KiCad StepUp tools cheat sheet

https://github.com/easyw/kicadStepUpMod

1) What StepUp tools are for?

KiCad StepUp tools are a FreeCAD Macro and a FreeCAD WorkBench to help in **Mechanical Collaboration** between KiCad EDA and a Mechanical CAD.
With StepUp it is possible to:

- **load kicad board and parts in FreeCAD and export it to STEP (or IGES)** for a full ECAD MCAD collaboration
- **load *kicad_mod* footprint in FreeCAD to easy and precisely align the mechanical model** to kicad footprint
- **convert the STEP 3D model of parts, board, enclosure to VRML with Materials properties** for the best use in kicad
- **check interference and collisions for enclosure and footprint design**
- **design a new pcb Edge with FreeCAD Sketcher and PUSH it to an existing kicad_pcb Board**
- **PULL a pcb Edge from a kicad_pcb Board, edit it in FC Sketcher and PUSH it back to kicad**
- **PUSH & PULL 3D models positions between FreeCAD and KiCAD**
- **ECAD / MCAD Collaboration and Synchronization** (compressed **'stpZ' format** allowed)
- **footprint generation even for complex pads and shapes**
- **generate Blender compatible VRML files**

2) Requirements

KiCad StepUp tools need with the following requirements:

- **KiCad Stable Release >= 4.0** or kicad **Nightly Development Builds**
- **FreeCAD** stable release >= **0.18** (FC daily is supported too)
- a library of STEP 3D models now available as default from KiCad/packages3D

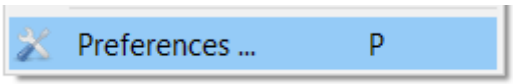
3) How to install StepUp tools

KiCad StepUp tools can be installed as a **FreeCAD Macro** but it is strongly suggested to install StepUp as a **FreeCAD WorkBench.**
Since KiCad StepUp tools have been added to FC WorkBenches, so they can can be installed through the FreeCAD addons installer or starting from FC version 0.17, through the **addons manager** in the FC Tools Menu. Then StepUp buttons will be available to be customized in FC Toolbars.

If KiCad StepUp tools are installed as a FC WorkBench, then **it will be possible to Open directly from the FC File Menu a *kicad_pcb* board file or a *kicad_mod* footprint file** and many useful features will be also available.

4) Configure StepUp tools

To use StepUp tools for converting a *kicad_pcb* Board to a mechanical STEP model you just need to **configure** your 3D prefix path(s) like your **KISYS3DMOD** value into the FreeCAD StepUp preferences page, located in the preferences system of FreeCAD (Edit menu -> Preferences).



Just click the green icon:

5) Tips

Tips to use StepUp tools at its best

- never use a scale different from 1:1:1 in your 3D models
- configure your [prefix3D] in the FreeCAD StepUp preference page to your KISYS3DMOD path
- use STEP or STPZ or IGES or VRML or WRZ or mixed type of models in your board
- use bounding boxes to reduce your STEP board file size if required
- each 3D model is suggested to be be a single object (union of parts or compound in FC)
  note: compound may be slower than union, because it needs to re-create a compound after loading the model

6) Useful Video Tutorials

Here some links of StepUp tutorial:

- StepUp: Align Parts to Kicad footprint
- StepUp: converting a KiCad board and Parts to STEP
- StepUp: PUSH & PULL a PCB Edge using FC Sketcher
- StepUp: PUSH&PULL 3D models between KiCAD & FreeCAD (ECAD MCAD Synchronization)

There is also a video tutorial made by a user:

- StepUp: Installing, Import 3D model, Exporting the Board

Note: in the video the user is copying all demo files, when in fact it is better to install StepUp as a FreeCAD WorkBench.

7) Need Help?

KiCad info forum is a great resource:
https://forum.kicad.info/search?q=step

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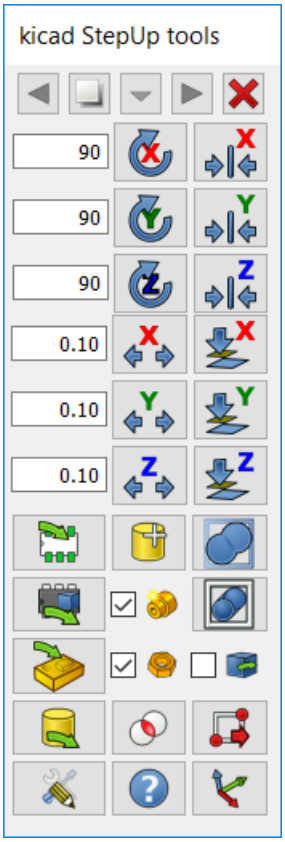
The Main Gui

A brief recap on KiCad StepUp tools buttons.
Note: each button has a Tooltip



Load '*kicad_pcb*' Board
Load a 'kicad_pcb' file into FreeCAD

Import 3D model to be Aligned
Import a 3D STEP model into FreeCAD

Load '*kicad_mod*' Footprint
Load a *'kicad_mod'* footprint into FreeCAD

Export 3D model Aligned
Export a 3D STEP & VRML model back to KiCad

Export selected to STEP
Export selected objects or Board and Parts to hierarchical STEP file

Push & Pull PCB Edge
Read and Write pcb Edge from KiCad into FC Sketcher

Add Reference Axis
Add reference Axis to the FreeCAD design

Check Interferences and Collisions
Check Interference and Collisions in Board Design

Help
Mini Help inside StepUp tools

Preferences Config Page
showing the preferences Page

Make a Union
Make a Union of Parts

Make a Compound
Make a Compound of Parts

Option checkboxes

Materials properties
Adding Material to VRML when Exporting a 3D model

Virtual mechanical
Adding Virtual kicad Parts when Loading a 3D model of the PCB

export Board to STEP
Automatically export Board & Parts to STEP after Loading a 3D model of the PCB if checked

Useful Video Tutorials

Here some links of StepUp tutorial:

- StepUp: Align Parts to Kicad footprint
- StepUp: converting a KiCad board and Parts to STEP
- StepUp: PUSH & PULL a PCB Edge using FC Sketcher
- StepUp: ECAD MCAD Synchronization & Collaboration

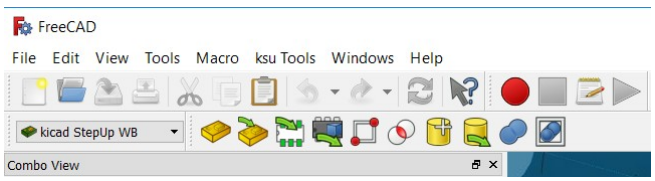
There is also a video tutorial made by a user:

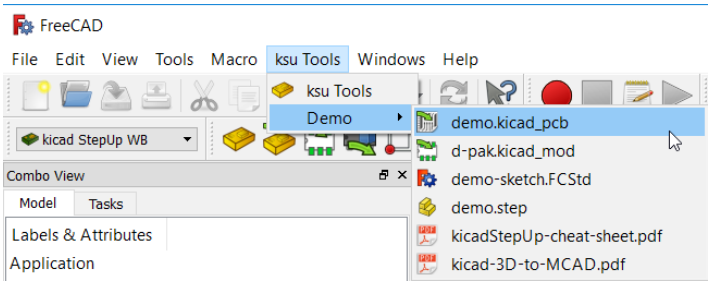
- StepUp: Installing, Import 3D model, Exporting the Board

Note: in the video the user is copying all demo files, when in fact it is only needed *kicad-StepUp-tools.FCMacro* file.

The WorkBench

A screenshot on KiCad StepUp WB.
Demo and Manuals in the StepUp WB Menu





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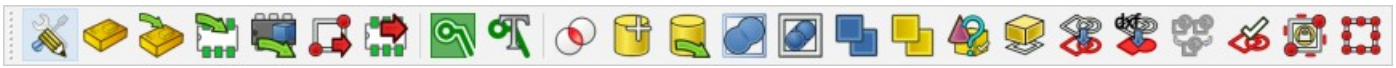
The WorkBench

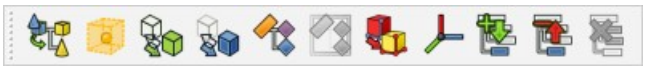
A screenshot on KiCad StepUp WB.
Note: each button has a useful Tooltip
Demo and Manuals in the StepUp WB Menu

