
Kicad StepUp starter Guide

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1. Basic Info

kicad StepUp 3D mechanical exporter for collaborative exchange between KiCad and FreeCAD/MCAD; With **kicad StepUp**, it is possible to work in kicad EDA with the same component model data available in the **STEP AP214 3D format**, and obtain a 3D STEP AP214 model of the pcb board and a complete board assemblies with electronic modules, to be used for **MCAD interchange**. The accurate 3D visualization of components on board assemblies in kicad 3dviewer, is maintained in the same accuracy and aspect in STEP AP214 format.

The **kicad StepUp** maintains the usual way to work with kicad, but improves the process to work in a collaborative way with mechanical designers bringing near ECAD and MCAD environments.

New!!! now kicad StepUp comes in 3 flavours:

1. running as a **script**
2. running as a **GUI**
3. running as a **Mod** native FreeCAD **WorkBench**

[kicadStepUp at sourceforge¹](http://sourceforge.net/projects/kicadstepup/)

[YouTube Kicad StepUp New Tutorial video²](https://youtu.be/h6wMU3IE_sA)

[YouTube Kicad StepUp old script video³](https://youtu.be/Ukd47VXYzQU)

2. requirements

KiCad EDA⁴ version 4.00 or later

FreeCAD⁵ version 0.15 or later (use only STABLE versions)

¹ <http://sourceforge.net/projects/kicadstepup/>

² https://youtu.be/h6wMU3IE_sA

³ <https://youtu.be/Ukd47VXYzQU>

⁴ <http://kicad-pcb.org/>

⁵ <http://freecadweb.org/>

3. OverView

to run the demo:

in Linux: change dir to the folder in which you have extracted the demo

```
./launch-kicad_StepUp-Tools-demo.sh
```

in windows: change dir to the folder in which you have extracted the demo

```
launch-kicad_StepUp-Tools-demo.bat
```

in OSX: change dir to the folder in which you have extracted the demo

```
./launch-kicad_StepUp-Tools-OSX-demo.sh
```

the demo comes with a kicad project, along with all needed STEP and wrl modules, just to be used just out of the box

(**NB** use the script from inside the dir)

to see the kicad board, change dir to the folder in which you have extracted the demo

in windows:

```
launch-kicad-demo-project.bat
```

in linux:

```
./launch-kicad-demo-project.sh
```

in OSX:

```
./launch-kicad-demo-project-OSX.sh
```

4. kicad StepUp tools GUI

*KiCad StepUp GUI:
new tools for ECAD/MCAD collaboration*

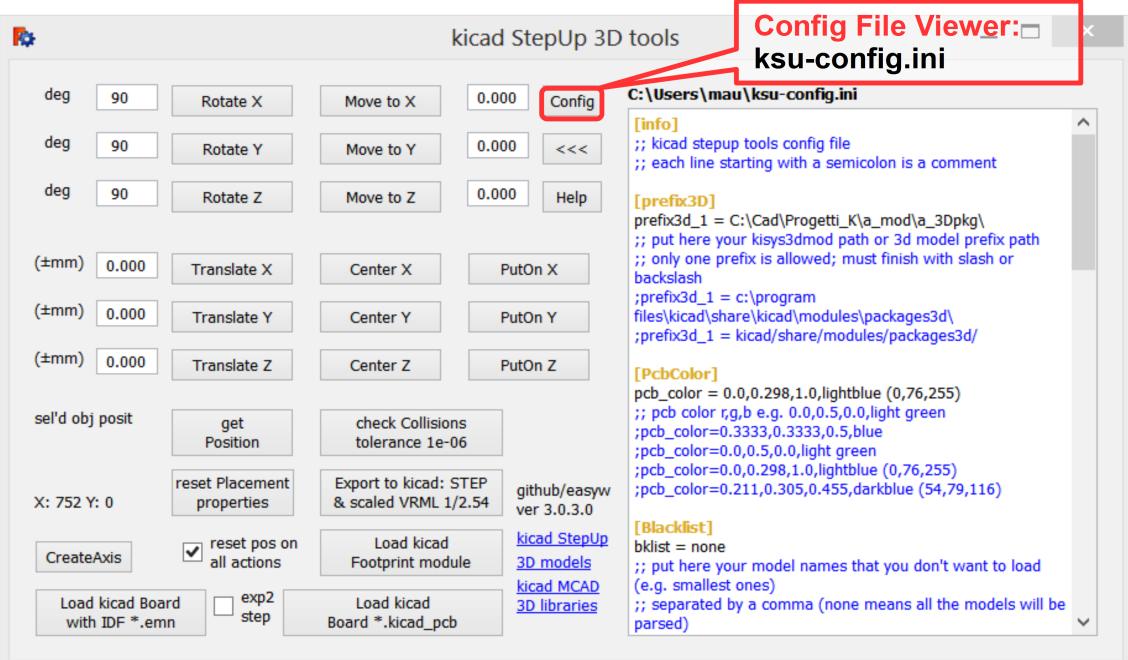
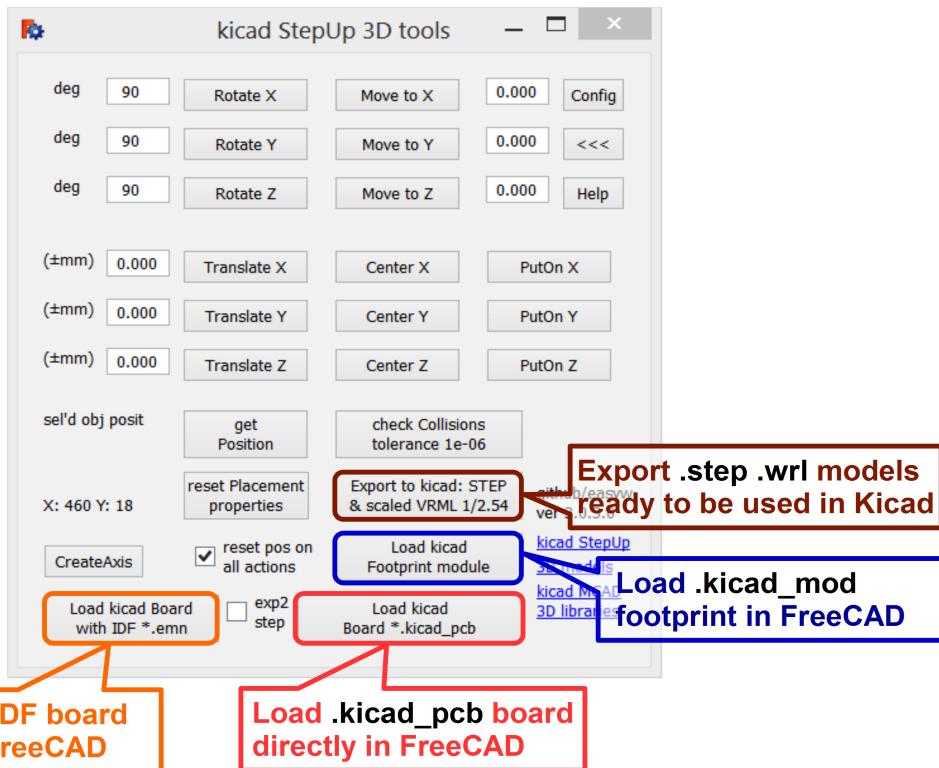


Figure 1. kicad StepUp tools GUI Overview

5. Introduction

kicad StepUp is a 3D mechanical exporter for kicad board and assemblies. It will improve a collaborative exchange between KiCad and FreeCAD/MCAD. With **kicad StepUp** script, it is possible to work in kicad EDA with the same component model data available in the **STEP AP214 3D format**, and obtain a 3D STEP AP214 model of the pcb board and a complete board assemblies with electronic modules, to be used for **MCAD interchange**.

The accurate 3D visualization of components on board assemblies in kicad 3dviewer, can then be maintained in the same accuracy and aspect in STEP AP214 format, just generating VRML models from STEP or FreeCAD mechanical models and exporting the board through kicad StepUp script.

The **kicad StepUp** script maintains the usual way to work with kicad, but improves the process to work in a collaborative way with mechanical designers bringing near ECAD and MCAD environments.

Kicad StepUp allows the user to modeling the 3D modules starting from FreeCAD (instead of using Wings3D), creating models in STEP AP214 and rendering the pcb board and components in native STEP AP214.

Note: **kicad StepUp** 3D MCAD exporter is compatible with:

STEP with colors files (**.step**, **.stp** extensions)

IGES with colors files (**.iges**, **.igs** extensions)

Designing in kicad native 3d-viewer will produce a fully aligned STEP version with the same view of kicad 3d render.

