

Layout BEAMER Advanced Features

February 2010

Outline

- Setting your Defaults
- Layers to Data types
- Center to field
- Beam step size fracturing
- Adjusting field boundaries
- Fracture Modes

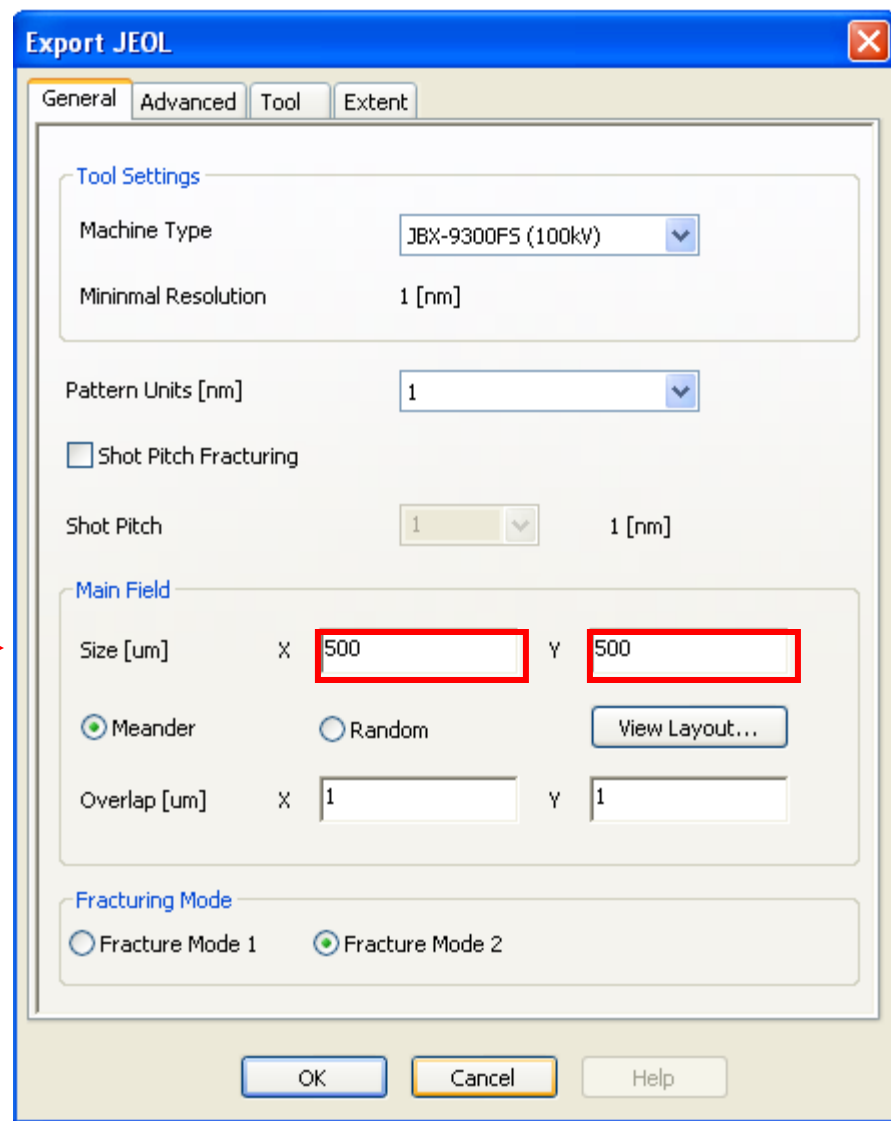
Setting the Defaults

Before moving the “EXPORT” button to the process flow, right click on it and select “Set Defaults”

Go through the process of exporting a file (select .v30 file, give the file a name)

Now you can select the defaults to apply to your specific process.

The most IMPORTANT default is to **change the main field size to 500 x 500 um**. If you do not change this, then there will be an error when your file is compiled.



The screenshot shows the 'Export JEOL' dialog box with the following settings:

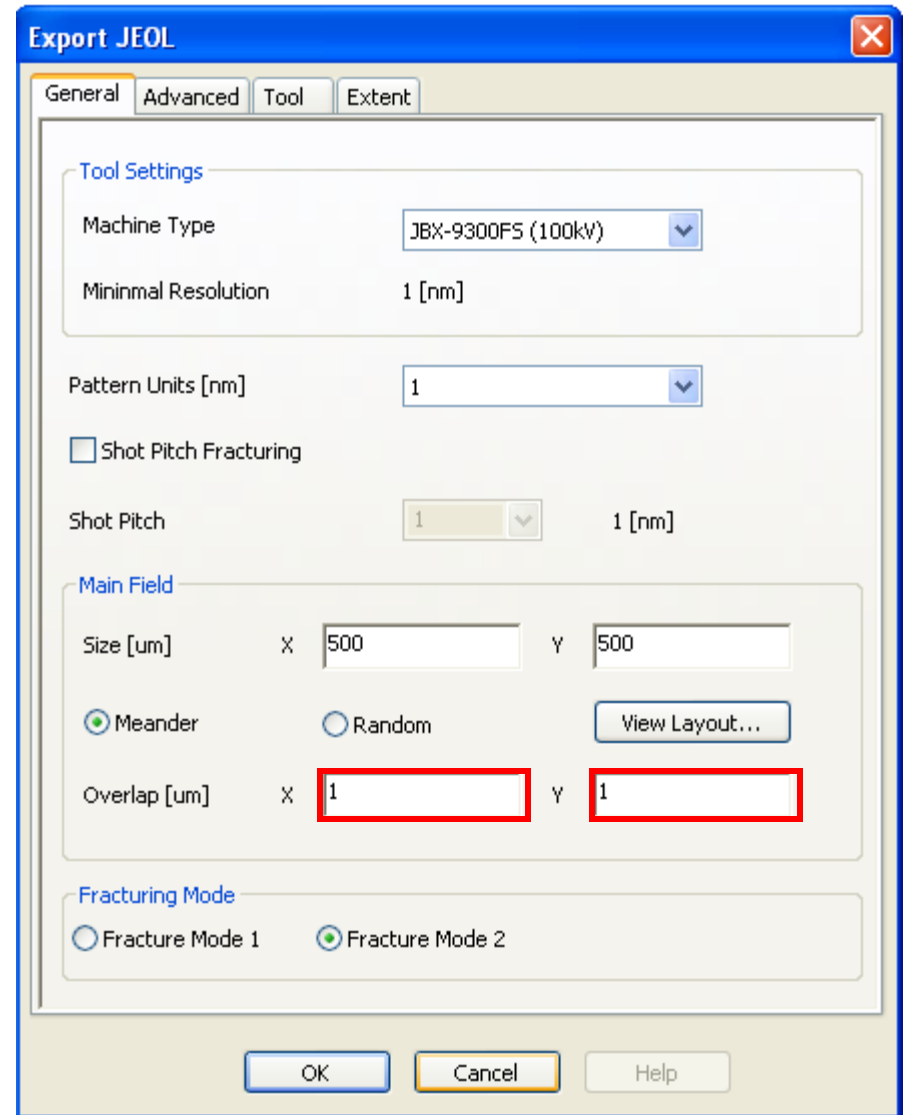
- General** tab selected.
- Tool Settings**: Machine Type is JBX-9300FS (100kV), Minimal Resolution is 1 [nm].
- Pattern Units [nm]**: 1.
- Shot Pitch Fracturing**: (unchecked).
- Shot Pitch**: 1 [nm].
- Main Field**: Size [um] X is 500, Y is 500. Meander is selected (radio button), Random is unselected. Overlap [um] X is 1, Y is 1. A 'View Layout...' button is present.
- Fracturing Mode**: Fracture Mode 2 is selected (radio button), Fracture Mode 1 is unselected.
- Buttons: OK, Cancel, Help.

A red arrow points from the text 'The most IMPORTANT default is to change the main field size to 500 x 500 um' to the '500' and '500' input fields in the 'Main Field' section.

Overlap

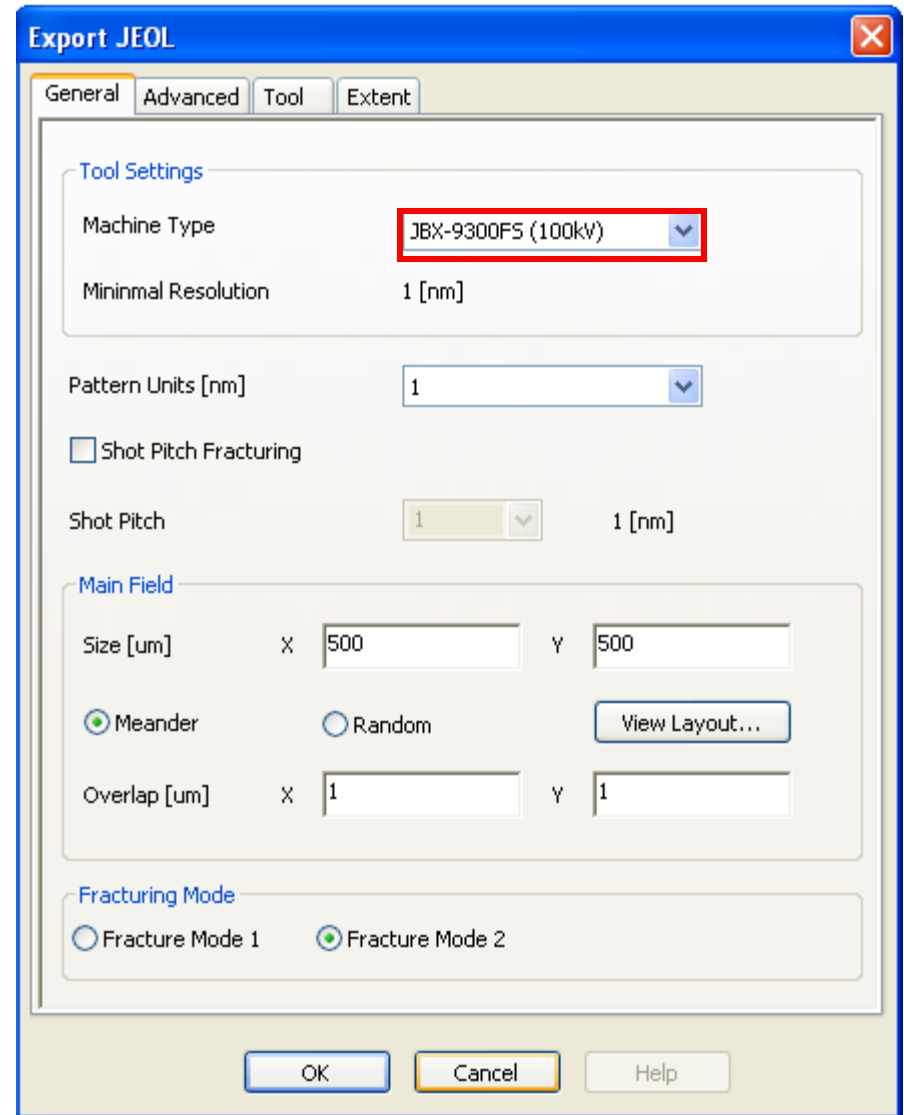
The overlap function adjusts the pattern so that if you have a feature that falls on a field boundary it will move that feature to the left or right by 1 μm (or less) so that it no longer falls on the field boundary.

