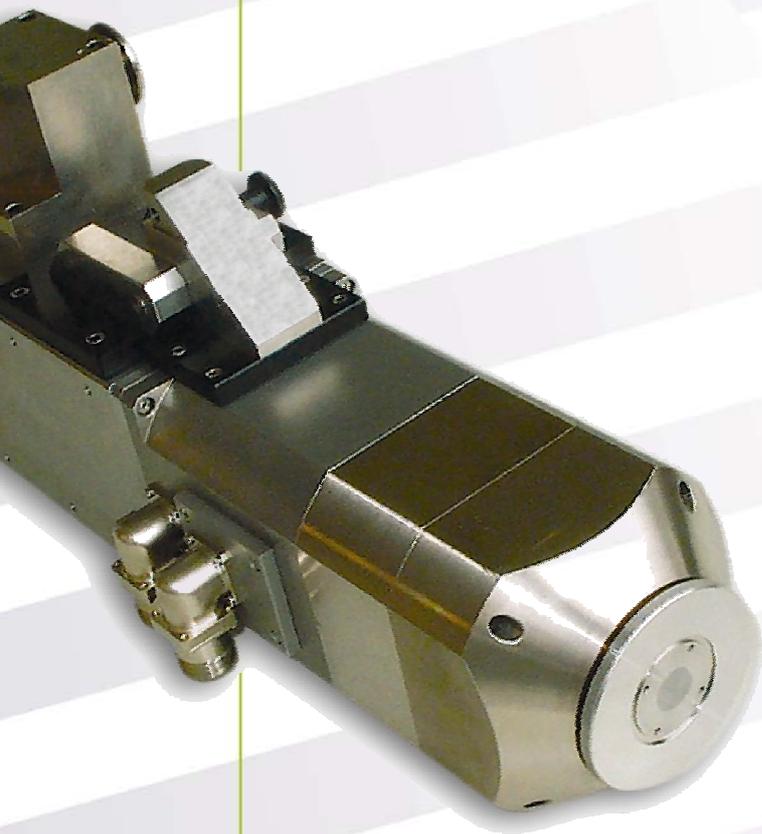


# User Manual

FXEControl Version 2.2

X-Ray System



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## Initialisation

The controller hardware (PLC) for the X-ray system is connected to the PC via a serial cable. An initialisation procedure establishes the link to the PLC when ***FXEControl*** is started. This may take approx. 30 s.

## Startup / Warmup of the X-ray system

After switching on the X-Ray system a Startup procedure must be performed before the X-Ray system is ready to use; this is initiated using the **Startup** button (see 0). The Startup performs a self-test on the X-ray system.

The Startup can be cancelled by switching off the X-ray radiation using the **X-Ray Off** button (0). The Startup includes the Warmup (initiate using the **Warmup** button, 0) that can also be cancelled using **X-Ray Off**. During the Warmup only the first two steps of the Startup are performed (the radiation is switched on and the acceleration voltage increased continuously to the maximum value). After the cancellation of the Startup or Warmup, the acceleration voltage can only be increased to the value reached at the time of cancellation.

**Note:** If the FXE system has no valid Warmup data, all relevant controls in FXEControl are not available, e.g. the X-ray radiation cannot be switched on using the **X-Ray On** button. If FXEControl is quit and then re-started while the rest of the X-ray system was left switched on, it is not necessary to perform a new Startup or Warmup.

## FXEControl main window

Fig. 5 shows the main window of *FXEControl* with X-Ray switched on. Before execution of the Startup / Warmup, most controls are deactivated.

### Switching on the X-ray radiation

- The X-ray radiation is switched on using the green *X-Ray On* button. This button is disabled once clicked and the red *X-Ray Off* button becomes available. After switching off radiation the *X-Ray On* button is enabled again.

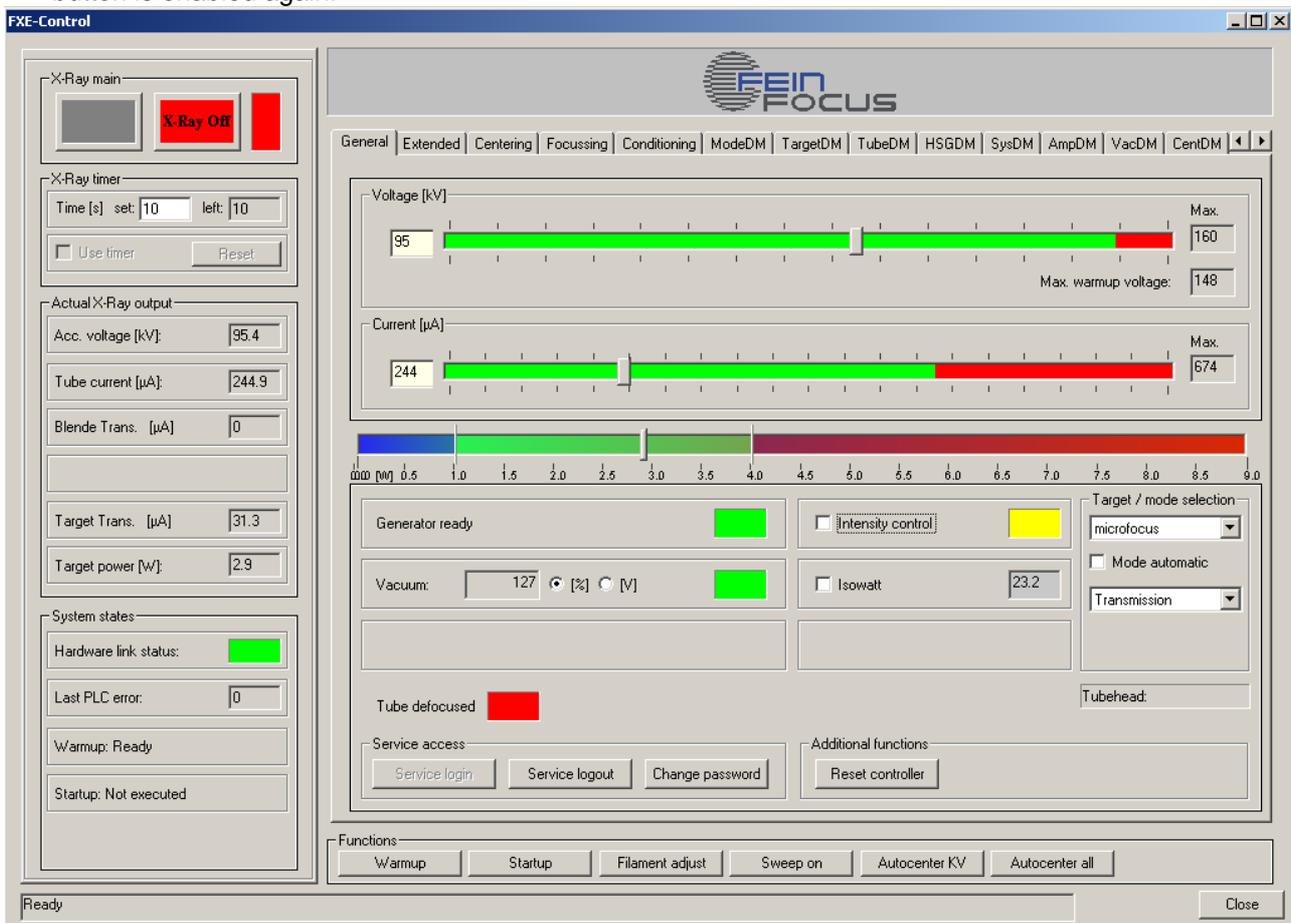


Fig. 5: FXEControl after Switching On the Radiation

## X-Ray Main Group

Note: The X-ray radiation is automatically switched off if the Main window is minimised or if the program is closed.

### X-Ray On / X-Ray Off buttons

Using these buttons the X-ray radiation is switched on and off and the state is indicated by a colour display. Red means here "Radiation is switched on", green "Radiation is switched off". To ensure unambiguous indication of the state and prevent incorrect operation, the buttons become available alternately, i.e. when the radiation is switched on, only the *X-Ray Off* button is available, and vice versa.

### X-Ray Timer functions

Using the elements in this group an "exposure period" for the X-ray radiation can be entered. If the *Use Timer* check box is selected, when the *X-Ray On* button is clicked the radiation is automatically switched off again after the expiry of the time set in the *Time [s] set* edit control. The *left* display field indicates the time remaining until the radiation is switched off.