Main Tool bar

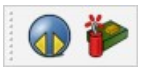


Push&Pull Tool bar

Helpers



Show tools

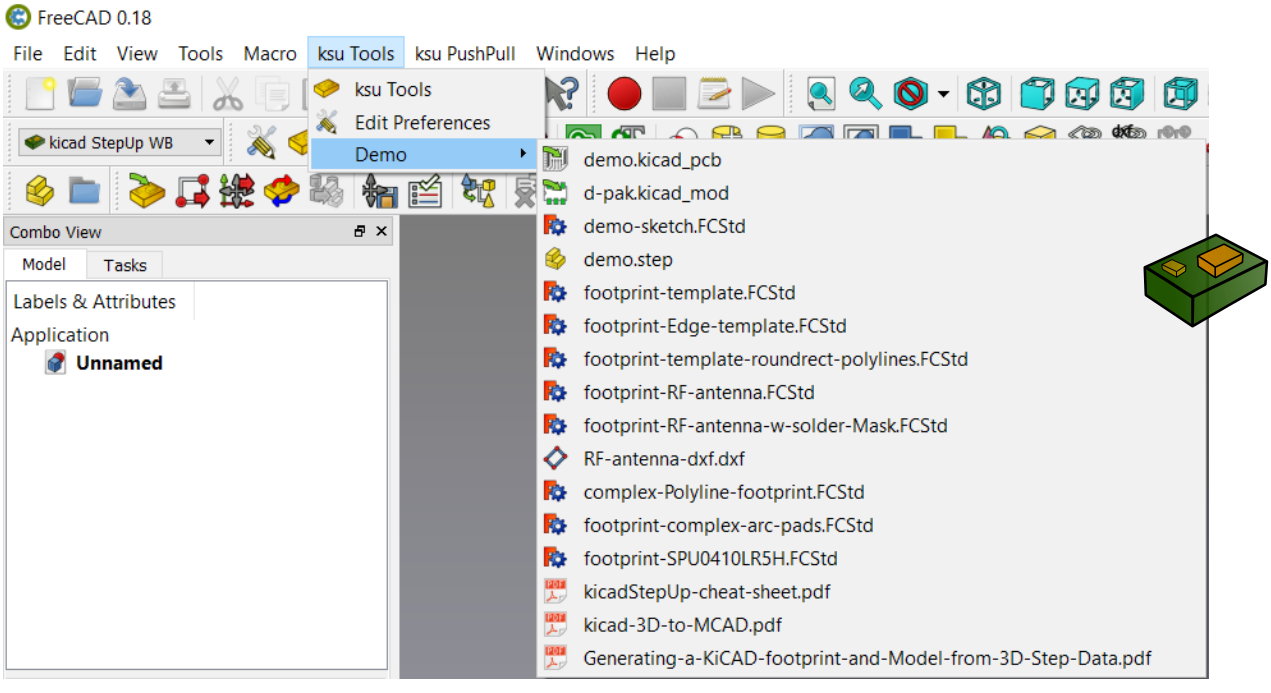


Useful Designing external workbenches

Two external workbenches:

- Manipulator workbench useful to align and move assemblies and STEP models
  Aligner Mover and Caliper are companions in 3D modelling

Defeaturing workbench useful for editing STEP models, removing some features from the model; defeaturing and repairing tools.



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STEP compressed ['.stpZ']
VRML compressed ['.wrz']
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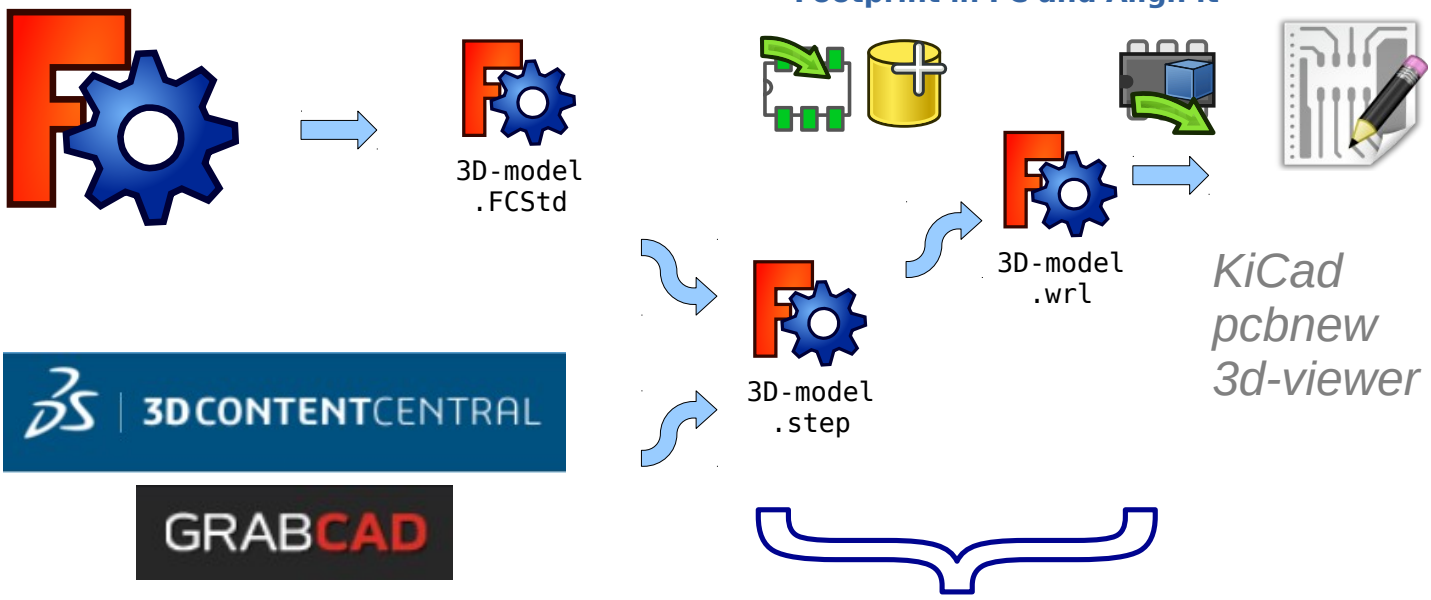
StepUp WorkFlow for 3D models

How to create a 3D model library for KiCad with StepUp tools



Use StepUp tools to Load the Footprint in FC and Align it

Use FreeCAD or any MCAD sw as 3D designer for a 3D model, or just download a 3D STEP model from on-line libraries

Place the exported models to the KISYS3DMOD folder

Use Manipulator WB

to align the STEP model to footprint
Manipulator workbench

Note:
when aligning a 3D model to a kicad footprint,
StepUp takes care of:

- 2D footprint rotation of kicad for the footprint alignment
- vrml model *z* rotation

It is mandatory that the footprint has:

- *x* and *y* of the 3D model rotation set to 0
- x, y and z of the 3D model translation set to 0

The user has to check/modify, if needed, the part of 3D vrml/step model in kicad as following

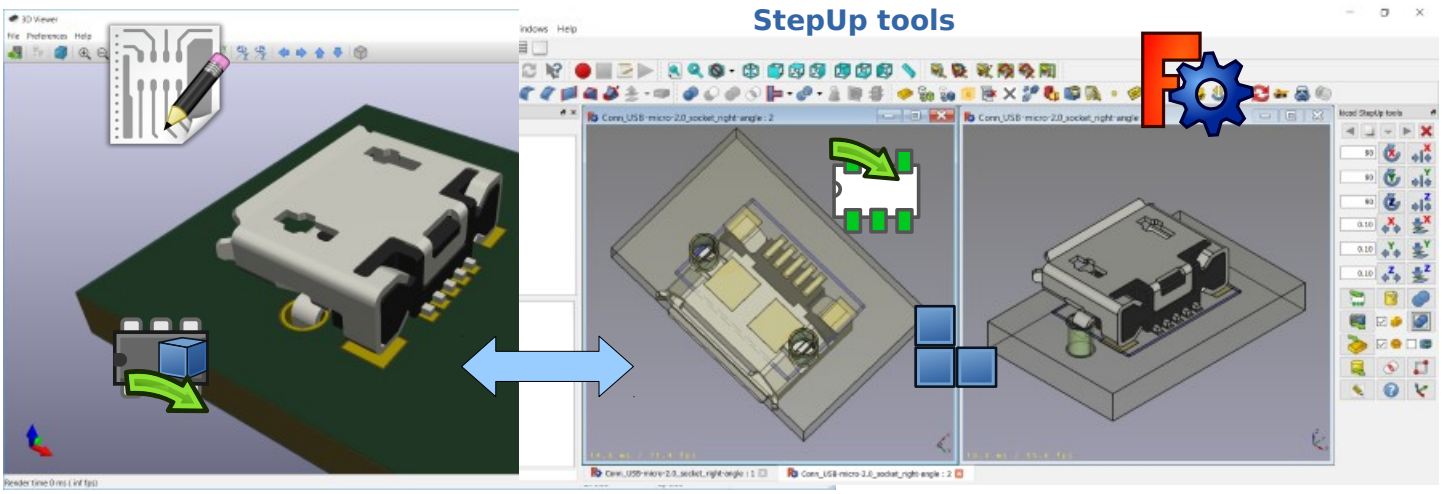
```
(model path/name.wrl
(at (xyz 0 0 0))
(scale (xyz 1 1 1))
(rotate (xyz 0 0 0))
```

`at (xyz 0 0 0)` **is mandatory, as much as** `scale (1 1 1)`
`rotate (xyz 0 0 z_value)` **can have a z rotation value**

Video Tutorials

Align Parts to Kicad footprint
Installing, Import 3D model, Exporting the Board

StepUp tools



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Generating smaller 3D model with bounding boxes