An overlap value of 1 μm is recommended by JEOL.



If it is not already specified, then you need to select the correct machine type:

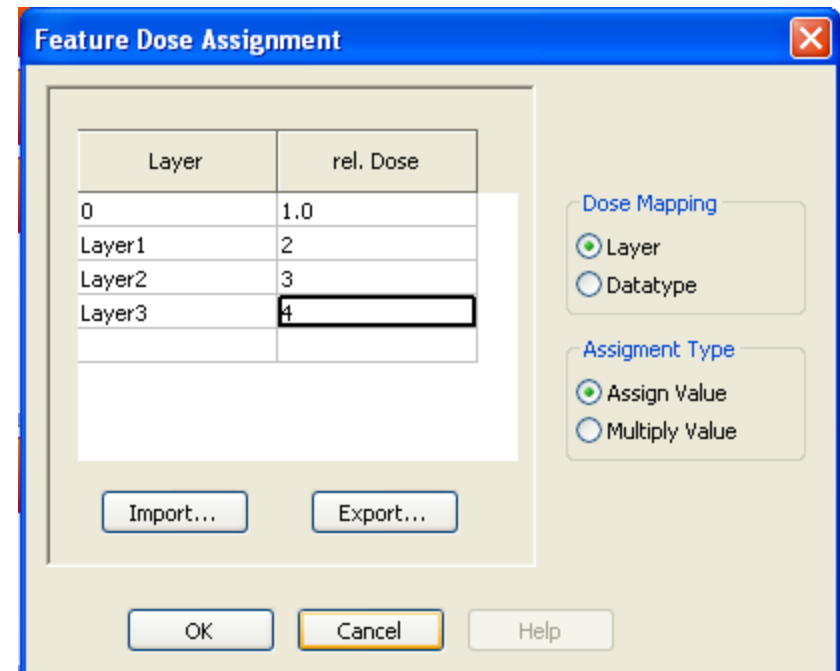
JBX-9300FS (100kV)



Multiple CAD Layers

Problem Description: CAD files can specify different features on different layers. The JEOL software specifies dose by data type, not layers, so you need to convert the different layers into different data types if you need to vary the dose for different features. (This was previously done in LinkCAD)

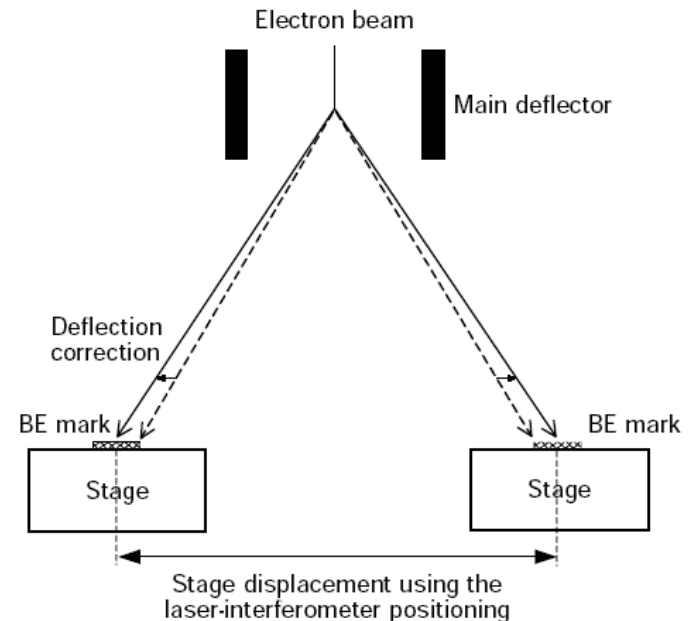
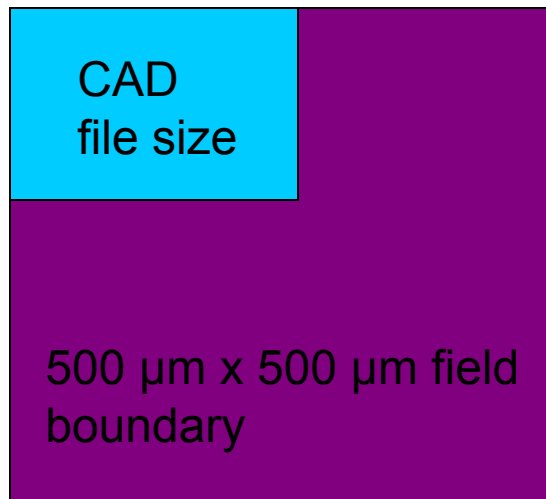
Solution: After importing your CAD file, add the “FDA” button to the process flow. In the FDA parameters (right picture) you need to select each layer of the CAD file and assign it a different rel. Dose. Then click OK.



