

# ***Conversion Job Manager***

*Version 1.42*  
*DWL 66 FS*

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## Preface

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This Manual gives an introduction into the DWL66fs variant of the Conversion Job Manager graphical user interface (GUI) controlling the data conversion. The Conversion Job Manager is a very variable tool, which includes a number of functions. To get the best results out of the possibilities the software offers, it is important that the user gets a good understanding of the workings of these functions.

The first two chapters of this manual give general information on the software, and an introduction into the workflow for setting up conversion jobs. In the following chapters, the separate functions are described in more detail, with their settings and options. The last chapter is on utilities for maintenance and troubleshooting. In the appendix, some processes are explained in more detail, and it contains a list of changes issued in newer software versions than the one this Manual is based on.

### ***Related Documentation***

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Heidelberg Instruments offers several further Manuals related to the machine and its operation. If you did not get one of these or need an update, please contact Heidelberg Instruments, Germany.

<b><i>Preinstallation Guide</i></b>	System requirements, sizes and weights of components etc.
<b><i>User Guide, Part I</i></b>	Step by step instructions for general system usage and standard applications
<b><i>User Guide, Part II</i></b>	Reference Manual for functions of the system GUI (User Menu)

## **Contact**

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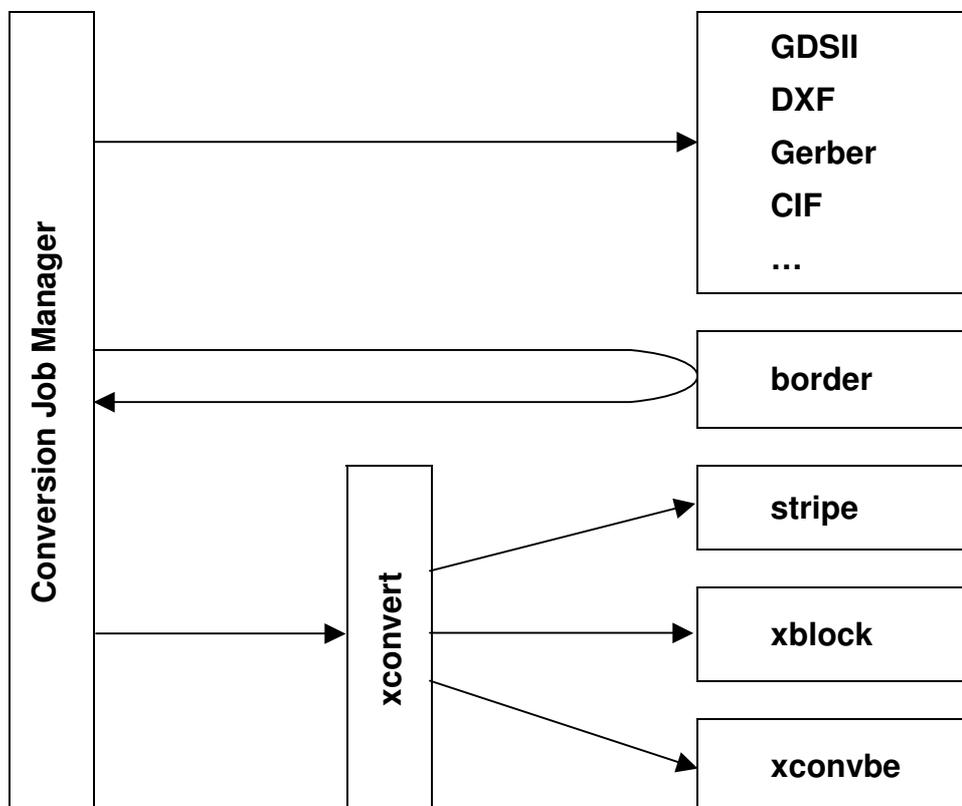
You can also reach Heidelberg Instruments via e-mail: [himt@himt.de](mailto:himt@himt.de), or visit our site on the Internet: <http://www.himt.de>

## Chapter 1: General

The Conversion Software Package consist of the conversion software itself on the one hand, which in itself again is divided into several programs controlled by one master program, and the Conversion Job Manager, a graphical user interface that allows to group parameters for design exposures into logical structures. These structures, and the way the program parts interact with each other, will be explained in the first section of this chapter. The second section gives some rules that have to be fulfilled for a design to make it convertible into the machine internal format, called LIC, which is adapted to the way the system is exposing design information.

### **Conversion Software Structure**

When a design is being converted, two kinds of operations have to be executed on the design: Design modifications according to the options and functions chosen, as well as the fracturing of the design into the units in which the machine is exposing. Ultimately, the data is stored in the LIC data format, which is optimized for fast processing by the system. There are several specialised programs for each step on the way, which are all being controlled by the master conversion program, **Xconvert**. This program in itself is being called on by the **Conversion Job Manager** (“app”), which also accesses some of the programs directly during job setup:



- **gdsii/dxf/gerber/cif/stl:**

Depending on the source data type, the Conversion Job Manager program invokes one of these conversion programs with its corresponding command line parameters. The program called then converts the design data into an intermediate, CIF-like format (HIMT Structure format). After the design is processed, the created HIMT file can be checked with the HIMT viewer software. HIMT files are stored in the ~/structures directory and can also be loaded directly into future jobs.

- **border:**

The border program determines the borders of the design data when a cell is being defined. The result is displayed in the Conversion Job Manager program.

- **stripe:**

The stripe program performs the first step of the Structure-to-LIC conversion and is called only once. The HIMT Structure data is divided into stripes covering the whole height of the design, where the width depends on the stripe width chosen (maximum stripe width is defined by the - configuration dependent - pixel size and the system's maximum number of pixels per scan). Each stripe file contains the Structure design data contained within the rectangle representing the stripe, with design coordinates listed relative to the lower-left corner of the stripe. The stripe files remain in Structure format and are stored in the temporary **stripes** directories.

- **xblock:**

The xblock program performs the second step of the conversion and is called once per stripe file. Each stripe data set is divided into blocks of 4096 pixels height in the y-direction, and the structures are cut according to these blocks. The resulting polygons are then converted into trapezoids and stored in SDF format (Structure Definition Format). Each SDF file contains data for one stripe. The SDF files are stored in the temporary **sdf** directories.

- **xconvbe:**

The xconvbe program is also called once per stripe. It reads in the SDF files, merges (CUTs, ORs or XORs) all layers (if required), and compresses the result into the final LIC format. In addition, spot size correction is executed in the xconvbe program, which is the most time consuming step of the conversion.

## ***Design Rules***

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In order to be correctly processed by the conversion software, designs must fulfill certain rules. Some of them apply to all design formats likewise, while others concern only special features of one specific design type.

### **GENERAL**

#### **THESE RULES APPLY TO ALL DESIGN FORMATS.**

**1. All Polylines must be closed.**

- Some data formats allow automatic closing of polylines
- Be aware of the possible ambiguities of polylines that are incorrectly closed especially, when there is only a little gap between the start and end-point of the polyline
- *Simply avoid any problems by closing polylines.*

**2. All closed polylines will be completely filled-out on the inside.**

- When placing a frame around any areas, make sure that the frame will not shadow all of the structures inside.
- Shadowing structures as a result of framing can only be avoided by using the XOR- mode feature
- See instructions regarding XOR-mode below if structures should be put within structures.

**3. Polylines crossing themselves will produce data errors.**

**4. "Doubled" vertices in polylines (which means the same coordinates are used twice without any other point between them) will produce data errors.**

**5. Single lines without width will be ignored (best case) or will cause the conversion to fail.**

**6. Polygons must show no more than 1,000,000 vertices.**

**7. Definition or reference depth can be at maximum 16.**

**8. The number of definitions or references can be at maximum 100,000.**

**9. Text is not supported (except for DXF).**

**10. Designs must not exceed the limits of 2000mm from (0,0) in either axis.**

## **GDSII**

- 1. The inclusion of other gdsii files or text libraries will be ignored.**
- 2. Node statements in gdsii are ignored.**

Also see the information on available design format options for Gerber in Chapter 3 for more information on the GDSII format.

## **DXF**

- 1. Use a 100% Autocad compatible editor.**
  - Try to load the file to Autocad itself and make sure, the file can be loaded.
- 2. Always join polylines correctly, be especially cautious, when using arcs within a polyline.**
- 3. Only one font is provided with the dxf conversion package.**
  - The dxf standard font will replace any font selected in the DXF-design.
- 4. Only the following attributes assigned to a text are supported: ROTATION, MIRRORING, SCALING.**
- 5. Avoid placing structures in layer 0.**
- 6. Do not use special characters in the layer names.**
- 7. Try to design by means of the metric system.**
  - Use millimeters (mm) as the standard unit (Some design programs will not accept inches!)
- 8. Polylines with widths must not have a change in its widths (tapered lines).**
- 9. Various scaling in x and y when inserting a block is not supported.**
- 10. External blocks are not supported.**
- 11. Try to use only the following entities: CIRCLE, POLYLINE / LWPOLYLINE (with or without width), and TEXT.**
- 12. Although our dxf translator supports newer dxf releases, we recommend to use Release 12.**

Also see the information on available design format options for DXF in Chapter 3 for more information on the DXF format.

## GERBER

1. *RS-274D only*: Always provide a complete set of information including at least the following: apertures used, digits of design data, and base unit (inch or mm).
2. Do not use incremental, but rather absolute coordinates.
3. Avoid using circular interpolation along with polylines and width.
4. Avoid using apertures without dimensions, e.g., circle with a zero diameter.
5. Flashmodeb (D3) remains until another drawing mode is chosen (sometimes called modal).
6. To create area-filled polygons, use the polygon aperture (RS274) or G36/G37 commands (RS274-X, RS274).

Also see the information on available design format options for Gerber in Chapter 3 for more information on the Gerber format.

## CIF

1. Definition or reference depth can be at maximum 50.

Also see the information on available design format options for CIF in Chapter 3 for more information on the CIF format.

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## Chapter 2: Setting up a Job

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The geometric arrangement of controls in the Conversion Job Manager indicates the order in which they have to be dealt with when setting up a conversion job. Always work from left to right, from top to bottom.

