



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

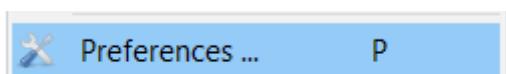
KiCad StepUp tools can be installed as a [FreeCAD Macro](#) but it is strongly suggested to install StepUp as a [FreeCAD WorkBench](#).

Since KiCad StepUp tools have been added to [FC WorkBenches](#), so they can 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:



Using **Snap** or **FlatPack** is requiring to 'bind mount' the 3D models folder
Some references at [GitHub Repo Issue](#)

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 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>



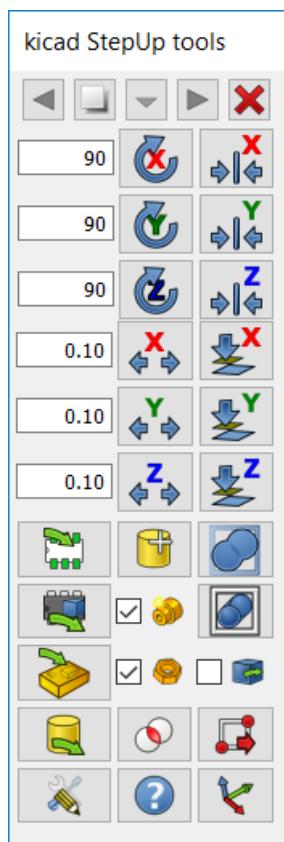
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The Main Gui

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



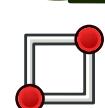
Export 3D model Aligned

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

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



Make a Union

Make a Union of Parts



Make a Compound

Make a Compound of Parts

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](#)

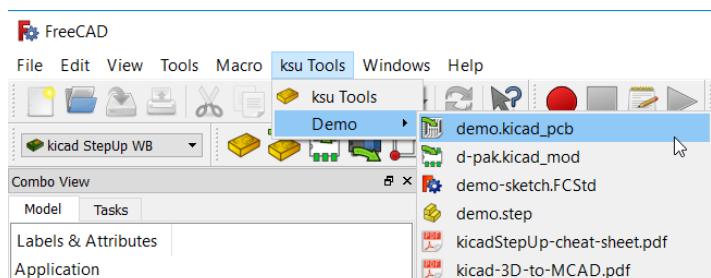
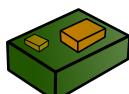
There is also a video tutorial made by a user:

- 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





KiCad StepUp tools cheat sheet

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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

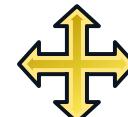


Useful Designing external workbenches



Two external workbenches:

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

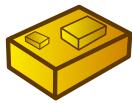


Defeaturing workbench useful for editing STEP models, removing some features from the model; defeating and repairing tools.



FreeCAD 0.18

The screenshot shows the FreeCAD 0.18 interface with the Kicad StepUp WB menu open. The menu path is: Tools > ksu Tools > Demo. The submenu lists several files: demo.kicad_pcb, d-pak.kicad_mod, demo-sketch.FCStd, demo.step, footprint-template.FCStd, footprint-Edge-template.FCStd, footprint-template-roundrect-polylines.FCStd, footprint-RF-antenna.FCStd, footprint-RF-antenna-w-solder-Mask.FCStd, RF-antenna-dxf.dxf, complex-Polyline-footprint.FCStd, footprint-complex-arc-pads.FCStd, footprint-SPU0410LR5H.FCStd, kicadStepUp-cheat-sheet.pdf, kicad-3D-to-MCAD.pdf, and Generating-a-KiCAD-footprint-and-Model-from-3D-Step-Data.pdf.



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StepUp WorkFlow for 3D models

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

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



3D-model
.FCStd

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



3D-model
.step

KiCad
pcbnew
3d-viewer



Place the exported models to the
KISYS3DMOD folder

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

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

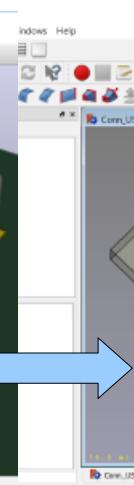
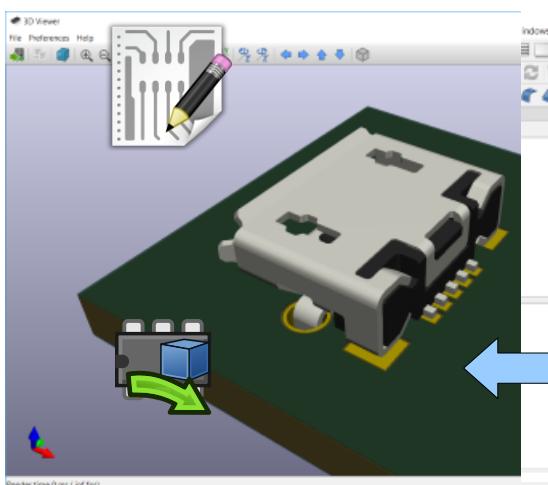
It is mandatory that the footprint has:

- 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



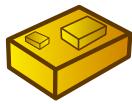
Video Tutorials

[Align Parts to Kicad footprint](#)

[Installing, Import 3D model, Exporting the Board](#)

StepUp tools





KiCad StepUp tools cheat sheet

<https://github.com/easyw/kicadStepUpMod>

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



Bounding Boxes

Black List

Bounding Box LIST:
put here a list of 3D models to be converted to Bounding Box, separated by a comma

Examples:
ALL -> all models will be converted to bounding boxes
R_0603, C_0603 -> these two models will be converted to BBox
LIST DSUB-15-HD_FH, DSUB-9_FH -> these two models will NOT be converted to BBox

Import-Export

Part design

kicadStepUp...

Black List

Black List:
put here your model names that you don't want to load (e.g. smallest ones) separated by a comma.

STEP
volume and height are also configurable.