Now the two words have the same accurate 3D visualization; it is possible to design in kicad EDA and transfer the artwork to MCAD (FreeCAD) smoothly

WYSIWYG from EDA to MCAD

6. WYSIWYG from EDA to MCAD

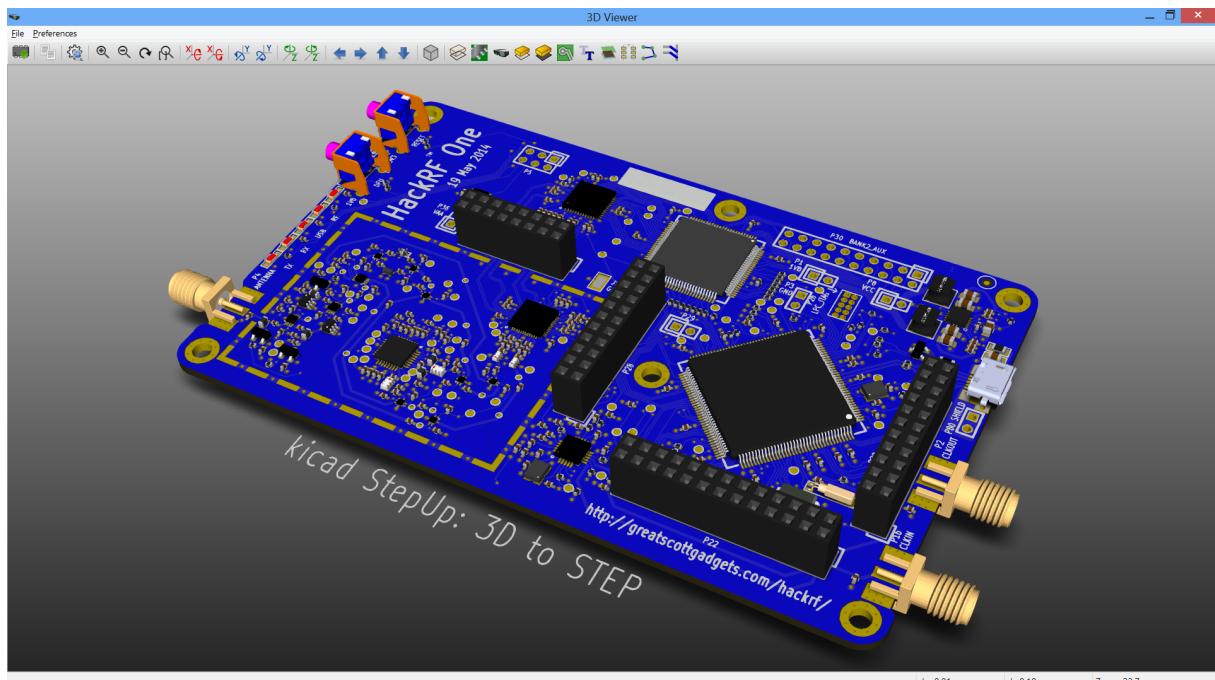


Figure 2. kicad StepUp in Kicad 3d-viewer

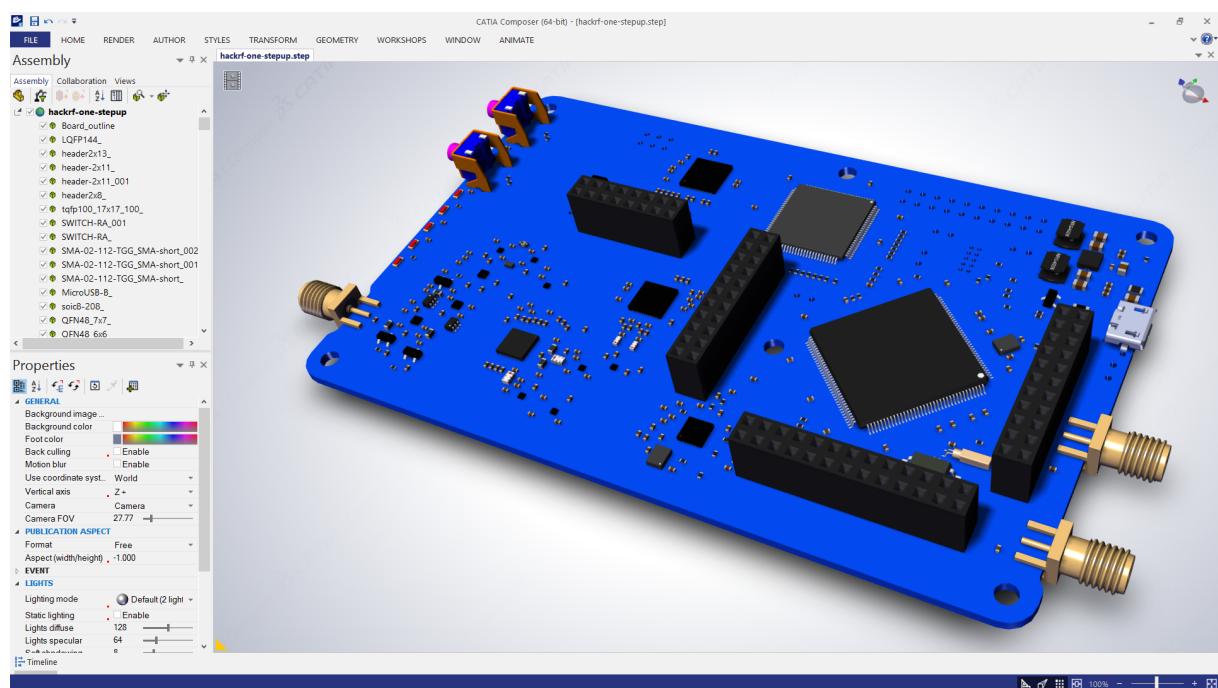


Figure 3. kicad StepUp in MCAD Catia

7. Basic How To (*using kicad StepUp the easiest way*)

(not changing the way you use kicad)

1. just copy the STEP 3d models in the same folder in which there are your wrl 3d models and use the same name of the wrl model name (e.g. r_0603.wrl # r_0603.step)

2. open in FreeCAD the Macro kicad-StepUp-tools.FCMacro and edit the config file ksu-config.ini (wich is autogenerate at first running of the macro) with e.g. notepad changing your model prefix to your KISYS3DMOD path

3. clik on the button to open your kicad pcbnew board file

4. watch the script assembling your 3D board with 3D models :)

you can also add the macro button to the FreeCAD toolbar following these instructions:

Note: [FreeCAD forum Customize Toolbar](#)⁶ how to add a button to Toolbar in FreeCAD adding also the kicad StepUp icon

5. the Macro can be executed as a script <path to Freecad executable file>/freecad <path to the Macro file>/kicad-StepUp-tools.FCMacro <name_of_board_without_extension>

(e.g. freecad kicad-StepUp-tools.FCMacro myboard)

just watch the Macro assembling your 3D board with 3D models :) 6. the kicad StepUp can be also a Mod WorkBench for FreeCAD:

copy the folder kicadStepUpMod in the right folder for your OS

[FreeCAD Installing workbenches](#)⁷

8. How To (*using kicad StepUp the best way*)

(getting the best from STEP models)

1. just copy the STEP 3d models in the same folder in which there are your wrl 3d models

2. export the STEP models, scaled 1/2.54 to wrl with the same name of the STEP model (e.g. r_0603.wrl # r_0603.step); in this way your 3D board in kicad pcbnew 3d-viewer and in FreeCAD workbench will look perfectly aligned

3. open in FreeCAD the Macro kicad-StepUp-tools.FCMacro and edit the config file ksu-config.ini (wich is autogenerate at first running of the macro) with e.g. notepad changing your model prefix to your KISYS3DMOD path

⁶ http://www.freecadweb.org/wiki/index.php?title=Customize_ToolsBar

⁷ http://www.freecadweb.org/wiki/index.php?title=Installing_more_workbenches

4. clik on the button to open your kicad pcbnew board file

5. watch the script assembling your 3D board with 3D models :)

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(e.g. *freecad kicad-StepUp-tools.FCMacro myboard*)

just watch the Macro assembling your 3D board with 3D models :) 7. the kicad StepUp can be also a Mod WorkBench for FreeCAD:

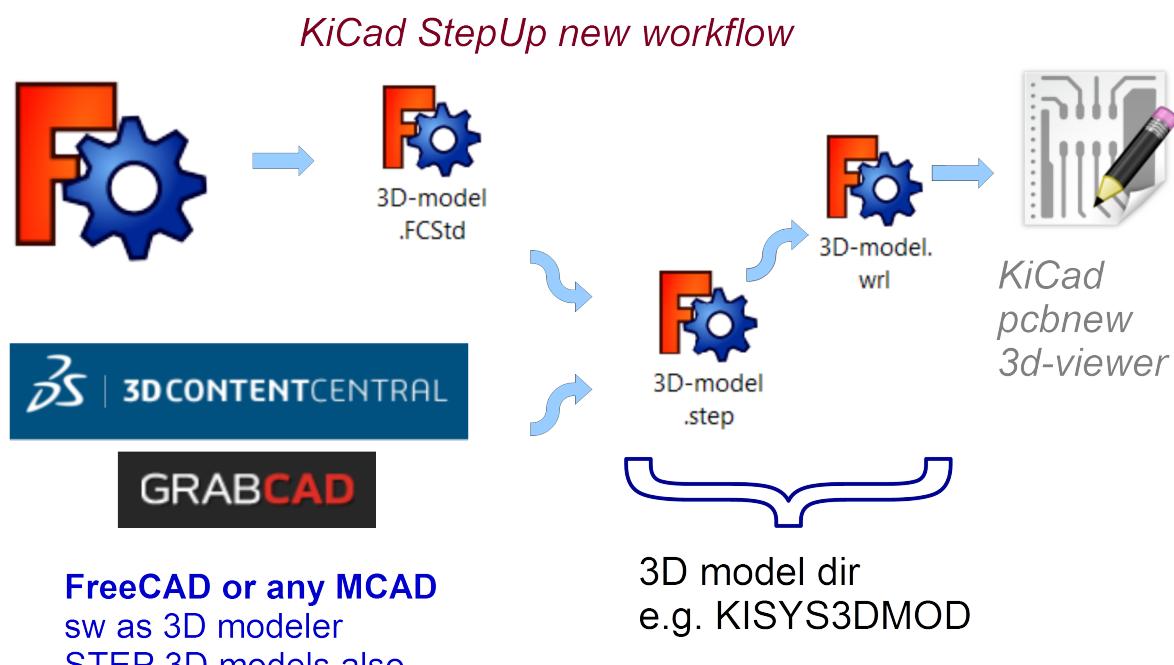
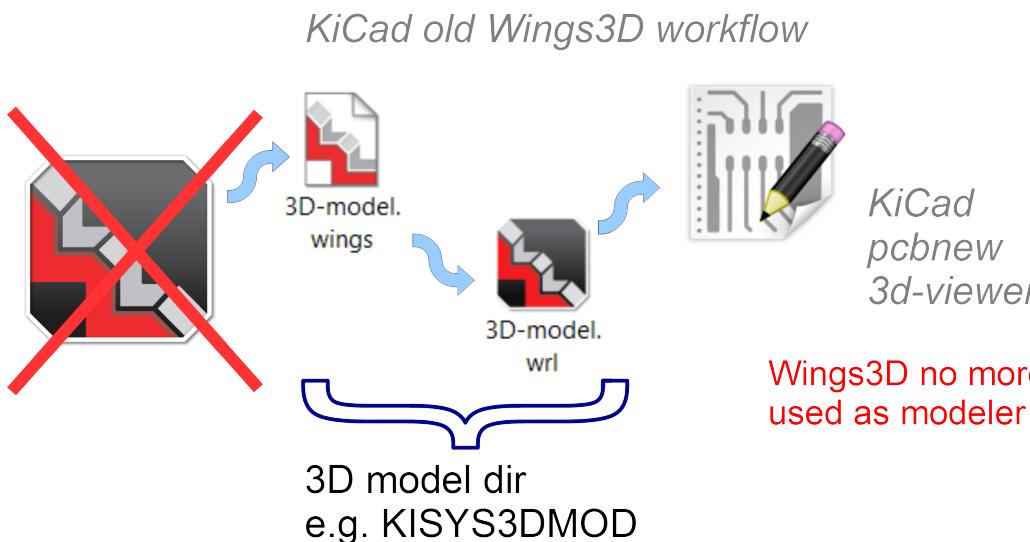
copy the folder kicadStepUpMod in the right folder for your OS

[FreeCAD Installing workbenches⁹](#)

⁸ http://www.freecadweb.org/wiki/index.php?title=Customize_ToolsBar

⁹ http://www.freecadweb.org/wiki/index.php?title=Installing_more_workbenches

9. kicad StepUp workflow



With this workflow, your KiCad design is ready to be converted to MCAD in just one click!!!

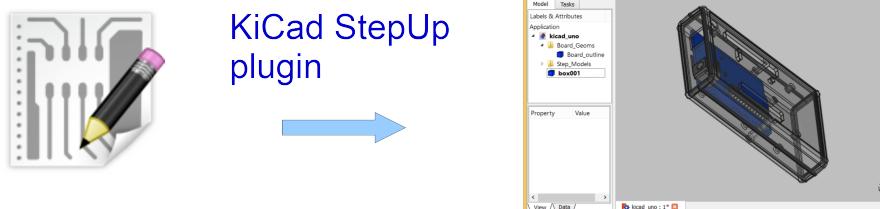


Figure 4. kicad StepUp WorkFlow

10. Create your own Library

The way to build a STEP models library to be easily used by the script is:

1. start modeling your 3d object in scale 1:1 in mm (which is the way in which mechanical stuff are used to be)
2. convert your model to STEP in scale 1:1
3. assure that your STEP module **is fused to just one solid object**
(Part Boolean Union in FreeCAD)
Note: here [FreeCAD forum fusion howto¹⁰](#) some tips to fuse correctly objects in FreeCAD
4. convert the model to wrl in scale 1/2.54 (0.3937001)
(which is the scale used by kicad 3d-viewer or maintain 1:1 scale in exporting and apply the scale 1/2.54 to the wrl model in 3d-viewer)
5. use the same name to wrl and STEP model
6. put the STEP model and VRML model in the same place
7. check if your vrml model is aligned to the kicad pcb footprint in pcbnew 3d-viewer
8. launch the script and check if the FreeCAD model and the kicad 3D viewer are aligned
9. in case of misalignment just verify your model;

all the conversion steps can be done with the use of **kicad-StepUp-tools.FCMacro**

Now it is possible to **Load the kicad footprint** inside FreeCAD to *interactively align 3d model to the footprint* in a live visual feedback

Note: **kicad StepUp** 3D MCAD exporter is compatible with:

STEP with colors files (.step, .stp extensions)

IGES with colors files (.iges, .igs extensions)

Using kicad pre-built libraries:

some ready-to-go 3D libraries are ready at

[kicad 3D MCAD VRML libraries¹¹](#)

and you can get more info at the forum

[kicad info forum 3D MCAD libs¹²](#)

[kicad info MCAD related arguments¹³](#)

¹⁰ <http://forum.freecadweb.org/viewtopic.php?t=8451#p69489>

¹¹ <https://github.com/easyw/kicad-3d-mcad-models>

¹² <https://forum.kicad.info/t/3d-new-library-for-mechanical-cad-exporting-and-enclosure-design/1763>

¹³ <https://forum.kicad.info/search?q=mcad>

11. Interactively align 3D part to kicad footprint

With **kicad-SteUp-tools Macro** it is possible to **Load the kicad footprint** in FreeCAD and align the 3D part with a visual real time feedback of the 3d model and footprint reciprocal position.

Once the 3D part is aligned to the footprint pads and silk, the model can be exported in STEP format and in VRML format for kicad 3d-rendering, just clicking on the **Scale to kicad VRML** button.

That will align EDA to MCAD 3d viewers. No need to reiterate the aligning process or empiric calculate offset and rotation to apply to VRML model.

You can also click on **Create axis** button to have an other ausilium in the part orienting process



Tip.

footprint aligner workflow:

- load the Macro
 - open the 3d STEP model in FC
 - Load the footprint with the macro Button
- or
- Load the footprint with the macro Button
 - import the 3d model in FC

(NB Import Ctrl+I, not Open Ctrl+O)



Tip.

use the **kicad-SteUp-tools.FCMacro** to easily align the 3D model to the footprint (then it will be aligned to the footprint also in kicad) (previously known as **move-rotate-scale macro**)

the macro can be launched with:

```
./launch-kicad_StepUp-Tools.sh
```

or with

```
launch-kicad_StepUp-Tools.bat
```

or just open the macro in FreeCAD and run it

or add the macro button to the FreeCAD toolbar following these instructions:

Note: [FreeCAD forum Customize Toolbar¹⁴](http://www.freecadweb.org/wiki/index.php?title=Customize_Toolbar) how to add a button to Toolbar in FreeCAD adding also the kicad StepUp icon

¹⁴ http://www.freecadweb.org/wiki/index.php?title=Customize_Toolbar

Note:

the macro takes care of 2D footprint rotation of kicad

it does take care of vrml model z rotation, it doesn't take care of x and y 3d model rotation

it doesn't take care of x, y, z 3d model translation

this behavior is intentional... you have to align your 3d STEP model of Freecad to your 2D footprint of kicad,

then if you export your step model to vrml (scaling 1/2.54) the vrml model will be aligned too

one has to check/modify, if needed, the part of 3D vrml 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

(those fields can be changed on the .kicad_mod text file or through the kicad GUI)