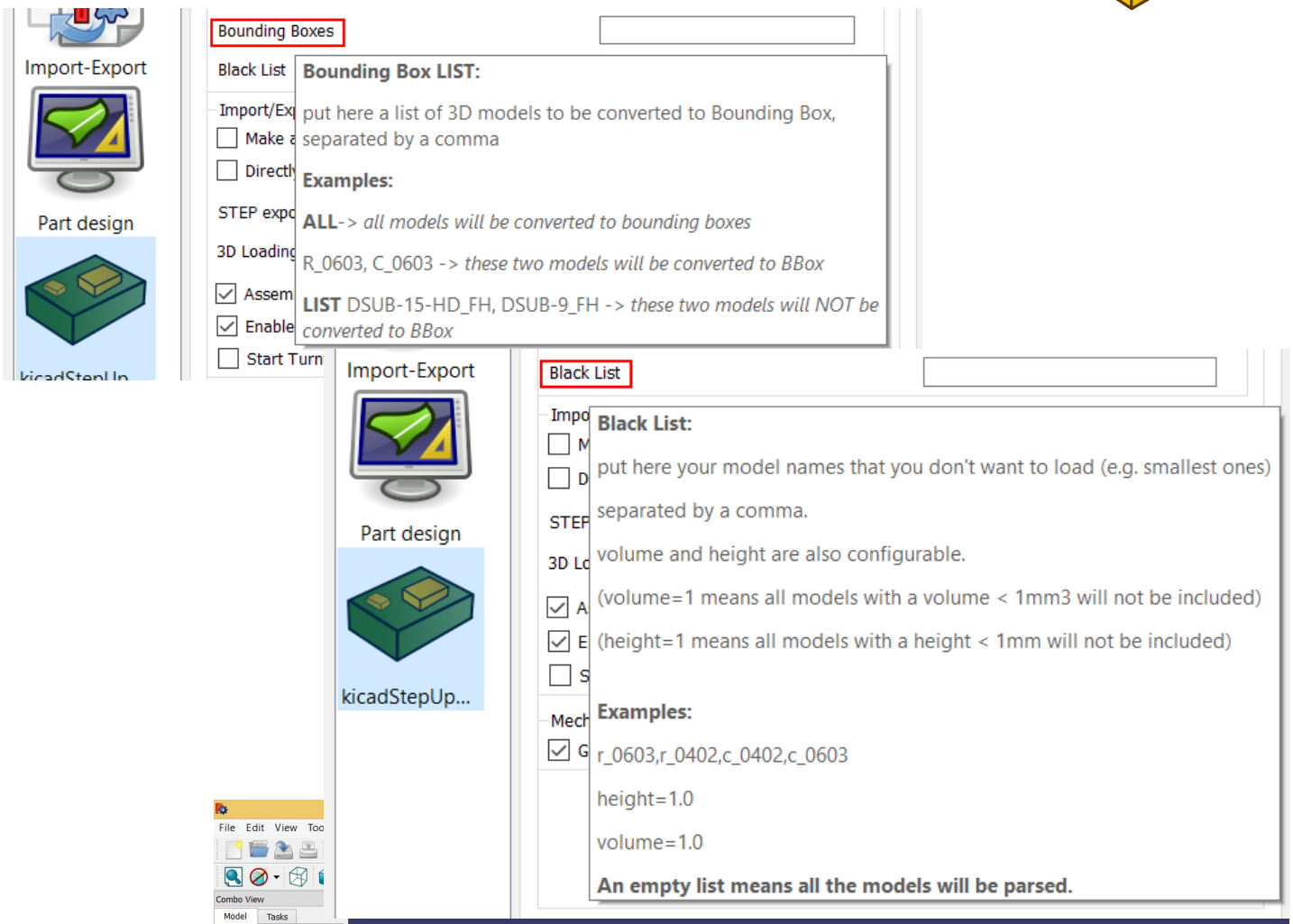
Sometimes the need would be just a 3D MCAD model for analysis or simple space constraints, so a nice detailed component models in MCAD system may be not required or desired;
in that case it is possible to configure the exporter to:

- skip 3D models by name
- skip models with a volume less than an assigned value
- skip models with a height less than an assigned value

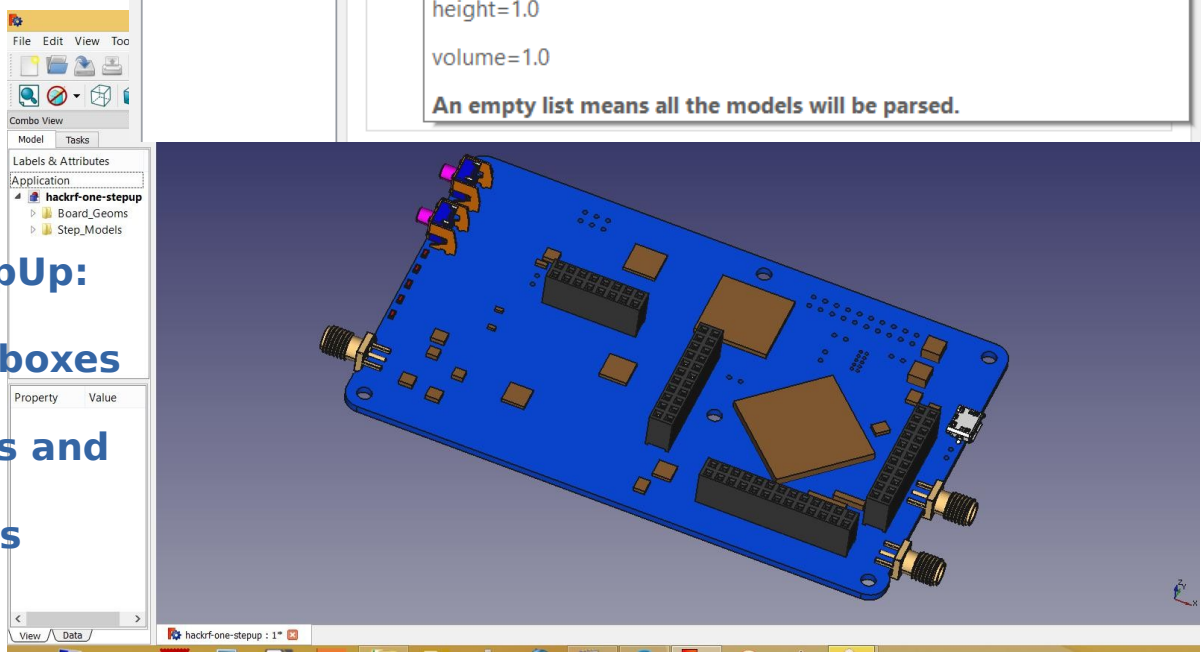
And then convert the remaining parts, or all but edge connectors, to bounding boxes
The result 3D MCAD model will have the accuracy of the pcb and assemblies only when needed, maintaining the model light as required.

Configuration file: Blacklist & BoundingBox parameters

Preferences Page



KiCad StepUp: Using bounding boxes for all but connectors and skipping small parts



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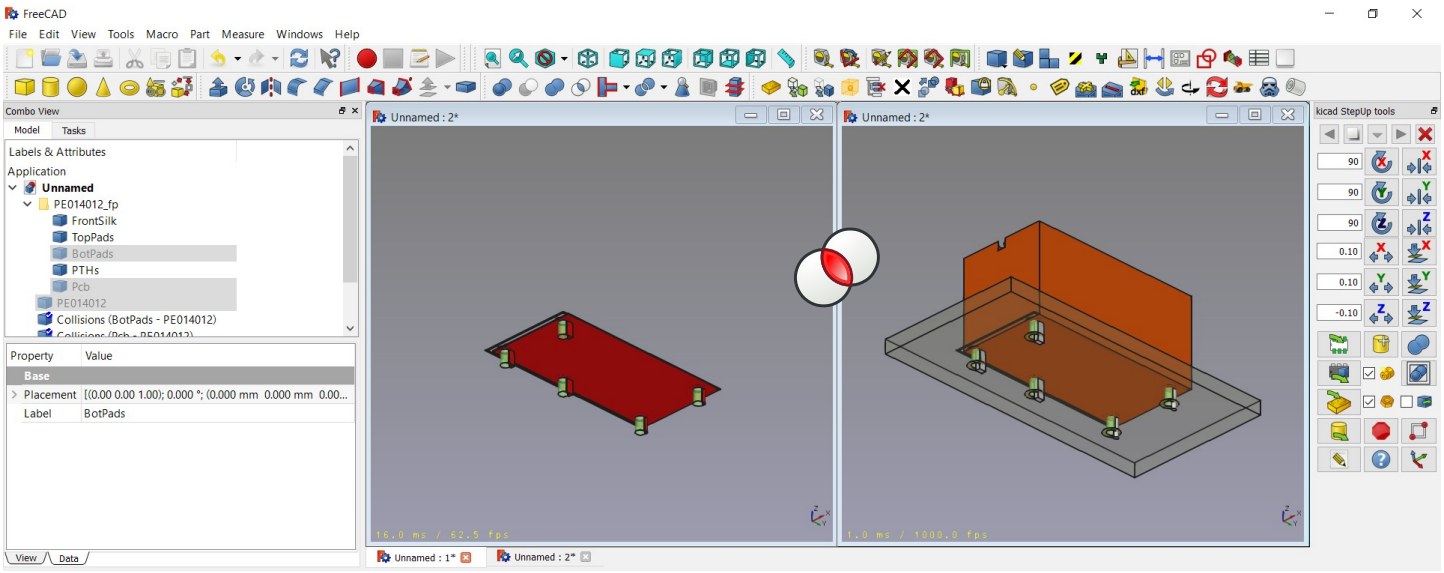
Check for Interference and mechanical constrains