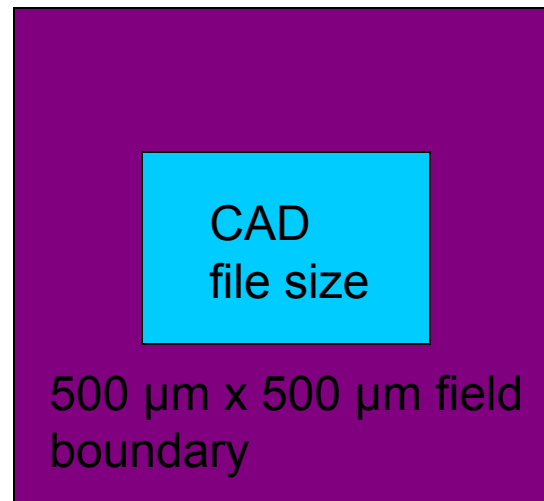
Center to Field Function

Problem Description: As you write patterns on the edge of a field boundary, the beam is more likely to be distorted.

JEOL software defines a field starting from the top left of your CAD pattern, putting small patterns on the edge of a field.



Solution: Move the pattern to the center of a field using Layout BEAMER



Application: This function only applies to patterns less than 500 μm x 500 μm (one field)

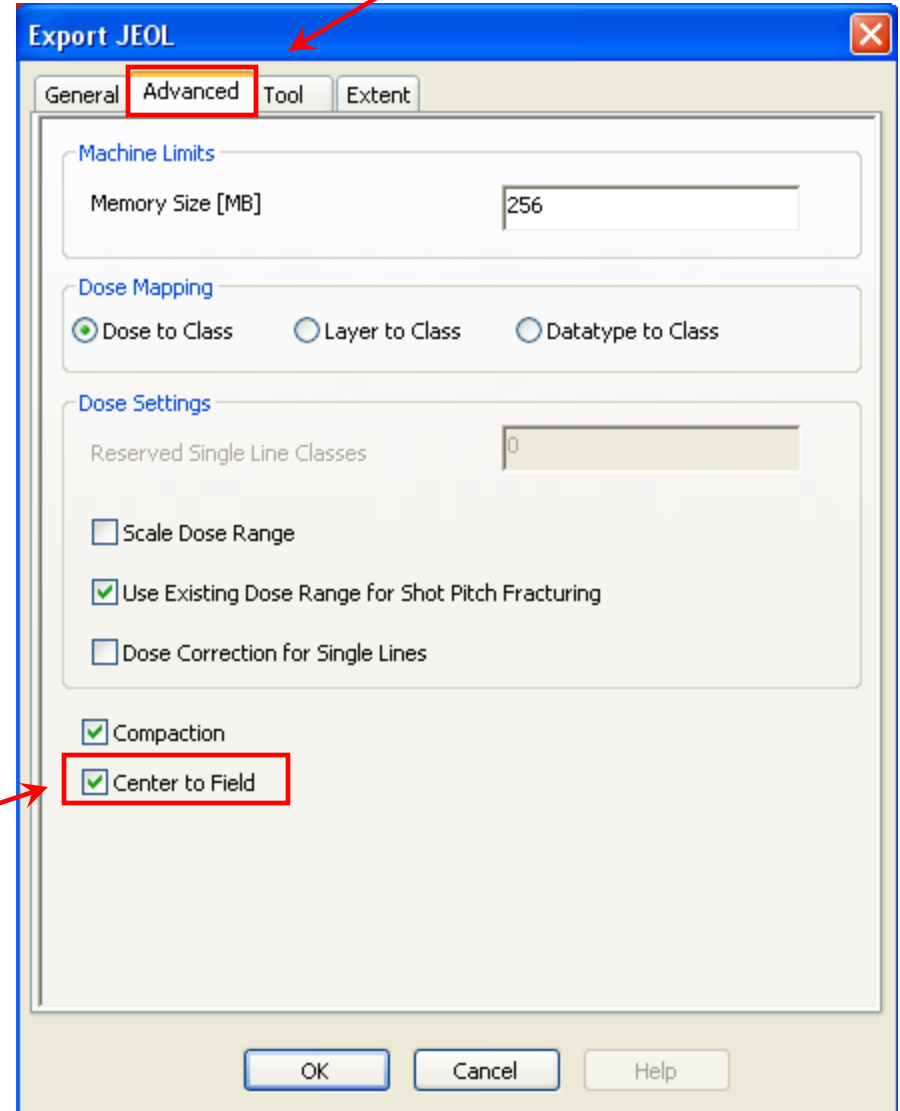
Implementation

In Layout BEAMER

Under the “EXPORT” Button

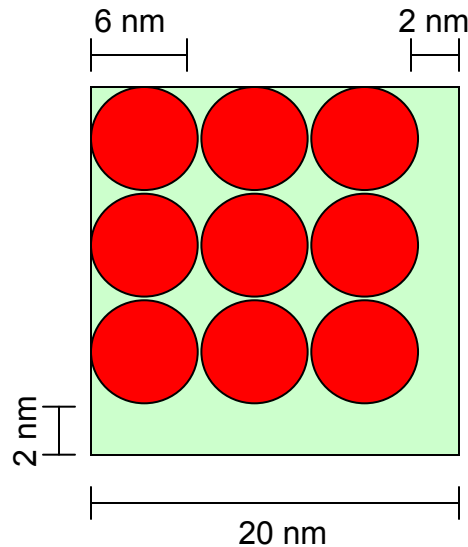
➤ Advance Tab

➤ Select “Center to Field”



Beam Step Fracturing

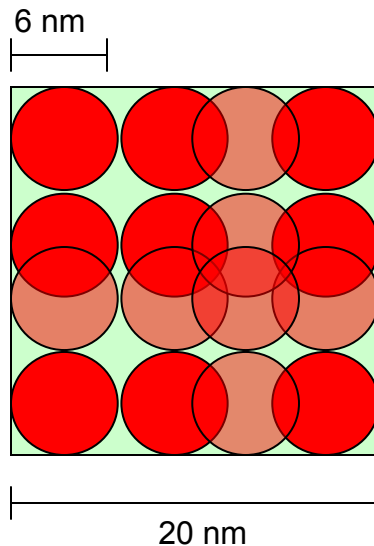