### Actual X-Ray Output group box

*Tube current [μA]* display:

Current flowing in the X-ray tube.

*Acc. Voltage [kV]* display:

Acceleration voltage in the X-ray tube.

*Cond. Ap. current [μA]* display:

Current at the aperture of the (optional) condensor. NOTE: The name of this display may differ depending on the X-Ray system configuration.

*Objective ap. current [μA]* display:

Current at the (optional) objective aperture. NOTE: The name of this display may differ depending on the X-Ray system configuration.

*Target current [μA]* display:

Current flowing in the X-ray target ( $\leq$  tube current).

*Target power [W]* display:

Output power of the X-ray tube, given by the product of the target current and acceleration voltage.

### System States displays

*Warmup* display:

Indicates the state of the X-ray system Warmup:

- Warmup has not been performed: "**Not executed**"
- Warmup running: "**Running**"
- Warmup has been performed: "**Ready**"

*Startup* display:

Indicates the state of the X-ray system Startup:

- Startup has not been performed: "**Not executed**"
- Startup running: "**Running**"
- Startup has been performed: "**Ready**"

*Hardware-Linkstatus* display :

Indicate the status of the link to the controller:

- Red: no link to the controller
- Green: link to the controller ok

*Last PLC Error* display:

Indicates the number of the PLC system error that occurred last. A value of 0 signifies "no error".

## **Functions button group**

### **Startup button**

Starts the Startup procedure for the self-test of the x-ray system. The Startup can be cancelled by switching X-Ray off.

### **Warmup button**

Starts the Warmup procedure. The Warmup can be cancelled by clicking *X-Ray Off*.

### **Autocenter All button**

Starts the automatic centering (of the electron beam in the X-ray tube) for the entire range of the acceleration voltage.

The deflecting currents can vary with acceleration voltage, for this reason the auto centering determines the suitable deflection currents for several voltage values and creates a centering table from these values. The centering table can also be edited manually (0).

On multiple stage tubes the auto-centering is performed for all centering units and all appropriate centering characteristics are measured.

### **Autocenter kV button**

Does automatic centering of the electron beam only for the actual acceleration voltage.

In case of multiple stage tubes the Autocenter kV function is performed for all centering units and all centering characteristics changed as appropriate.

### **Filament Adjust button**

Starts the optimisation of the cathode heater current.

### **Sweep On button**

Starts the sweeping mode used for centering the electron beam manually.

## General tab

### Voltage [kV] slider and edit control

Using the slider and edit control to the left of the slider, the setpoint for the acceleration voltage can be adjusted. The acceleration voltage affects, among other aspects, the spectrum (the hardness) of the X-ray radiation. A higher acceleration voltage results in a brighter X-ray image, as a larger portion of the radiation passes through the specimen to be investigated. On the other hand, the contrast of the image is reduced if the voltage is further increased when the brightness is already sufficient.

The two displays to the right of the slider indicate the maximum values for the acceleration voltage. The upper display indicates a constant value if (optional) intensity control is inactive. If intensity control is integrated into the *FXE* X-Ray System and is active, the maximum value of the acceleration voltage varies depending on the tube current set and the permissible target power (this, in turn, can be dependent on the tube mode, see 0). The other display indicates the maximum Warmup voltage. This is the maximum voltage that was reached during the Warmup. The smaller of the two maximum values defines the maximum acceleration voltage that can be set.

### Current [ $\mu$ A] slider and edit control

Using the slider and edit control to the left of the slider, the setpoint for the tube current can be adjusted. A higher tube current improves - for constant acceleration voltage - the signal-to-noise ratio in the X-ray image. However, the current cannot be increased without limit; the limit is defined by the thermal capacity of the target material at the focal spot. The smaller the focal spot, the less heat can be dissipated and thus the lower the maximum permissible tube current.

The display to the right of the edit control indicates the maximum value for the tube current. The max. tube current is constant if (optional) intensity control is inactive. If intensity control is integrated into the *FXE* X-Ray System and is active, the maximum value of the tube current varies depending on the acceleration voltage set and the permissible target power (this, in turn, can be dependent on the tube mode, see 0).

### Using the sliders for current and voltage

The setpoints for current and voltage can be adjusted using the sliders or edit controls. The sliders provide the following features for adjusting the values:

- Drag the slider with the mouse to the required value
- If the mouse has a wheel, this can be used for an incremental adjustment in 1 kV or 1  $\mu$ A steps
- In the same way the "Up" and "Down" cursor keys can be used for incremental adjustments in 1 kV or 1  $\mu$ A steps
- It is possible to adjust the values in 10 kV or 10  $\mu$ A steps by clicking with the mouse to the right (+10 kV /  $\mu$ A) or left (-10 kV /  $\mu$ A) of the slider

The way in which the controls for adjusting process variables are used is explained in more detail in 0.

### Combo boxes target / mode selection

These control elements are used to display and – if there are more than one - set the tube mode and target selection.

**ATTENTION: If the target is selected with the combo box, it is also necessary to install the corresponding physical target!**

**Therefore this setting has to be done just before switching the system off and changing the physical target or just after changing the physical target an re-power the system.**

**Do not switch on X-Ray with wrong target parameters! Otherwise the target could be destroyed!**

### Check box and indicator intensity control

Using this check box, the intensity control function is switched on and off.

### Check box mode automatic

Using this check box the tube mode automatic is switched on and off.

On *FXE* X-Ray systems without intensity control, this check box is not available.

## Target power range indicator

This colour indicator is used to indicate the actual target power and the power ranges that refer to the tube modes.

The intensity control can only operate in a specific target current range. If the target current drops below this range, the intensity control is switched off. The indicator is then completely blue with the text "Underflow". If the target current exceeds the range that can be controlled, the indicator is completely red with the text "Overflow".

## Tube defocused indicator

When the automatic defocussing of the tube is active at high power, a red indicator is shown in the display below the 'centering warning' indicator. Otherwise it is hidden.

## Vacuum indicators

For it to be possible to generate radiation in the X-ray tube, the tube must be evacuated. As the *FXE* X-ray system contains an "open" tube, the necessary vacuum must first be built up by pumping down after the system is switched on. Sufficient vacuum is indicated by a green indicator. In addition, a percentage value for the vacuum is indicated. The higher this value, the better the vacuum in the tube.

## Generator ready indicator

If the setpoints for acceleration voltage or tube current are changed when the radiation is switched on, the high voltage generator requires a certain amount of time to implement the required values and to reach a new steady state. During this time the *Generator ready* indicator is red. Once the values for current and voltage are stable, the indicator is green. With the radiation switched off, the indicator is yellow.

## Isowatt on check box and edit control

The *FXE* X-Ray System has an Isowatt function. When the Isowatt function is activated using the *Isowatt on* check box, it is not possible to adjust the tube current. The current is automatically adjusted to match the voltage setting such that the resulting power remains constant. The setpoint for the Isowatt power is entered in the *Power [W]* edit control.

## Service access (password protected)

### Service Login button

When this button is clicked, a dialog box for the entry of a password is opened. Following entry of the correct password, protected functions and controls become available (e.g. for reading and writing the focussing characteristics or for accessing the data modules). The password set in the *FXE* X-Ray System as shipped is "feinfocus". It is strongly recommended to change the password after commissioning – using the *Change Password* button - and only to give the new password to personnel trained on the usage of the x-ray system.

### Service Logout button

This button is only active on the entry of the correct password. If it is clicked, the protected functions are no longer accessible.

### Change Password button

This button is only available after the correct password is entered. A dialog box for changing the password is opened.

## Additional Functions

### Reset Controller button

Performs a warm start of the PLC. This can be useful if the PLC has crashed and therefore no longer responds. However, such a case occurs seldom. After such a reset, the Warmup procedure (0) must be performed again.

## Extended tab

The *Extended* tab (Fig. 6) contains controls for editing the focussing and centering characteristics as well as adjustments for the filament current and the sweeping mode. Some functions on this tab are password protected. It is only possible to access these functions after the correct password is entered.