3D Loading
(volume=1 means all models with a volume < 1mm³ will not be included)

Mechanical
(height=1 means all models with a height < 1mm will not be included)

Import-Export

Part design

kicadStepUp...

White List

White List:
put here your model names that you must load (e.g. smallest ones) separated by a semicolon.

STEP

Examples:
LED_D5.0mm_IRBlack;USB_Mini-B_Lumberg_2486_01_Horizontal

An empty list means all the models will be parsed.

An empty list means all the models will behave as usual.

WhiteList:
for must load models

hackr-one-stepup : 1*



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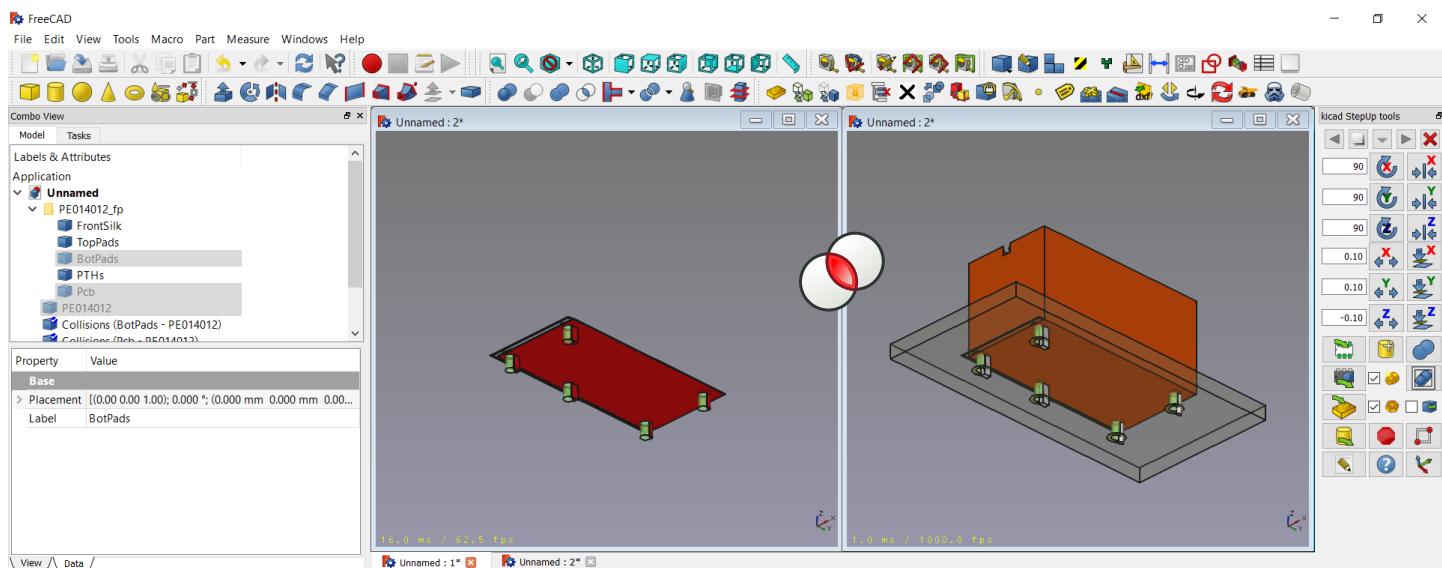
Check for Interference and mechanical constraints

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

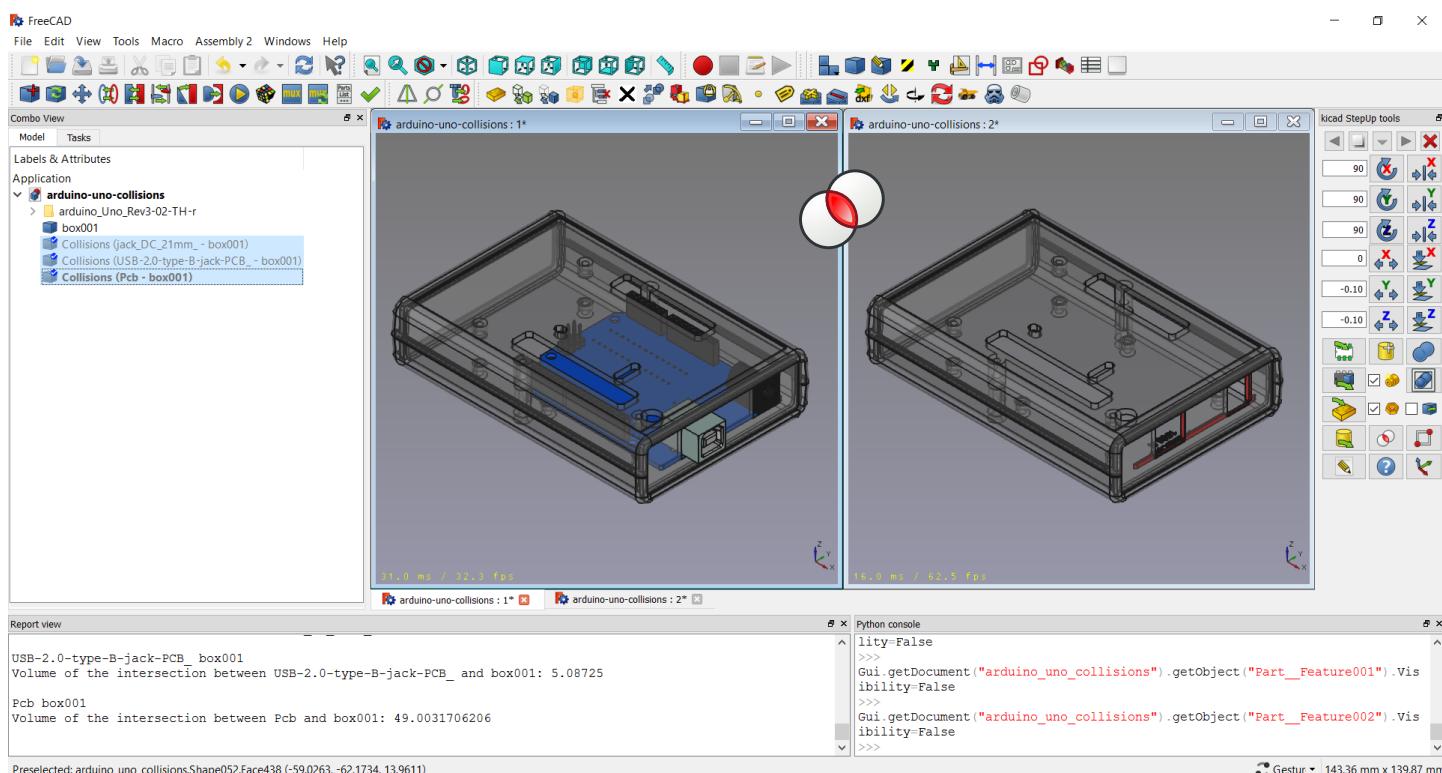
- detect collisions among part pins and drills for footprints
- detect collisions for enclosure clearance (between pcb with parts/connectors and enclosure)



