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1 Introduction
This document is a collection of the documentation of the freeware available for the TEM microscope. Before using the software, please refer to the copyright and liability limitation below.

1.1 Copyright and liability limitation
Please note:
- TEM Freeware is freeware and may be distributed and used freely.
- The copyright of the TEM Freeware lies with Mad Max Software.
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2 TEM Account Log

2.1 Introduction
The TEM Account Log software automatically monitors use of the TEM microscope, starting when you log in to Windows and closing when you log off again. You cannot close the program but only minimize it. The program will close automatically when you log off from Windows.

2.2 The main window

The window contains information about the current microscope session. The system assumes that you will work with one or more project codes (up to 60 characters). The project codes normally used are inserted in the drop-down list. The selection in the list is set automatically to your choice during the previous microscope session.

Project codes can be added to the list by typing the code in the edit control to the right of the Add code button. Press the Add code (which becomes enabled when values are entered) to enter the new code in the list. The software checks against duplication of codes already present.

To delete project code(s) no longer needed, select the required code in the drop-down list, then press the Delete code button.

Because the data are logged only when you log off from Windows, you cannot use more than one project code during a session. If it is necessary to use more than project code, you must log off from Windows after work under the first project code is finished (the data are then logged), then log on again and use the other project code.
2.3 Overview

You can get an overview of your microscope usage as logged. The overview is taken from the date given (in the edit controls to the right of the Show overview button). Default setting is the first of the current month.

The overview window contains two sets of data

On the left-hand side is a list of the individual entries. These entries are sorted initially on date, but they can be sorted differently by pressing the button at the top of the column that is to be the criterion for the sorting. Press the same button again and the sorting reverses its order (from e.g. a..z to z..a). On the right-hand side is a display of the totals per project code (taken from the date defined in the main window).

There is no printing function provided, but the totals can easily be copied over to Notepad. Click with the right-hand mouse button in the right-hand text part and choose Select all, then Copy in the popup menu. Then paste into Notepad.
3 Big Screen

3.1 Introduction
Big Screen is an application that can be used to fill the 'data' space of the TEM User Interface (in case there is no other useful information, like CCD or STEM images, to be found there), displaying a selection of microscope settings with a large, easy-readable font, and with a user-selectable foreground (font) and background color, to reduce ambient light from the monitor from interfering with TEM work at low light-level conditions.

3.2 General principles
An essential control for Big Screen is the right-mouse click (click with the right-hand mouse button). This will bring up a popup menu with various controls for Big Screen.

The Big Screen window can contain up to three panels, one for Optics parameters, one for Stage parameters and the third for Various parameters. These panels can be resized at will by dragging the splitters between them to other positions. The parameters displayed are adjusted automatically, centered horizontally in their panel and with equal spacing in the vertical direction. Big Screen does not check and see if there is enough space available for displaying all labels. It is up to you to define the size of the panels and size of the font to make sure the labels do not overlap and are visible.

In principle Big Screen can be run even if the TEM User Interface is not running. There is, however, little point in doing so, since the Control Pads (with the buttons and knobs) are disabled when the TEM User Interface is closed. If the TEM User Interface is closed, locking the Big Screen window to the 'data' space has no effect (apart from making the window non-sizeable).

Big Screen will store and recall user's individual settings.

3.3 Popup menu
The popup menu (which appears when the right-hand mouse button is clicked inside the Big Screen window) contains six categories of items that control Big Screen:
- Display
- Optics parameters
- Stage parameters
- Window position and size
- Help access

<table>
<thead>
<tr>
<th>Show color selection</th>
<th>Magnification</th>
<th>Mode</th>
<th>Spotsize</th>
<th>Defocus</th>
<th>Focus step</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select font</td>
<td>Lock to 'data' space</td>
<td>Always on top</td>
<td>Show help</td>
<td>F1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.4 Display

The display settings that can be chosen are the colors of foreground (font) and background and the size and type of the font used for displaying the microscope parameters. The colors can be selected by making the color selection bar visible. This bar will be displayed on the left-hand side of the Big Screen window and contains the colors available. Two of the fields will contain labels, 'FG' and 'BG' (foreground/font and background). To change the foreground color, click with the left-hand mouse button in the color field required. To change the background color, click with the right-hand mouse button in the color field required. You can also select the foreground color in the font selection dialog.

The Select font item of the popup menu brings up the Font selection dialog wherein the type of font, size and color can be selected. The font color is the same thing as the foreground color.