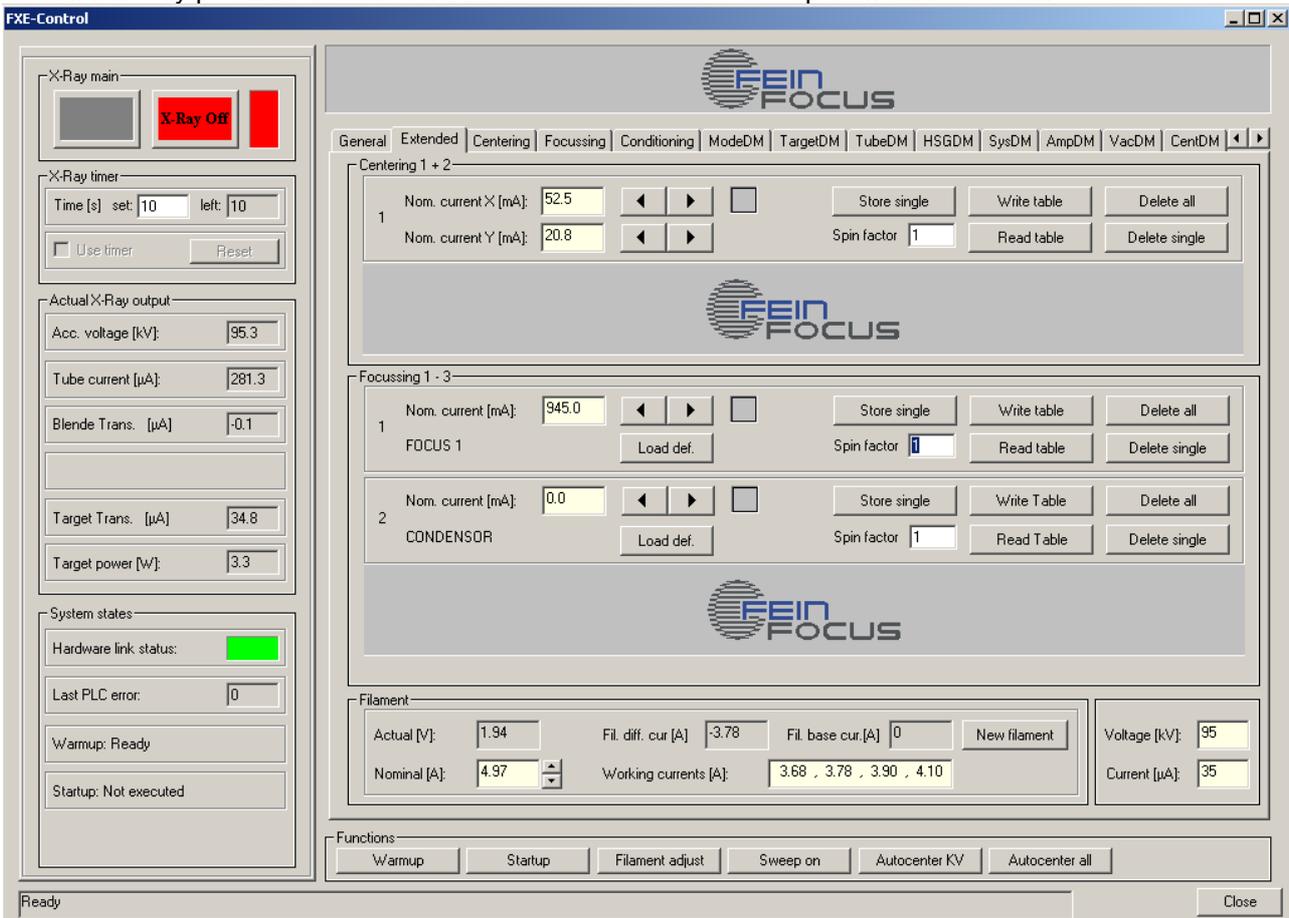


Fig. 6: Extended Tab

### Controls for centering

The controls in the *Centering (1+2)* group can be used for editing – depending on the type of *FXE* X-Ray System – one or two centering characteristics, as well as for adjusting the centering currents independent of the characteristic. Normally the centering currents and the centering characteristics do not need to be edited manually, as this is performed automatically using the auto-centering functions (0, 0). In certain cases, e.g. for test purposes, it can be useful to edit the data manually.

#### Controls for Nom. current X [mA] and Nom. current Y [mA]

The values for the x and y-deflecting currents related to the actual acceleration voltage can be adjusted using the edit controls and spin buttons. Using the spin buttons, the mouse wheel, or the cursor keys, it is possible to increment the settings. The increment can be changed using the *Spin factor* edit control. The increment is given by  $0.1 \text{ mA} \cdot \text{Spin factor}$ .

#### Store single button

Using this button the values for the deflecting currents displayed in the *Nom. Current X [mA]* and *Nom. Current Y [mA]* edit controls are saved as a base point on the centering characteristic and the intermediate values affected re-interpolated. To store the new characteristic in non-volatile memory, and thus to also retain it after the PLC is switched off, *WriteTable* (0) must be used.

### Delete single button

If the value for the deflecting currents displayed is a base point on the characteristic (is indicated by the **Base Point** indicator, 0), this base point is deleted by clicking **Delete single** and the intermediate values on the characteristic affected re-interpolated. To store the new characteristic in non-volatile memory, and thus to also retain it after the PLC is switched off, **WriteTable** (0) must be used.

### Delete all button

Using this button all the base points on the characteristic are deleted. To store the new (blank) characteristic in non-volatile memory, and thus to also retain it after the PLC is switched off, **WriteTable** (0) must be used.

### Write Table button

When this button is clicked, the centering characteristic is stored in non-volatile memory in the PLC and is thus retained after the controller is switched off. This function is password-protected.

### Read Table button

When this button is clicked, the centering characteristic stored in non-volatile memory in the PLC is read. Any changes not saved using **Write Table** are overwritten. This function is password-protected.

### Base Point indicator

A green cross in this display indicates that the values for the deflecting currents displayed in the **Nom. current X [mA]** and **Nom. current Y [mA]** edit controls represent a base point on the centering characteristic.

## Controls for focussing

The controls in the **Focussing (1-3)** group can be used for editing the focussing characteristic and, depending on the type **FXE** X-Ray System, also the condensor and shutter characteristics. In addition, it is possible to adjust the focussing, condensor, and shutter currents independent of the characteristics.

Hint: The **FXE** X-ray system can be configured in a way so that editing the focus / condensor / shutter characteristics can be done only with X-ray switched on.

### Nom. current [ mA ] edit controls and spin buttons

The values for the focussing and, if available, condensor and shutter currents related to the actual acceleration voltage can be adjusted using the edit controls and spin buttons. Using the spin buttons, the mouse wheel, or the cursor keys, it is possible to increment the settings. The increment can be changed using the **Spin factor** edit control. The increment is given by 0.1 mA\*Spin factor.

### Store single button

Using this button the value for the focussing/condensor/shutter currents displayed in the **Nom. current [mA]** edit control is saved as a base point on the corresponding characteristic and the intermediate values affected re-interpolated. To store the new characteristic in non-volatile memory, and thus to also retain it after the PLC is switched off, **WriteTable** (0) must be used.

### Delete single button

If the value for the focussing/condensor/shutter current displayed is a base point on the characteristic (is indicated by the **Base Point** indicator, 0) this base point is deleted by clicking **Delete single** and the intermediate values on the characteristic affected re-interpolated. To store the new characteristic in non-volatile memory, and thus to also retain it after the PLC is switched off, **WriteTable** (0) must be used.

### Delete all button

Using this button all the base points on the characteristic are deleted. To store the new (blank) characteristic in non-volatile memory, and thus to also retain it after the PLC is switched off, **WriteTable** (0) must be used.

### Write Table button

When this button is clicked, the focussing/condensor/shutter characteristic is stored in non-volatile memory in the PLC and is thus retained after the controller is switched. This function is password-protected.

### Read Table button

When this button is clicked, the focussing/condensor/shutter characteristic stored in non-volatile memory in the PLC is read. Any changes not saved using **Write Table** are overwritten. This function is password-protected.

#### **Button Load def.**

With this button a default table will be load from the PLC.

#### **Base Point indicator**

A green cross in this display indicates that the values for the focussing/condensor/shutter current displayed in the **Nom. current** edit control represent a base point on the corresponding characteristic.

#### **Shutter on check box**

FEINFOCUS X-Ray systems have a shutter as an option.