Interference checking for Footprints



Interference checking for PCB & Enclosure





KiCad StepUp tools cheat sheet

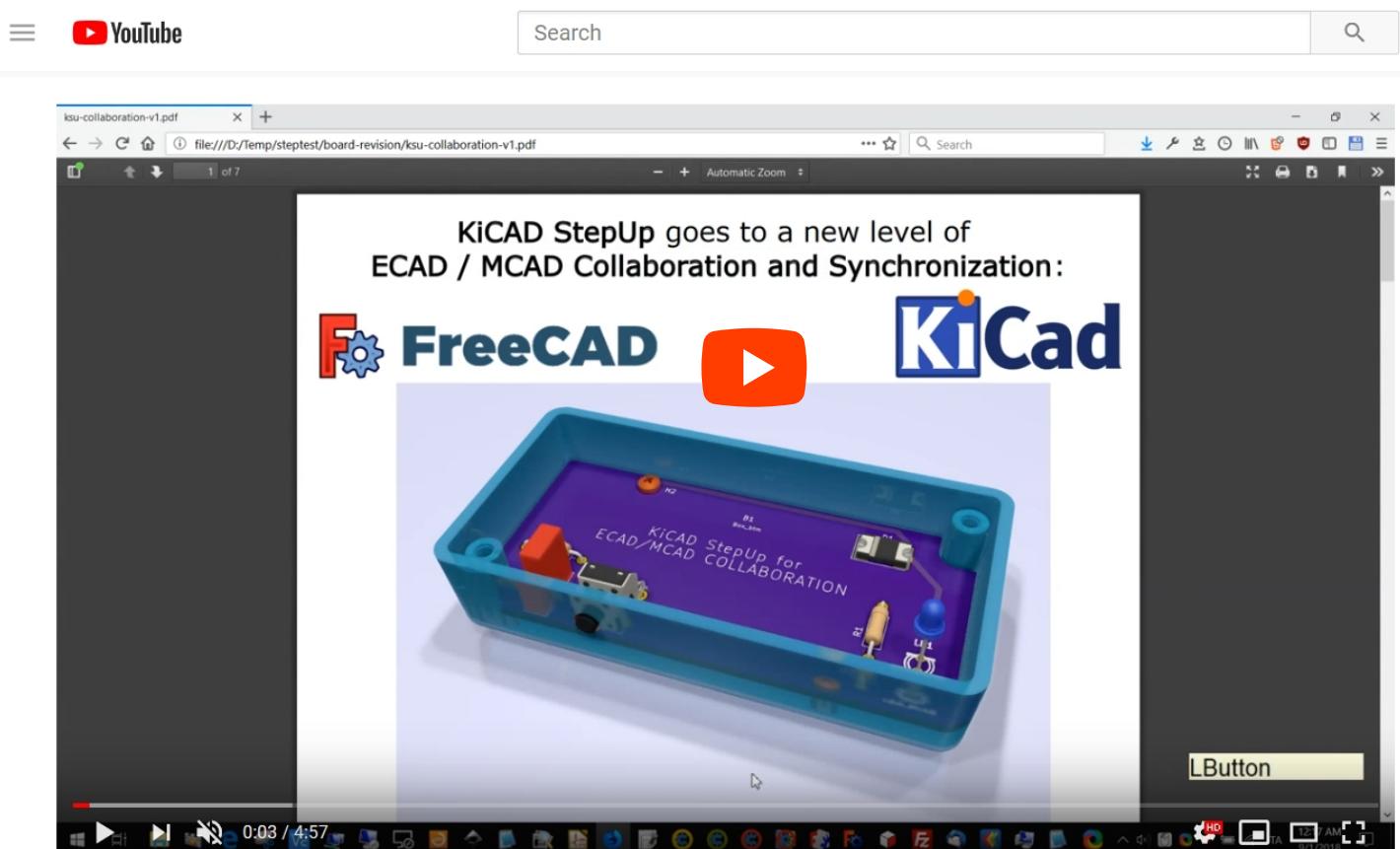
<https://github.com/easyw/kicadStepUpMod>

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



The ECAD MCAD
collaboration tutorial
ECAD MCAD Synchronization



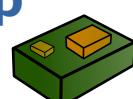
Tips

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

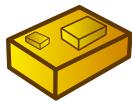
PCB Placement

Grid Origin

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 for Getting to Blinky

Getting To Blinky by StepUp

Sketcher for Getting to Blinky

all constrains and even BSplines or Ellipses are allo...