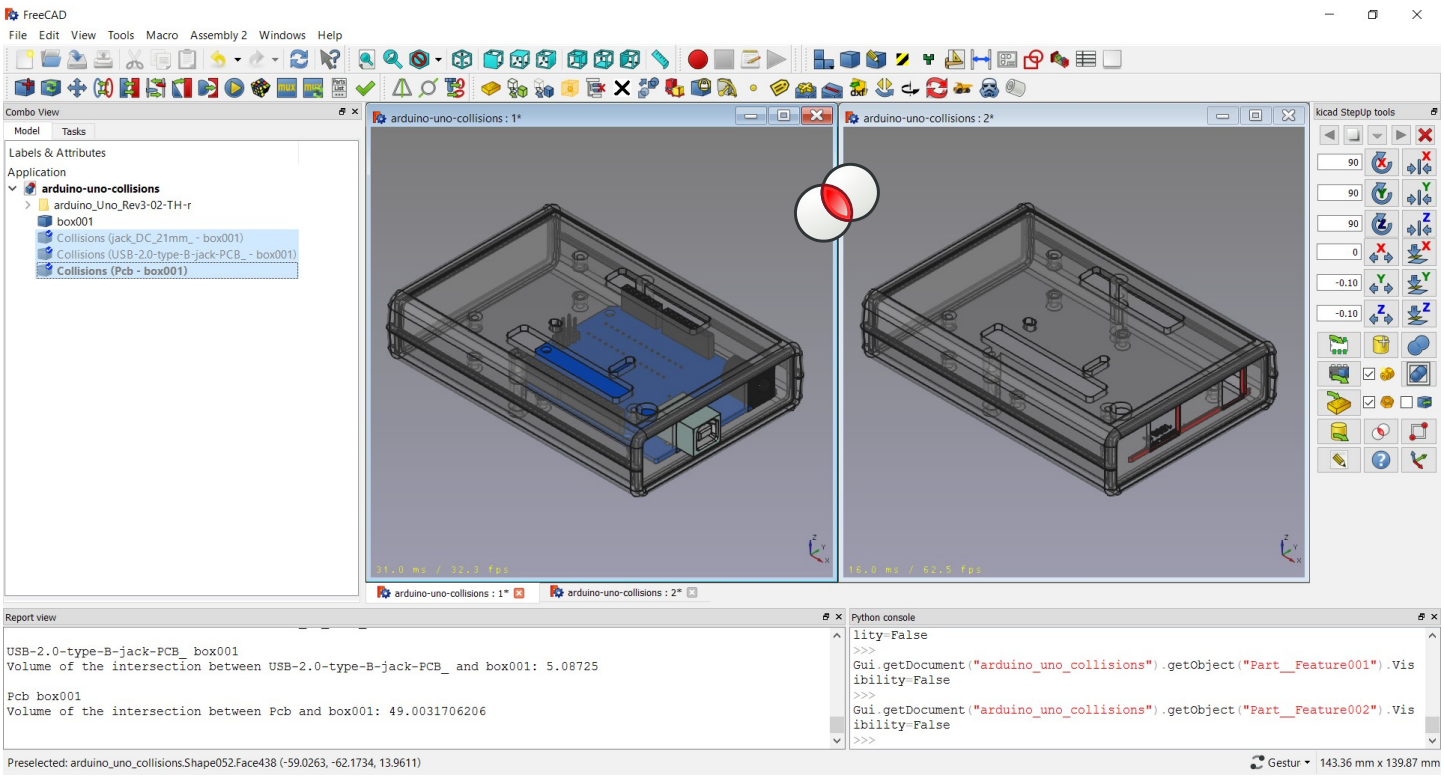
With kicad-SteUp-tools it is also possible to detect collisions and check mechanical constrains:

- detect collisions among part pins and drills for footprints
- detect collisions for enclosure clearance (between pcb with parts/connectors and enclosure)

Interference checking for Footprints



Interference checking for PCB & Enclosure



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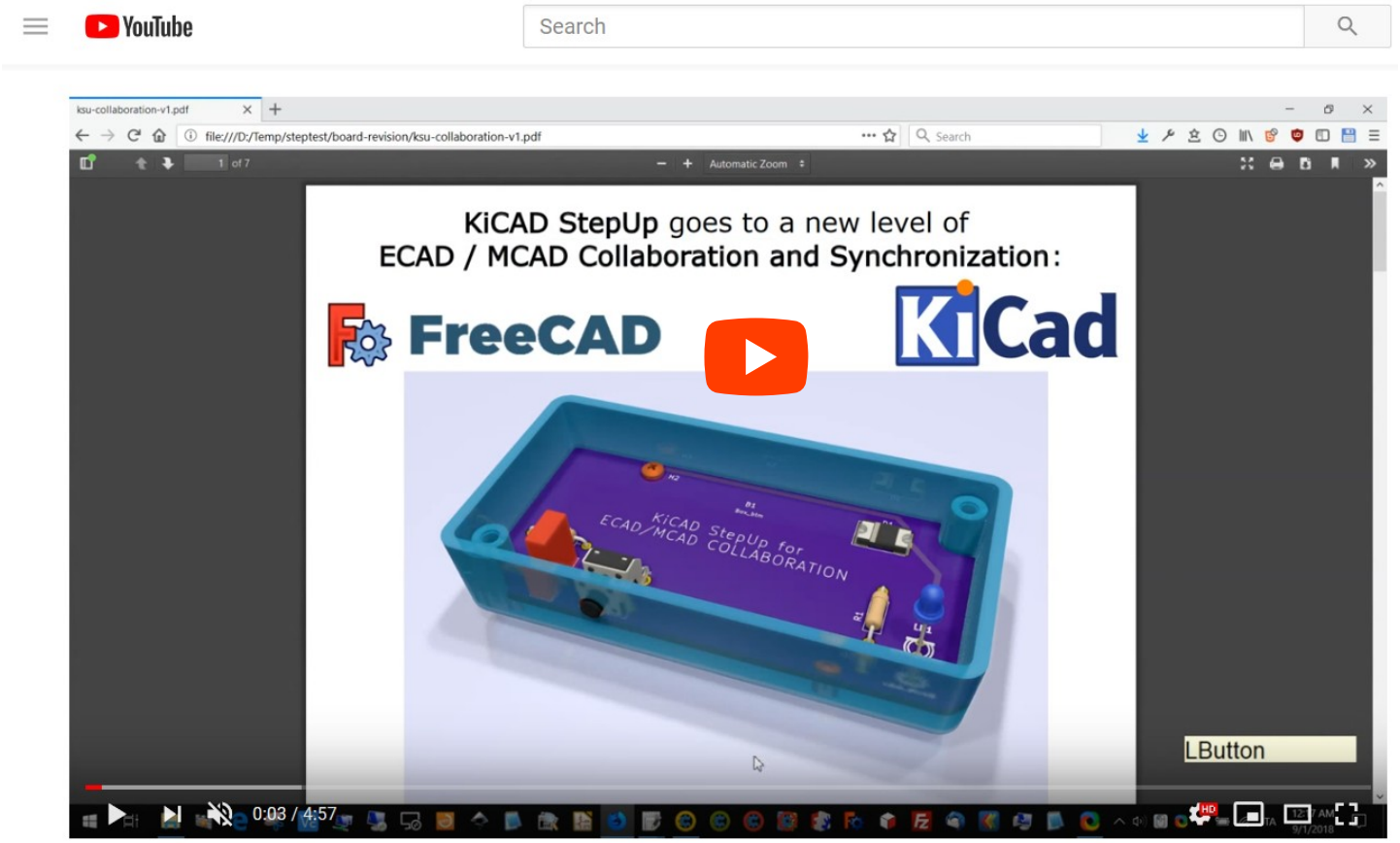
StepUp: ECAD MCAD Synchronization

KiCAD StepUp goes to a new level of **ECAD / MCAD Collaboration and Synchronization**:
Push/Pull 3D model placement from/to KiCAD board to/from FreeCAD mechanical design.
It is possible to move 3D packages around on the 3D PCB mechanical sw, via both the X and Y axis.
The syncing process can be done even if the board is (fully) routed (i.e. when a new release requires some mechanical reviews).

ECAD MCAD integration is now fully implemented.



kicad StepUp: ECAD MCAD Synchronization

FreeCAD KiCad

The ECAD MCAD collaboration tutorial

ECAD MCAD Synchronization

Tips

It is suggested to configure *the preferences Page* to use **grid origin** and **place a grid origin** to **kicad_pcb** file