Figure 5. kicad StepUp icon

Kicad StepUp starter Guide

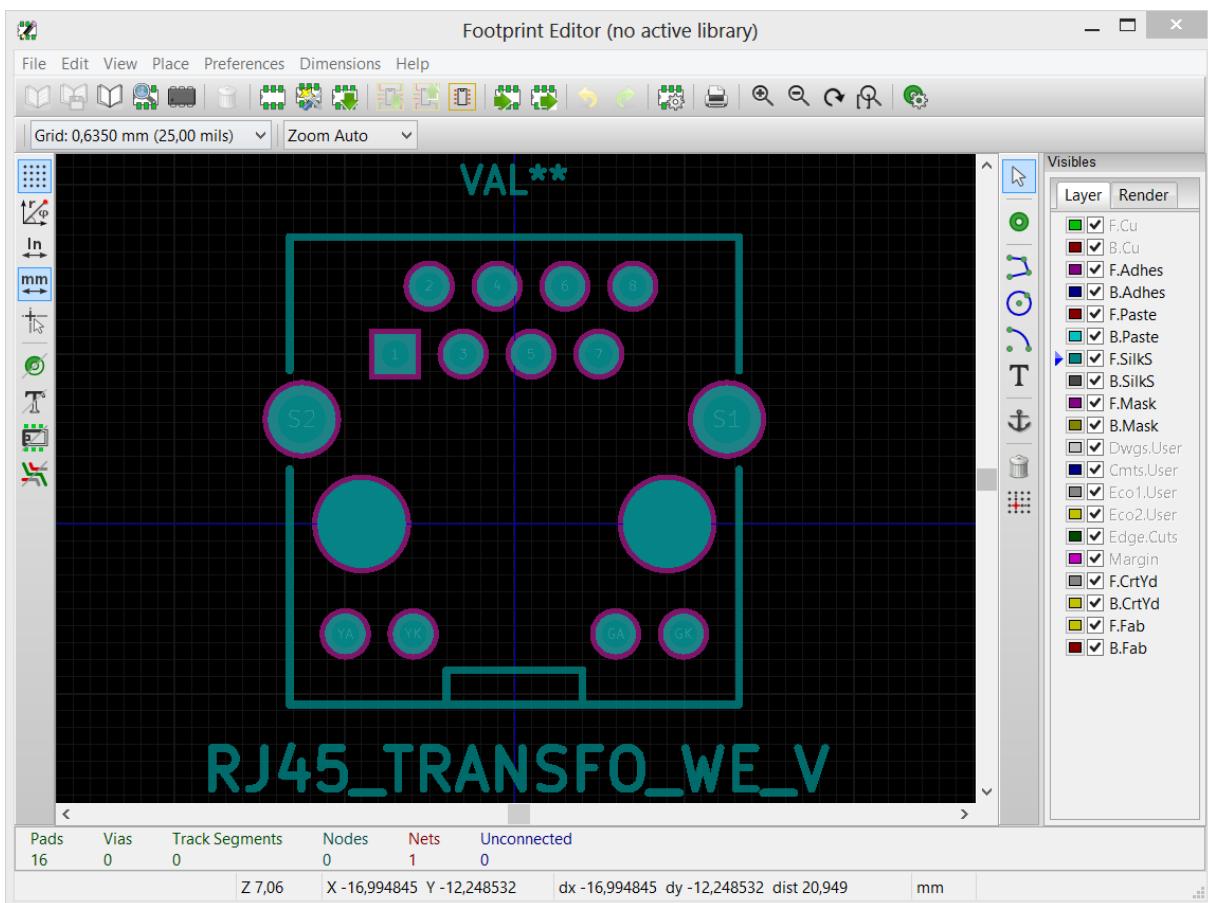


Figure 6. kicad pcbnew: Load Footprint

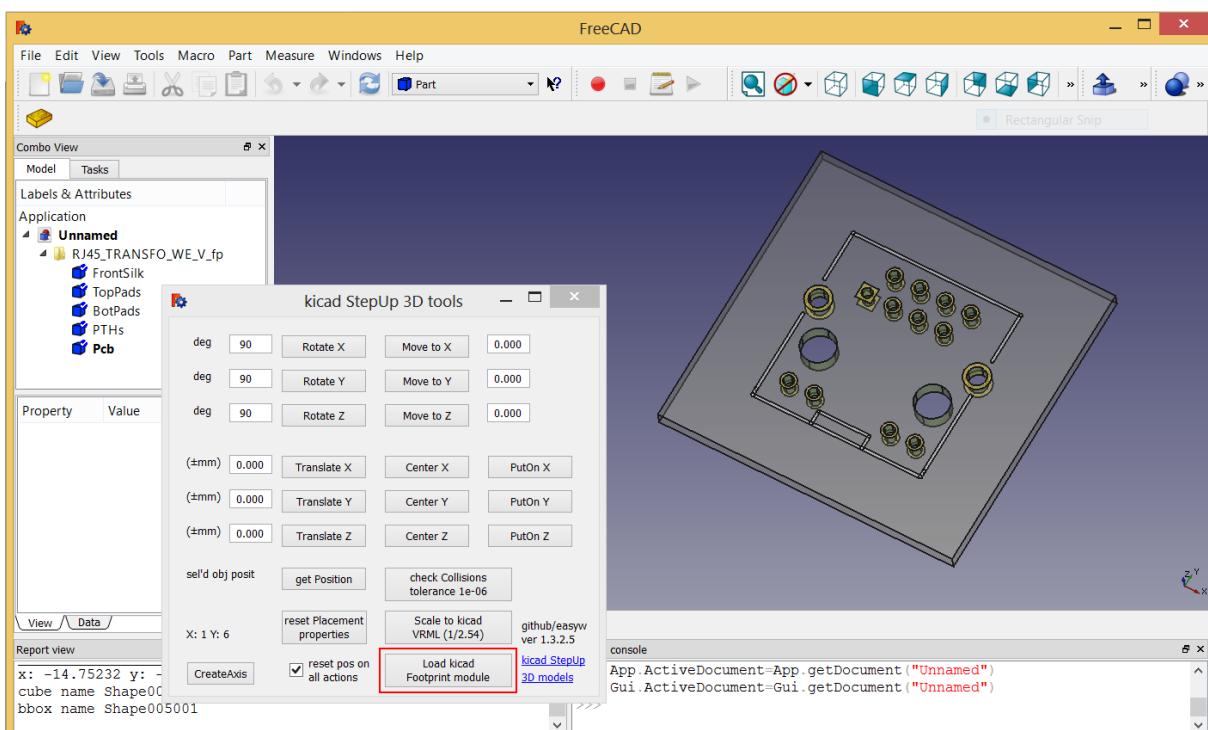


Figure 7. kicad StepUp tools: Load Footprint

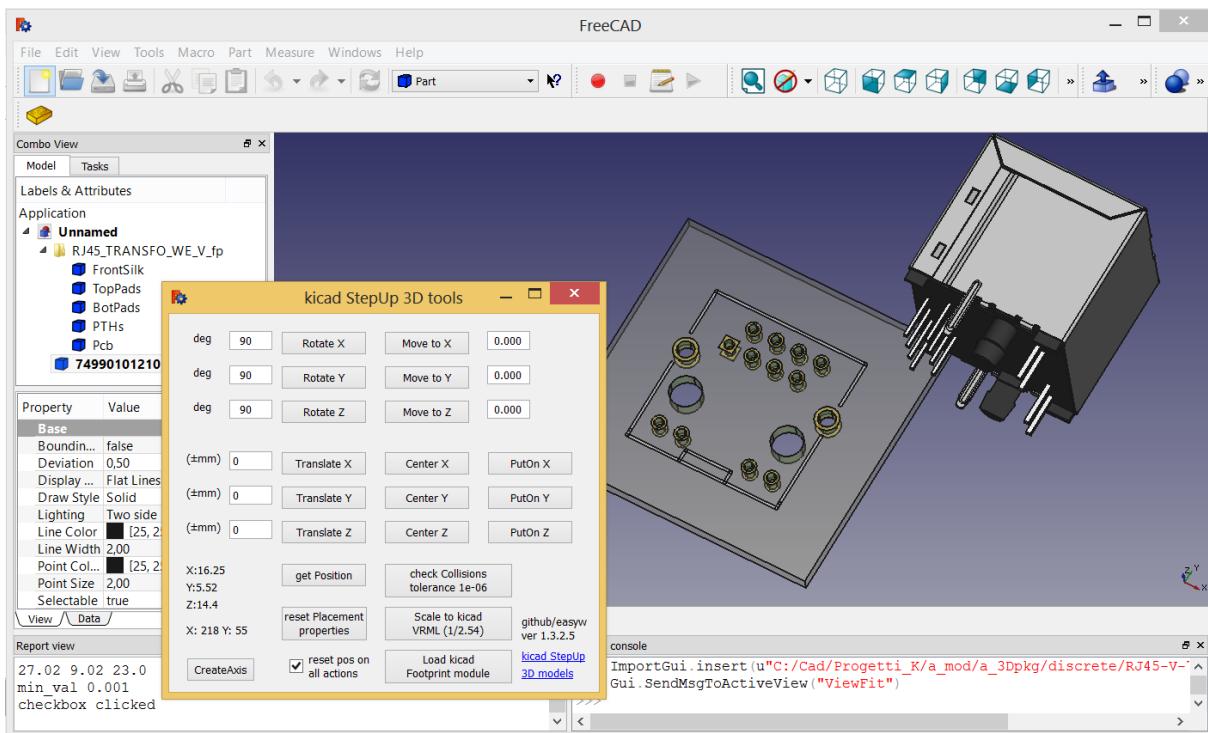


Figure 8. kicad StepUp tools: Align 3D model to footprint

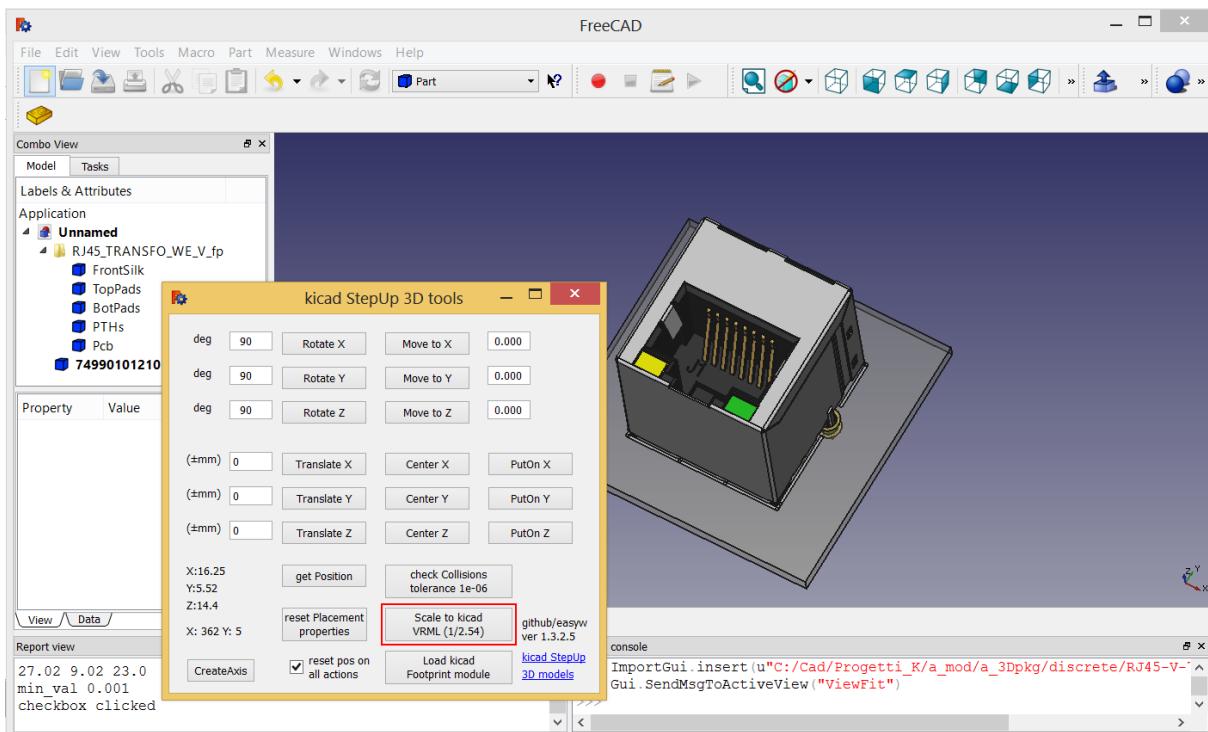


Figure 9. kicad StepUp tools: 3D STEP model aligned