The Sketcher tutorial PUSH & PULL a PCB Edge using FC Sketcher

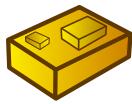
Tips

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

PCB Placement Grid Origin

D1 Getting To Blinky

close your KiCad Board file and reload the new Version



KiCad StepUp tools cheat sheet

<https://github.com/easyw/kicadStepUpMod>

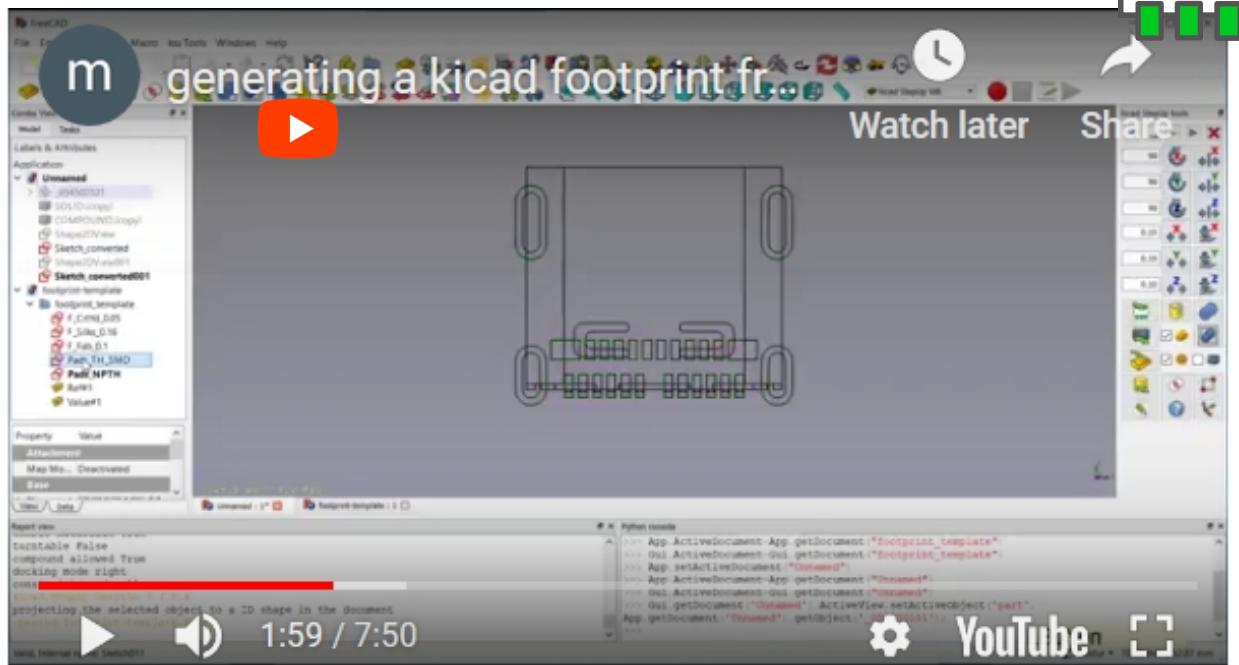
StepUp: The Sketcher for footprint generation

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

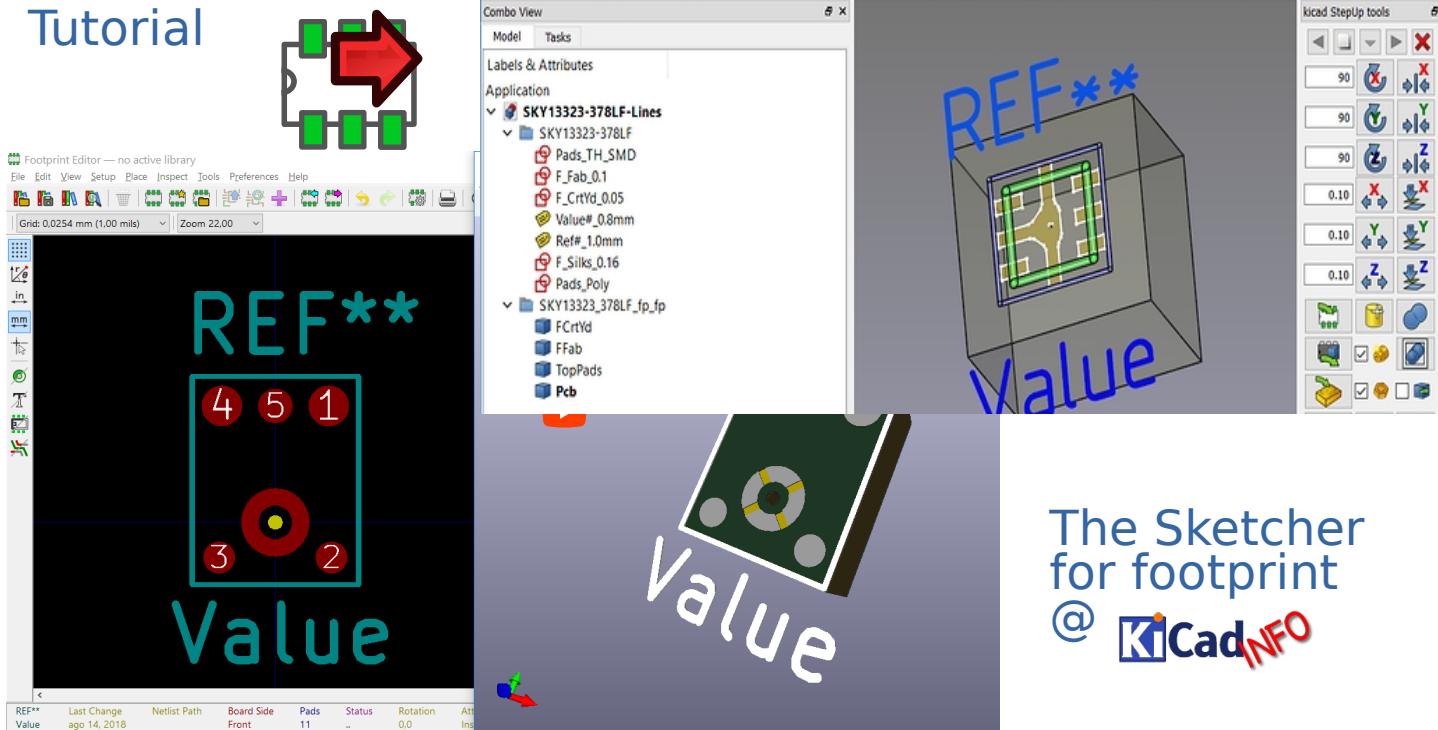
- create a new footprint in FreeCAD Sketcher and PUSH it to kicad_mod file
- modify an existing kicad footprint in FreeCAD Sketcher and PUSH it back to 'kicad_mod'