3.5 Optics parameters

Six optics parameters can be selected for display, magnification (or camera length), microscope mode, spot size, intensity setting and defocus value. If none of these values is selected, the Optics panel will not be visible.

80000 x
HM-STEM
Spot size 3
Defocus 0.000 um
Focus step 5
3.6 Stage parameters

The stage parameters that can be selected for display are all relevant axes. The b tilt axis is only displayed if a double-tilt holder is present. If stage parameters is not selected, the Stage panel will not be visible.

<table>
<thead>
<tr>
<th>Stage</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>112.36 um</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>-254.25 um</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>-65.25 um</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>25.12°</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>-1.21°</td>
<td></td>
</tr>
</tbody>
</table>

3.7 Window position and size

The Big Screen window can be locked to the 'data' space of the TEM User Interface (the empty space left over by the user interface in its various display modes). If the display of the TEM User Interface is changed and the Big Screen window is locked, the size of the Big Screen window is adjusted automatically. When locked, the Big Screen window cannot be resized (though it can be moved around).

You can also check the ‘Always on top’ item. If checked, the window will remain on top of other windows.

3.8 Help access

By selecting the Show help item of the popup menu (or pressing the F1 function key) the help file is displayed.
4 Preset Magnifications

The Preset Magnifications Control Panel provides rapid switching between a number (up to six) of user-defined magnifications through the user buttons (L1..L3, R1..R3) on the TEM Control Pads. When a previously defined setting (consisting of Magnification, Intensity setting and Spot size) are active, a press of the associated user button switches the microscope to those settings. The Preset Magnifications function thus assists in work on the microscope where a fixed set of magnifications is used repeatedly (as e.g. in diagnostic screening).

The operation is as follows:

- Press Active if the button is gray to activate Preset Magnifications.
- Decide which user button to use and check the check box for that user button.
- Press the associated Define button (which becomes yellow). The software asks to select the required magnification, intensity setting and spot size.
- Press the Define button again (button goes back to normal). The settings are now defined.
- To go back to these settings, press the user button on the TEM Control Pad.

To redefine the settings under a user button:
- Press the required user button.
- Press the associated Define button (which becomes yellow again).
- Change the settings and press the Define button again.

Settings are user-specific and stored automatically when the TEM User Interface is closed and recalled when it is re-opened. First-time users get the settings as defined by the Supervisor (Note: only Supervisor, not Service or Factory), if available.

Note: Preset Magnifications requires TEM Scripting on the microscope.

Active button

The active button determines whether the Preset Magnifications are assigned to the user buttons. The function is active when the button is yellow, inactive when it has the normal button color.

Automatic

When the Automatic check box is checked, the Preset Magnifications function automatically becomes activated when the TEM User Interface is started (if not, it only becomes active once the Active button is pressed).

User button check box

The check boxes determine whether a particular user button is used. To activate a user button, check the box and define the settings. To deactivate, click on the check box to remove the check.

Magnifications

For active user buttons the magnifications used are displayed in a list to the right of the check boxes.
Define buttons
The Define buttons allow definition of the microscope settings associated with a user button. For the procedure, see above.

Instructions
The instructions field at the bottom will display instructions on how to proceed, or a status description or error message.
5 Screen Saver

The TEM Screen Saver can be used as an easy check on the status of an unattended microscope (provided a user is logged on).

The TEM Screen Saver (called TEM Vacuum Saver in the Display Properties) acts as a normal screen saver and has three modes of display:

1. There is no connection to the Tem server: the display states Not connected to TEM server and draws red octagons.
2. There is a connection to the Tem server and the column valves are closed: the display states Column valves closed and draws green balls.
3. There is a connection to the Tem server and the column valves are open: the display states Column valves open and draws red octagons.

There is no automatic preview in the small “monitor” in the Display Properties, but the Preview button will start a screen saver preview.
6 Serial Sections

6.1 Introduction

The serial section software provides an automatic way of retrieving one or more locations within a series of sections by driving the CompuStage to each location as directed by the user. The software is a separate application that you can find in the Start menu under Programs\TEM.

The serial section software assumes that the specimen contains a number of sections cut from a single block. Each of the sections can be defined and the software can then determine equivalent locations for each section. In this way a three-dimensional impression of the specimen can be obtained, e.g. by recording images for a particular location in each section and combining all these images.