The following is an example for the setup of a typical conversion job. It shows the workflow to be followed for creating such a job. For the details concerning the options and parameters set on the way, please refer to the following chapters.

### 1 Startup Linux

Login with user name 'convert' and a password if one is set (factory password setting: 'convert').

### 2 Prepare Design

Copy the design file(s) into the correct directory: CIF files into the subdirectory cif, GDSII files into gdsii, GERBER files into gerber, etc.

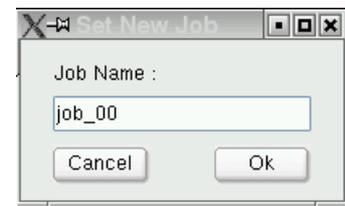
### 3 Start Conversion Job Manager

Start the graphical user interface ("application menu") either by clicking on the symbol on the desktop, or by entering "app" in a shell window.



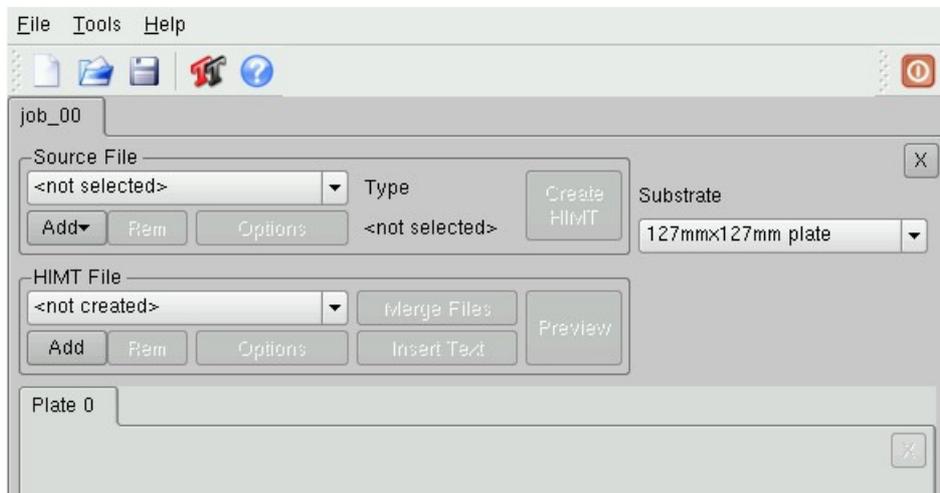
### 4 Create New Job

Press the  icon button to start a new conversion job. In the **Set New Job** window insert a job name. In this example, **job\_00** is used.



## 5 Define Source File(s)

A register card named **job\_00** appears directly below the main menu toolbar:



Here, the first two steps of data conversion are controlled: The conversion into the HIMT structure format in the **Source File** frame, and the modification of structure files (merging, stepping, text insertions, reconversion, viewing) in the **HIMT File** frame. **Note:** To close a job without saving, click on the cross in the upper right corner of the job's register card.

Insert a source file into the drop down list of source files by pressing the **Add** button of the **Source File** frame. A list of available design types appears: GDSII, DXF, Gerber-RS274, and CIF. Choose the design type of the design to be used in the job. A file selection window with the contents of the related directory will pop up, within which the required source file has to be selected. Confirm by clicking on **Open**. The new file is now inserted in the source file list, and the **Design Options** window opens. If later a design should be removed from the list, use the **Rem** button of the Source File frame.

*Note:* Only files for which no structure file was created can be removed.

## 6 Set Design Options

For each design format, different options for design adaptation (e.g., magnification, layer selection, merging, stepping, rotation, mirroring) are available. For explanations on the available options refer to the related **Design Format Options** section.

## 7 Create HIMT File

After all options are set, choose **Create Default**. The design will be translated into the structure format, including the options chosen, and stored under the same name as the design, but without extension. If a different name should be used, choose **Create** and enter a new name in the dialog box.



## 8 Load / Modify HIMT File

Any HIMT File that was translated within a job is automatically added to the HIMT File selection list in that job. In addition, structure files created during other job sessions can be loaded for use in the current job. Click on **Add** to open a window showing the contents of the structure directory. Select a structure, and click on **Open**. The selected HIMT Structure File appears in the selection list and is available as source design. Any design can be removed from the list using the **Rem** button.

If several HIMT Files should be merged to a new file, text should be added to a HIMT File, or a source design should be retranslated using the original options as basis, the functions of the HIMT File frame can be used. Refer to the chapter on **Functions of the HIMT File Frame** for more detailed information.

## 9 Set Substrate Options

In the selection list to the right of the design setup frames, select a substrate size. If the required size is not in the list, it has to be entered in the file Xgui/substrates.txt, and the job has to be restarted.



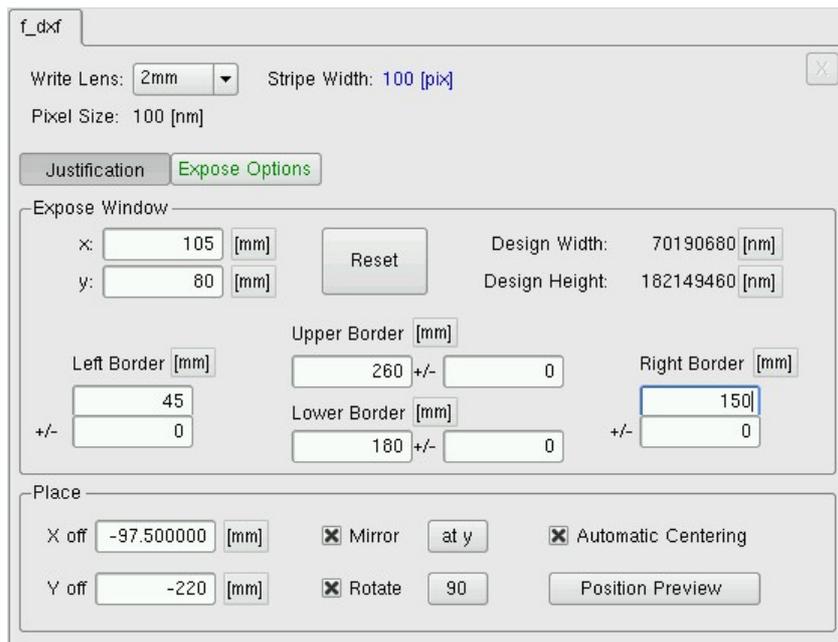
## 10 Set Exposure Parameters

Now it is possible to select all parameters for the conversion of the selected design to the LIC format using the control functions of the design register card. Some displayed parameters are interdependent. If another write lens is selected, the pixel size is automatically updated.



## 11 Check Justification Parameters

Click on **Justification** to activate the justification parameter page of the design cell:



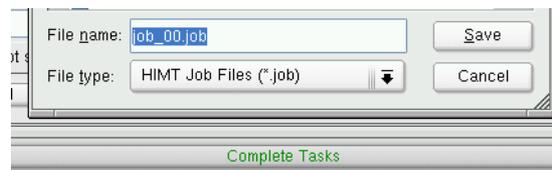
Borders and positioning on the plate are at first automatically taken from the design. To change these, just click into the boxes and enter the new numbers. Several additional options can be activated by selecting the corresponding checkboxes. The button **Position Preview** opens the position preview window where the positioning of the design on the plate can be examined. Refer to the chapter on **Justification Options** and the section on Position Preview in the Utilities chapter for more information.

## 12 Choose Expose Options

Click on **Expose Options** to activate the expose options parameter page. Here, some additional parameters like spot size correction values (CD control) can be adjusted if needed. For more information, refer to the section on **Expose Options**.

## 13 Save Settings to Job File

Once all options are set, press the **Complete Tasks** button to save the conversion job settings and proceed to the expose job setup.

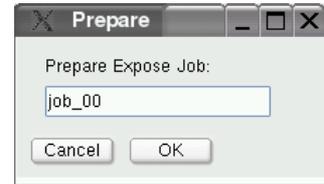


## 14 Start Conversion

In the **Prepare Exposure** window that opens after saving, click on **OK** to proceed to data conversion.

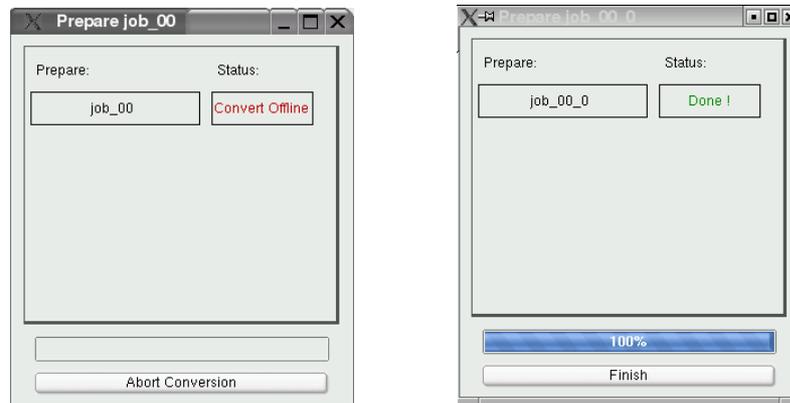
If the LIC data directory that would be created exists already, a window with a proposal for a name change will appear. The name proposed can be changed manually.

Click on **Accept Proposal** to avoid the overwriting and use the new name, or choose **Overwrite All** if overwriting is not critical. **Note:** Expose jobs linked to the original LIC data might fail if it is overwritten with data converted with different options.