Problem Description: For small shapes, the recommended shot pitch (6 nm) is not always divisible by the shape size. This causes the shape dimensions to be slightly less than specified in the CAD file.



Example: Specifying a 20 nm square will yield an 18 nm square when using a shot pitch of 6 nm.

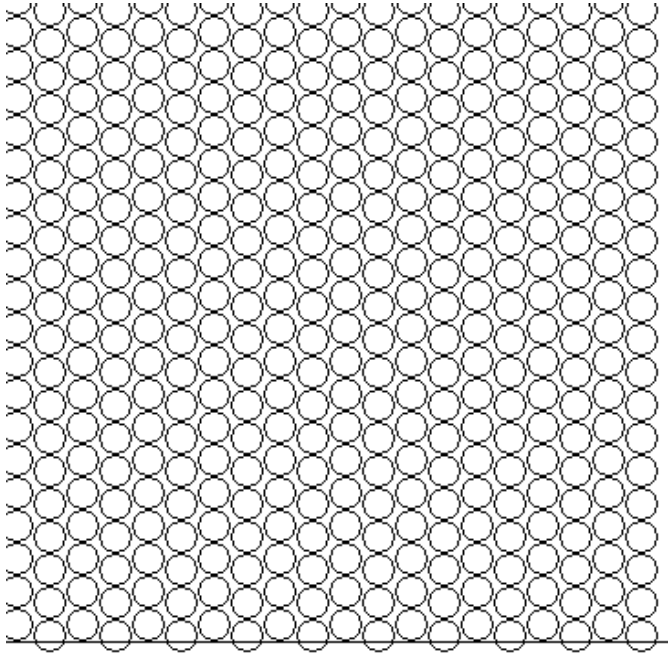
Solution: Use beam step fracturing through Layout BEAMER

Extra pixels are added to the shape and overlap in the center to achieve accurate shape sizes. The central pixels that overlap get a lower, adjusted dose to make the overall dose at each position in the shape equal.

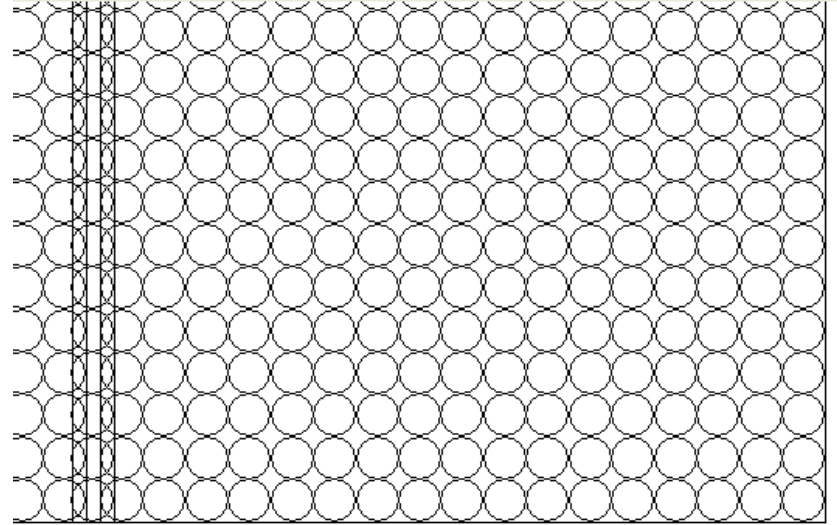


Overlapping pixels in the middle of your feature will not affect the pattern as much as missing pixels on the edge. The middle of the feature is already affected by backscattering