KiCad StepUp Workbench

STEP compressed ['.stpZ']
VRML compressed ['.wrz']
formats are allowed

KiCad StepUp tools cheat sheet

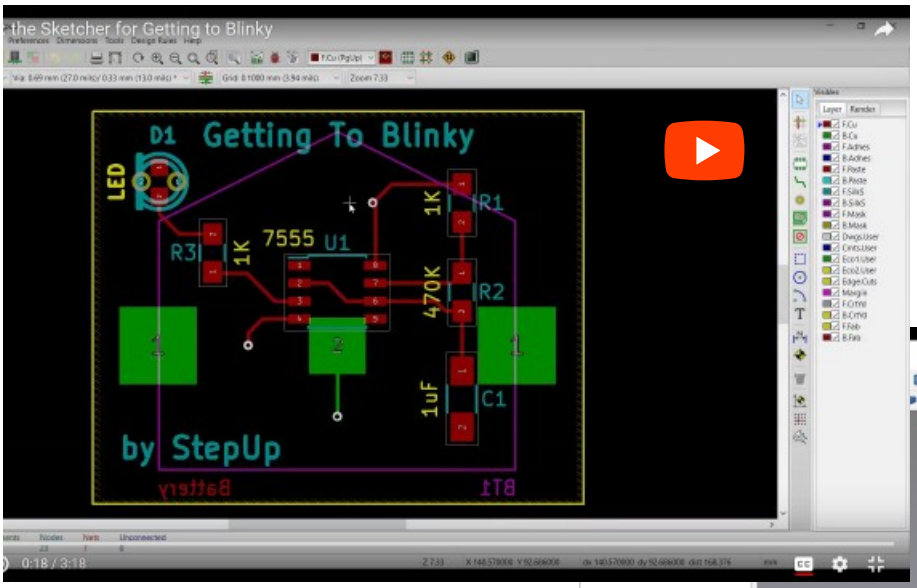
https://github.com/easyw/kicadStepUpMod

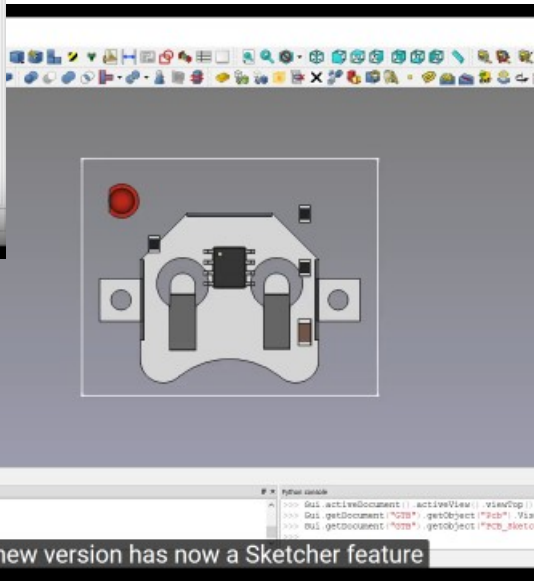
StepUp: The Sketcher

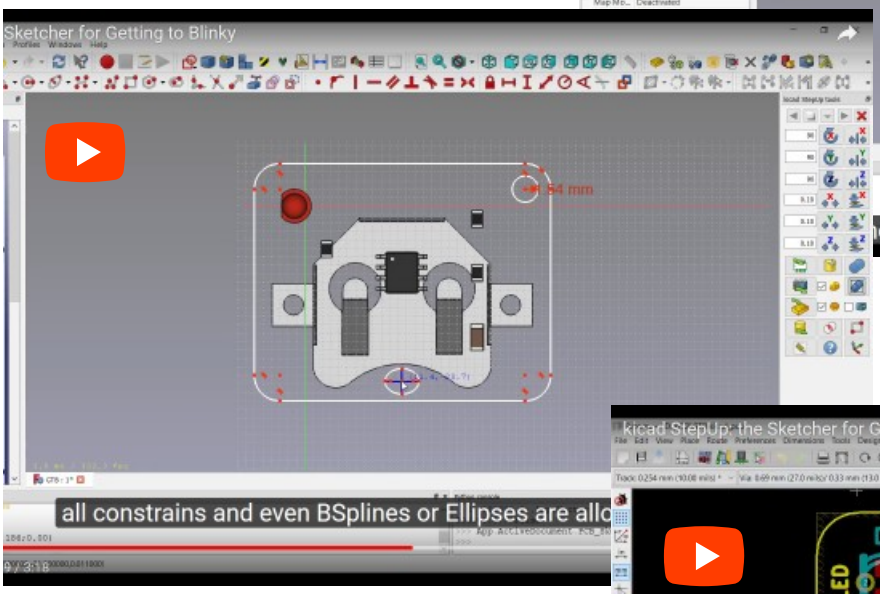
With kicad-SteUp-tools it is also possible to use FreeCAD Sketcher to create or modify a PCB Edge.

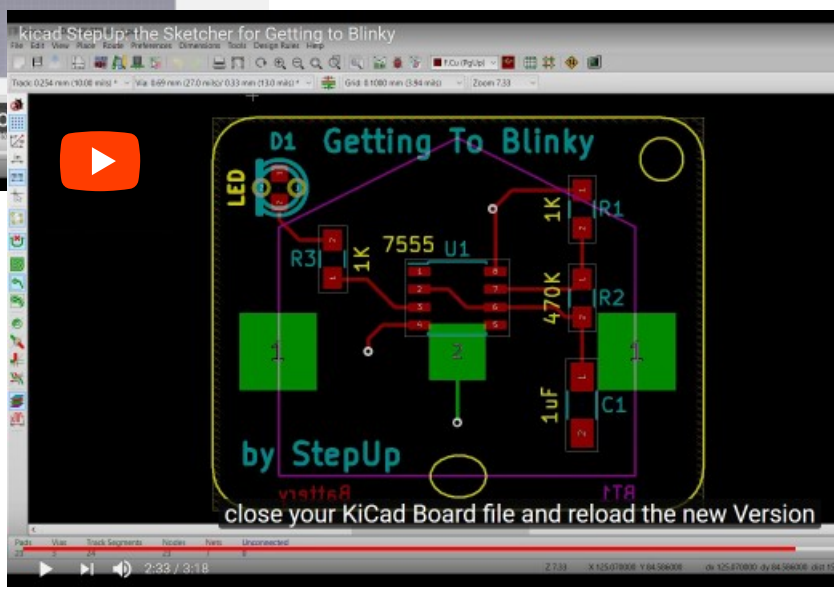
- create a new PCB Edge in FreeCAD Sketcher and PUSH it to kicad_pcb file
- read a PCB Edge from an existing kicad_pcb file and PULL it to FreeCAD Sketcher
- modify a PCB Edge in FreeCAD Sketcher and PUSH it to KiCad Board

Line, Circles, Arcs are supported and also **Bsplines or Ellipses** are supported and converted to KiCad compatible format









The Sketcher tutorial

PUSH & PULL a PCB Edge using FC Sketcher

Tips

It is suggested to configure *the preferences Page* to use **grid origin** and **place a grid origin** to **kicad_pcb** file

KiCad StepUp tools cheat sheet

https://github.com/easyw/kicadStepUpMod

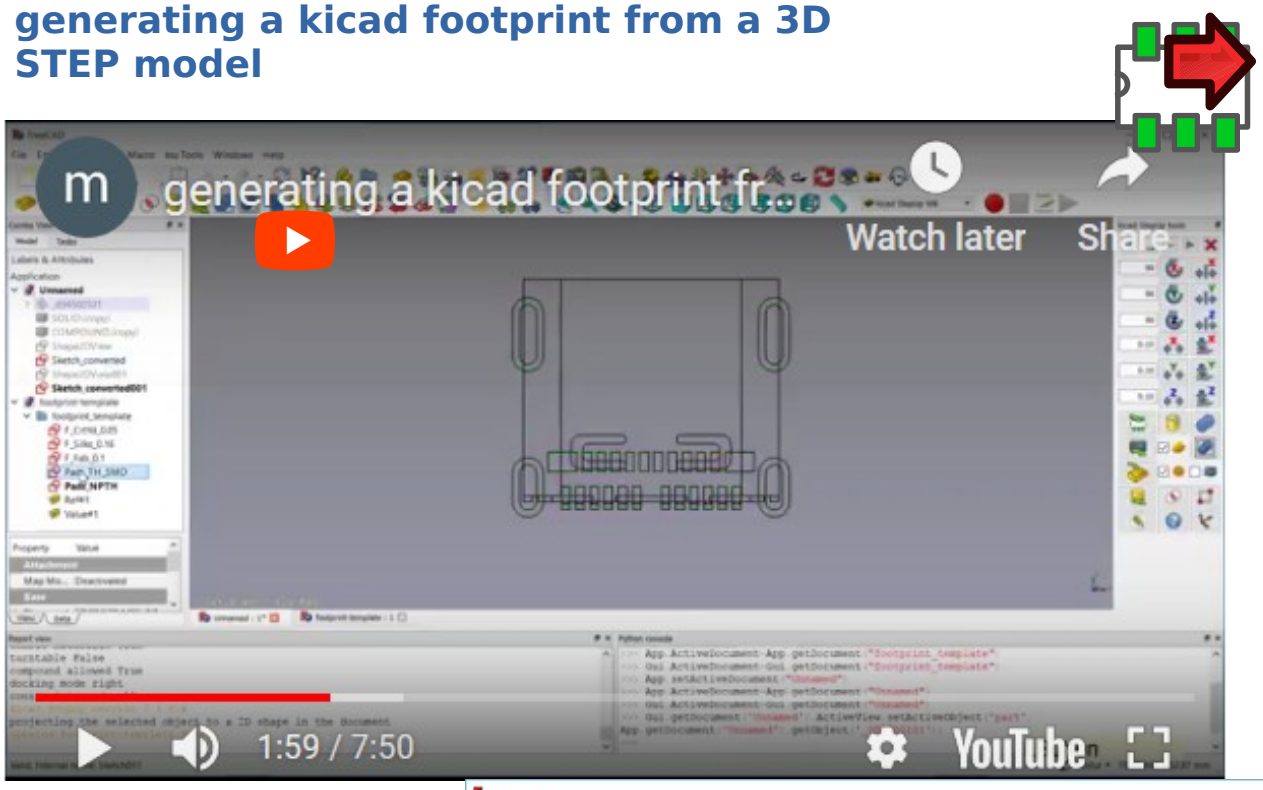
StepUp: The Sketcher for footprint generation

With kicad-SteUp-tools it is also possible to use FreeCAD Sketcher to create or modify a Kicad footprint.