## 15 Finish

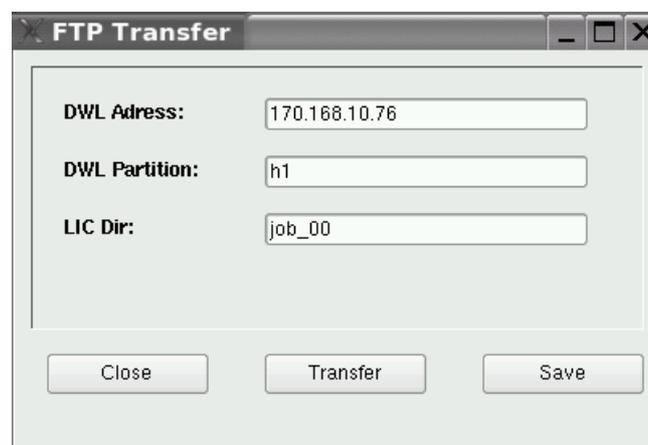
During conversion, a Status Bar shows the current status (Conversion is running / Conversion Finished). Once all tasks are processed successfully, **Close** the status bar and click on the **Finish** button of the Prepare Job window.



## 16 Data Transfer

After conversion, the data can be directly transferred to the DWL66 system. A window opens showing the standard settings for data transfer via FTP. Do any necessary changes to start the transfer, then choose **Transfer**. If the target IP address or target partition was changed, these changes can be stored as default by choosing **Save**. If no transfer should be done, choose **Close**.

**Note:** During exposures, data transfer should be avoided.



## Chapter 3: Design Format Options

Before a format can be converted to the unified HIMT structure format, some options have to be set according to the respective formatting rules and the way they can be transferred to a structure design. The only exception for this is the **Extended Gerber Format (RS-274X)**, where no additional information is needed.

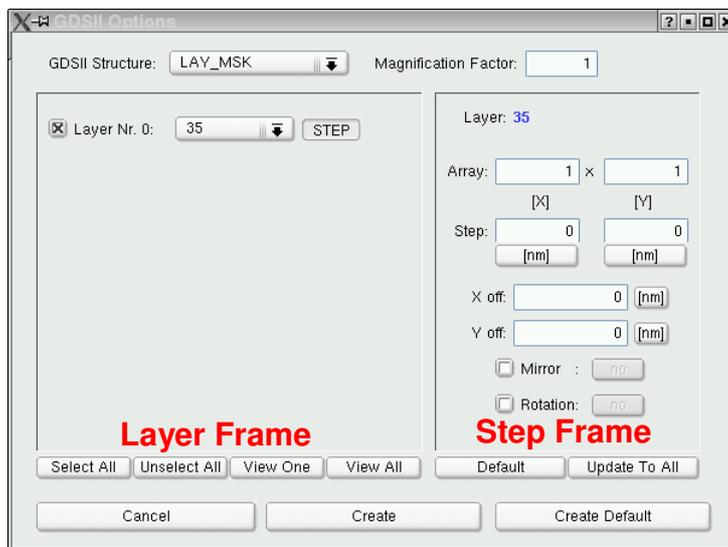
After translation to the structure format, a design can be viewed with the HIMT viewer by clicking on the **Preview** button below the HIMT structure file list to check the result. For more information about the Viewer, please refer to the Viewer section in the Tools chapter further down in this manual.

### GDSII

If a gdsii design file has been chosen as source file, a window opens that shows information about the design, and contains controls to set the available options for design conversion. The **GDSII Structure Name** of the currently active design is given in the drop-down list at the top. If the name given is not the name of the main structure to be used, any of the other structure names in the design can be chosen from the drop-down list.

To the right of the structure name list, a **Magnification** factor for stretching or shrinking the design can be set. The magnification affects the complete design in both axes. Any floating point number is valid.

Further controls to set options for the design layers are located in the two frames below the top row: the **Layer Frame** to the left, and the **Step Frame** to the right. Explanations for these functions follow.



Once all options have been set, press **Create Default** to store the resulting configuration information into the corresponding configuration file **gdsii.cfg** and create an HIMT File with a name extracted from the source file name. If the HIMT File should get a different name e.g, because several HIMT Files with different options are to be created from the same source, click on **Create** and enter a new name in the dialog box. To close the window without saving, press **Cancel**.

## LAYER FRAME OPTIONS AND CONTROLS

In the Layer Frame, a list of the layers present in the design is shown. Each layer is assigned to a layer number and can be selected or deselected by clicking into the leading **Layer Checkbox**. If there is more than one layer, it is also possible to set operations between layers (<or> (default), <cut>, <xor>). For a further explanation of these operations please refer to the **Appendix** section on **Layer Merging**. Also, the order of the layers can be changed by changing the layer names in the drop down list for each layer number.

By pressing the **STEP** button behind a layer name, more options for each layer are activated in the Step Frame to the right of the Layer Frame.

At the bottom of the Layer Frame, control buttons give access to additional functions:

- **(Un)Select All** – all layers in the list are selected or deselected at once
- **View One / All** – either only the first layer or all the layers are shown in the layer list, and activated in the process (checkboxes set to selected).

## STEP FRAME OPTIONS AND CONTROLS

With the controls given in the Step Frame, it is possible to set an array for step-and-repeating a design layer, as well as to mirror, rotate, or shift it. The order of operation is 1) shift and step, 2) rotation, 3) mirroring.

- **Step & Repeat:**
  - **Array** – enter the number of columns (X) and the number of rows (Y) for the grid, according to which the design layer should be stepped.
  - **Step** – set the distances of the rows and columns for the step and repeat function. The unit can be nm,  $\mu\text{m}$  or mm. Click on the unit button to cycle through the available units until the correct one is shown.
- **Other Operations:**
  - **X / Y off** – enter the distances in X and Y by which the layer should be shifted with respect to the origin. Available units are nm,  $\mu\text{m}$  or mm. Click on the unit button to cycle through the units.
  - **Mirror** – activate the option by clicking into the checkbox, then choose the mirroring axis by cycling through the available options using the axis control button (at x / at y).
  - **Rotation** – activate the option by clicking into the checkbox. Available rotation angles are 90°, 180°, and 270° clockwise. Choose the rotation angle by clicking on the rotation angle control button.
- **Controls:**
  - **Default** – loads the default settings for layers (checkboxes deactivated, array 1 x 1)
  - **Update To All** – the current settings will be copied for all layers of the design

## DXF

On selecting a DXF design file, a window opens that shows information about the design, and contains controls to set the available options for design conversion.

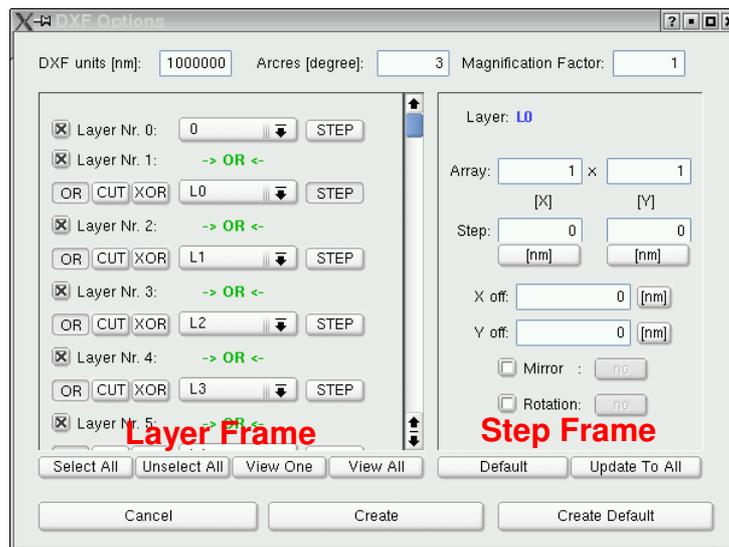
In the top row of the window, the **dxf units** can be set according to the design grid used. The default setting is 1000000 nm per dxf unit. For designs created in an inch grid, the number should be set to 25400000 nm per unit. If any other grid has been used, adjust the number to the distance in nm used per dxf unit.

In the center of the row, the resolution for arcs is being set. The **arcres (arc resolution)** parameter defines the angle unit used when converting arcs to polylines during conversion from DXF to Structure format. For each "arcres" angle unit in an arc, one polyline point is created. The unit is entered in degrees (Range: 0.1 to 20 degrees)

**Note:** The smaller the angle, the better the approximation to an arc, though conversion time increases. A good value is in the range of 3 to 9 degrees.

To the right, a **Magnification** factor for stretching or shrinking the design can be set. The magnification affects the complete design in both axes. Any floating point number is valid.

Further controls to set options for the design layers are located in the two frames below the top row: the Layer Frame to the left, and the Step Frame to the right.



Once all options have been set, press **Create Default** to store the resulting configuration information into the corresponding configuration file **dxf.cfg** and create an HIMT File with a name extracted from the source file name. If the HIMT File should get a different name e.g, because several HIMT Files with different options are to be created from the same source, click on **Create** and enter a new name in the dialog box. To close the window without saving, press **Cancel**.

## LAYER FRAME OPTIONS AND CONTROLS

In the Layer Frame, a list of the layers present in the design is shown. Each layer is assigned to a layer number and can be selected or deselected by clicking into the leading **Layer Checkbox**. If there is more than one layer, it is also possible to set

operations between layers (<or> (default), <cut>, <xor>). For a further explanation of these operations please refer to the **Appendix** section on **Layer Merging**. Also, the order of the layers can be changed by changing the layer names in the drop down list for each layer number.

By pressing the **STEP** button behind a layer name, more options for each layer are activated in the Step Frame to the right of the Layer Frame.

At the bottom of the Layer Frame, control buttons give access to additional functions:

- **(Un)Select All** – all layers in the list are selected or deselected at once
- **View One / All** – either only the first layer or all the layers are shown in the layer list, and activated in the process (checkboxes set to selected).

## STEP FRAME OPTIONS AND CONTROLS

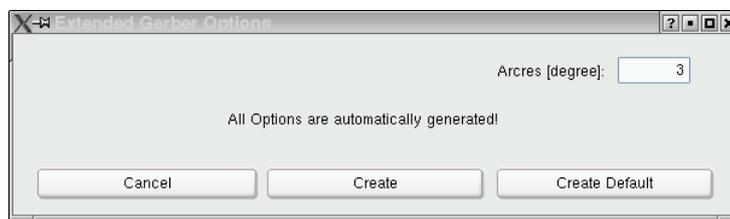
With the controls given in the Step Frame, it is possible to set an array for step-and-repeating a design layer, as well as to mirror, rotate, or shift it. The order of operation is 1) shift and step, 2) rotation, 3) mirroring.