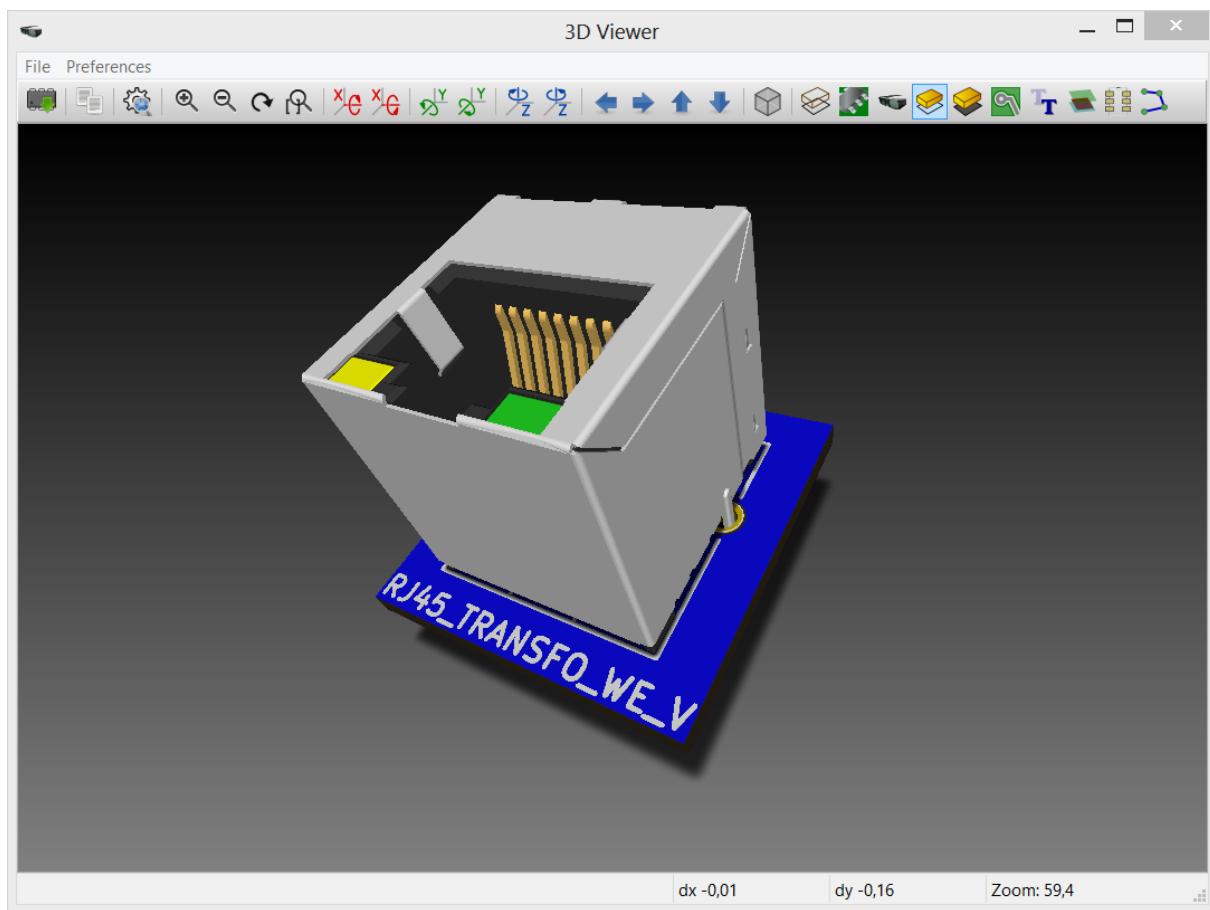


Figure 10. kicad StepUp tools: 3D VRML model aligned

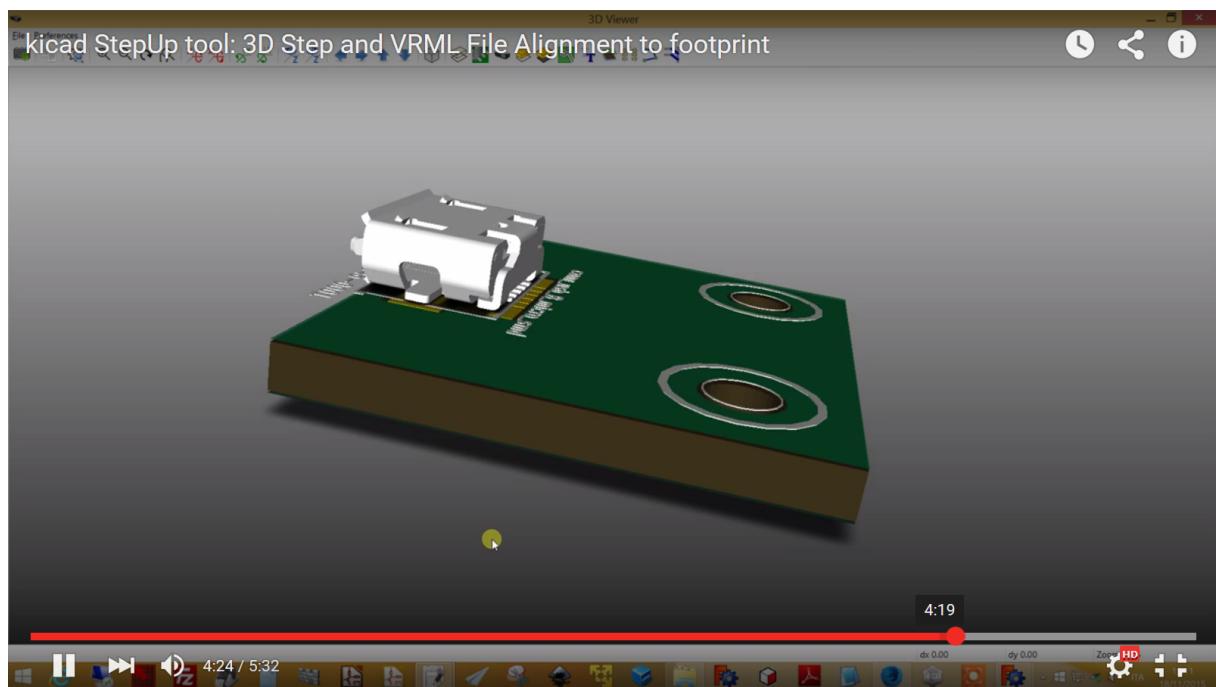


Figure 11. kicad StepUp tools: align 3D STEP and VRML to footprint - video tutorial

YouTube Kicad StepUp tool: Align 3D Step model to pcbnew footprint video¹⁵

¹⁵ <https://youtu.be/O6vr8QFnYGw>

12. 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
- 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.