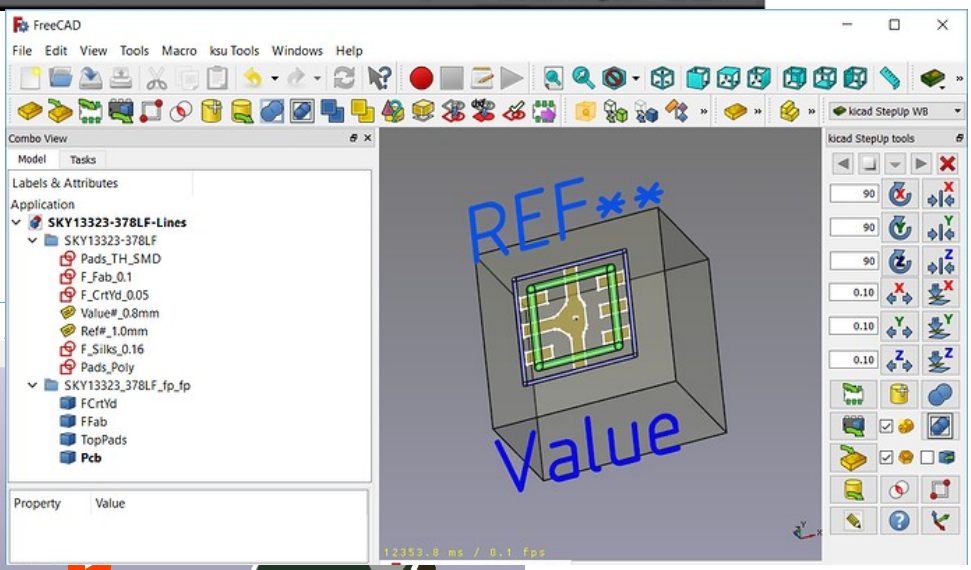
- create a new footprint in FreeCAD Sketcher and PUSH it to kicad_mod file
- modify an existing kicad footprint in FreeCAD Sketcher and PUSH it back to 'kicad_mod'

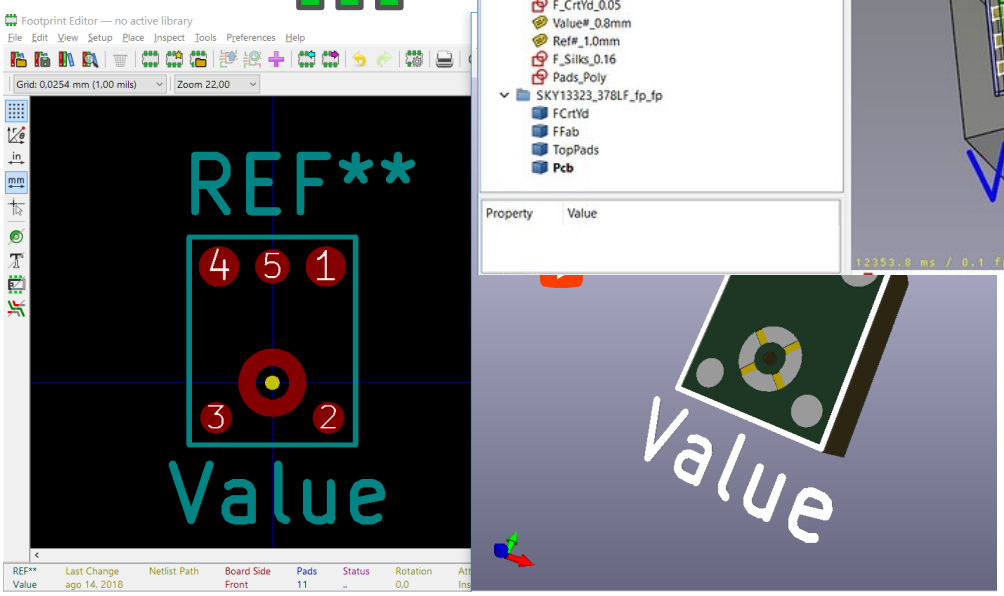
Line, Circles, Arcs are supported and also **Bsplines or Ellipses** are supported and converted to KiCad compatible format

generating a kicad footprint from a 3D STEP model



The Sketcher for footprint: Tutorial





The Sketcher for footprint @ KiCadINFO

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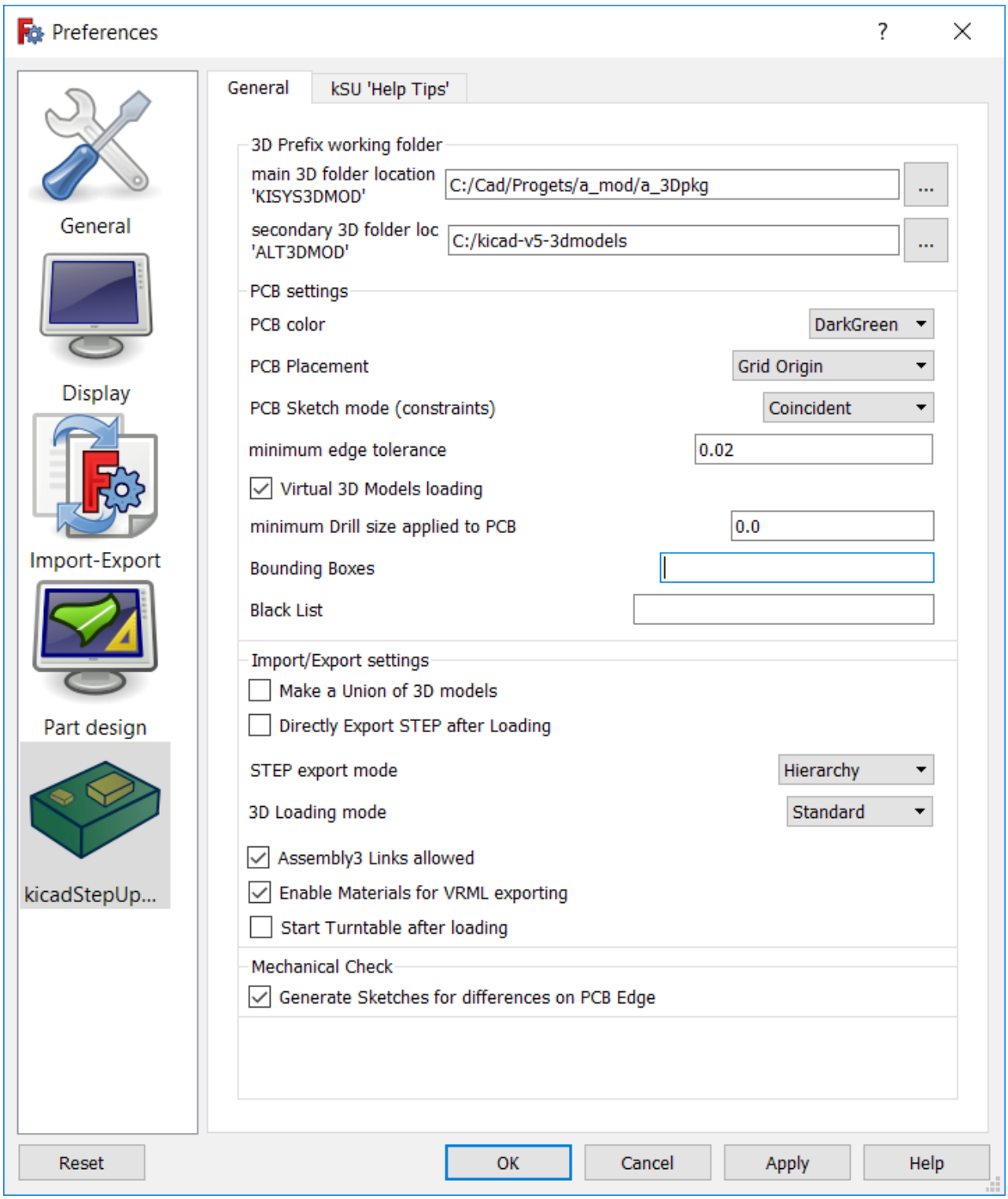
Preferences Page for configuring main parameters