This check box switches the shutter on/off. Switching on the shutter results in the deflection of the electron beam into a so-called beam dump such that the X-ray tube no longer emits any radiation. The advantage of the shutter is that the deflection, and with it switching between radiation on/off, takes place very quickly because - unlike when switching off the radiation using **X-Ray off** – the generator (HTG) is not affected. On switching on or off the HTG as well as on changing the tube current or acceleration voltage, there is always a certain delay until a steady state is established.

#### **Filament group box**

With the edit control **Nominal [A]** (password protected) the cathode filament current (**Fehler! Verweisquelle konnte nicht gefunden werden.**) can be adjusted manually. Using the spin button, the mouse wheel, or the cursor keys, it is possible to change this value in 0.05 A steps.

The edit control **Working currents [A]** shows the filament (working) currents determined by the filament adjustment function.

With the display **Actual [V]** the actual (monitor) value for the filament is displayed. This is a voltage ([V]) and was only incorporated for diagnostics purposes. The actual filament current can unfortunately not be measured on the current **FXE** X-Ray System.

The display fields **Fil. diff. cur [A]** and **Fil. base cur [A]** can be used as a watch for the life cycle of the filament if the button **New filament** is pressed after changing the filament. The difference current increases with the aging of the filament.

#### **Voltage[kV] and Current[μA] edit controls**

These edit controls have been added in addition to the edit controls on the General tab (0, 0), among other reasons so that it is not necessary to switch back and forward between tabs when adjusting the acceleration voltage as a function of the focussing and centering currents.

## Centering tab

The centering characteristic is shown graphically and in tabular form on this tab. It is also possible to edit the values in the table by double-clicking the entries with the mouse.

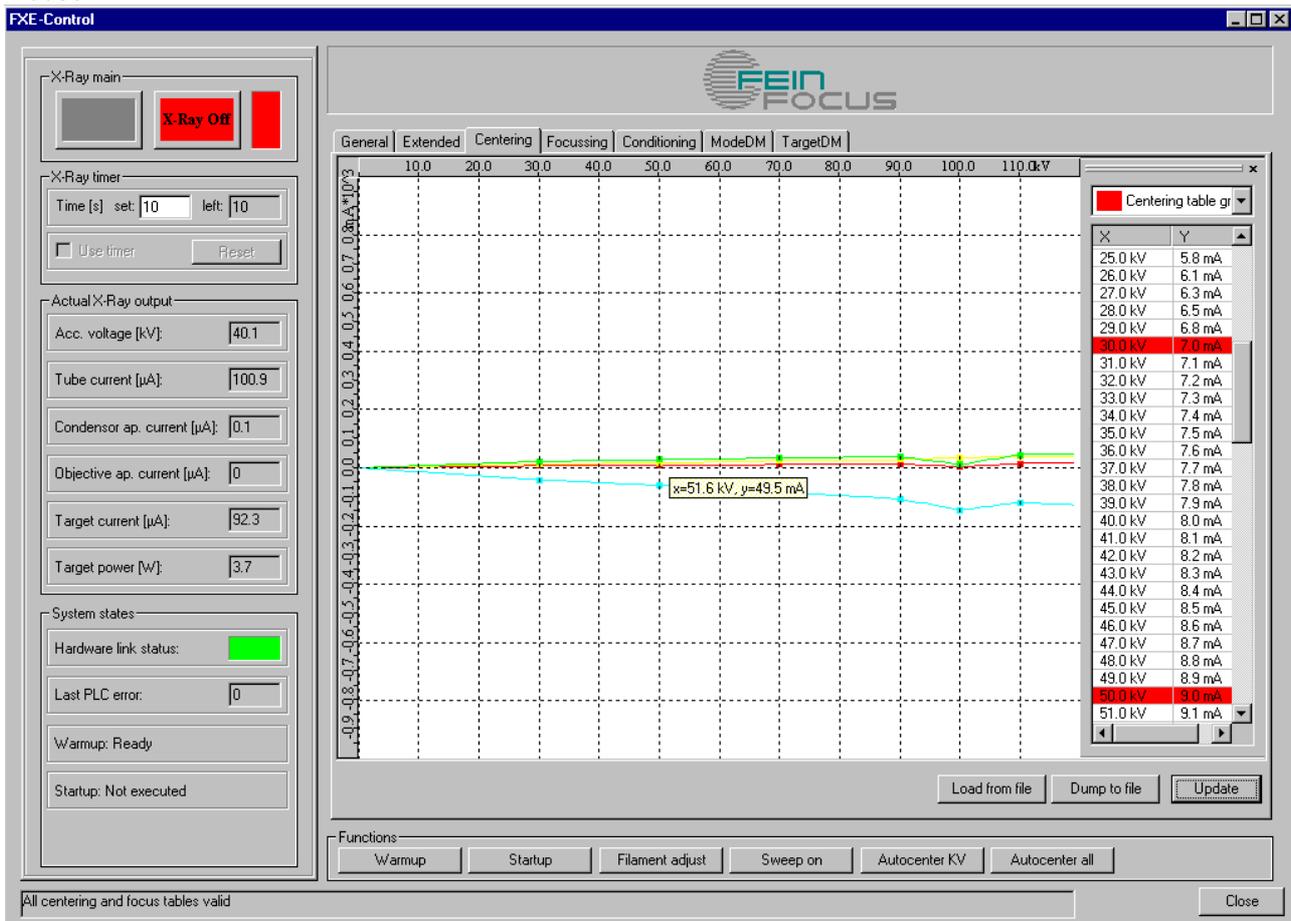
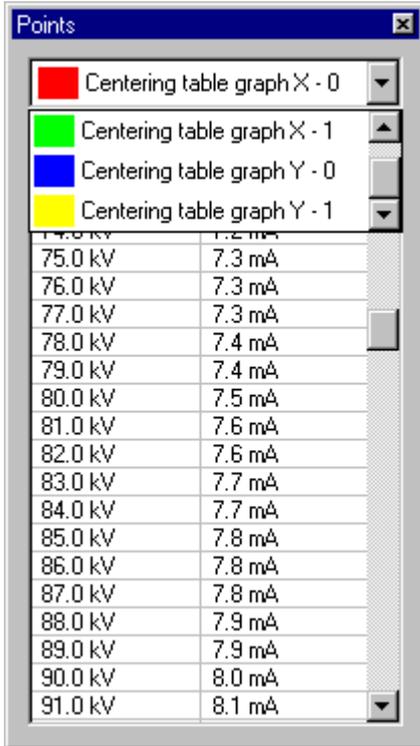


Fig. 7: Centering Tab

Fig. 7 shows a centering characteristic in graphic and tabular form. The red green lines and represents the x-deflecting currents for the 1. and 2. centering unit, the blue and the yellow lines the y-deflecting currents for the 1. and 2. centering unit. The points marked are the base points. The characteristic can have up to 250 pairs of values. In the example the maximum acceleration voltage for the tube used is however only 160 kV. For this reason, no centering currents are stored for values above 160 kV.

Using the **Update** button, the centering characteristic saved in the PLC is explicitly read and the display updated. In the normal case, it is not necessary to use this button, as the characteristic and its display are automatically updated if it is edited during the actual process (that is by **FXEControl** itself). It is, however, conceivable that the characteristic may be edited by other processes connected to the controller - which may be running on other computers. In such cases the display can be updated using the **Update** button.

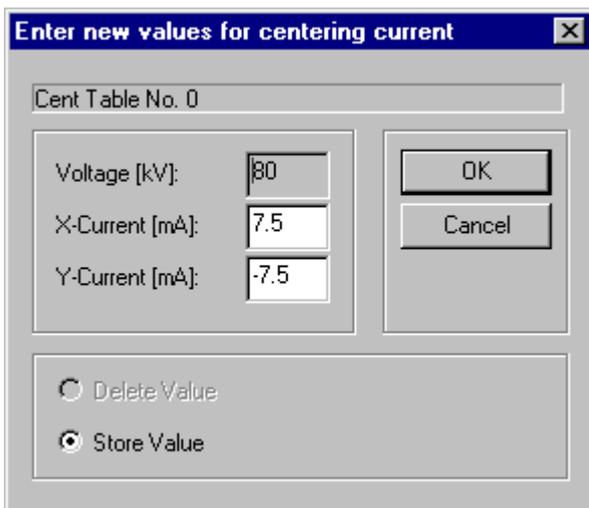
There are a few further options for the display of the graph that are described in Section 0. For example the colours can be changed, the display areas adjusted, or the markings for the base points hidden.