- **Step & Repeat:**
  - **Array** – enter the number of columns (X) and the number of rows (Y) for the grid, according to which the design layer should be stepped.
  - **Step** – set the distances of the rows and columns for the step and repeat function. The unit can be nm,  $\mu\text{m}$  or mm. Click on the unit button to cycle through the available units until the correct one is shown.
- **Other Operations:**
  - **X / Y off** – enter the distances in X and Y by which the layer should be shifted with respect to the origin. Available units are nm,  $\mu\text{m}$  or mm. Click on the unit button to cycle through the units.
  - **Mirror** – activate the option by clicking into the checkbox, then choose the mirroring axis by cycling through the available options using the axis control button (at x / at y).
  - **Rotation** – activate the option by clicking into the checkbox. Available rotation angles are 90°, 180°, and 270° clockwise. Choose the rotation angle by clicking on the rotation angle control button.
- **Controls:**
  - **Default** – loads the default settings for layers (checkboxes deactivated, array 1 x 1)
  - **Update To All** – the current settings will be copied for all layers of the design

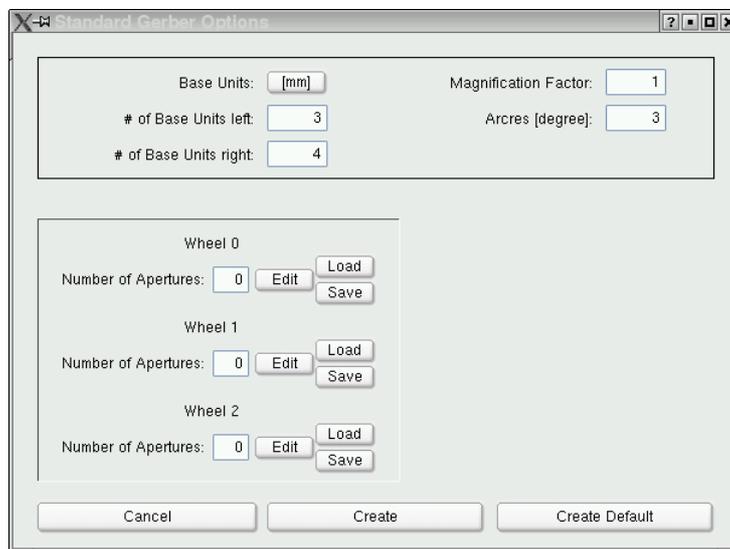
## Gerber

The Conversion Job Manager automatically detects the type of gerber file, and options setup proceeds accordingly.

**Gerber RS-274X (EXT\_GERBER):** After the file has been selected, a message window opens, informing the user that all options are set automatically. An editable text box gives the possibility of changing the arc resolution setting. Press **Create Default** to store the resulting configuration information into the corresponding configuration file **gerber.cfg** and create an HIMT File with a name extracted from the source file name. If the HIMT File should get a different name e.g, because several HIMT Files with different options are to be created from the same source, click on **Create** and enter a new name in the dialog box. To close the window without saving, press **Cancel**.



**Gerber RS-274D (STD\_GERBER):** If a standard gerber file has been selected, a window opens that shows information about the design, and contains controls to set the available options for design conversion.



In the top of the window, some general parameters can be set:

- **Base Units** – by clicking on the control button, the base unit can be changed from mm to inches and back.
- **Magnification Factor** – the complete design will be stretched or shrunk by the factor given here. Any floating point number is valid.
- **# of Base Units left / right** – enter the number of digits to the left and right of the decimal point as used in the design.

Below, after opening the window, a list of three aperture wheels is given with no apertures defined so far. To define the apertures of a wheel, first enter the **Number of Apertures** that wheel should contain, and then click on **Edit**. If a definition file is available from a previous wheel, click on **Load** and select the wheel name.

When editing a wheel, a frame opens to the right of the wheels list, showing a number of definition slots according to the number of apertures entered for the wheel. For each aperture to be defined here, the corresponding **Name of Aperture** in the design has to be entered. Next, the **Type** of aperture has to be chosen, together with the defining parameters, which depend on the aperture type. Four kinds of apertures are supported by the conversion software:

- **C** – Circle; enter **Size** in base units (diameter)
- **S** – Square; enter **Size** in base units (dimension of sides)
- **F** – File; enter **Name** of design file to be used (gerber file). The file entered here can be an arbitrary gerber file; however, the file requires identical settings (units, digits and apertures) to those of the current configuration. The current tool position will be the origin of the design defined in the file given.
- **P** – Polyline; no additional parameters needed.

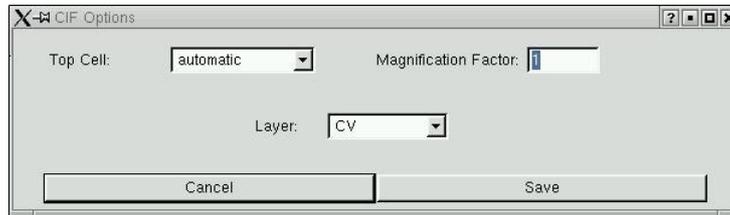
To save the definitions of a particular wheel for future use, click on the corresponding **Save** button in the wheels list and choose a name for the wheel. The definitions will be saved in the conversion home directory under the name given by the user and can be loaded again for a different design by clicking on the **Load** button behind the corresponding wheel in the wheels list.

Press **Create Default** to store the resulting configuration information into the corresponding configuration file **gerber.cfg** and create an HIMT File with a name extracted from the source file name. If the HIMT File should get a different name e.g, because several HIMT Files with different options are to be created from the same source, click on **Create** and enter a new name in the dialog box. To close the window without saving, press **Cancel**.

## **CIF**

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If the selected source file is a CIF design file, a window opens that shows information about the design, and contains controls to set the available options for design conversion.



- **Top Cell** – choose top cell number from the list. If set to automatic, the highest number in the list will be used as top cell.
- **Magnification Factor** – the whole design will be stretched or shrunk by the factor given here. Any floating point number is valid.
- **Layer** – choose from the list which layer should be converted.

Once all options have been set, press **Create Default** to store the resulting configuration information into the conversion configuration file and create an HIMT File with a name extracted from the source file name. If the HIMT File should get a different name e.g, because several HIMT Files with different options are to be created from the same source, click on **Create** and enter a new name in the dialog box. To close the window without saving, press **Cancel**.

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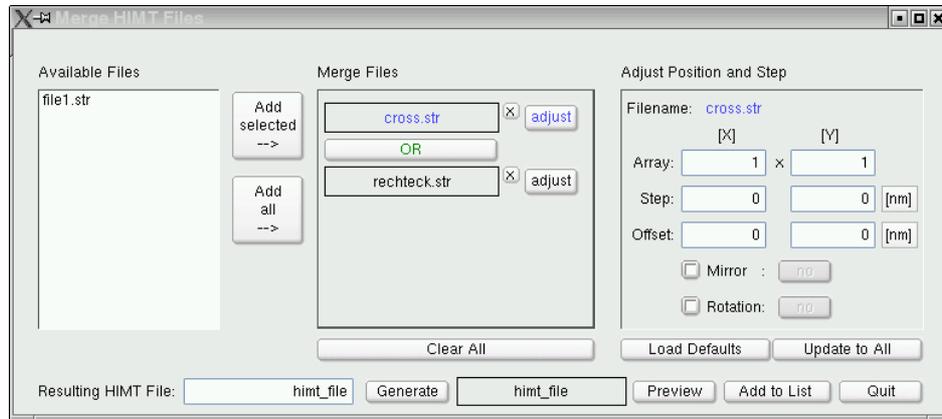
## Chapter 4: Functions of the HIMT Files Frame

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The HIMT File frame serves to directly load existing HIMT structure files into the source list for cells, or to modify designs that were already translated into the structure format. The available functions are:

- **Add** - loads a structure file available in the “structure” directory into the selection list for structure files, as well as the design selection list for cells.
- **Rem** - Removes a structure file from the list. Does not delete the file itself.
- **Options** - Opens a slightly modified Options window for the source file type from which the structure was created, and loads the creation options used. Can be used to create new structure files with similar options but different names (**Create / Create Default**), or to overwrite the existing structure with data created with different options (**Overwrite**).
- **Merge Files** - Regardless of the source format, structure files can be merged and in this window. In addition, structure files can be stepped. Only structure files that were loaded into the file selection list are available for merging and stepping. See below for details.
- **Insert Text** - While text is usually not supported in the source design files, text lines can be added to the HIMT File using this utility. The structure file has to be selected within the selection list before the button is clicked.
- **Preview** - Shows the selected structure file in the HIMT Viewer. See the section on the HIMT Viewer in the Utilities chapter for more detailed information.





## **Merging Structure Files**

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When selecting **Merge Files** in the HIMT File frame, the Merge HIMT Files window opens. This window contains all options available for merging of HIMT Files that were previously loaded into the HIMT File selection list. All files available for merging are listed on the left side of the window. Highlight the files that should be merged and click on **Add selected** to transfer them to the **Merge Files** list. If all available files should be merged, **Add all** can be used to transfer the complete list at once.

After transfer to the Merge File list, a file is automatically marked as selected for merging in the checkbox behind the structure file name. Unchecking the box will exclude the file from the merging process. In addition to the checkbox, a button labeled **adjust** exists for each design in the list. This button activates the **Adjust Position and Step** frame for the corresponding design. In this frame, the design can be shifted with respect to the other designs, or stepped, before merging. Using this frame, the tool can also be used just for stepping of a HIMT File. The step frame offers the same functions as the step frames of the GDSII and DXF Options windows. While the step frame is active for a design, the file name tag and adjust button of that design within the Merge File frame are labeled in blue.

Between the Merge File list entries, a selection button for merging operations appears as soon as the list contains more than one entry. Clicking on the button toggles between the possible operations OR / CUT / XOR. See the **Appendix** section on **Layer Merging** for a more detailed description of these operations.