The config file *ksu-config.cfg* let you configure the following parameters:

1. 3D path prefix

your KISYS3DMOD path (see kicad for help) or 3D model path prefix
\${KIPRJMOD} var is supported

2. blacklist of 3D models

none=all 3D models will be parsed;
volume=1 means all models with a volume < 1mm³ will not be included
height=1 means all models with a height < 1mm will not be included

3. pcb color r,g,b

e.g. 0.0,0.5,0.0,light green

4. bounding box option

LIST list of modules, separated by a comma, not converted to bbox
ALL or off

5. placement options of board and parts

useAuxOrigin, useBaseOrigin, useBasePoint;x;y, usedefault, +AutoAdjust

6. virtual modules to be or not added to board

if a module has virtual attribute in kicad pcbnew, can be selectively parsed

7. fuse modules to board and make a single object of pcb and parts

fuseAll, nofuse

Note: be careful ... fusion can be heavy or generate FC crash with a lot of objects
please consider to use bbox or blacklist small objs in case of *fuseAll* option

13. Skipping small parts and using Bounding Boxes

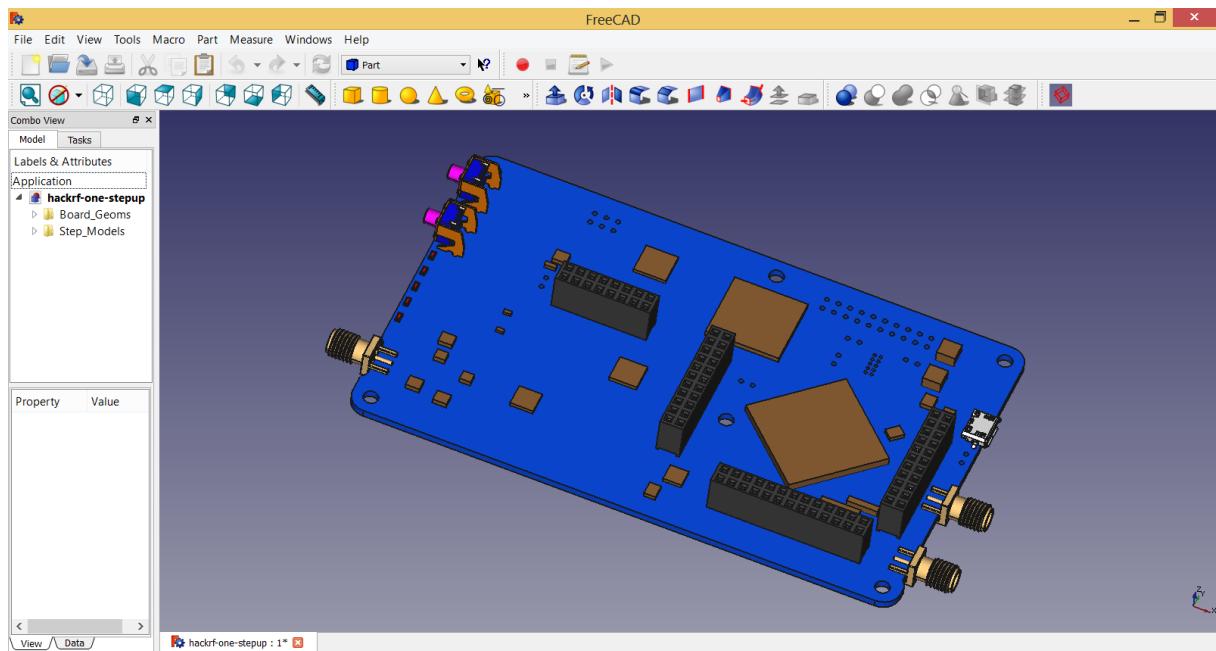


Figure 12. kicad StepUp: using bounding boxes for all but connectors and skipping small parts

14. Check for Collisions and mechanical constrains

With **kicad-StepUp-tools Macro** it is also possible to **detect collisions** and **check mechanical constrains**