Points	
<input type="checkbox"/>	Centering table graph X - 0
<input type="checkbox"/>	Centering table graph X - 1
<input type="checkbox"/>	Centering table graph Y - 0
<input type="checkbox"/>	Centering table graph Y - 1
75.0 kV	7.3 mA
76.0 kV	7.3 mA
77.0 kV	7.3 mA
78.0 kV	7.4 mA
79.0 kV	7.4 mA
80.0 kV	7.5 mA
81.0 kV	7.6 mA
82.0 kV	7.6 mA
83.0 kV	7.7 mA
84.0 kV	7.7 mA
85.0 kV	7.8 mA
86.0 kV	7.8 mA
87.0 kV	7.8 mA
88.0 kV	7.9 mA
89.0 kV	7.9 mA
90.0 kV	8.0 mA
91.0 kV	8.1 mA

Fig. 8: Tabular Representation of the Centering Characteristics.

Fig. 8 shows the table window for the centering characteristic(s). The table window is a "docking window", i.e. it can be dragged out of the tab window and "docked" somewhere else. The size of the window can also be adjusted. Using the list box at the top of the window you can switch between the 1st and 2nd centering characteristic and x and y-tables. The table is a more convenient method of using the *Store single* and *Delete single* actions described in 0 and 0; these actions can be performed by double-clicking an entry with the mouse. The dialog box shown in Fig. 9 then appears.



Enter new values for centering current

Cent Table No. 0

Voltage [kV]: 80

X-Current [mA]: 7.5

Y-Current [mA]: 7.5

OK

Cancel

Delete Value

Store Value

Fig. 9: Dialog Box for Editing the Pairs of Values for the Centering Current on the Centering Characteristic(s)

The actual voltage is shown in the *Voltage [kV]* edit control. The setpoint for the voltage is used as an index for the characteristic and is automatically set to the value selected in the table when this dialog box is opened, so that when the radiation is switched on, changes in the values are correctly reflected immediately - also in the X-ray image. If the *Store Value* option is selected and the dialog box closed using **OK**, the pair of values entered is saved as a base point. The *Delete Value* option is only available if the pair of values selected is a base point. This point can then be deleted.

## Focussing tab

The focussing characteristic is shown graphically and in tabular form on this tab. It is also possible to edit the values in the table by double-clicking the entries with the mouse.

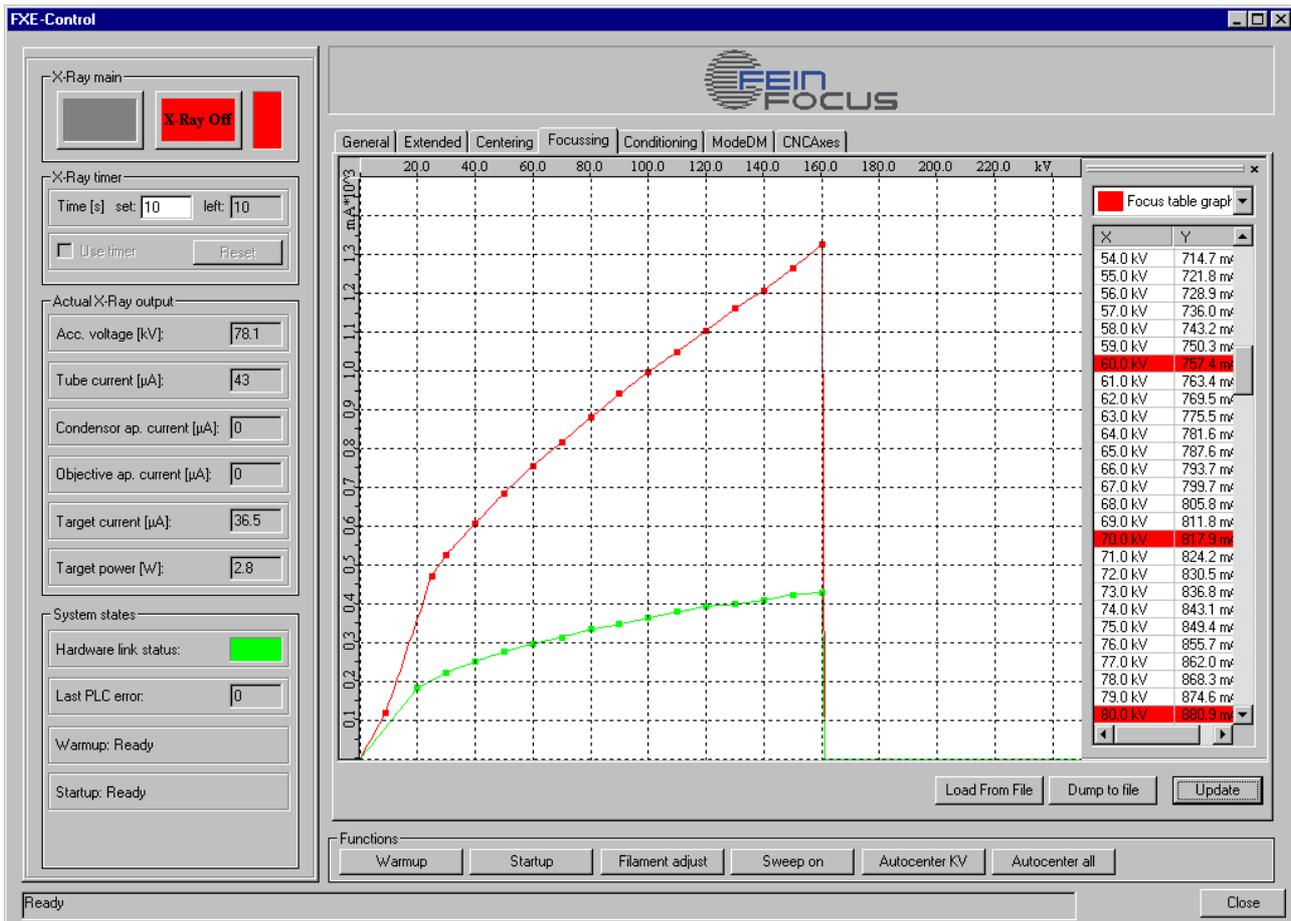
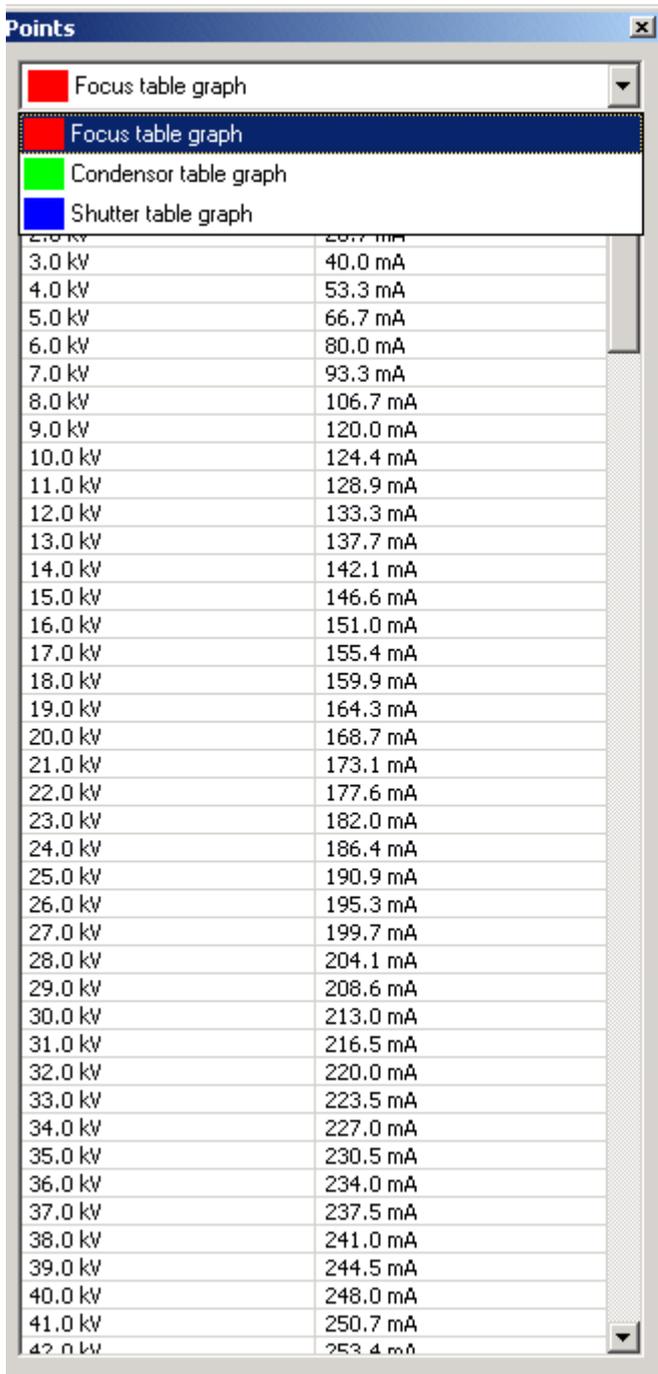


Fig. 10: Focussing Tab

Fig. 10 shows a focussing (Focus table graph 0, red line) and condensor (Focus table graph 1, green line) characteristic in graphic and tabular form. The points marked are the base points. The characteristic can have up to 250 pairs of values. In the example the maximum acceleration voltage for the tube used is however only 160 kV. For this reason, no focus currents are stored for values above 160 kV.