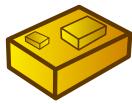
Line, Circles, Arcs are supported and also **Bsplines or Ellipses** are supported and converted to KiCad compatible format

generating a kicad footprint from a 3D STEP model



The Sketcher for footprint: Tutorial



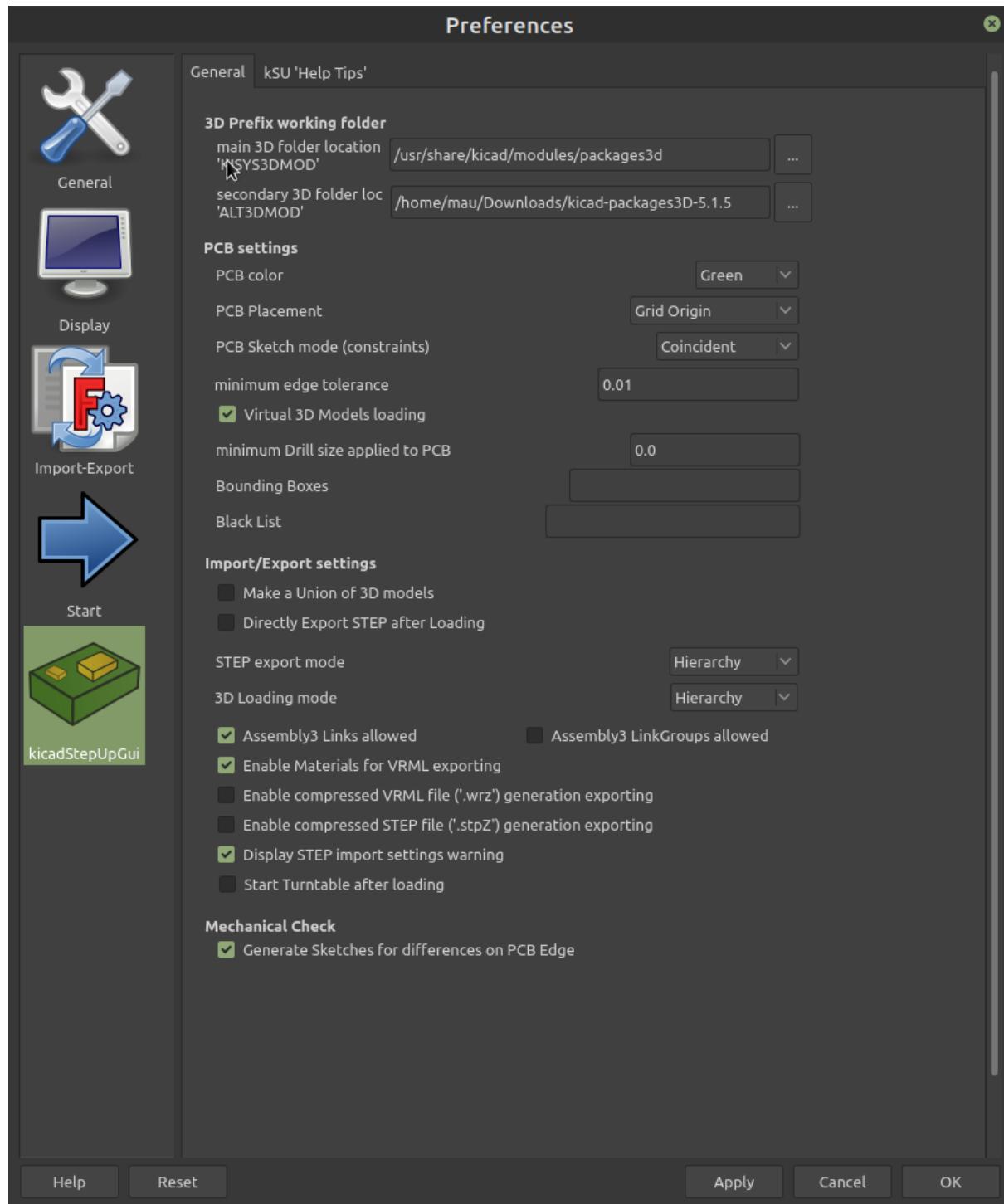


KiCad StepUp tools cheat sheet

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Preferences Page for configuring main parameters