Shot Array in Layout BEAMER



Without shot pitch fracturing



With shot pitch fracturing

Limitations: Do NOT use shot pitch fracturing with circular or curved objects

Implementation

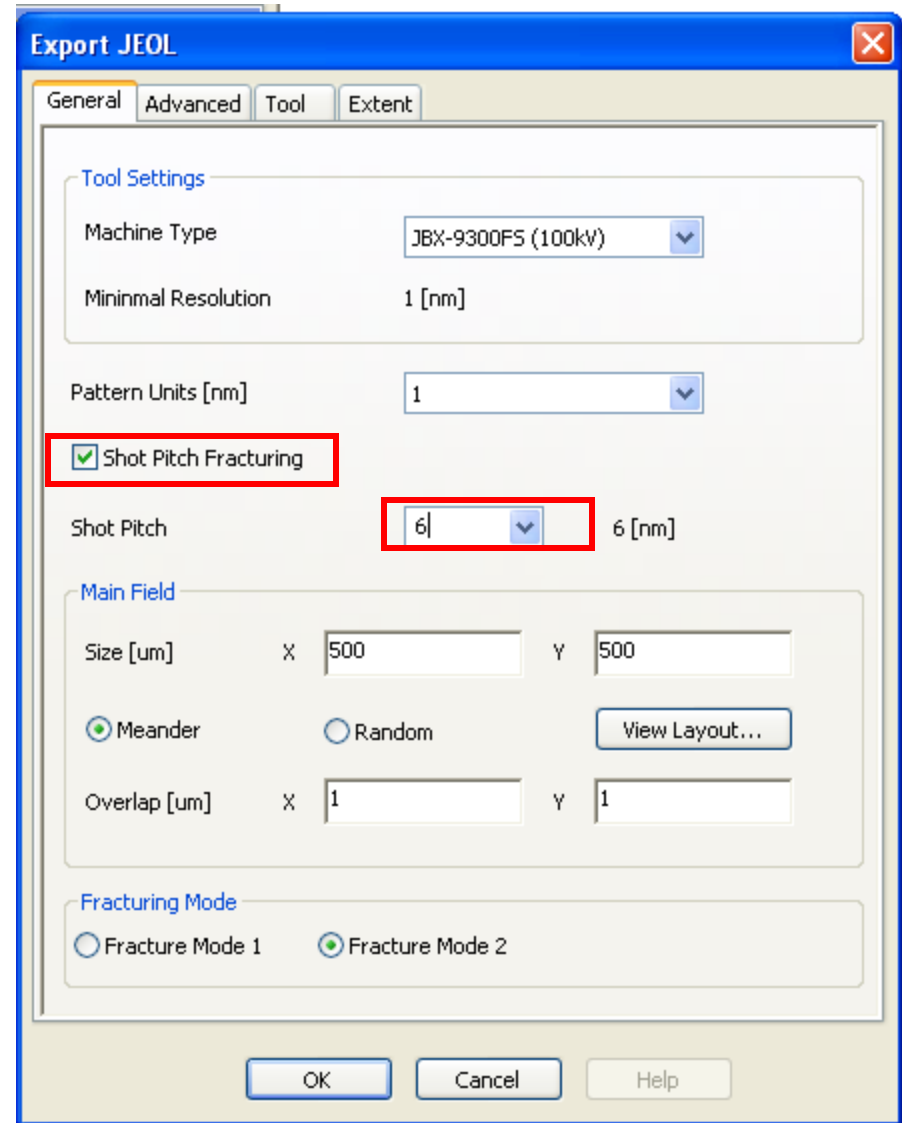
In Layout BEAMER

Under the “EXPORT” Button

➤ General Tab

➤ Select “Shot Pitch Fracturing”

➤ Set the shot pitch to what you plan to define it in your schedule file (usually 6 nm).

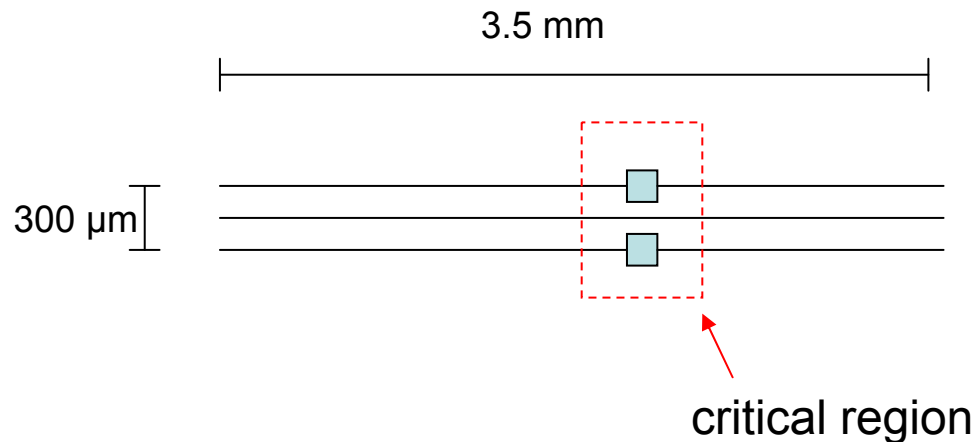


Adjusting Field Boundaries

Background: The field boundary stitching errors on our JEOL JBX-9300FS EBL System cannot be avoided. Stitching errors occur because the beam can only be deflected over a 500 μm by 500 μm area. If continuous writing larger than one field is needed, then the stage has to move (with a motor), this is accurate to 0.1 μm . The inaccuracy of the stage is what causes a stitching error.