Using the **Update** button, the characteristics saved in the PLC are explicitly read and the display updated. In the normal case, it is not necessary to use this button, as the characteristic and its display are automatically updated if it is edited during the actual process (that is by *FXEControl* itself). It is, however, conceivable that the characteristic may be edited by other processes connected to the controller - which may be running on other computers. In such cases the display can be updated using the **Update** button.

There are a few further options for the display of the graph that are described in Section 0. For example the colours can be changed, the display areas adjusted, or the markings for the base points hidden.



The screenshot shows a window titled "Points" with a list box at the top containing four items: "Focus table graph" (red), "Focus table graph" (dark blue), "Condensor table graph" (green), and "Shutter table graph" (blue). Below the list box is a table with two columns: voltage in kV and current in mA. The table contains 21 rows of data, starting from 3.0 kV and ending at 42.0 kV.

3.0 kV	40.0 mA
4.0 kV	53.3 mA
5.0 kV	66.7 mA
6.0 kV	80.0 mA
7.0 kV	93.3 mA
8.0 kV	106.7 mA
9.0 kV	120.0 mA
10.0 kV	124.4 mA
11.0 kV	128.9 mA
12.0 kV	133.3 mA
13.0 kV	137.7 mA
14.0 kV	142.1 mA
15.0 kV	146.6 mA
16.0 kV	151.0 mA
17.0 kV	155.4 mA
18.0 kV	159.9 mA
19.0 kV	164.3 mA
20.0 kV	168.7 mA
21.0 kV	173.1 mA
22.0 kV	177.6 mA
23.0 kV	182.0 mA
24.0 kV	186.4 mA
25.0 kV	190.9 mA
26.0 kV	195.3 mA
27.0 kV	199.7 mA
28.0 kV	204.1 mA
29.0 kV	208.6 mA
30.0 kV	213.0 mA
31.0 kV	216.5 mA
32.0 kV	220.0 mA
33.0 kV	223.5 mA
34.0 kV	227.0 mA
35.0 kV	230.5 mA
36.0 kV	234.0 mA
37.0 kV	237.5 mA
38.0 kV	241.0 mA
39.0 kV	244.5 mA
40.0 kV	248.0 mA
41.0 kV	250.7 mA
42.0 kV	253.4 mA

Fig. 11: Tabular Representation of the Focussing/Condensor/Shutter Characteristic.

Fig. 11 shows the table window for the focussing/condensor/shutter characteristics (Focus table 1 is the condensor characteristic, Focus table 2 the shutter characteristic). The table window is a "docking window", i.e. it can be dragged out of the tab window and "docked" somewhere else. The size of the window can also be adjusted. Using the list box at the top of the window you can switch between the focussing/condensor/shutter characteristics. The table is a more convenient method of using the *Store single* and *Delete single* actions described in 0 and 0, these actions can be performed by double-clicking an entry with the mouse. The dialog box shown in Fig. 12 then appears.

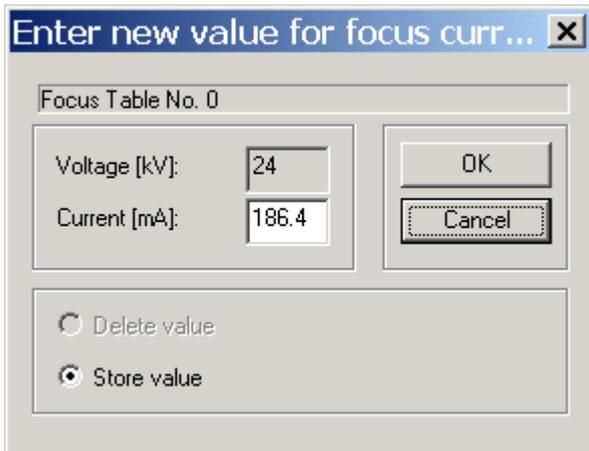


Fig. 12: Dialog Box for Editing the Focussing Characteristic

The actual voltage is shown in the **Voltage [kV]** edit control. The setpoint for the voltage is used as an index for the characteristic and is automatically set to the value selected in the table when this dialog box is opened, so that when the radiation is switched on, changes in the values are correctly reflected immediately - also in the X-ray image. If the **Store Value** option is selected and the dialog box closed using **OK**, the pair of values entered is saved as a base point. The **Delete Value** option is only available if the pair of values selected is a base point. This point can then be deleted.

## Conditioning tab

When auto-conditioning is running, *FXEControl* maintains a log on the number of breakdowns that occur and the vacuum in the tube. The conditioning log is shown graphically and in tabular form on this tab. The values shown cannot be edited; they can only be read. The log is also saved in the text file *BreakTable.txt*. After auto-conditioning these files are to be found in the application folder for *FXEControl*.