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

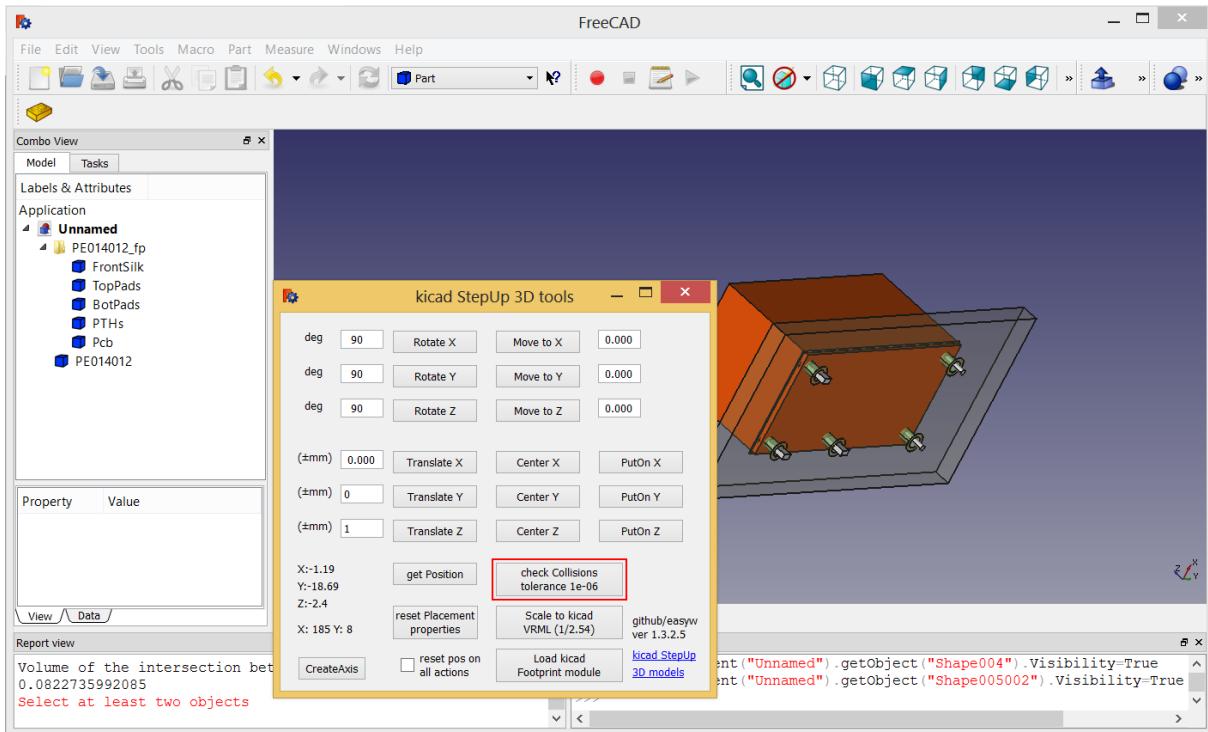


Figure 13. kicad StepUp tools: collisions check for 3D part module and footprint

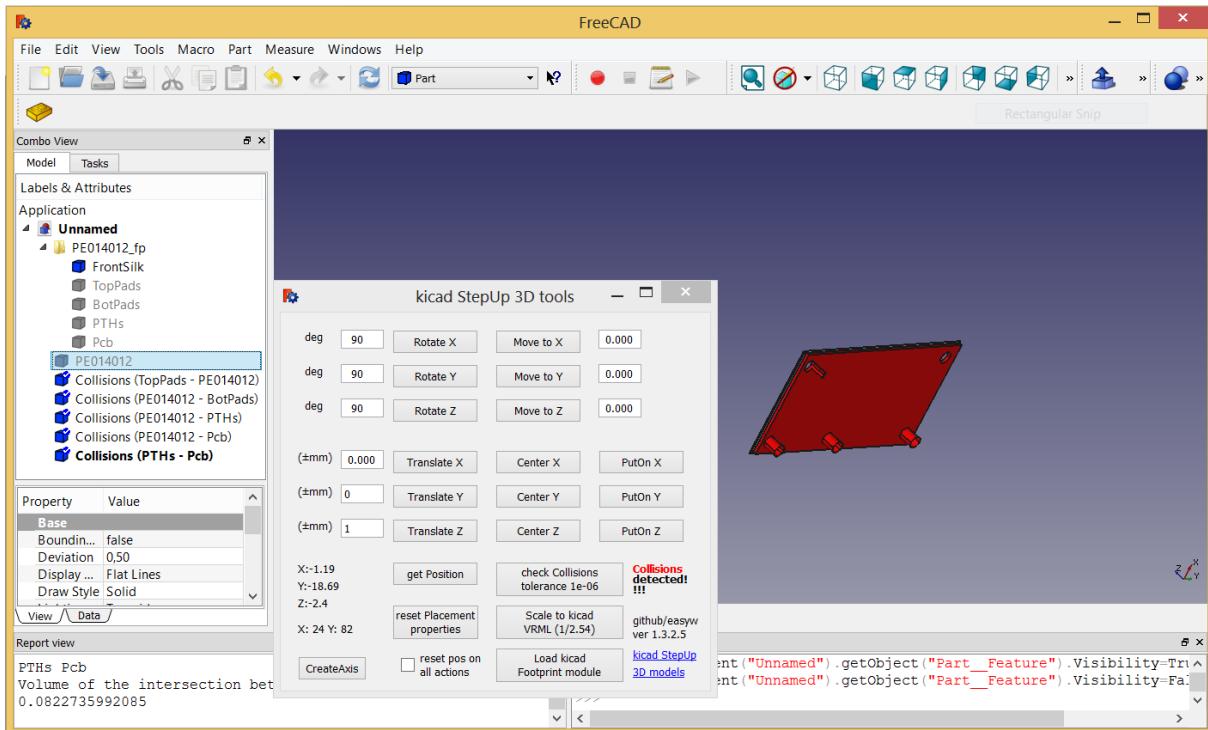


Figure 14. kicad StepUp tools: collisions found for 3D part module and footprint

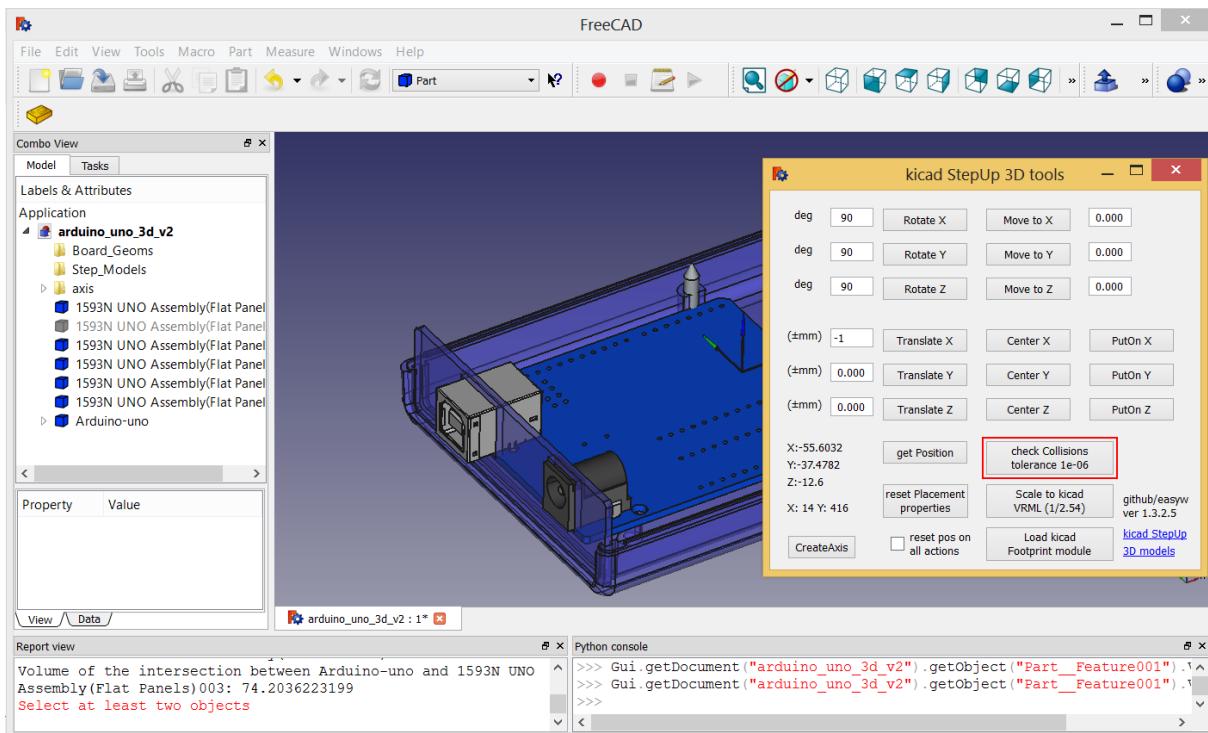


Figure 15. kicad StepUp tools: collisions check for 3D pcb and connectors with Arduino-uno-enclosure

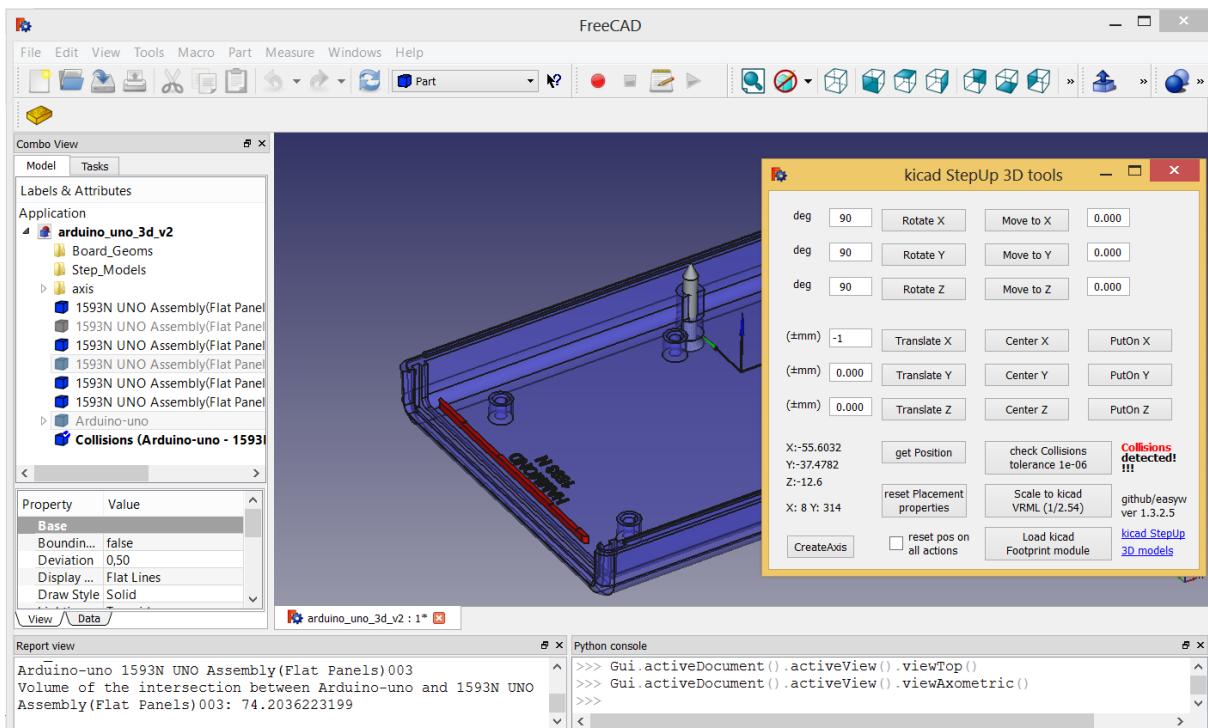


Figure 16. kicad StepUp tools: collisions found for 3D pcb and connectors with Arduino-uno-enclosure

15. STEP AP214 and VRML FreeCAD scripted repository ready to kicad StepUp

repository of 3D STEP models:¹⁶

me and HyOzd have done a repository of many electronic components **STEP AP214** and **VRML** models, with some nice scripts to build parametric models for **SOIC**, **SSOP**, **TSSOP**, **SOT**, **QFP**, **QFN** ICs, **DIP** ICs, **Chip Resistors**, **Chip Capacitors**, **Pin Headers**

just compiling a parametric text file with dimensions from component data sheet **3D-script-generator** and **3D models**¹⁷

more is coming ...

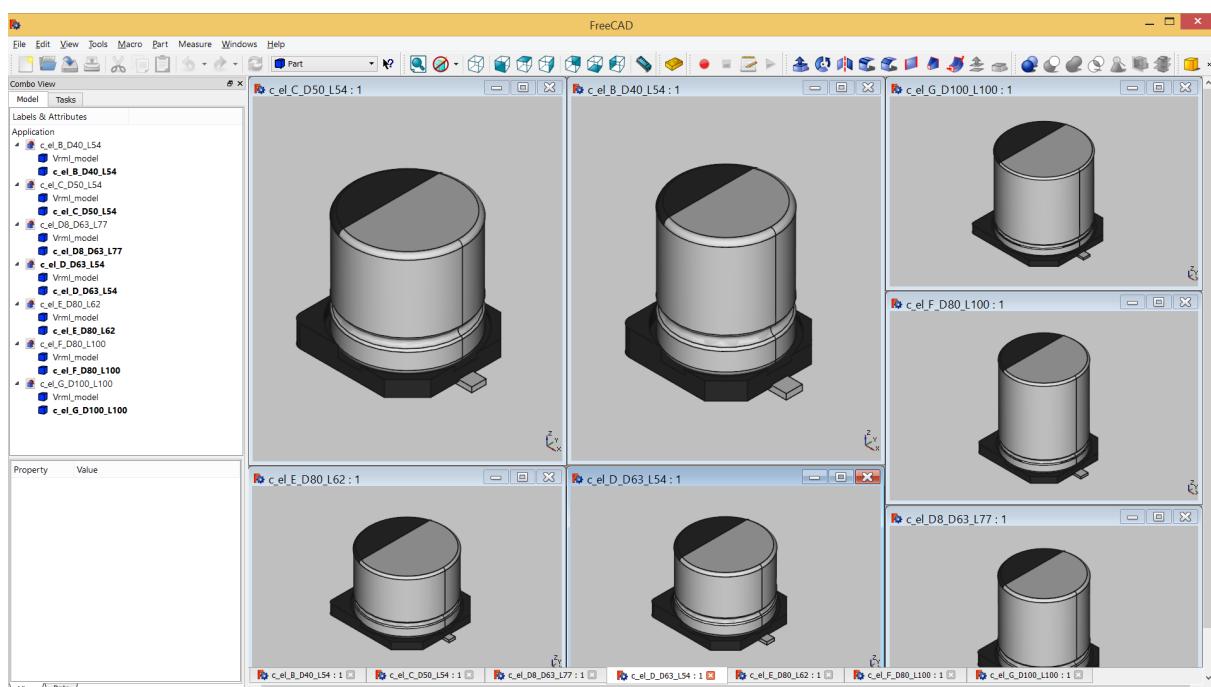


Figure 17. kicad StepUp: parametric STEP & VRML library

¹⁶ <https://github.com/easyw/kicad-3d-models-in-freecad>

¹⁷ https://github.com/easyw/kicad-3d-models-in-freecad/tree/master/cadquery/FCAD_script_generator