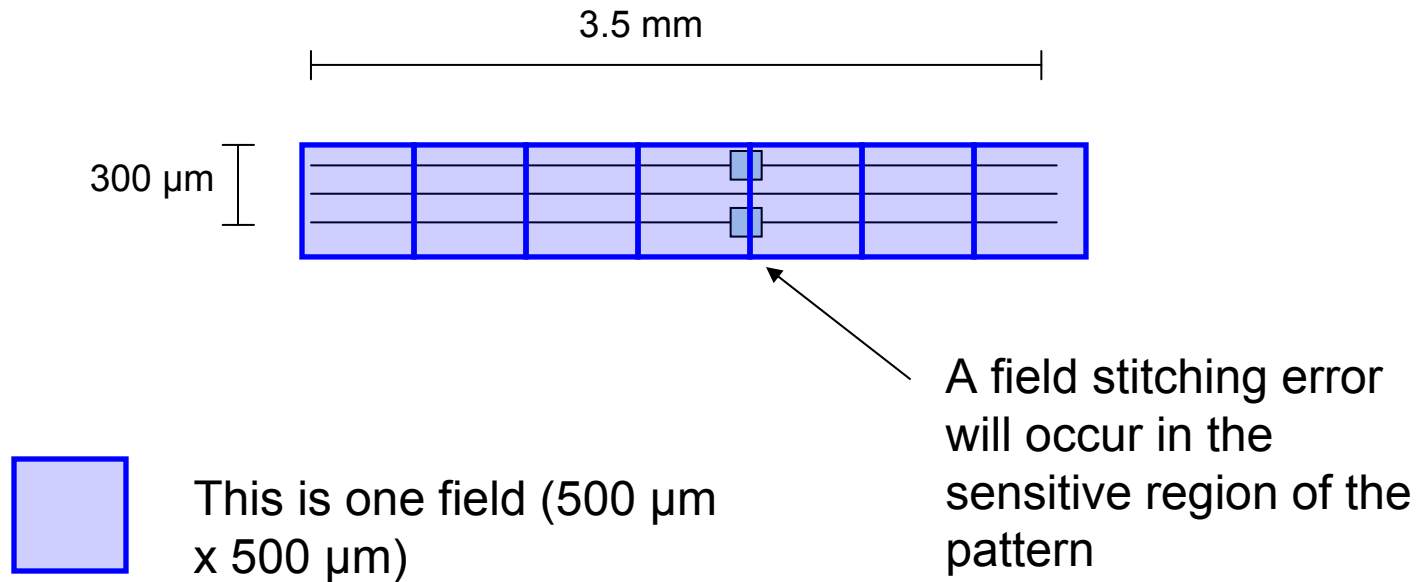
Problem Description: Some patterns have critical regions (ex: optics work). The field stitching error can fall in the middle of these critical regions, degrading the performance of a device.

Example CAD layout

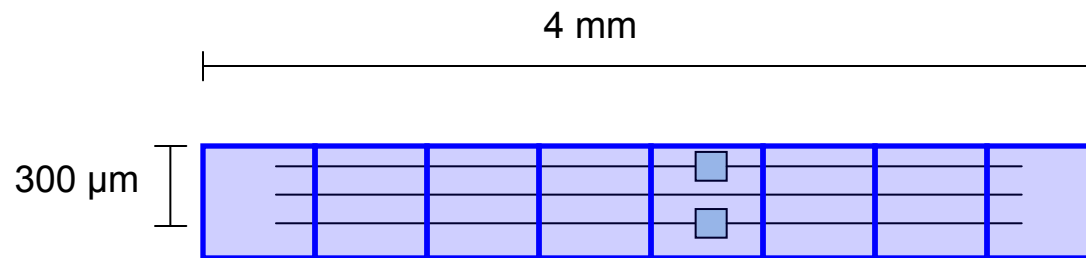


Field Boundaries

On the JEOL JBX-9300FS EBL System, the fields start from the upper left hand corner of the pattern. From the upper left, a field boundary stitching error will occur every 500 μm to the right and every 500 μm down.



Solution: Adjusting the Field Boundaries through Layout BEAMER can avoid a field stitching error in the sensitive region of the pattern



There is no longer a field boundary at the sensitive area of the pattern. An extra field has been added.