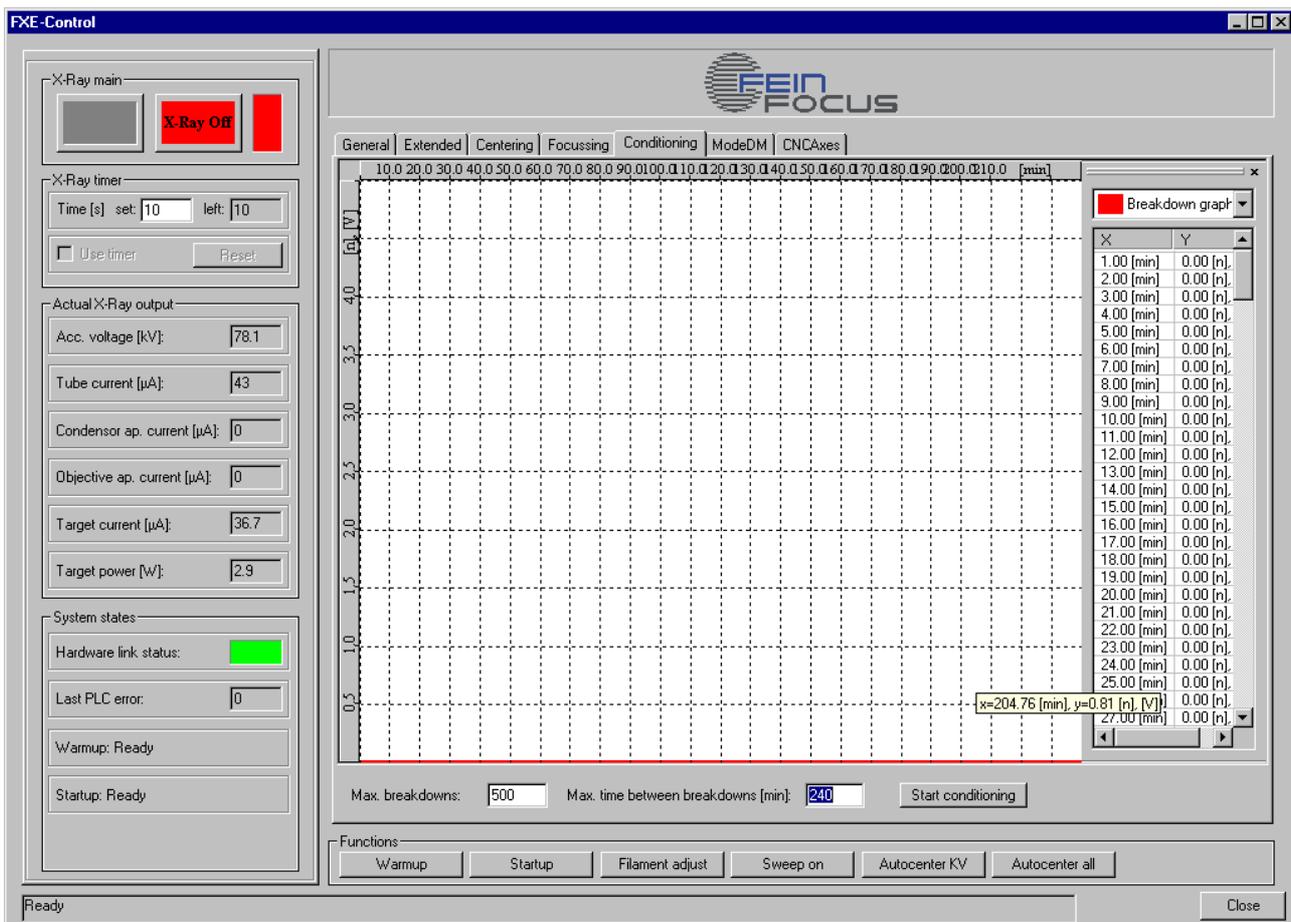


Fig. 13: Conditioning Statistics Tab

Fig. 13 shows the graphic and tabular representation of the conditioning log. The red points show the number of breakdowns that have occurred in intervals of 1 minute (breakdowns).

### Button Start Conditioning

Using this button the auto-conditioning of the tube is started. When auto-conditioning is running, *FXEControl* maintains a log on the number of breakdowns that have occurred and the vacuum in the tube. The log is saved in the text file *BreakTable.txt*. Following auto-conditioning, these files are in the application folder for *FXEControl*.

### Edit control Max. breakdowns

The auto-conditioning aborts if the number of occurred breakdowns exceeds the value entered here.

### Edit control Max. time between breakdowns [min]

The auto-conditioning will be finished if the time elapsed since starting the function or since the last breakdown occurred is longer than the value entered here.

## Other options for the graphical displays

The graph windows have a context menu that can be opened by clicking the window with the right mouse button. This context menu contains options for the display of the graph. The following menu commands and submenu commands are available:

### View Points

Displays or hides the table window.

### Point Marks

Displays or hides the characteristic base points or measured points.

### Scatter Graph

Displays or hides the lines joining the base points. If *Point Marks* and *Scatter Graph* are selected, only the base points are shown. If *Scatter Graph* is selected and *Point Marks* cleared, nothing is shown.

### Trace Mouse Coordinates

Displays or hides the indication of the co-ordinates of the mouse pointer.

### Axis

Displays or hides a grid for the axes.

### Fit

There are three submenu commands:

- *Width*: Adjusts the range of values such that the graph fills the x axis.
- *Height*: Adjusts the range of values such that the graph fills the y axis.
- *Page*: Adjusts the value range such that the graph fills the x and y axes.

### Zoom tool

This menu command provides a tool for zooming in on a section of the graph.

There are two submenu commands

- *Zoom Tool*
- *Apply*

If the *Zoom Tool* command is selected, a cross-hatched rectangle appears that can be dragged using the mouse to adjust the size and position of the area of the graph for the zoom. In addition, the *Apply* command becomes available. When this menu command is selected, or the cross-hatched area double-clicked with the mouse, the zoom is performed. The cross-hatched area then appears magnified. To see the complete graph again, *Fit →Page* or the *General* tab in the *Properties* dialog box (0) can be used.

## Properties

Opens the dialog box shown in Fig. 16. This has three tabs that are briefly described in the following.

### General tab

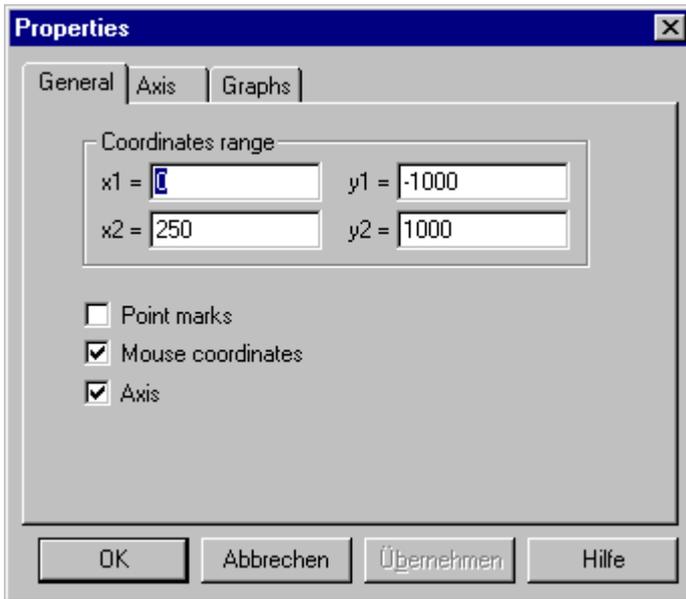


Fig. 16: Properties Dialog Box from the Context Menu for Graphs, General Tab

This tab provides a further means of adjusting the area shown. While using the *Zoom Tool* the area is selected using the mouse, the area can be entered here by typing numerical values. In addition, the *Point marks* (5.12.2), *Mouse coordinates* (5.12.4) and *Axis* (5.12.5) options are also available here again.

#### Axis tab

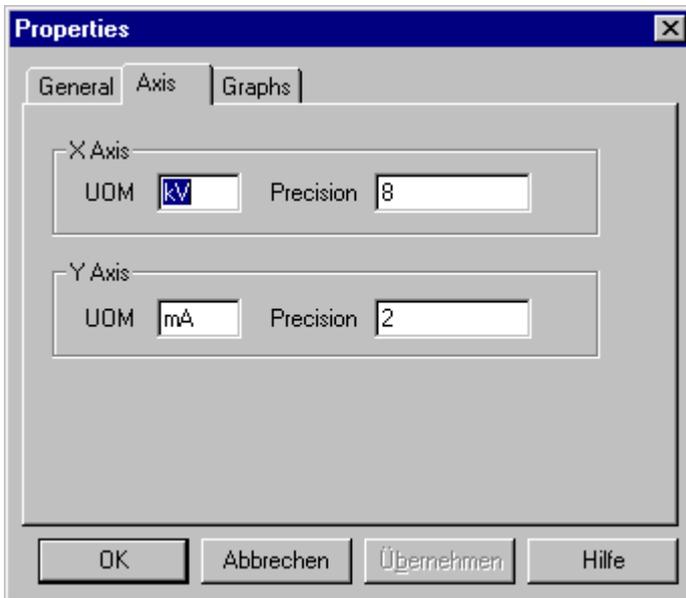


Fig. 17: Properties Dialog Box for the Context Menu for Graphs, Axis Tab

Using the *Axis* tab the axis labels (*UOM*, means unit of measurement) and the number of points after the decimal separator (*Precision*) for the x and y-values can be changed.

#### Graphs tab

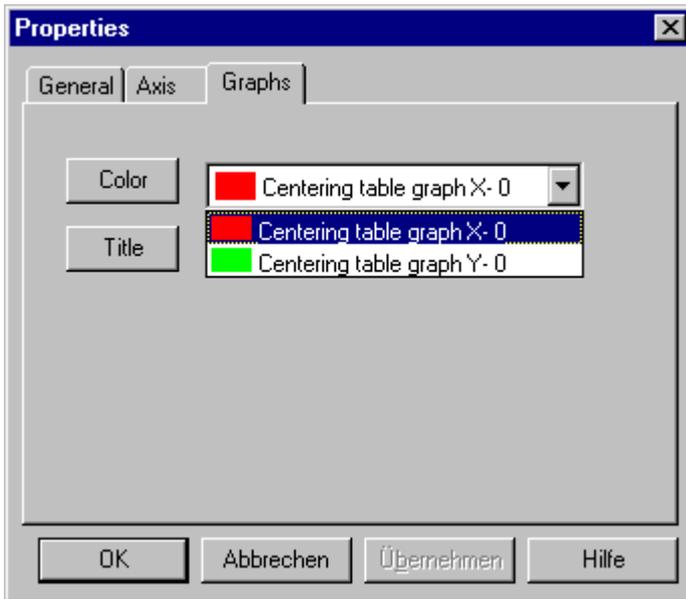


Fig. 18: Properties Dialog Box for the Context Menu for Graphs, Graphs tab  
Here the colours (*Color*) and the title (*Title*) of the graphs (here the centering characteristics) can be changed. The graph to which the setting relates is selected using the combo box.