The method used by the software is as follows. A first section must be defined by moving each of the four corners of the section (or specially applied marker points near the corners such as laser-drilled reference holes) with the specimen stage to the screen center (at which point the software will read the stage locations). The four points must always be in a certain sequence. The first two points define the baseline. By definition, this is the bottom of the cutting block which must be as perpendicular as possible to the cutting direction. The third point is one (the best defined) of the corners at the top of the section. Point four is used only for display purposes and needs to be defined only for the first section (its position is calculated for all other sections).

From these data the software determines a number of variables for each section:

- the **baseline rotation angle** (the slope of the line through points 1 and 2)
- the **baseline stretch factor** (the ratio of the distances between points 1 and 2 in any section and that in the first section). Although not critical for the performance of the software, under normal circumstances the baseline stretch should be very close to 1.0
- the **perpendicular stretch factor** (the ratio of the projection of point 3 onto the baseline in any section and the same projection in the first section). In practice this factor can vary quite a bit.

After a first section is defined, locations can be stored or other sections can be defined (locations can be stored in any section and at any stage of using the software). For each subsequent section, the three relevant corners (1 through 3) must defined as for the first section. Locations are stored by centering them on the screen and selecting the relevant function (Location, Insert).

Once a sufficient set of data has been defined, the software can be instructed to move from section to section (where it will go to equivalent locations for each section) or from location to location within each section. Location-section combinations can be marked as visited to allow the operator to keep track of what has been done (an unmarked location is shown as a red number, a marked one as a black number on a green background). The software can display an overview of the visits status. Marking as visited
can be automatic when the program is instructed to go to a location for a particular section or by active selection by the operator. The choice between automatic or user marking is done under Control options.

Stored locations are either defined in the first section or, when the operator stores a location while on another section, the stored location X,Y values are calculated back to the equivalent location in the first section.

The location recalculation method works as follows:
1. determine the length of the projection of the location onto the baseline along the perpendicular and the distance of the projection point on the baseline from point 1.
2. determine for the current section the point on the baseline, adjusted for the baseline rotation and baseline stretch.
3. project the location from the point of the baseline along the perpendicular, adjusted for the perpendicular stretch.

**Note:** The method used for calculating the point assumes that any change in location position is wholly determined by a baseline stretch and a perpendicular stretch. The implication is that the cutting direction must be nearly or wholly perpendicular to the baseline. If the stretching due to the cutting deviates significantly from the perpendicular, the software will not work properly. **This methodology has been adopted on purpose because there is in the three or four corner points insufficient accuracy to determine a variable cutting direction.**

### 6.2 Location

A Stored location is any location at which the operator presses the Insert key or selects Insert from Location menu. If use labels (see Control Options) is active, a dialog will appear asking the operator to enter the label (a string with a maximum of 120 characters) for the location.

The number of stored locations that the program can handle is limited only by the amount of memory available on the computer. However, the program will not mark locations visited for more than 64 locations (per section).

### 6.3 Section

A Section represents a piece of tissue on the specimen. Each section is defined by three corner points, the first two defining the baseline (the bottom of the block where the knife hits first), the third one of the upper corners (the best defined of the two).

The fourth corner is set only for the first section and is used only to allow display of the section shape on the screen.

If a section is represented by a single X,Y value (e.g. under Show section or Goto section), that value is the center of the section, defined as the X and Y values that lie halfway between the lowest and highest values for all four corners.
### 6.4 Overview

It can be difficult to keep track of which location in which section has been inspected or recorded. The software therefore marks location-section combinations as visited (either automatically or by operator selection).

Sections are plotted vertically, locations horizontally. Green section-location combinations have been marked as visited. If the left-hand mouse button is double-clicked on any rectangle representing a section-location combination, the program will bring up a dialog giving the information about the location indicated. If the button Go there is pressed, the program will move the specimen stage to that section-location combination (and mark the location as visited if automatic marking is switched on).

If the Print button is pressed in the Status overview dialog, the overview is printed. Note that the print-out may spread over several pages if many locations have been stored.

The maximum number of locations for the program keeps track of having been visited is 64, the maximum number of sections is 200.
6.5 Menu
The menu contains six main items, File, Setup, Section, Location, Display and Help. Depending on the current status of the program, some of the items may be grayed (inactive).

6.5.1 File menu
The File Menu provides the operations that are concerned with Data and Settings files as well as Printing.

- **New specimen**
  Resets all series settings (section, location definitions, status) as currently defined and makes ready for a new specimen.

- **Open**
  Opens an existing data file allowing continuing working with the specimen. To allow accurate restoring of stage coordinates use reference points.