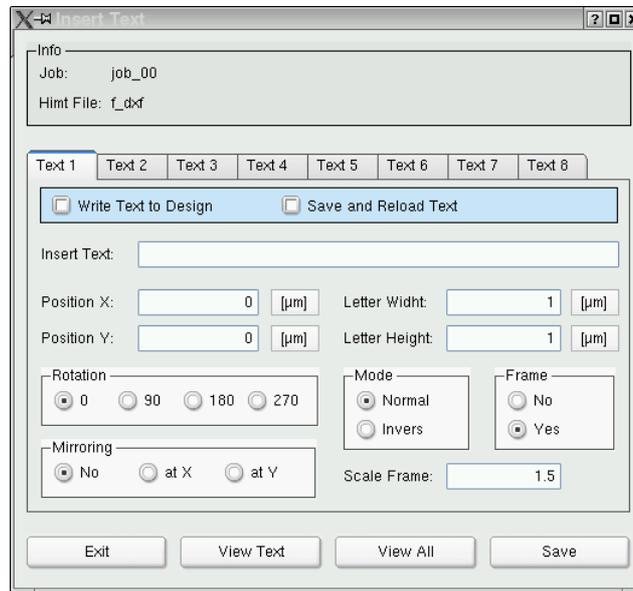
After all settings are prepared, the name of the new structure file that will be created can be changed in the **Resulting HIMT File** editable text box. Click on **Generate** to create the file with the parameters given. Once a merged file is generated, it can be viewed using the **Preview** button. To add it to the structure file selection list of the job, click on **Add to List**. When finished with all merging processes, click on **Quit** to close the window.

## STEP FRAME OPTIONS AND CONTROLS

With the controls given in the Step Frame, it is possible to set an array for step-and-repeating a design layer, as well as to mirror, rotate, or shift it. The order of operation is 1) shift and step, 2) rotation, 3) mirroring.

- **Step & Repeat:**
  - **Array** – enter the number of columns (X) and the number of rows (Y) for the grid, according to which the design layer should be stepped.
  - **Step** – set the distances of the rows and columns for the step and repeat function. The unit can be nm,  $\mu\text{m}$  or mm. Click on the unit button to cycle through the available units until the correct one is shown.
- **Other Operations:**
  - **X / Y off** – enter the distances in X and Y by which the layer should be shifted with respect to the origin. Available units are nm,  $\mu\text{m}$  or mm. Click on the unit button to cycle through the units.
  - **Mirror** – activate the option by clicking into the checkbox, then choose the mirroring axis by cycling through the available options using the axis control button (at x / at y).
  - **Rotation** – activate the option by clicking into the checkbox. Available rotation angles are 90°, 180°, and 270° clockwise. Choose the rotation angle by clicking on the rotation angle control button.
- **Controls:**
  - **Default** – loads the default settings for layers (checkboxes deactivated, array 1 x 1)
  - **Update To All** – the current settings will be copied for all designs within the Merge Files list.

## Text Insertion



Text lines can be added to any structure file using this utility. When the Insert Text button of the HIMT Files frame is clicked, the Insert text window opens and offers all necessary parameters and functions for insertion of up to 8 texts into the design. To select a text for definition or editing, click on the corresponding register card tag. The text is entered into the Insert Text line. With the functions below this line, the characteristics of this text within a design can be set:

- **Position X / Y** - position of the text within the design. Clicking on the units button changes the unit in which the value is displayed
- **Letter Width / Height** - size of the letters of this text
- **Rotation** - set clockwise rotation angle
- **Mirroring** - choose mirroring axis, if any mirroring should be done
- **Mode** - sets if the letters should be exposed in normal (letters exposed) or invers mode (letters not exposed).
- **Frame** - Selects if a frame should be added around the letters. This will automatically invert the letter itself. Is disabled if Invers mode is set. Per default, the frame is 1.5 times bigger than the text. To change frame size, change the scaling factor in the **Scale Frame** text line

To view the result of all text design settings, click on **View Text**. To see the text as it appears in the design, click on **View All**. With **Save**, the text is stored within the job. Any text register card that has the **Save and Reload Text** checkbox selected is also stored into a default file and will be available from any job. Any text on a register card that has the **Write Text to Design** textbox selected will be merged into the currently selected structure file. **This is irreversible!** To remove a text from a structure file, it has to be recreated from the source file.

## Chapter 5: Justification Options

After a design cell has been created, the Justification Options page is used to determine the positioning of the design on the plate, how much and which part of the design is to be exposed, and what other operations should be done with the design to prepare it for exposure (Mirroring, Rotation).

The screenshot shows the 'Justification Options' dialog box with two tabs: 'Justification' and 'Expose Options'. The 'Expose Options' tab is active. It is divided into two main sections: 'Expose Window' and 'Place'.

**Expose Window:**

- X: 105 [mm]
- y: 80 [mm]
- Design Width: 70190680 [nm]
- Design Height: 182149460 [nm]
- Reset button
- Left Border [mm]: 45, +/- 0
- Upper Border [mm]: 260, +/- 0
- Lower Border [mm]: 180, +/- 0
- Right Border [mm]: 150, +/- 0

**Place:**

- X off: -97.500000 [mm]
- Y off: -220 [mm]
- Mirror at y
- Rotate 90
- Automatic Centering
- Position Preview button

The **Justification Options** page is divided into the **Expose Window** frame and the **Place** frame. The **Expose Window** frame contains the parameters for choosing which part of the design should be exposed. The **Place** frame contains the options for design adjustment operations.

### EXPOSE WINDOW FRAME

The part of a design that is chosen for exposure is called the expose window. In the upper left part of the **Expose Window** frame, the **X** / **Y**: text boxes show the size of the current expose window. In a new cell, these numbers correspond to the design size as given on the right (**Design Width** / **Height**). The numbers in the **X** / **Y**: text boxes are simultaneously updated whenever the expose window borders are changed.

The borders of the expose window can be adjusted either by directly changing the numbers in the **Upper** / **Lower** / **Left** / **Right Border** text boxes in the lower part of the frame, or by entering the change in the +/- text boxes.

To return to the original border values (i.e. expose window borders correspond to design borders), click on the **Reset** button.

All numbers can be shown either in mm,  $\mu\text{m}$  or nm. To change the unit scale, click on the unit symbol (**[mm]** / **[ $\mu\text{m}$ ]** / **[nm]**) until the desired scaling is shown. The numbers in the corresponding text boxes will be adjusted automatically.

## PLACE FRAME

In addition to the design operation options, the **Place** frame offers a **Position Preview** utility where the positioning of the design on the plate can be controlled. Please refer to the Position Preview Window section in the Utilities chapter for more information.

The design operations available in the **Place** frame are:

- **X / Y off** – shifts the design origin by the distance given. Click on unit symbol ([nm] / [µm] / [mm]) to change the scale.
- **Mirror checkbox** – click into this checkbox to activate mirroring of the design, then choose the mirror axis by clicking on the **at X / Y** button behind the text.
- **Rotate checkbox** – click into this checkbox to activate rotation of the design. Rotation can be done by 90°, 180° or 270°. Click on the rotation angle button (**90 / 180 / 270**) until the right angle for clockwise rotation is shown.
- **Automatic Centering** – if this checkbox is selected, the design origin will be shifted to the center of the expose window borders. The resulting shift is automatically shown in the **X / Y off** textboxes. Useful if alignment is to be done with respect to the plate center.

## Chapter 6: Expose Options

The **Expose Options** page gives control over the exposure mode for each cell. It is divided into four areas:

- **Standard Options**

- **XOR Mode** checkbox: Enables the XOR mode for all occurrences of stacked structures within the design, as if they were on different layers. For a more thorough explanation of the results of the XOR mode, please refer to the section on **Layer Merging**. Standard setting for stacked structures is OR (merging of the structures).
- **Calculate Exposed Area** checkbox: With this option active, the area of the exposed design is calculated during conversion.
- **Scale Offset** checkbox: If this option is selected, any scaling factor will also be effective for the design offset on the plate that is set in the Justification page
- **Exposure Mode** list: Possible options are non-inverted (defined structures are exposed) or inverted (all areas around the structures are exposed).
- **Lic Directory** list: The name of the target directory for the for the design data can either be created automatically (option *automatic*), the standard name "lic" can be used (option *lic*), or a new name can be defined (option *other value*) in a separate dialog window, which will then for this job be added to the drop-down list.
- **Scale X** list: The drop-down list offers standard scalings ( $1 / 2$ ) as well as the possibility to enter a custom value (option *other value*) in a separate dialog window, which will then for this job be added to the drop-down list.
- **Scale Y** text box: The entry in this text box is automatically calculated to compensate for the mismatch between the 10nm design grid and the interferometer tic size of the positioning hardware. It should only be changed if absolutely not avoidable, and only by integer factors of the original number.

- **Spotsize Correction**

- **ZX / ZY**: also called spot size correction. All exposed areas will be adjusted in size by the values given here for x and y axis, to compensate for the effect of the writing spot diameter. Positive and negative values can be given here, resulting in an increase or decrease in structure sizes. Click on the unit symbol (**[nm]** / **[ $\mu$ m]** / **[mm]**) to change the scaling unit.

**Note:** The structures are increased or decreased in steps of two address grid units, one per structure side. Any number entered, which is not a multiple of 2 x the address grid (=1/5 pixel), will be rounded accordingly.