All buttons have Tooltips



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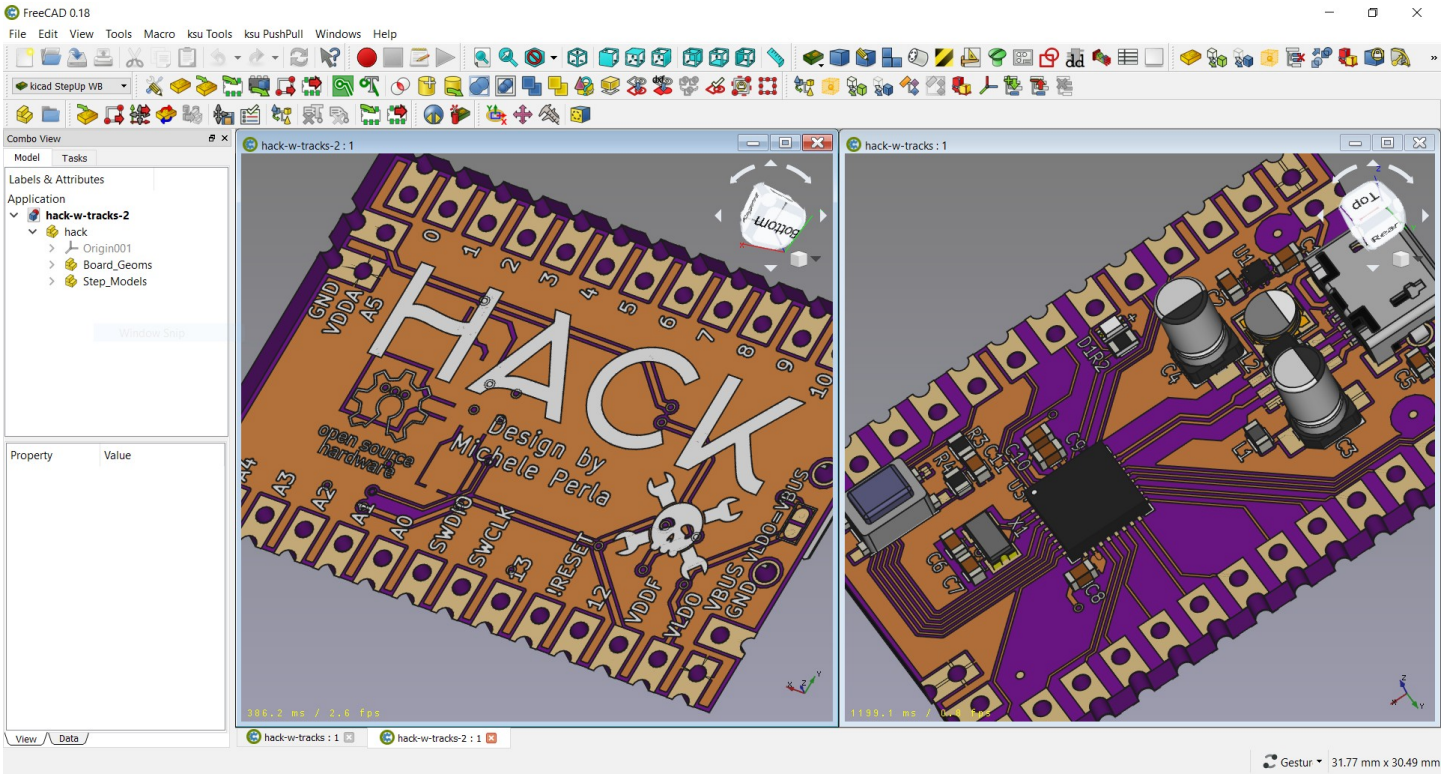
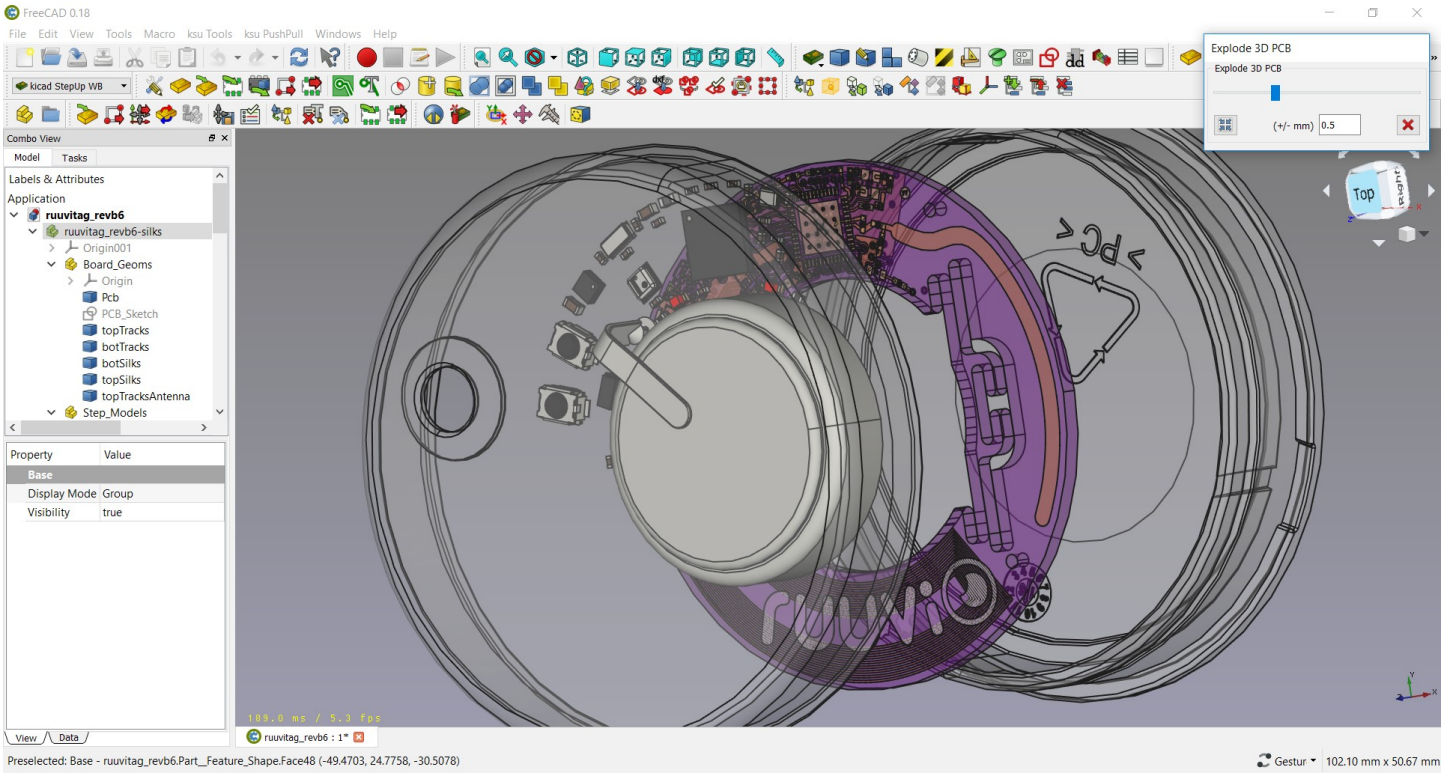
Tracks and SilkScreen MCAD integration

New ability to import Top and Bottom tracks and SilkScreen layers





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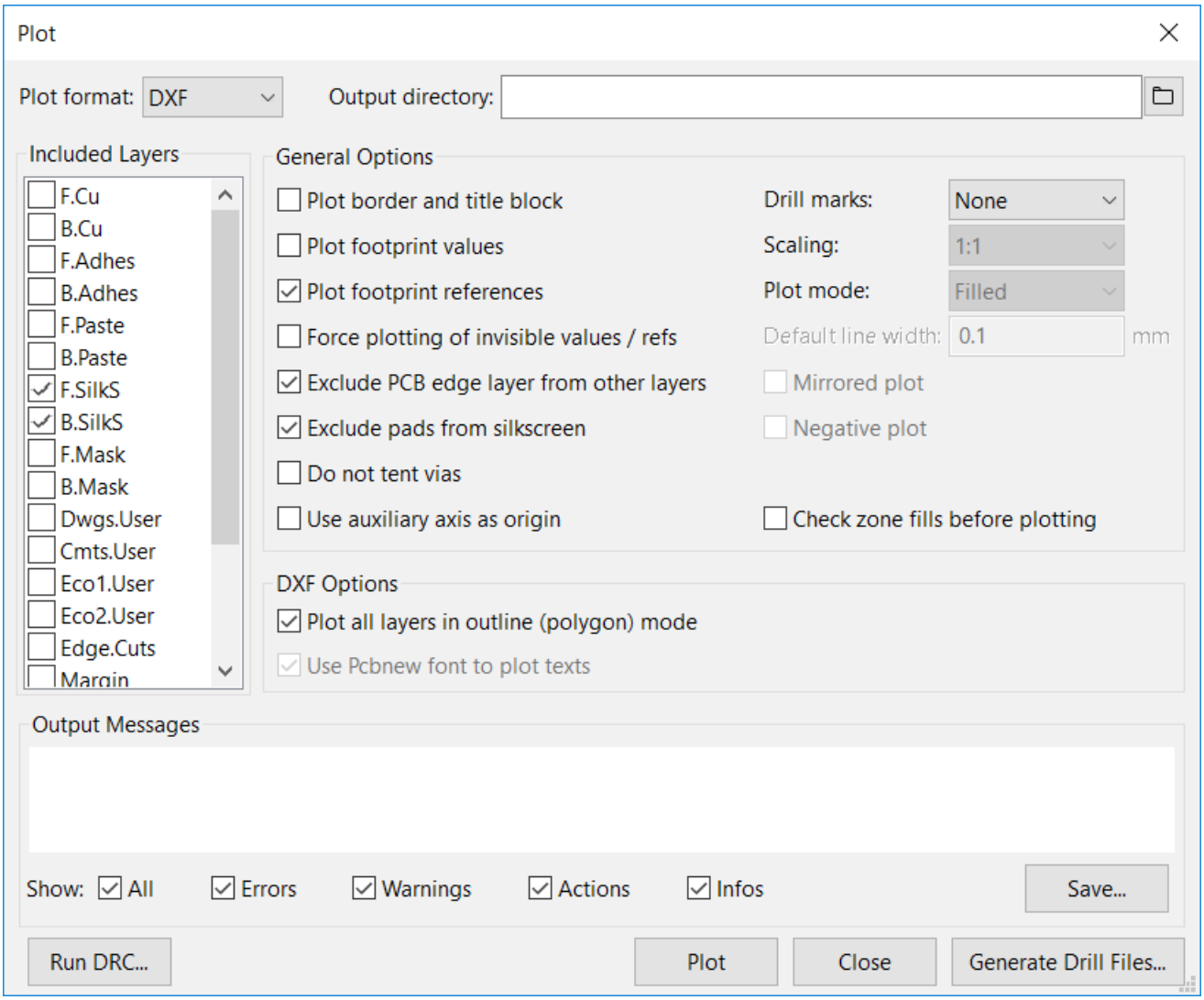
Tracks MCAD integration

New ability to import Top and Bottom tracks and SilkScreen layers

Top and Bottom tracks are imported directly from 'kicad_pcb' source file into FreeCAD designing document.