All buttons have Tooltips



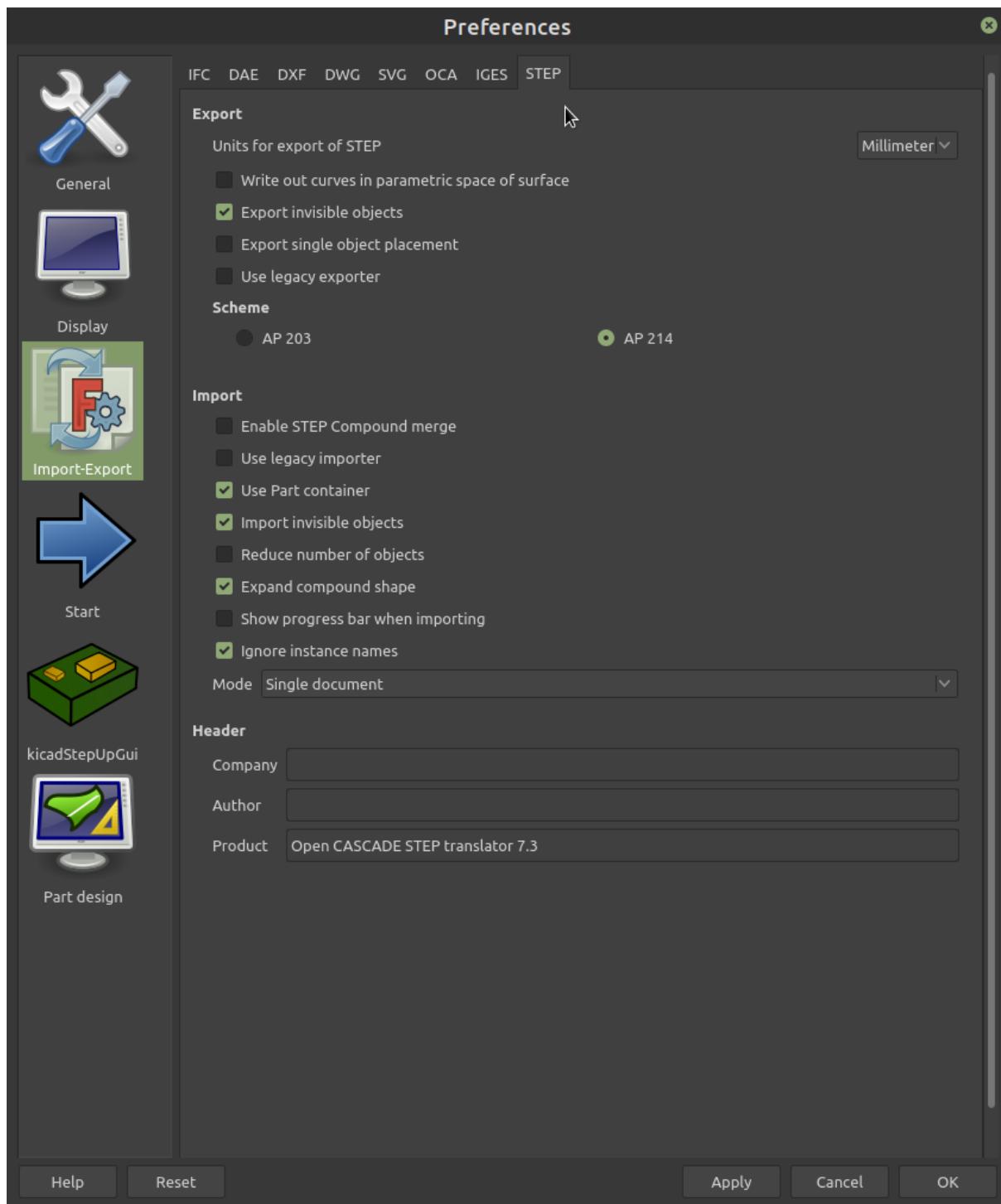


KiCad StepUp tools cheat sheet

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Preferences Page for configuring STEP Import Export (FC0.19)