- **Advanced Options**

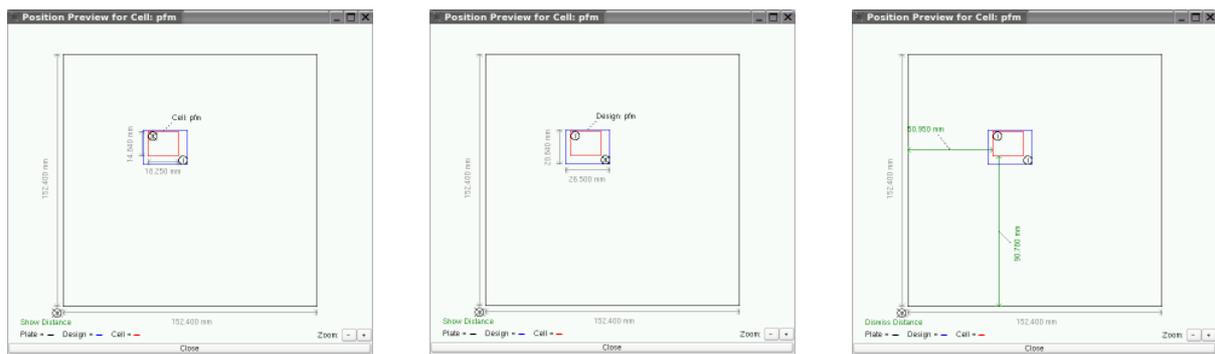
- **Add Frame**: Extends the borders for conversion by the value given in the text box, in all directions. Can be used to set the limits of an inverted exposure at an even distance from the design borders. Automatically changes the border values entered in the **Justification** window.
- **Add pixel**: Can be used to define an overlap between stripes to improve stitching quality. Each stripe will be enlarged in width by the number of pixels given, but stripe positions will be defined at the same standard distance. Choose a number from the drop-down list or enter an integer number <8 manually into the edit box, then activate the checkbox to set the option.
- **Interlace**: If this option is selected, scan positions are no longer fixed in a stripe system, but will change in a system determined by the number chosen from the drop-down list. Enhances stitching quality, but leads to a considerably longer exposure time (more than the interlace factor chosen).

## Chapter 7: Utilities

Several utilities have been developed to facilitate the use of the Conversion Software Manager. The most important of these are the **Position Preview Window** and the **HIMT Viewer**, which are accessible from different layers of conversion preparation.

### *The Position Preview Window*

The **Position Preview Window** is a simple viewer that displays positions and sizes of designs via frames, and links to additional information. It is accessible via the **Position Preview** button in the **Justification** set. In the window, a black rectangle with an **i** at the lower left corner represents the plate, while the cell borders are represented in red, with an **i** symbol in the upper left corner. The original borders of the design contained in the cell are shown in blue, with the **i** symbol in the lower right corner. A left-click on any **i** symbol adds information about the size of the related structure into the image. A second left-click removes the numbers and arrows again.

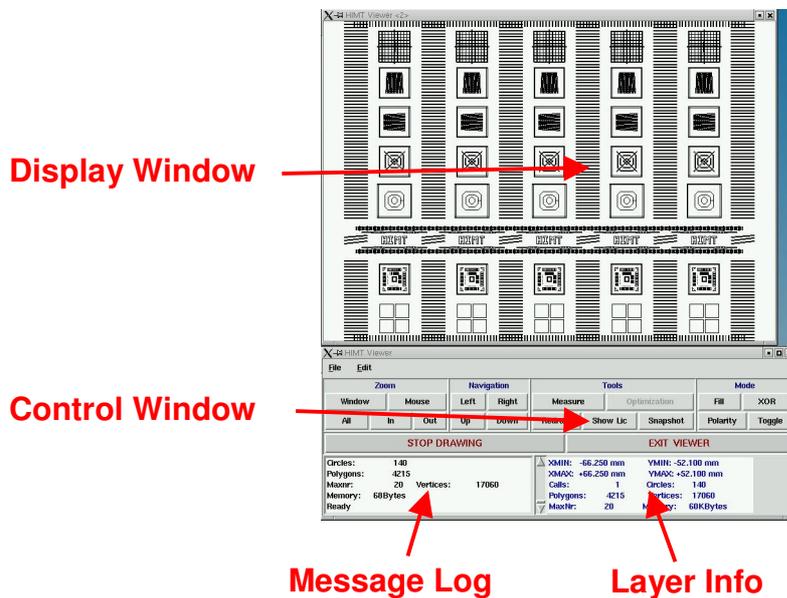


Below the plate **i** symbol, another switch can be found represented by the text line **Show Distance / Dismiss Distance**. If Show Distance is displayed, clicking on the text will add the distance of the lower left cell border from the lower left edge of the substrate to the image, and the text will change to Dismiss Distance. Clicking on the text again will remove this information.

## The HIMT Viewer

The **HIMT Viewer** for viewing designs is a crucial tool for design preparation and conversion optimization. At the same time it can be used to gain more information about the design and the conversion results that are to be expected. It displays the HIMT Structure data created from a source file in a Tk/Tcl based X-Windows interface.

The **HIMT Viewer** consists of two windows: The **Control Window** and the **Display Window**. In the **Control Window**, there are two text boxes showing information on the current status: The **Message Log** box on the left shows information concerning the current task, like progress and usage information, and the **Layer Info** box on the right gives general information about the design layers loaded.



On opening, the complete design is automatically drawn in the **Display Window**, and all relevant information is given in the text boxes of the **Control Window**. While usually the loading of the design does not take very long, the graphical representation in the **Display Window** can take several minutes. During that time, a separate window shows a status bar for the drawing tasks. If it is not necessary to view the whole design, drawing can be interrupted at any time by clicking on the **STOP DRAWING** button in the **Control Window**. In the same way, any **Redraw** may be interrupted.

The HIMT Viewer is closed by clicking on the **EXIT VIEWER** button. All tasks are interrupted, and both windows are closed. The **Exit** function can also be found in the **File** menu.

The Control Window offers several sets of controls for specific tasks. These are grouped into four frames: **Zoom**, **Navigation**, **Tools**, and **Mode**. In addition, some more functions can be found in the menus **File** and **Edit** of the **Menu Bar**.

Whenever a function is used which does act directly on the **Display Window** (like **Zoom**, or **Measurement**), the Message Log window will show instructions for the function procedure. However, the following rules generally apply for these functions:

- The button of the active command on the **HIMT Viewer** will change color to make it easily visible which function is currently active.
- Clicking the center mouse button will end a function.
- New button commands are not permitted until the center button of the mouse is pressed.
- In two-button mouses, the center mouse button can be substituted by clicking both buttons simultaneously.

## **ZOOM**

With the **Zoom** functions, parts of the design can be enlarged for further inspection. This can be done by using fixed zoom steps, or by choosing the region to be displayed.

- **Window** – Using the mouse, a region within the current view of the design can be selected. This window will then be displayed in a sufficient magnification to fill the **Display Window**. The **Window** function is active for only one zoom and has to be selected again if any further zooming is to be done.
- **Mouse** – Click onto a feature to zoom in or out around it. Left button click zooms in, right button click zooms out. Zoom is done stepwise. The function stays active until ended by a center mouse button click.
- **All** – On use of this button, the magnification will be reset to a full view of the design.
- **In / Out** – These buttons allow a stepwise zoom onto or out of the center of the current view.

## **NAVIGATION**

With the buttons of the **Navigation** frame, the display can be moved **Up**, **Down**, **Left** or **Right** to view different parts of the design.

## **TOOLS**

The **Tools** frame contains several useful functions for exposure preparation and design evaluation.

- **Measure** – This function enables the measuring of distances within the design section currently displayed in the **Display Window**. While **Measure** is running, the button is displayed in red. Note that all **Zoom** or **Navigation** buttons are deactivated while the **Measure** function is active.  
As soon as the function is started, the **Coordinates** text box appears in the lower left corner of the **Display Window**. Whenever the mouse pointer is positioned anywhere within the design window, the x and y position in mm within the design will be automatically updated in the **Coordinates** box. If the **HIMT Viewer** was started from the **LIC Directory Manager**, the text box gives additional information on the position within the fracturing structure (stripe, block). Otherwise, these numbers are arbitrary and can be disregarded.  
To do a distance measurement, first the left mouse button has to be clicked to initialize a measurement procedure. The mouse pointer will change to a cross,

and the online update of pointer coordinates will freeze. Now move the cross to the starting point of the measurement and click again. The cross will be copied to the position selected, and the display in the **Coordinates** text box will change to distances, which are again automatically updated whenever the pointer is moved. To end a measurement, click left again. The **Coordinates** text box returns to showing current pointer coordinates, and the next measurement can be started.

- **Optimization** – This tool is needed to set exposure optimization parameters. It is only enabled when the Viewer is opened from the **Optimization** page of a cell. Please refer to the Chapter on Optimization Options for more information.
- **Redraw** – Redraws the current view.
- **Show LIC** – this function can only be used if an offline conversion of the design has been done. It can be used to view a LIC file containing a certain structure. After activating the function, click on the structure. A second HIMT Viewer showing only the corresponding LIC file will open.
- **Snapshot** – captures a screenshot of the **Display Window** and saves it in JPEG format as design#.jpg, where the number # counts up while the Viewer stays open.  
**Note:** files are overwritten without notice, so it is recommended to rename image files directly after their creation.

## MODE

The functions of the **Mode** frame determine the way a design is displayed. The options correspond to the options applicable in the Conversion Software Manager. Each mode function stays active until deselected. While a mode function is active, the corresponding button is displayed in blue color.

- **XOR** – The default mode for the display of overlapping structures in different layers is **OR**. In the **XOR** mode, overlap regions negate each other (see the **Appendix** section on **Layer Merging** for further explanations).
- **Toggle** – For **Gerber** files, this mode has to be activated to get the correct results. Every second design layer is applied as a CUT layer on the previous layer. For multiple layers, this results in a CUT/OR/CUT/OR... sequence. The result is displayed in black and white (no distinction between layers). Will not work in combination with the XOR mode.
- **Fill** – All structures are usually displayed in outlines, i.e. only the structure borders are drawn. In the **Fill** mode, all exposed areas will be filled.  
**Note:** Polygons with too many points cannot be filled. View text messages in the **Message Log**.
- **Polarity** – switches filling mode between clear (noninverted) and dark (inverted) polarity.