- **Save**
  Saves the currently defined series settings into a data file.

- **Save As**
  Same as Save but allowing change of file name.

- **Control options**
  Leads to control options dialog.

- **Default settings**
  Resets settings to default values for program.

- **Print Screen**
  Prints the graphical display.

- **Print List**
  Prints a complete list of all sections and all locations per section.

- **Printer setup**
  Leads to the Printer setup dialog (e.g. for selecting Landscape printing).

- **Exit**
  Exits the program.

6.5.2 Setup menu
In the Setup Menu, the operator defines reference points. It is also possible to move the stage to 0,0 before or during work on a specimen.

- **Reference points**
  Starts procedure for storing reference points (new file) or finding back old points (stored data on old file).

- **Show rf. pt. data**
  After reference points from an old file have been found again, the program can display the relation between old and new reference points, such as rotation angle and relative shifts.

- **Stage to center**
  Moves the specimen stage to 0,0.
6.5.3 Section menu
In the Section Menu, the functions concerning the sections are found.

Insert
Starts the procedure for defining a new section.

Delete
Presents a list of sections (as serial numbers plus the section center) from which one or more sections can be selected for deletion. If a section is marked for deletion accidentally, click again on the section and the highlight will be removed. If only one section is defined as yet, that first section definition will be deleted.

Delete All
Deletes all sections currently defined.

Show section
Brings up an overview of all data concerning the current section (corner positions, rotation angle, baseline and perpendicular stretch factors). Pressing the Go there button instructs the program to move the stage to the section selected (either to the currently active location or to the section center; the latter if no location has been stored yet).

Goto section
Present a list of sections (as serial numbers plus the section center). If one of these sections is selected and OK is pressed, the stage is moved to that section (either to the currently active location or to the section center; the latter if no location has been stored yet).

Next section
Move the stage to the next section (either to the currently active location or to the section center; the latter if no location has been stored yet). The menu item is grayed if no next section exists.

Previous section
Move the stage to the previous section (either to the currently active location or to the section center; the latter if no location has been stored yet). The menu item is grayed if no previous section exists.

Status overview
Displays an overview of section-location combinations visited.

Mark location
Marks a location as visited. The menu item is enabled only if User mark has been selected under Control options.
6.5.4 Location menu
The Location menu contains a number of functions that are related to the locations stored.

Note: A hidden function is present in the program if hyperlabels are (see under Control options): Clicking with the left-hand mouse button on a stored location will bring up a dialog with data (X, Y, label) of the stored location if such a location is near. Pressing the button Goto there will move the stage to the location.

Insert
Inserts the current stage location in the stored list.

Delete
Presents a list of locations (as serial numbers plus the label) from which one or more locations can be selected for deletion. If a location is marked for deletion accidentally, click again on the location and the highlight will be removed.

Delete All
Deletes all stored locations.

Display list
Displays a list with all stored locations (X, Y, label) for the current section and allows printing of the list.

Show number
Shows a list of stored locations (with number and label) for the current section, allowing selection of one location for which the data (X, Y, label) will be shown. A button Goto allows moving the stage to the stored location.

Goto number
Shows a list of stored locations (with number and label) for the current section, allowing selection of one location where the stage will be moved.

6.5.5 Display menu
The Display Menu allows the operator to select the method of displaying the section and location data on the monitor. The active selections are checked.

Current section
Displays the currently active section. The numbers of the current section and current location are displayed top left. Locations are shown as red (not visited) or black on green numbers (visited). A scale bar is shown at bottom right. If hyperlabels are used (see Control options), it is possible to display the data of each location (X, Y position and label) by clicking on it with the left-hand mouse button. If the button Goto is pressed, the stage is moved to the location.

Overview
Displays an overview of all sections.

Whole specimen
Displays the sections in relation to the whole specimen.

For current section:
Baseline
Displays the current section with the baseline horizontally on the monitor.

Screen orientation
Displays the current section in its orientation as on the TEM microscope’s viewing screen for the currently active magnification.

Stage X,Y axes
Shows the current section with the stage X axis horizontal and the Y axis vertical.
6.5.6 Help menu

Show Brings up the Help file. Pressing the F1 function key is equivalent.

About Brings up the program About box with version and copyright information.