Top and Bottom SilkScreens are imported from Top and Bottom DXF files, exported from KiCAD source file.

KiCAD export configuration



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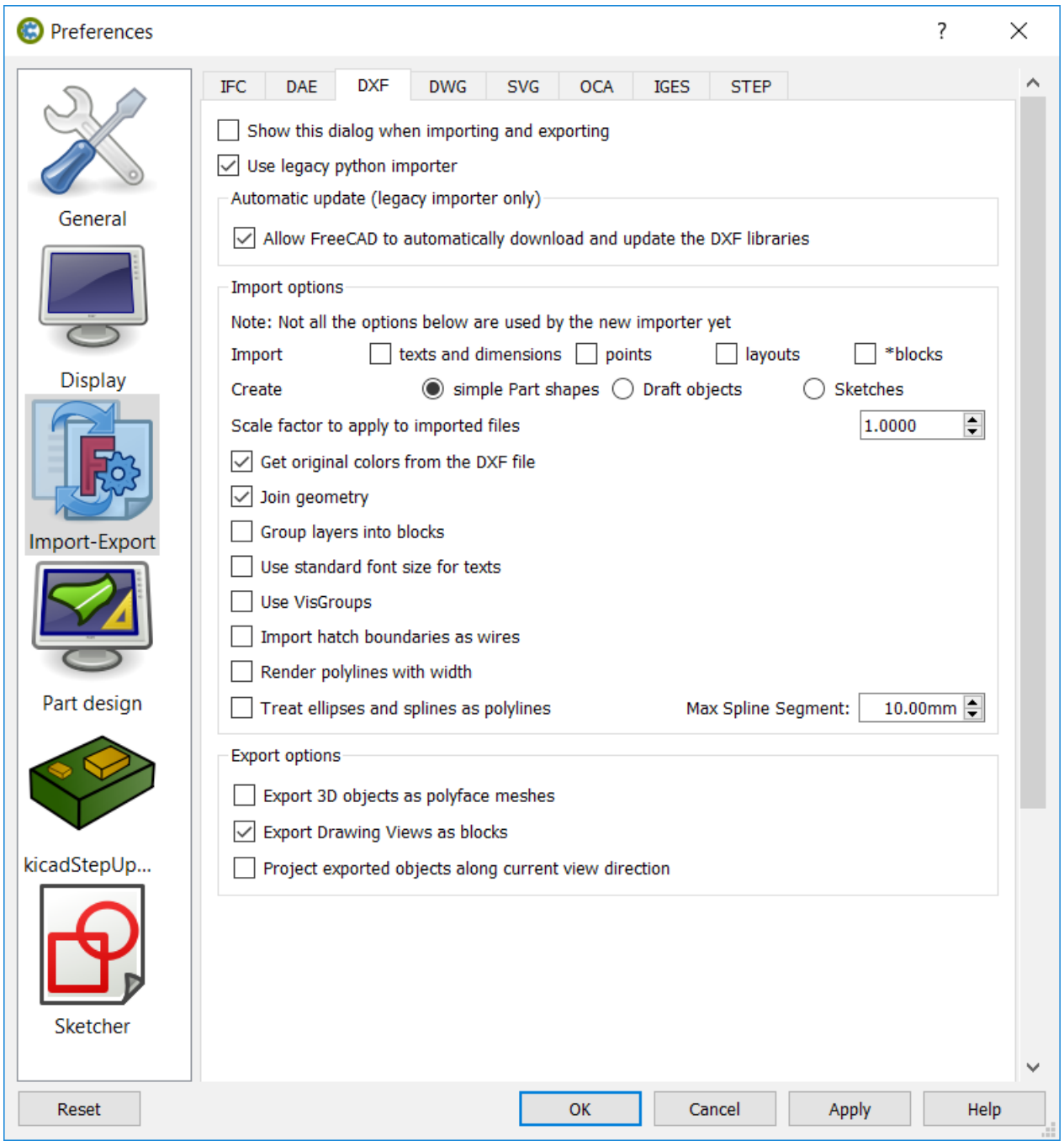
Top and Bottom SilkScreens are imported from Top and Bottom DXF files, exported from KiCAD source file.

FreeCAD import configuration



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StepUp Credits

kicad StepUp tools author is Maurice **https://github.com/easyw/kicadStepUpMod**

IDF import for FreeCAD - Milos Koutny (milos.koutny@gmail.com)
CadQuery module - CadQuery FreeCAD module https://github.com/jmwright/cadquery-freecad-module/
hyOzd freecad macros - https://bitbucket.org/hyOzd/freecad-macros
FreeCAD-PCB - marmni <marmni@onet.eu26>
Kicad semantic parser - "Zheng, Lei" https://github.com/realthunder/fcad_pcb

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Risk disclaimer

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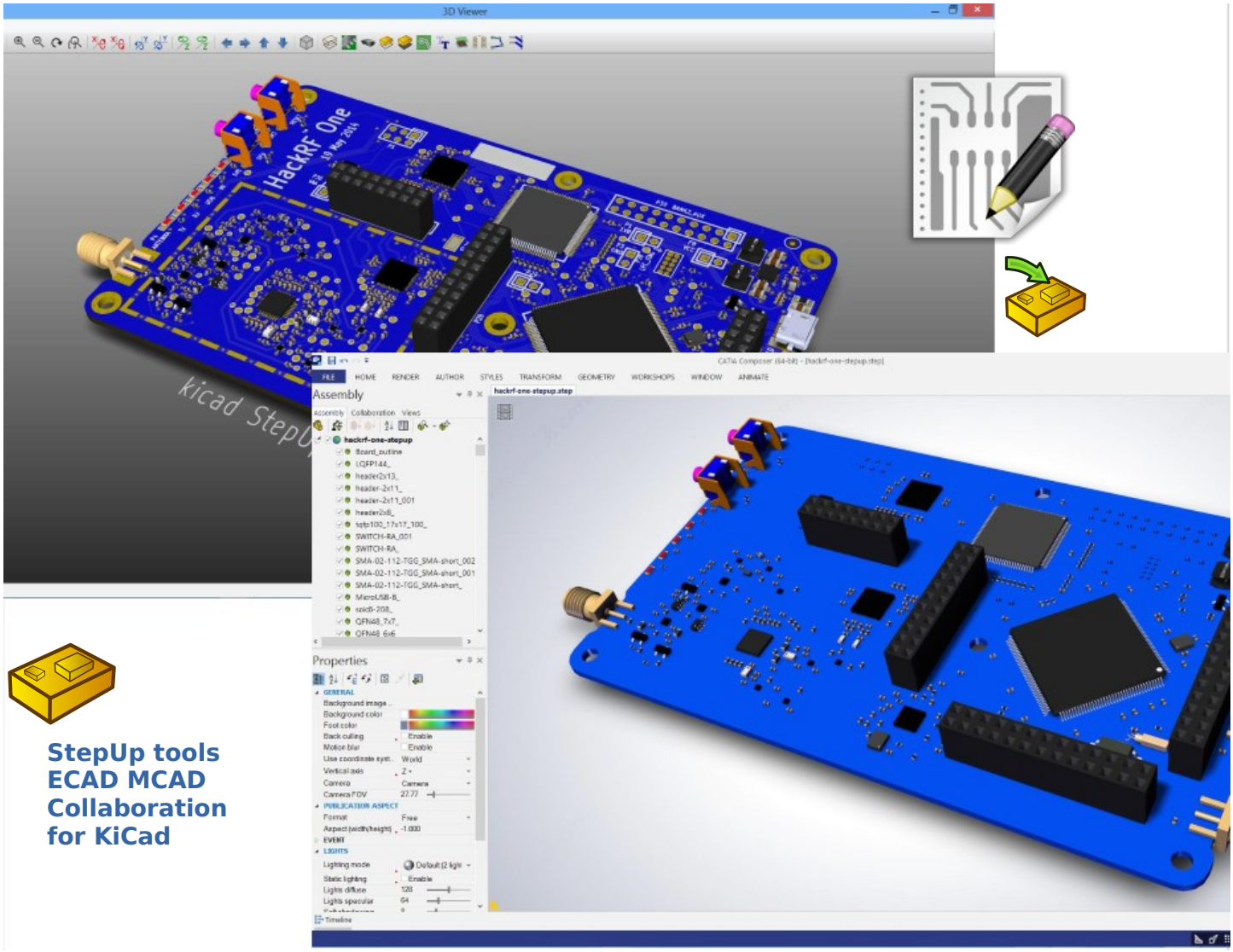
DO NOT RELY UPON ANY INFORMATION FOUND HERE WITHOUT INDEPENDENT VERIFICATION



StepUp tools
ECAD MCAD
Collaboration
for KiCad