## MENU BAR

- **File**
  - **New** – unloads all layers

- **Add Layer** – adds a design or layer to the already loaded layers. Each new layer will be displayed in a different color (**black**, **red**, **blue**, **green**...) unless the **Toggle** mode was chosen (see **Mode** frame).
- **Load Layer** – unloads the previous layer(s) and loads a new one.
  - Note:** Apart from structure files, the converted LIC files can also be loaded into the HIMT viewer. See the section on the **HIMT Viewer** in the **Utilities** chapter for more information.
- **Unload Layer** – unloads a layer chosen from the **Message Log**.
- **Save <...>** - saves the currently loaded layer(s) in the format chosen. In the case of CIF, DXF or Structure, all layers are saved into one target file, while for Gerber the layers are saved into individual files and a target directory has to be chosen. Only a D10 polygon aperture is used.

The Structure 9.0 format is an advanced Structure format that is not compatible with conversion.

  - ◇ All saving operations overwrite existing files without prompting
  - ◇ All output data is flattened and so, therefore, the output data may be large
  - ◇ The output filters will only support circles and polygons
  - ◇ With repeated saving, converting to structure, and reloading, layers can be separated or merged in any combination of design data types

Any of the supported conversion software input formats may be converted to CIF, DXF or GERBER via the Structure format.
- **Exit** – ends all current tasks and closes the HIMT Viewer
- **Edit**
  - **Setup** – shows the parameters used for adding a grid. Adjust parameters to exposure configuration to get correct results.
  - **List Layers** – shows in the **Message Log** box a list of the layers currently loaded.
  - **Add / Remove Grid** – adds or removes a blue grid showing the fracturing of the data into stripes. Use **Setup** first to adjust the relevant parameters.
  - **Save Window** – can be used to save a part of a design as a structure file. From the currently displayed design part, a section can be selected using the mouse (follow instructions in the **Message Log** box) and will be saved in the directory ~/structures.

## MESSAGE LOG

At startup, the **Message Log** displays the **HIMT Viewer** version and revision number as well as the loading information of the current design. While the HIMT Viewer is open, status, usage hints, and all operations are recorded and can be scrolled through.

## LAYER INFO

The **Layer Info** provides information regarding all currently loaded layers. To obtain information concerning an individual layer, scroll through the status list for a report on the layer after loading.

- **XMIN, XMAX, YMIN, YMAX** – represents the extent of all layers loaded in mm.
- **Calls** – counts the occurrences of calls, where structures from separate files were added to the current design.
- **Circles** – total number of circles loaded.
- **Polygons** – total number of polygons loaded.
- **Vertices** – total number of vertices (points) in all polygons.
- **Max Nr.** – gives the maximum number of vertices in one polygon occurring in the loaded layers.
- **Memory** – shows the amount of memory used (approximately).

## Other Menu Functions

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The main menu and the toolbar of the Conversion Software Manager offer several standard functions in addition to the specialised functions discussed above:

### FILE

The functions offered in the **File** menu are the standard functions for Jobs and the GUI itself. All of them are also represented by icons in the toolbar.

- **New Job** /  – creates a new job, prompting the user for a name. If a job is already open, it has to be closed first, by clicking on the **X** button in the upper right corner of the Job level page.
- **Load Job** /  – loads a job from the file list
- **Save Job** /  – saves the current job under a given name
- **Exit** /  – closes the Conversion Job Manager GUI. Hotkey: Ctrl+Q.

### TOOLS

Besides utilities discussed above, the **Tools** menu offers the following options:

- **Set Font** /  – to change the font used in the Conversion Software Manager. A separate window opens where from lists a different font type, style and size can be chosen for the graphical user interface. Factory standard is Adobe Helvetica, Normal, 9pt.

## HELP

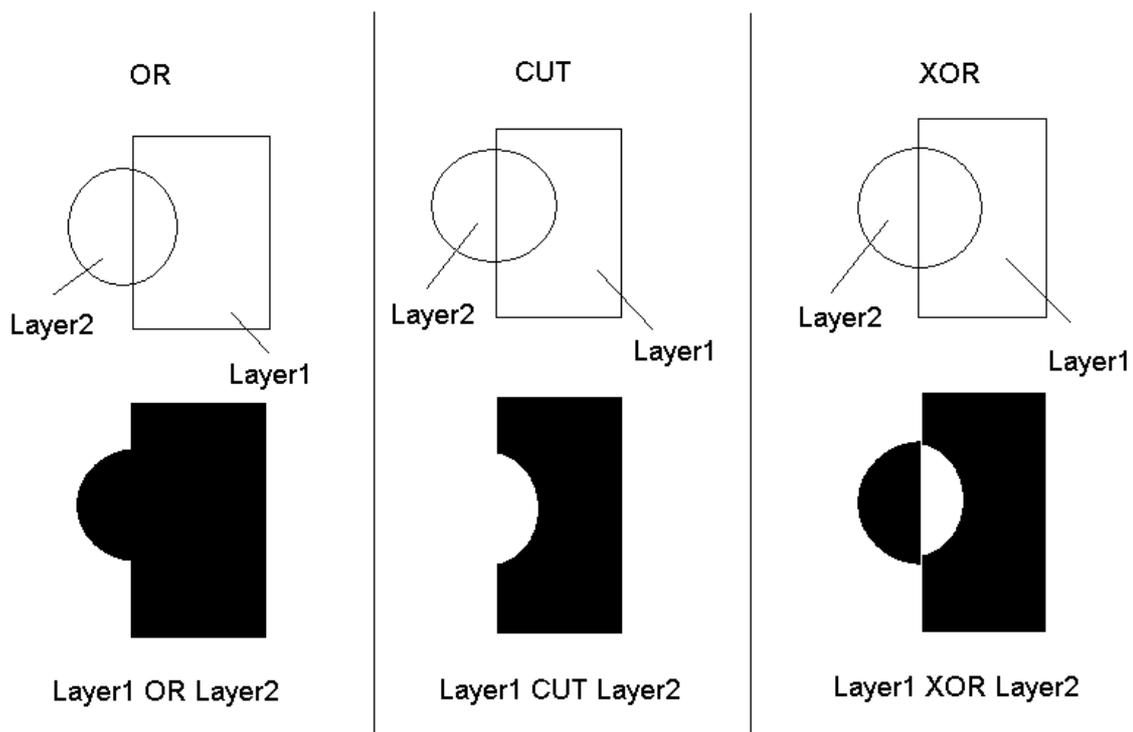
The help menu offers some helpful information for using the Conversion Software Manager:

- **What's this** /  – changes the mouse cursor to a question mark. When pointing on a specific feature with this cursor, a small help window will open with a help text for that feature. Can also be activated with a right-click, or using the hotkey combination Shift-F1. (*Help texts not yet implemented – January 2007*)
- **About** – shows the version and contact information. Can also be opened with hotkey F1. The Conversion Job Manager Version can also be read from the user interface title bar.

## Appendix A: Layer Merging

Some of the design formats that can be converted to LIC are layer based (DXF, GDSII). Also, generally structures can overlap within a design. In both cases, the treatment of overlapping structures has to be defined, sometimes by the user, sometimes by the software.

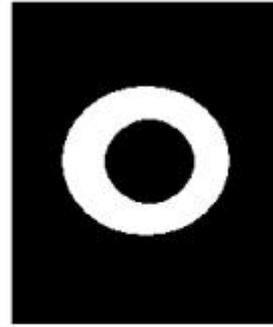
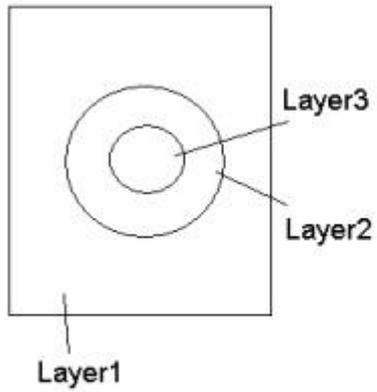
The available operations for merging are logical operations. Currently, the commands **CUT**, **OR** and **XOR** are supported for layer merging, **OR** and **XOR** for overlapping structures. For a better understanding, these operations are explained here graphically with an example:



- **OR** results in a true merging of the structures,
- **CUT** subtracts the a layer from the previous layer,
- **XOR** leads to a cutting only in the overlap region, while elsewhere both structures remain intact.

Only the **CUT** operation is dependent on the order of operation.

Multiple layers can be merged using different operations:



Layer1 CUT Layer2 XOR layer3  
or  
Layer1 XOR Layer2 XOR layer3

In this example, the desired result can even be obtained by two different combinations of operations, as the XOR and the CUT operation are identical as long as the second structure is completely within the first one.

## Appendix B: Greyscale Conversion

The conversion software accepts two input formats for greyscale structure conversion:

- DXF-designs where each layer corresponds to one of the 63 grey levels (Greyscale DXF)
- 3-dimensional STL designs (option)

For other input formats, solutions can be customized.

### Design Rules

#### GREYSCALE DXF

In addition to the standard DXF rules, the following rules apply:

- Structures on different layers may not overlap; each layer may only contain those areas that are to be exposed with the corresponding gray value.
- With complex structures, file sizes might increase above the limit manageable by the conversion software. Try to keep structures as simple as possible.

#### STL DESIGN RULES

So far, only STL elements are supported by the conversion software and can be stepped to form a larger array.