All buttons have Tooltips



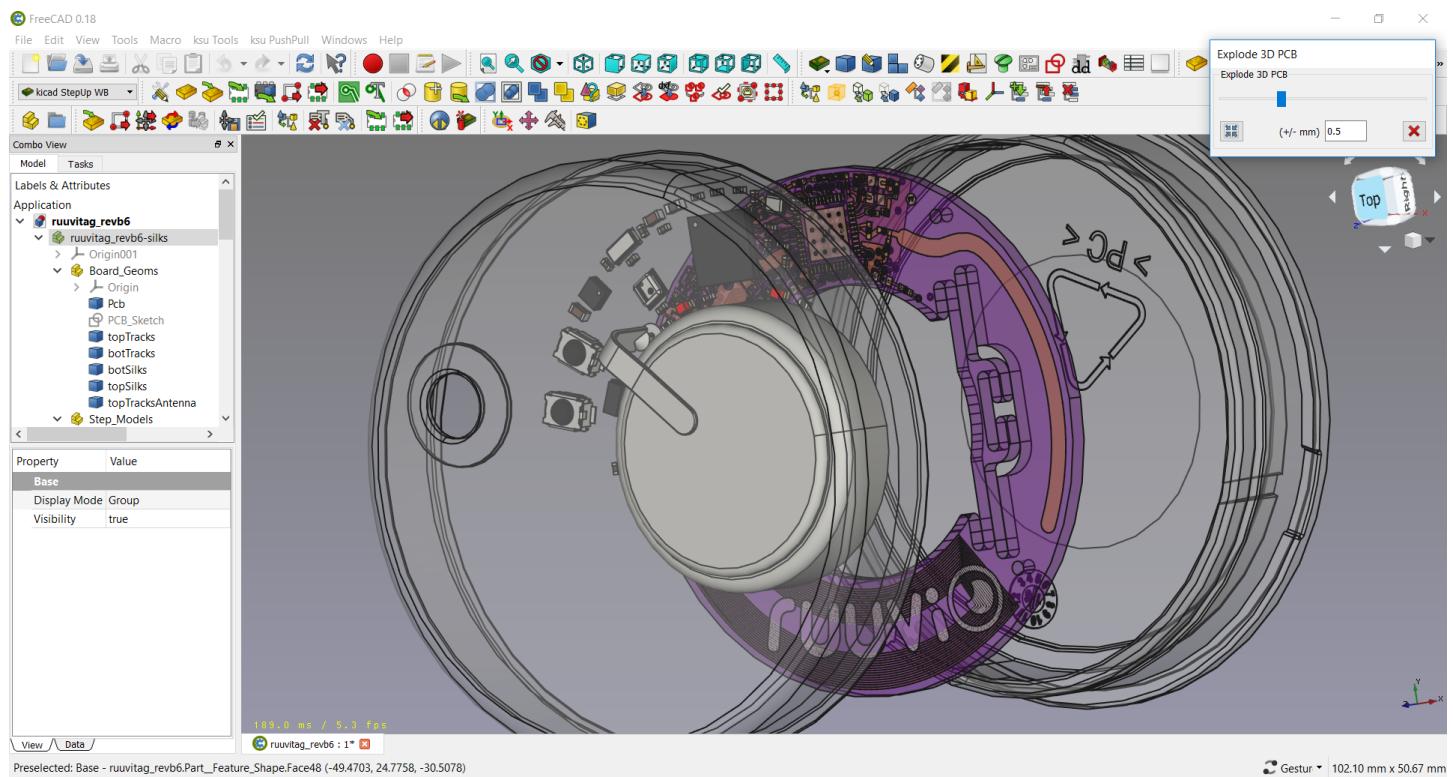
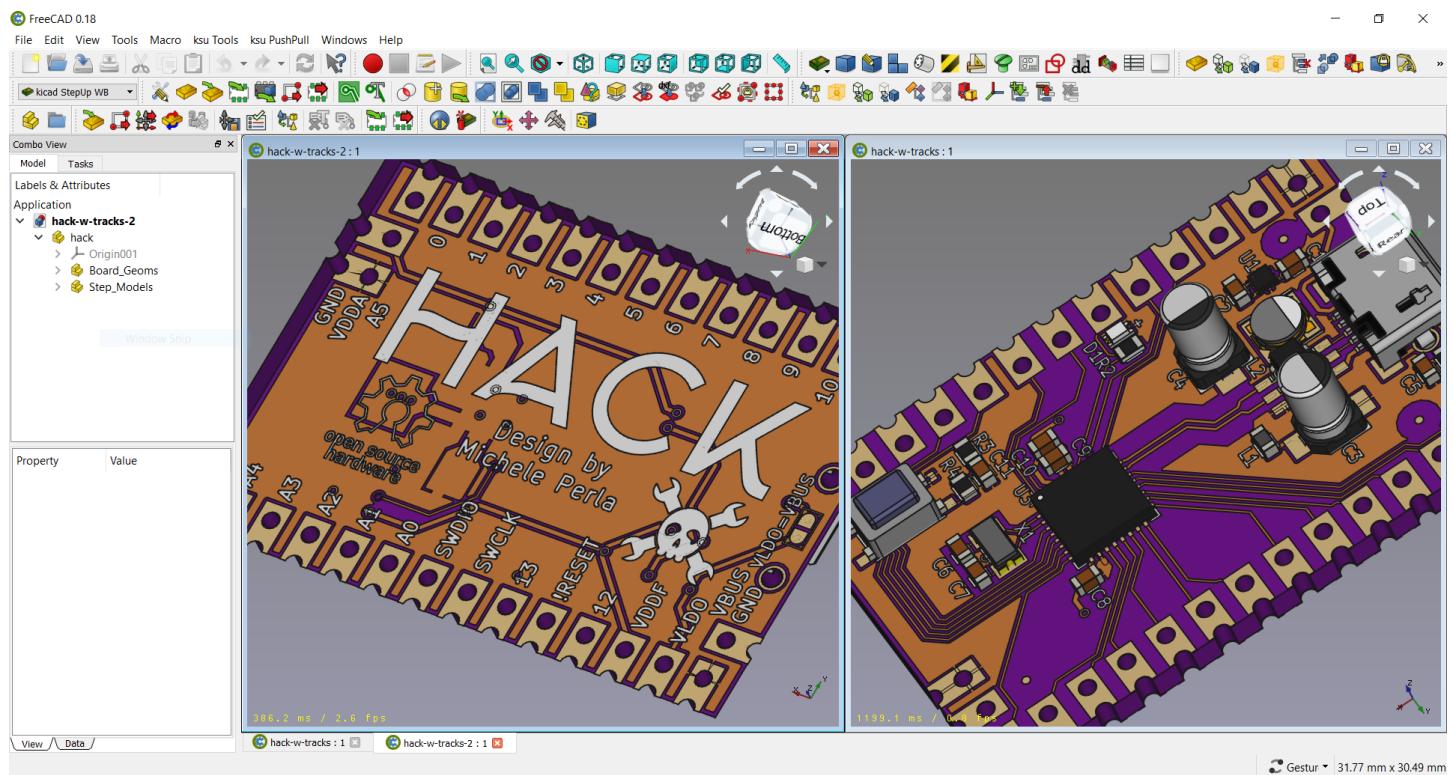


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Tracks and SilkScreen MCAD integration

New ability to import Top and Bottom tracks and SilkScreen layers





KiCad StepUp tools cheat sheet

<https://github.com/easyw/kicadStepUpMod>

Tracks MCAD integration

New ability to import Top and Bottom tracks and SilkScreen layers
(for PCB signal integrity and EMC simulation design please refer to [fcad_pcb](#) repo)



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

The screenshot shows the 'Plot' dialog box in KiCad. The 'Plot format' dropdown is set to 'DXF'. The 'Included Layers' list includes F.Cu, B.Cu, F.Adhes, B.Adhes, F.Paste, B.Paste, F.SilkS, B.SilkS, F.Mask, B.Mask, Dwgs.User, Cmts.User, Eco1.User, and Eco2.User. The 'General Options' section contains checkboxes for 'Plot border and title', 'Plot footprint values', 'Plot footprint references' (which is checked), 'Force plotting of invisible values / refs', 'Exclude PCB edge layer from other layers', 'Exclude pads from silkscreen' (which is checked), 'Do not tent vias', 'Use auxiliary axis as origin', and 'Check zone fills before plotting'. It also includes dropdowns for 'Drill marks' (None), 'Scaling' (1:1), 'Plot mode' (Filled), and 'Default line width' (0.15 mm). The 'DXF Options' section includes checkboxes for 'Plot graphic items using their contours' (which is checked) and 'Use Pcbnew font to plot texts'. A red box highlights the 'Export units: Millimeters' dropdown. The 'Output Messages' section at the bottom allows filtering by 'All', 'Errors', 'Warnings', 'Actions', and 'Infos', with a 'Save...' button. The bottom bar features 'Run DRC...', 'Plot' (which is highlighted in blue), 'Close', and 'Generate Drill Files...' buttons.