6.6 Control options

Control options (under Setup menu) allow the operator to choose how to use the Serial Sections software. The options are:

- Whether the grid used is a so-called relocatable grid (a grid with a special "ear" on one side that allows it to be fitted into the single-tilt specimen holder of the CompuStage in only one way).
- Whether to use labels (a user-defined string) for stored locations.
- Whether to use hyperlabels. Hyperlabels are "hyperlinked" labels of the locations in a section. The labels will flash blue when the cursor moves over them and when clicked will bring up a dialog with information about the location with a button that allows a direct Goto to the location.
- Whether to mark locations as visited automatically when the program is instructed to move the stage there (By visit) or whether the marking only takes places when the user selects Mark location in the Section menu.
- The colors of the various items on the display: background, foreground (outline of sections and text at top left), sections, locations and current stage location. The definition of these colors is through a standard color definition dialog.

6.7 Reference points

Reference points are locations on the specimen that are easily recognized and can be used as reference when the specimen is removed from the specimen holder and later put back in again. By finding the reference points again, the program can recalculate the old locations to new ones.
Reference points should be located close to but not at the periphery of the specimen. Locations further from the center increase the accuracy of relocation but if a reference point later lies outside the reach of the stage, it is not possible to recalculate the old locations to new ones. Because specimens are often shifted up to 0.2 mm when re-inserted into the specimen holder, keep the reference points less than 800 um away from the center.

Setting the reference points can be done at any stage of working with the Serial Section software (but before the data are saved into a file, otherwise the reference points are not included in the file). When an old file containing reference points is opened, the software will ask to redo the reference points immediately. If the reference points are not redone at this stage, the software will display the stored locations in their original configuration. It is then no longer possible to redo the reference points (unless by reading in the file again).

6.7.1 Setting reference points for new data

During the procedure wherein new reference points are defined, the operator is asked to drive the stage to 2 or 3 points that can be recognized. It is suggested to avoid points that lie on the opposite side of the center as this will make it much more difficult to decide later whether the specimen has been reloaded in the same way or upside down. If at least two points are defined lying at an angle of about 120°, then it will be easier to decide. Three points make recognition of an upside-down position of the specimen even easier. If no third reference point is to be set, then simply press OK while keeping the specimen stage at the same location as for point 2. The third point will then be ignored.

6.7.2 Redoing reference points for old data

If an old file containing reference points is reopened, the software will suggest to go through the procedure for relocating the old reference points. The software will show the distribution of the old reference points and list the label of each point in turn. The reference point locations will be updated with the new ones, once a reference point has been found again.

During this procedure the software can assist in finding back the old reference points through the Assist function. The Assist function will list a number of possibilities depending on which reference points must be found again:
- move the specimen stage to the old location for point 1
- move the specimen stage in a circle, around 0,0 for point 1, around 1 for point 2, etc.
- calculate alternative locations for points 2 and 3 on the assumption that the specimen is upside down

After finding reference point 1, the software will calculate what the most likely new location is for reference point 2 and ask if the stage must be driven there. The same is done for point 3 (if a third reference point had been set originally).

For each reference point found back as well as the whole set of the reference points the software will go through a number of consistency checks (distances between old points and new points comparable, angles from the center of gravity of the old three-point triangle and old points and the center of gravity of the new three-point triangle and new points comparable).

The software can handle rotation, shift and mounting upside down of the specimen. The software also calculates a 'stretch' parameter that is related to the percentage difference in dimensions between old
and new reference points. The software cannot however accommodate severe distortions due to bending of the specimen, so some care should be taken to ensure the integrity of the specimen. The various values can be displayed under Show ref. pt. data.

### 6.8 Section data display

The Section data display dialogs shows the data for the section selected.

![Section data dialog](image)

<table>
<thead>
<tr>
<th>Section number</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.02</td>
<td>-100.01</td>
</tr>
<tr>
<td>2</td>
<td>0.02</td>
<td>-200.01</td>
</tr>
<tr>
<td>3</td>
<td>80.02</td>
<td>-190.01</td>
</tr>
<tr>
<td>4</td>
<td>70.02</td>
<td>-110.01</td>
</tr>
</tbody>
</table>

Rotation: 270.00°
Perpendicular stretch: 100.00%
Baseline stretch: 100.00%

These data consist of the X,Y positions of the four corners, the rotation angle of the baseline, and the perpendicular and baseline stretch values.
6.9 Select section

For selecting a section (a single section for go to or one or more sections for deleting) the software brings up the Select section or Delete section dialog. The two dialogs are similar in operation, the main differences being the text of the main button (OK or Delete) and the possibility of multiple section selection (use Ctrl+Click or Shift+Click; Ctrl+Click on an already selected - that is, highlighted - section, will remove the selection again).
6.10 Location list

The Display list item of the Location menu displays a list with all stored locations (X, Y, label) for the current section and allows printing of the list.