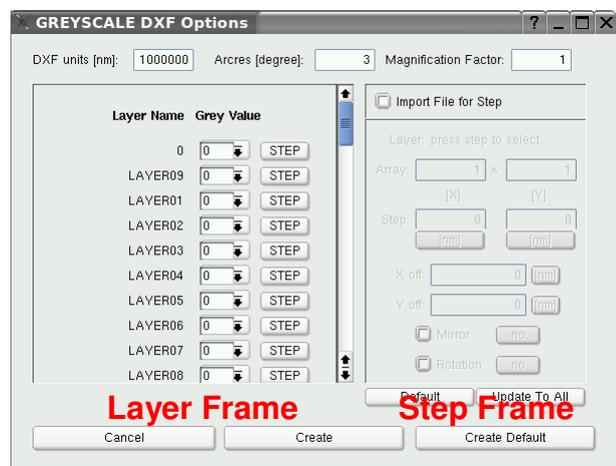
- STL element size may be max. 100x100µm
- everything has to be designed within the positive octant
- only binary STL files are supported

### Greyscale DXF Options

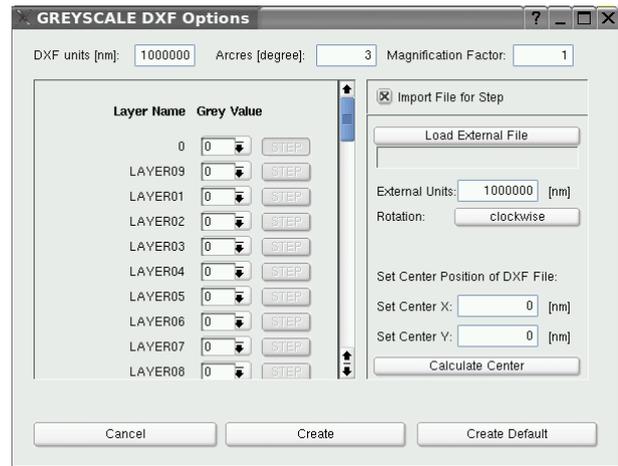
The Greyscale DXF Options window offers the same general functions as the standard DXF Options window:

- **DXF units** - size of one design unit, in nm
- **Arcres** - arc resolution; angle unit used during translation of arcs to polylines, in degree
- **Magnification Factor** - stretches or compresses the complete design

In the **Layer frame** to the left, a grey value has to be assigned to each design layer. The **STEP** button activates the Step frame for a design.



The Step frame on the right contains the same typical functions to step, shift, mirror or rotate a layer as the standard DXF Options window does. In addition, it offers the possibility to load this data from an existing step file, if the **Import File for Step** checkbox is selected. This file has to contain the information on X offset, Y offset and rotation for each occurrence of a layer in a separate line. The unit for the offset parameters is determined by the entry in the **External Units** text box, and the rotation direction can be selected with the **Rotation** button (clockwise / counterclockwise). Set these parameters before clicking on **Load External File**. The data contained in the file will be used for all layers of the design.



**Note:** stepping and repeating complex 3D structures over a large area requires large hard disk storage space!

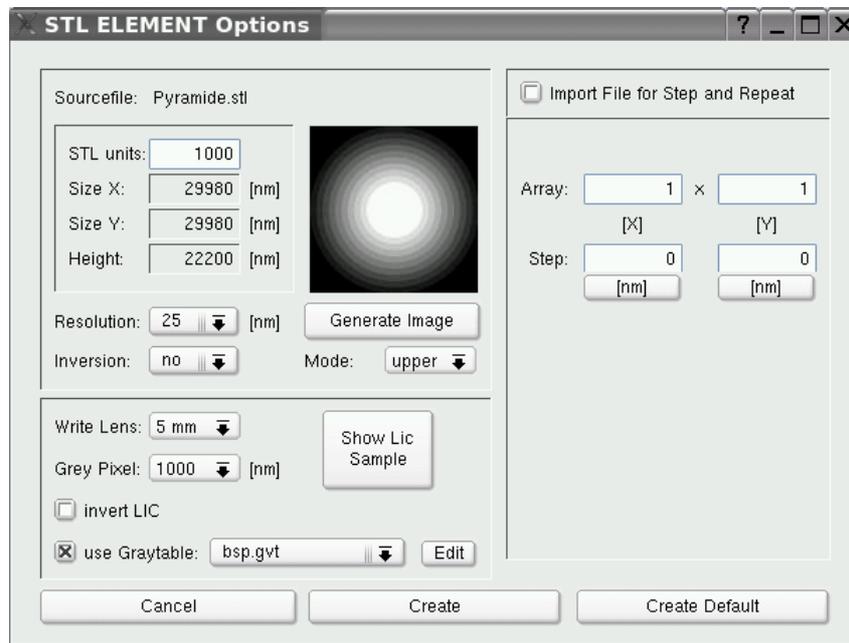
**Notes on external step files:**

- parameters have to be separated by spaces
- no header line is allowed
- unit for rotation is degrees

Rotations are per default executed around the coordinate origin. If rotation should be executed around a different point, the coordinates of this point have to be entered into the Center Position text boxes (**Set Center X / Set Center Y**). In case the rotation should be executed around the design center, and this is not at the same time the design origin, the system will calculate these parameters from the origin borders when the button **Calculate Center** is pressed. The result of the calculation is displayed in the Center Position text boxes.

Once all options are set, an HIMIT File with the same name as the source file (**Create Default**) can be created, or a different name can be chosen (**Create**, enter name in dialog box). To close the window without creating an HIMIT File, click **Cancel**.

## STL Element Options



The conversion of an STL element to an HIMT File requires two steps. First, the STL element has to be translated into a high resolution greyscale bitmap. The options and functions necessary for this can be found in the upper left frame.

**STL units** - enter the unit size the element was created with. Check on the values returned for **Size X** (width), **Size Y** (length), and **Height** to verify that the correct unit was used.

**Resolution** - sets the resolution the image is created with. The available resolution values are listed in a drop-down list. The value selected should be as large as possible without losing structure elements, to reduce data bulk.

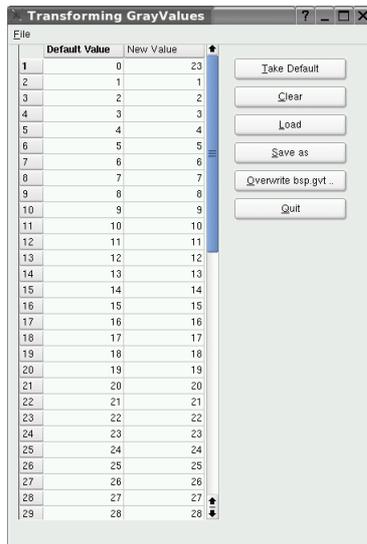
**Inversion** - determines if the maximum distance should be interpreted as maximum exposure depth (grey level 100%, no inversion), or minimum exposure depth (grey level 0%, inversion)

**Mode** - selects which of the element borders (lower / upper) is the one that has to be scanned for greyscale value determination

After all parameters are set, click on **Generate Image** to create the bitmap and display it in the image frame above the Generate Image button. If the result is wrong, or does not show sufficient resolution, repeat image generation with different parameters until the result is satisfactory.

For the translation of the bitmapped STL element into a structure element for Lic file generation, the pixel size has to be chosen. As the basic pixel size is determined by the write lens used, first select the **Write Lens** from the drop down list. Now, the **Grey Pixel** drop down list contains several possible pixel sizes for Lic file generation. Depending on the design structure, it might be recommendable to interpolate to double or quadruple pixel size, on the one hand to decrease the Lic data size, on the other hand some structures get better surface quality with less greyscale resolution. Which structures work best with which resolution should be determined by test exposures.

With the **invert LIC** option, the direction of structure imprint into the resist can be changed including the surrounding area (in contrast to the **Inversion** option of the STL → Bitmap translation, where only the STL element itself can be inverted). To check on the resulting grey level distribution, click on **Show Lic Sample**. An HIMT Viewer window will open that shows the system grey levels that will be entered into the LIC file. Refer to the section on the **HIMT Viewer** in the **Utilities** chapter for more information on the functions of the HIMT Viewer.

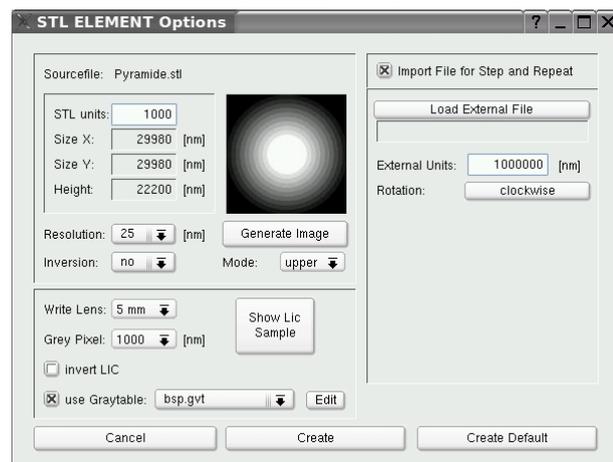


Usually, the grey levels of the bitmap are linearly translated into the grey values available in the machine. However, it is possible to select a different mapping of bitmap levels to machine levels via a user defined graytable. When the checkbox **use Graytable** is selected, a predefined grey table can be selected from the drop-down list beside it. Alternatively, the **Edit** button can be clicked to open the **Transforming Gray Values** window where a new table can be defined. The left column of the displayed table shows the default value for a grey level, the right column can be edited to adjust the grey level step sizes e.g., to adapt to the behavior of a certain resist, or to change the value for the area around the structure to an in-between value. To reload the default value into the editable column, click on **Take**

**Default**. To completely clear all entries from the editable column, click **Clear**. With the **Load** button, a predefined grey table can be loaded and viewed or edited. Once editing is finished, use either the **Overwrite <table file name>** button to store the edited data under the same name, or the **Save as** button to choose a different name. To close the window and return to the STL Element options window, click on **Quit**.

**Note:** Greytable files can also be edited directly in the directory Xgui/gvt. However, it is important that the standard format is preserved.

The right part of the STL Element Options window contains a Step frame similar to the ones used in 2D Design Option windows (DXF, GDSII), but for design stepping only. Either an array for element distribution can be defined with fixed pitches for each axis, or an external file can be loaded in which positions and rotations for the element occurrences can be defined freely. This file has to contain the information on X offset, Y offset and rotation for each occurrence of the element in a separate line. The unit for the offset parameters is determined by the entry in the **External Units** text box, and the rotation direction can be selected with the **Rotation** button (clockwise / counterclockwise). Set these parameters before clicking on **Load External File**. Rotation is automatically executed around the center of the generated bitmap (i.e., usually the center of the element).



**Note:** stepping and repeating complex 3D structures over a large area requires large hard disk storage space!

**Notes on external step files:**

- parameters have to be separated by spaces
- no header line is allowed
- unit for rotation is degrees

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## **Appendix C: Software Revision History**

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This section contains relevant additions, changes and bugfixes issued after the version this manual is based on.

<b>Version</b>	<b>Revision</b>	<b>Affected Section</b>	<b>Change</b>
1.4	2	-	-