## CNC Axes tab

Fig. 21 shows the *CNC Axes* tab. This is only available if *FXEControl* is connected to the PLC for a FEIN-FOCUS X-Ray System with manipulator (not on pure *FXE* X-Ray Systems). Using the controls on this tab, all key manipulator functions can be controlled.

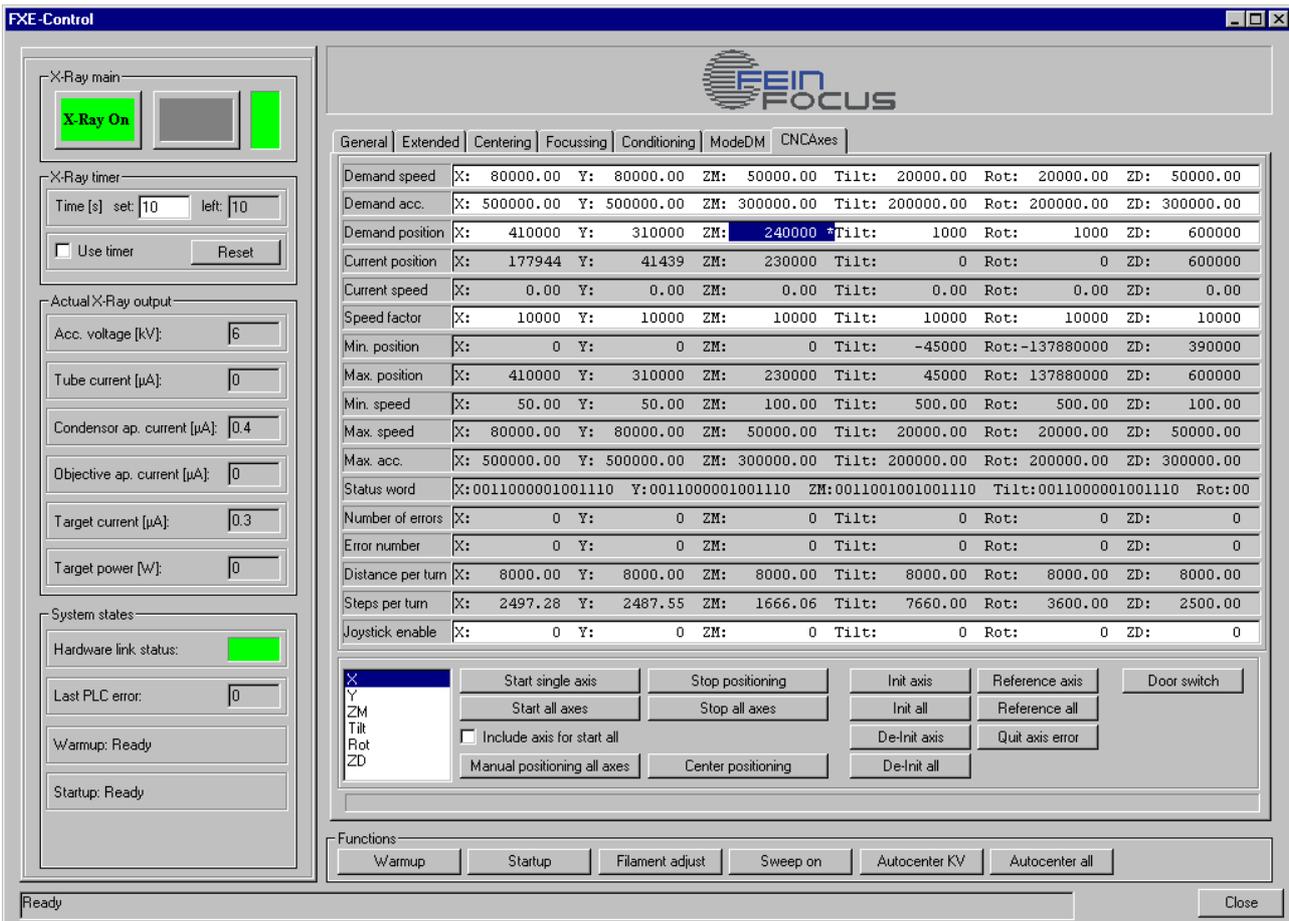


Fig. 21: *CNC AXES* Tab

### Edit and display fields for axis variables

Using the edit controls the setpoints for position, speed and acceleration for each manipulator axis can be specified. The entries must be accepted using *<RETURN>*. In addition, actual values for positions and speeds are displayed along with error numbers, numbers of errors, and statuses. The edit control *Joystick enable* is currently used only by FOX systems. The joysticks of the operating panel of the FOX system can be ebaled / disabled with these edit controls.

### List box for axis selection

The commands for a single axis (buttons .. *single axis..*) refer to the selection in this list box.

### Buttons for axis commands

#### Init Axis button

Initialisation of the axis. Initialisation means here that certain parameters are transmitted from the PLC to the drive amplifier and the axis switched on. Only after the axis has been initialised is it possible to perform a movement command.

#### Init all button

Initialisation of all axes.

**De-Init axis button**

De-initialises the axis (switches it off).

**De-Init all button**

De-initialisation of all axes.

**Start single axis button**

Sends a movement command for absolute positioning at the position in the *Demand position* edit control given for the axis selected with the list box. The setpoints for the speed and acceleration for the movement command are also taken from the related edit controls for the axis in the *Demand speed* and *Demand acc.* edit controls.

**Start all axes**

Sends a move command for the absolute positioning of all axes. The setpoints for positions, speed and acceleration are taken from the edit controls *Demand position*, *Demand speed* and *Demand acc.*. In order to actually move an axis with this command, an activate flag has to be set (see below).

**Check box Include axis for start all**

An activate flag for the axis selected with the List box is set with this check box. Only if this flag is set, the axis will move after sending the *Start all axes* command.

**Stop positioning button**

Interrupts the positioning of the axis selected with the list box.

**Stop all axes button**

Interrupts the positioning of all axes.

**Reference axis button**

Starts a reference run for the axis selected with the list box. After the PLC is switched on, a reference run must first be made before movement commands can be sent.

**Reference all**

Starts referencng runs for all axes.

**Manual positioning button**

Performs a movement command on the axis without a specific destination position. If the movement command is not interrupted using *Stop positioning* or *Stop all axes* the manipulator moves to the end position for the axis. The end position is defined in the configuration data for the PLC. The speed can be modified during the movement of the axis using the *Speed factor* values.

**Quit error button**

Resets an error that has occurred on the axis selected with the edit control, see the *Number of errors* edit control related to the axis.

**Center positioning button**

Moves the manipulator to its central position.

**Door switch button**

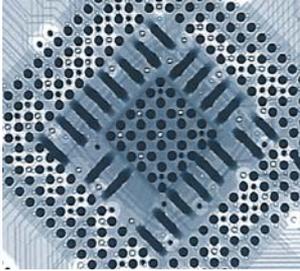
Button for opening/closing the door on the X-ray chamber.

## Using the specialised edit controls

For adjusting some values such as *Voltage [kV]* (0) there are specialised edit controls in *FXEControl*. On the entry of values in these edit controls, the values are not sent immediately to the PLC, but only after acceptance using the *<RETURN>* key. The reason for this is that changes to values in the PLC require a certain amount of time (approx. 20 to 50 ms) and are therefore only to be performed when expressly required by the user. In addition, the background colour for the edit control is used to indicate whether the value has been sent to the PLC since it was changed.

- If the value displayed matches the value in the PLC, the edit control has a light blue background.
- After changes are made, the background colour of the edit control changes to orange.
- The background colour remains orange until one of the following conditions is met:
  - The change is accepted using *<RETURN>* and thus written to the PLC.
  - The edit control loses the focus (i.e. a different control is selected), in this case the change is rejected and the previously valid value displayed again.
  - The change is rejected by pressing the *<Esc>* key and the previously valid value is displayed again.

## Notice



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