<table>
<thead>
<tr>
<th>No.</th>
<th>X</th>
<th>Y</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.021</td>
<td>-110.009</td>
<td>Test 1</td>
</tr>
<tr>
<td>2</td>
<td>20.022</td>
<td>-120.008</td>
<td>Test 2</td>
</tr>
<tr>
<td>3</td>
<td>30.023</td>
<td>-130.007</td>
<td>Test 3</td>
</tr>
<tr>
<td>4</td>
<td>40.025</td>
<td>-140.006</td>
<td>Test 4</td>
</tr>
<tr>
<td>5</td>
<td>50.026</td>
<td>-150.005</td>
<td>Test 5</td>
</tr>
<tr>
<td>6</td>
<td>60.027</td>
<td>-160.004</td>
<td>Test 6</td>
</tr>
<tr>
<td>7</td>
<td>0.020</td>
<td>-100.010</td>
<td>Test 7</td>
</tr>
</tbody>
</table>

OK  Print

6.11 Select location

For selecting a location (a single location for go to or one or more locations for deleting) the software brings up the Select location or Delete location dialog. The two dialogs are similar in operation, the main differences being the text of the main button (OK or Delete) and the possibility of multiple location selection (use Ctrl+Click or Shift+Click; Ctrl+Click on an already selected - that is, highlighted - location, will remove the selection again).

Select location

<table>
<thead>
<tr>
<th>No.</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Test 1</td>
</tr>
<tr>
<td>2</td>
<td>Test 2</td>
</tr>
<tr>
<td>3</td>
<td>Test 3</td>
</tr>
<tr>
<td>4</td>
<td>Test 4</td>
</tr>
<tr>
<td>5</td>
<td>Test 5</td>
</tr>
<tr>
<td>6</td>
<td>Test 6</td>
</tr>
<tr>
<td>7</td>
<td>Test 7</td>
</tr>
</tbody>
</table>

OK  Cancel

Delete location

<table>
<thead>
<tr>
<th>No.</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Test 1</td>
</tr>
<tr>
<td>2</td>
<td>Test 2</td>
</tr>
<tr>
<td>3</td>
<td>Test 3</td>
</tr>
<tr>
<td>4</td>
<td>Test 4</td>
</tr>
<tr>
<td>5</td>
<td>Test 5</td>
</tr>
<tr>
<td>6</td>
<td>Test 6</td>
</tr>
<tr>
<td>7</td>
<td>Test 7</td>
</tr>
</tbody>
</table>

Delete  Cancel
7 Vacuum Logger

7.1 Introduction
Vacuum Logger is a program for the TEM microscope that allows logging of vacuum pressures and the high tension condition (disabled, off, on). The logging data are written to a file and, if selected by the user, displayed graphically on the screen. The graph can be printed. Logging files can be read by the program (on-line on the microscope as well as off-line) and displayed graphically. All data logged are in Pascal. The program allows a maximum number of 10000 measurement cycles.

7.2 General principles
There are two modes of operation for Vacuum Logger, on-line and off-line. When starting, Vacuum Logger will attempt to connect to the TEM microscope software. If it succeeds, it will continue with on-line operation. If it fails to connect to the TEM software, it will continue with off-line operation. In the latter case, controls and menu items used for on-line operation will be removed or disabled.

7.2.1 On-line operation
With on-line operation you can:
- Log vacuum system pressures, high-tension status, and vacuum and gun events.
- Obtain a graphical display of selected parameters against time elapsed.
- Read Vacuum Logger files and display their contents graphically.
- Print the graphical display.

7.2.2 Off-line operation
With off-line operation you can:
- Read Vacuum Logger files and display their contents graphically.
- Print the graphical display.

7.3 Program structure
The program contains three elements for controlling the logging and graphical display, the program menu, a panel directly underneath the menu for selection of logging parameters such as logging interval and start/stop date and time, and a panel at the bottom for controlling which elements are displayed graphically. The graphical display itself covers the area between the panels at the top and the bottom.

Vacuum Logger will store and recall user’s individual settings.

7.4 How to run the logging software
Program Vacuum Logger is an application, not a service. This implies that you have to be logged in (to Windows NT) to run the software and that the program will be closed (and thus log no further) when you log out from Windows NT.
7.5 Menu
The menu contains four main items, File, Display, Log and Help.