KiCad StepUp tools cheat sheet

<https://github.com/easyw/kicadStepUpMod>

Tracks MCAD integration

New ability to import Top and Bottom tracks and SilkScreen layers



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

FreeCAD import configuration

The screenshot shows the FreeCAD Preferences dialog with the DXF tab selected. The left sidebar lists categories: General, Display, Import-Export, Part design, kicadStepUp..., and Sketcher. The DXF tab contains the following settings:

- Show this dialog when importing and exporting:
- Use legacy python importer:
- Automatic update (legacy importer only):
- Allow FreeCAD to automatically download and update the DXF libraries:
- Import options:**
 - Note: Not all the options below are used by the new importer yet
 - Import: texts and dimensions, points, layouts, *blocks
 - Create: simple Part shapes, Draft objects, Sketches
 - Scale factor to apply to imported files: 1.0000
 - Get original colors from the DXF file:
 - Join geometry:
 - Group layers into blocks:
 - Use standard font size for texts:
 - Use VisGroups:
 - Import hatch boundaries as wires:
 - Render polylines with width:
 - Treat ellipses and splines as polylines:
 - Max Spline Segment: 10.00mm
- Export options:**
 - Export 3D objects as polyface meshes:
 - Export Drawing Views as blocks:
 - Project exported objects along current view direction:

At the bottom are buttons: Reset, OK (highlighted in blue), Cancel, Apply, and Help.



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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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<http://www.gnu.org/licenses/agpl-3.0.en.html>

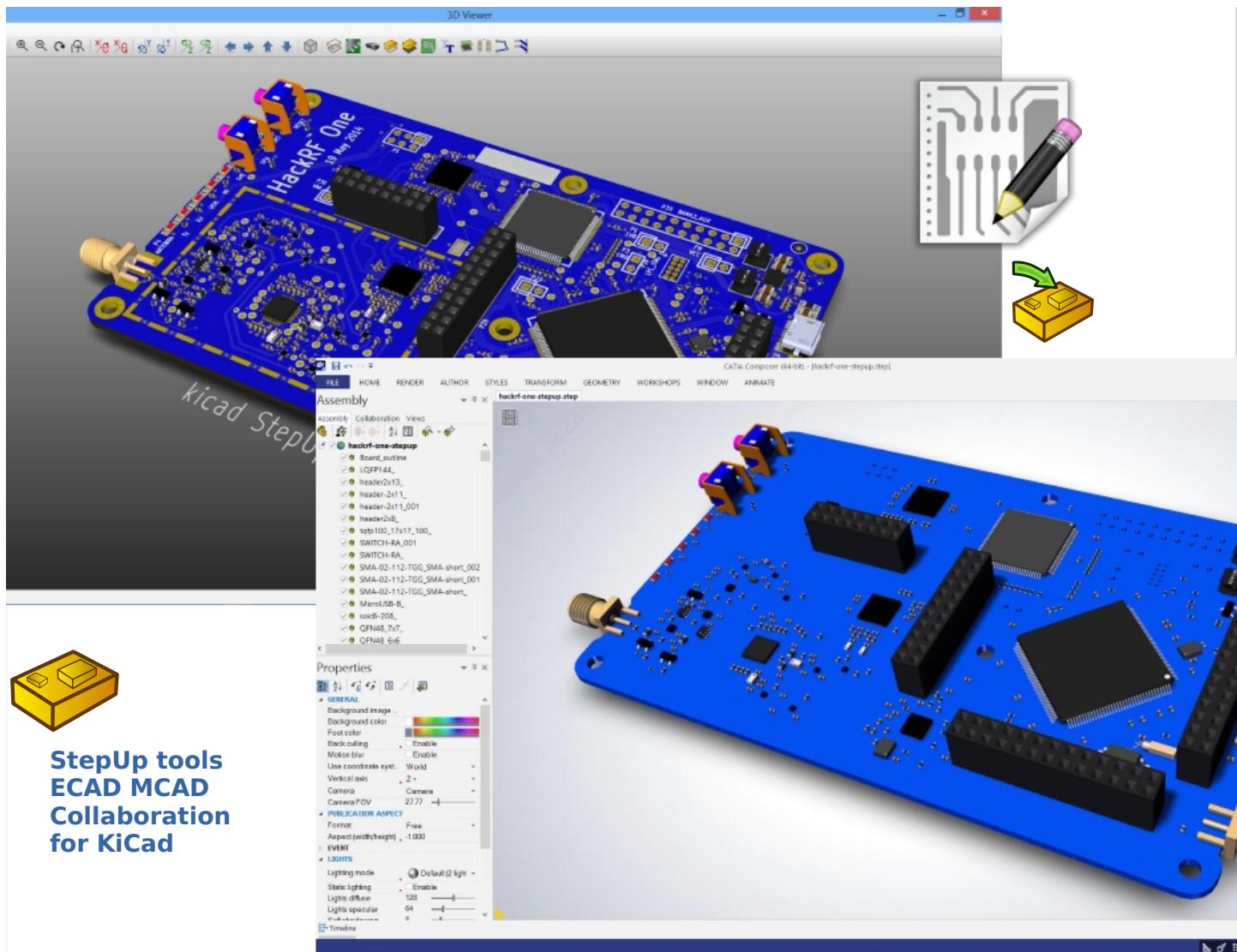
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StepUp tools
ECAD MCAD
Collaboration
for KiCad