Implementation

In Layout BEAMER

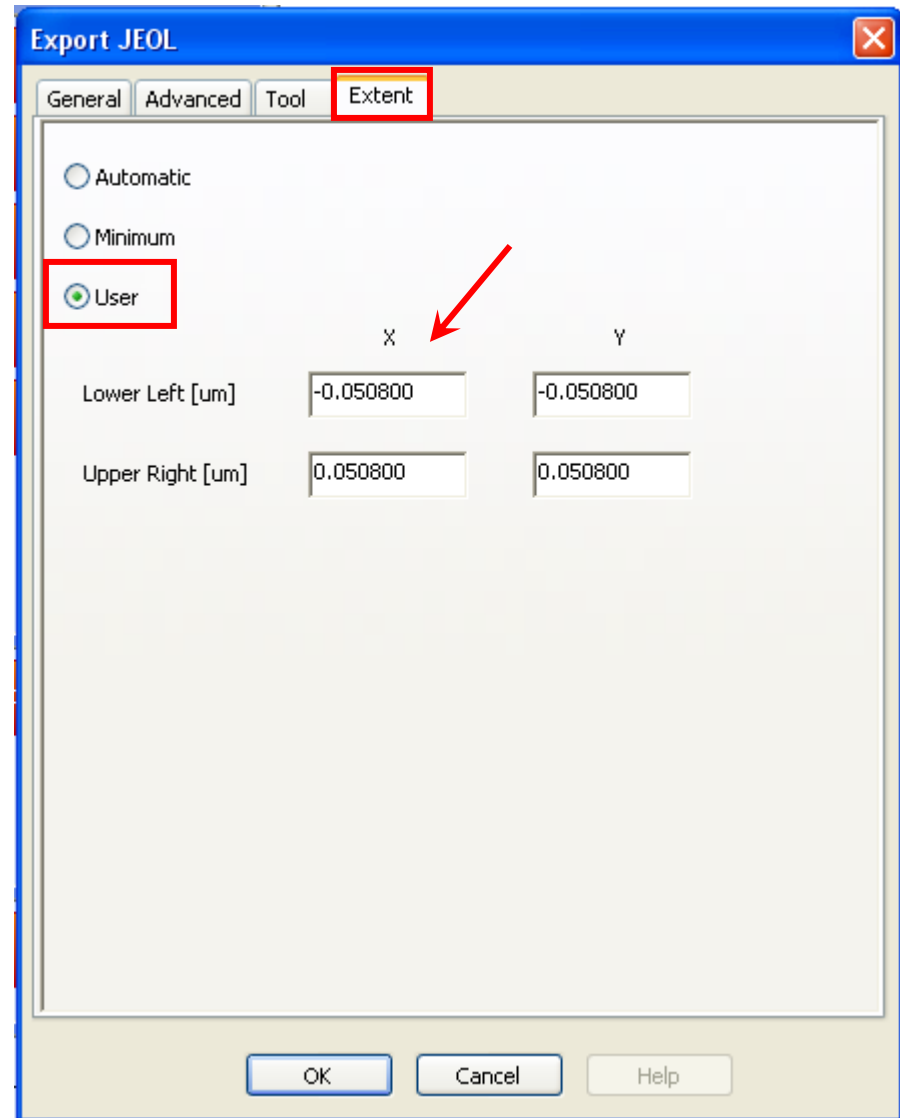
Under the “EXPORT” Button

➤ Extent Tab

➤ Select “User”

You can now adjust the pattern chip size.

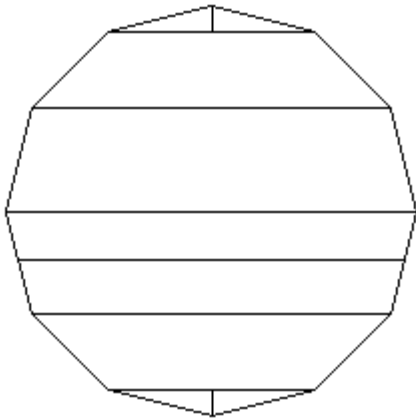
Ex: If you would like to move the field boundary 250 μm to the left, then you can change the lower left corner to be 250 μm less in the x direction



Fracture Mode

Problem Description: All shapes have to be converted to polygons to be compatible with the JEOL software. Circles, get broken up into a lot of different polygons. The fracture mode specifies how the circle is broken up into polygons.

Different fracturing methods can affect the quality of patterns, the e-beam writing time, and the file sizes.

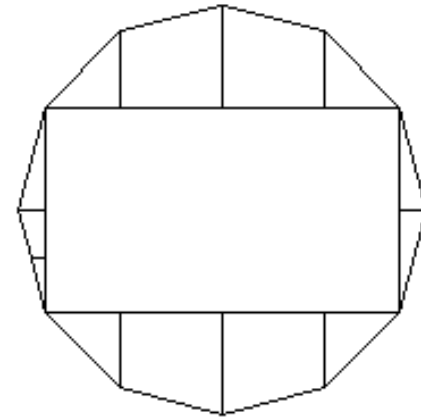


Fracture mode 1

Rougher curves

Less fractured shapes

Smaller file sizes/Less
writing time



Fracture mode 2

More fractured shapes

Larger file sizes/More
writing time

For most users, we recommend fracture mode 2 because this model is closest to the model JEOL uses to fracture circles

Implementation

In Layout BEAMER

Under the “EXPORT” Button

➤ General Tab

➤ Select which fracture mode you would like