7.5.1 File menu
New        Defines a new name for the log file. For starting logging this is not strictly necessary as Start always brings up the Save file dialog wherein the filename is defined. If New file has been done, the Save file dialog will not be displayed when Start is pressed.
Open       Opens an existing log file and displays the data graphically. Selecting Open always stops any logging currently being done.
Print      Prints the graphical display.
Printer setup  Leads to the Printer setup dialog (e.g. for selecting Landscape printing).
Exit       Exits the program.

7.5.2 Display menu
Settings    Brings up the Display settings dialog, which allows selection of all display parameters.
Statusbar   Shows or hides the Statusbar wherein display parameters can be defined for individual pressures or high tension.
Lock to data space   The Vacuum Logger window can be locked to the 'data' space of the TEM User Interface (the empty space left over by the user interface in its various display modes). If the display of the TEM User Interface is changed and the Vacuum Logger window is locked, the size of the Vacuum Logger window is adjusted automatically. When locked, the Vacuum Logger window cannot be resized (though it can be moved around).

7.5.3 Log menu
Start/stop  Starts or stops logging. If delayed action is on, the actual measurements will start once the start date and time are past. Otherwise logging starts or stops immediately. You cannot pause logging by start-stop-start, because the second start will require a new filename (or, if you select the previous filename, the previous file is overwritten).
Delayed action When checked, delayed action is on, otherwise it is off. After selecting delayed action, you still have to start logging (but now you start the timer that looks if the start date and time have passed).

7.5.4 Help menu
Show       Brings up this Help file. Pressing the F1 function key is equivalent.
About      Brings up the program About box with version and copyright information.
7.6 Logging parameters
Logging can be done at selected intervals (1, 5, 10, 30 seconds, 1, 5, 10, 30, 60 minutes), selected from the drop-down list in the panel underneath the menu.

Logging can be started and stopped manually or in delayed-action mode. In delayed-action mode the panel contains additional controls for defining Start date and time and Stop date and time. The formatting of date and time must be exactly as indicated (a maximum of two characters for the date, then month, then year, all separated by hyphens; a maximum of two characters for the hour, then a colon, then two characters for the minutes).

Note: It is possible that the 1 second interval is not totally stable and may result in the program hanging (since the logging data are saved for each measurement the logging file will still be accessible). Especially for larger series of measurements (>200 cycles) it is advised not to use the 1 second interval. For this reason it is also not possible to display the vacuum pressures for the log interval of 1 second. If it is necessary to log at 1 second intervals, first collect the log and then read in the log file to obtain a display.

7.7 File
The logging file is a text file. The file starts with a header, which contains the start date and time and a line displaying the names of all vacuum elements measured. The last item is the high tension status. The individual measurements are separated by tabs, making it easy to read the file into spreadsheet programs like Excel (read in as text file).

Below come lines of three different types:
- **Measurement data.** Each measurement is on a separate line, containing the date and time of the measurement. The Event type (listed in the first column) is type 0. The data, separated by tabs, are in Pascal unit, except for the high tension which is 0 (disabled), 1 (off) or 2 (on).
- **Vacuum status events.** These are events triggered by the vacuum system itself and received by the program. These events can come in at any time (not at the specified measuring intervals) and are logged under Event type 1.
- **High tension events.** These are events triggered by the high tension system itself and received by the program. These events can come in at any time (not at the specified measuring intervals) and are logged under Event type 2.

The data logged are always the complete data from the microscope, not just the elements selected for display in the graph.
7.8 Display
The central part of the Vacuum Logger window is reserved for a graphical display of the pressures and high-tension status. The horizontal scale is the true time of the log (thus even if the logging interval is changed during the acquisition, the values will still plot properly along the scale).

- For a display of a file read from disk, the horizontal scale stretches from the start time to the end time.
- During logging, the horizontal scale will start at the start time, but the end of the scale is adjusted in steps. Initially the program will choose an end value for the horizontal scale. Once the logging time has exceeded that value, the scale will be expanded (typically by a factor 2). Since the display width doesn't change, the display of the pressures will jump back halfway. In this way the graphs will appear to 'grow' progressively to the right as logging proceeds, with stepwise adjustments when the horizontal scale becomes too short.

Underneath the display are some parameters.

In the off-line case the top line lists the start time at far left. The corresponding value on the scale is the absolute left-hand point (not a tick that may or may not be centered on the label). The far right right value is the end time of the log and once again the corresponding value is the far right-hand point of the scale. In the center is listed the interval represented by the tick marks. The tick marks are chosen such that they represent unitary (whole) values. This means that the first tick mark in the figure below coincides with the first unit value (1 hour) after the start time, in this case 2:00:00 PM (so not 1 hour after 1:21:21 PM). At the lower line is indicated the number of measurement cycles read from the log file.

<table>
<thead>
<tr>
<th>1:21:21 PM</th>
<th>Ticks : 1 hour</th>
<th>10:12:58 AM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement cycles : 2678</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the on-line case the top line is the same as in the off-line case, showing the start and end times of the scale and the tick mark value. The lower line now shows on the left how many measurement cycles have been done, in the center when the next measurement will take place, and on the right the current system time.

<table>
<thead>
<tr>
<th>7:55:21 PM</th>
<th>Ticks : 1 minute</th>
<th>8:03:41 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement cycle : 7</td>
<td>Next measurement : 7:55:57 PM</td>
<td>7:55:54 PM</td>
</tr>
</tbody>
</table>

7.9 Print
The print from Vacuum Logger will be a close a match to the display with some modifications.

- The height and width of the print-out will be matched to the paper size (Portrait or Landscape) available, while the ratio of height and width will be the same as the display.
- The background of the graph will be white. Light colors such as yellow are made somewhat darker for better printing. It is advised to use a color printer, otherwise it may not be possible to distinguish between multiple lines in the graph.
- The printed graph has a header listing the vacuum elements displayed with their scale value. These labels are in the same colors as the lines and act as legend. If a pressure is displayed with log scale, the label is followed by '(log)' with a number indicating the exponent of the value used for the base.
7.10 Display parameters
Pressures and the high-tension status can be displayed graphically in the display of Vacuum Logger. The display parameters are defined in the Statusbar underneath the display window.

<table>
<thead>
<tr>
<th>Setting</th>
<th>GP1</th>
<th>Display in graph</th>
<th>Scaling factor</th>
<th>Default</th>
<th>100000.00</th>
<th>Log</th>
<th>Color</th>
<th>Green</th>
</tr>
</thead>
</table>

The following controls are present in the Statusbar, from left to right:
- A drop-down list with the settings that can be displayed.
- A checkbox that determines whether a setting is displayed.
- A drop-down list box with a range of scaling factors (used as maximum display values), including Default (set by the program to the maximum value found for the particular setting). All pressures are scaled individually. The high-tension status is scaled from disabled (just above the base line) to off (center) to on (just below the top).
- The value of the maximum of the particular setting. When Default is chosen, this is the maximum value of the display scale.
- A checkbox to select between regular and log scaling.
- A drop-down list box with a selection of colors.

7.10.1 Display settings dialog
In addition to selection of display parameters in the Statusbar, it is also possible to bring up the Display settings dialog, which contains controls for defining the display parameters for all pressures and high tension together.

7.10.2 Log scale
Because of the large range available to the vacuum pressures (from air pressure to values in the range of $10^{-6}$ Pascal), it can be difficult to display a pressure graphically such that fine detail as well as the whole range is visible. Because of this, pressures can be displayed on a log scale.
Since a log scale in principle can go to very small numbers, the minimum of the log scale is not 0 (as it is for the regular scale). Instead the minimum of the log scale is the truncated exponent of the smallest value of the particular pressure. For example, if the pressures range from 99.9 to 1.1, the truncated log value of $1.1 = 0$ will be minimum of the display scale. While a pressure ranging from $3.33 \times 10^{-2}$ to $1.2 \times 10^{-5}$ will have as minimum the truncated log value of $1.2 \times 10^{-5} = -5$. The maximum value is as defined by the user (Default or one of the fixed values).

There is no fixed recipe for determining whether a log scale is useful or not, because it will depend on the pressure range as well as the absolute values. If the pressure range is within a factor 10, a normal scale is more useful. Similarly, a small pressure range can also lead to compression of the graph at the top of the display, for example when there are a few values just inside a lower decade.

The figures above show an example of the effect of plotting a vacuum pressure on a log scale. The regular scale (on the left) is dominated totally by the 'spike' of high pressure and the fine details of the pressure changes are invisible (unless the scale is modified so the 'spike' goes far off the maximum scale. In the log scale display on the right, the fine details are well visible while the 'spike' is still within the whole vertical range.