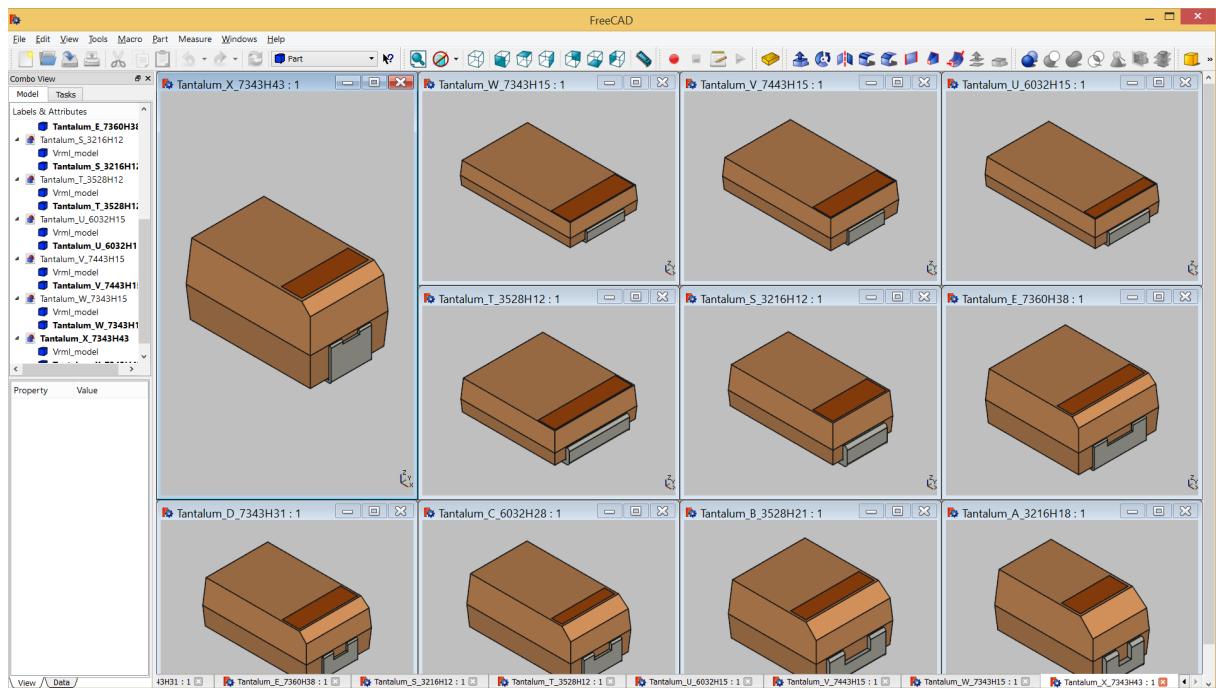


Figure 18. kicad StepUp: parametric STEP & VRML library

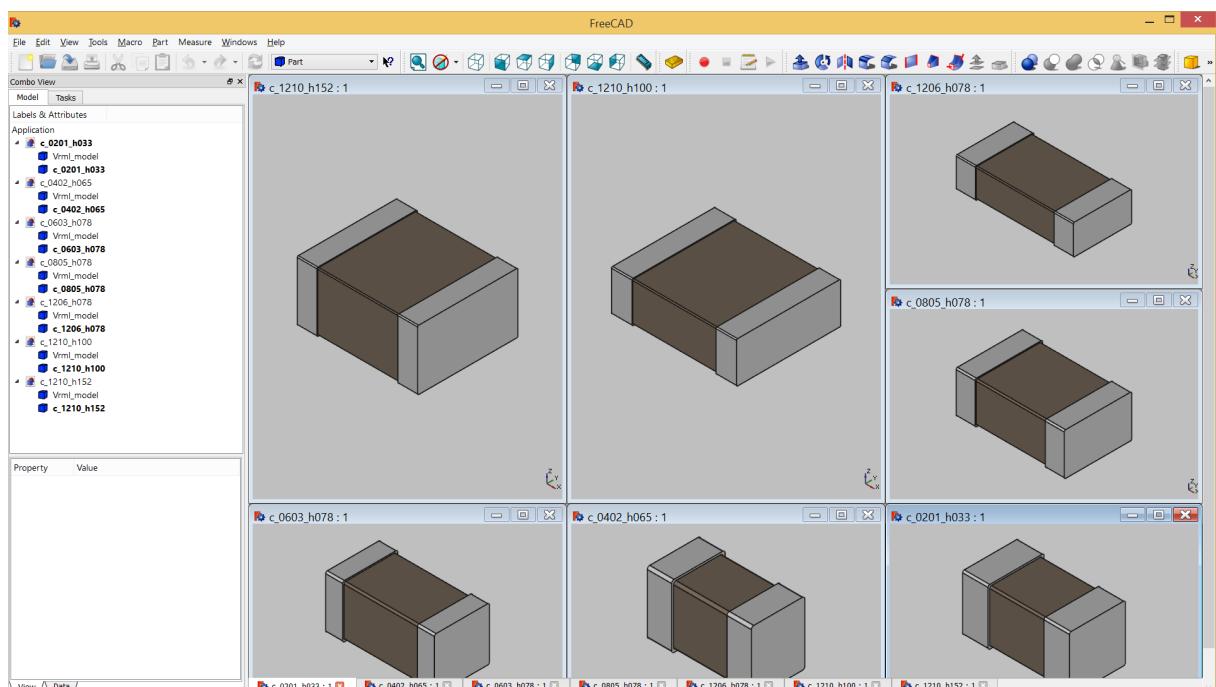


Figure 19. kicad StepUp: parametric STEP & VRML library

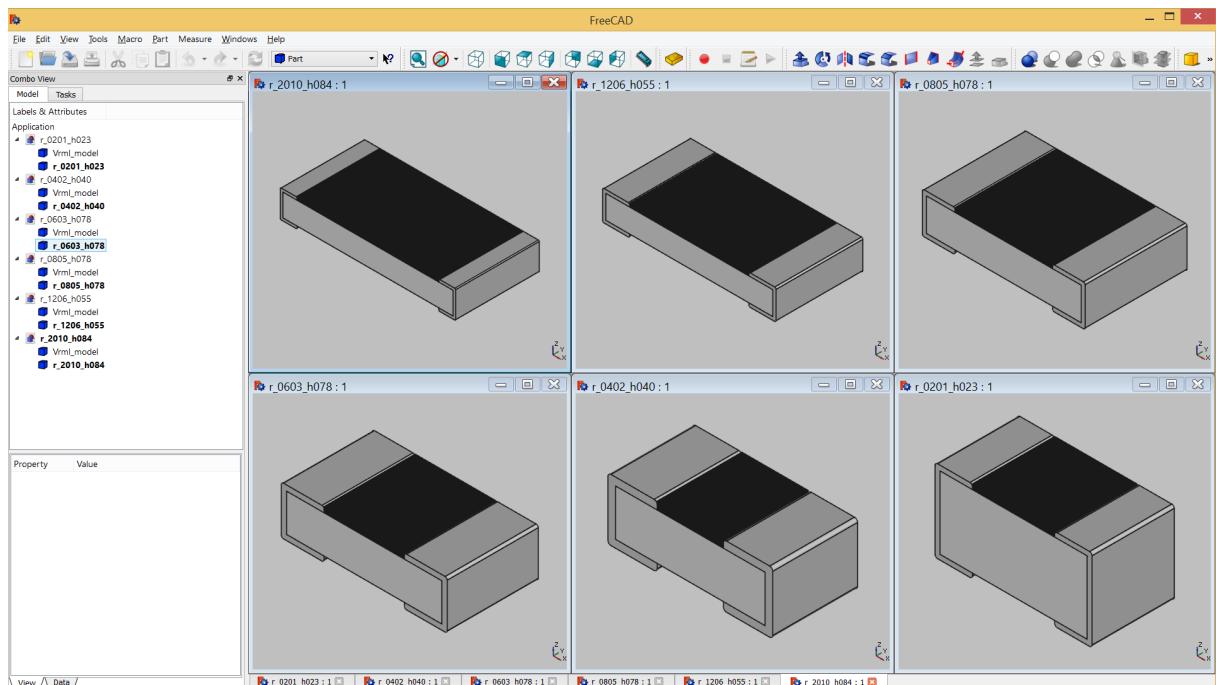


Figure 20. kicad StepUp: parametric STEP & VRML library

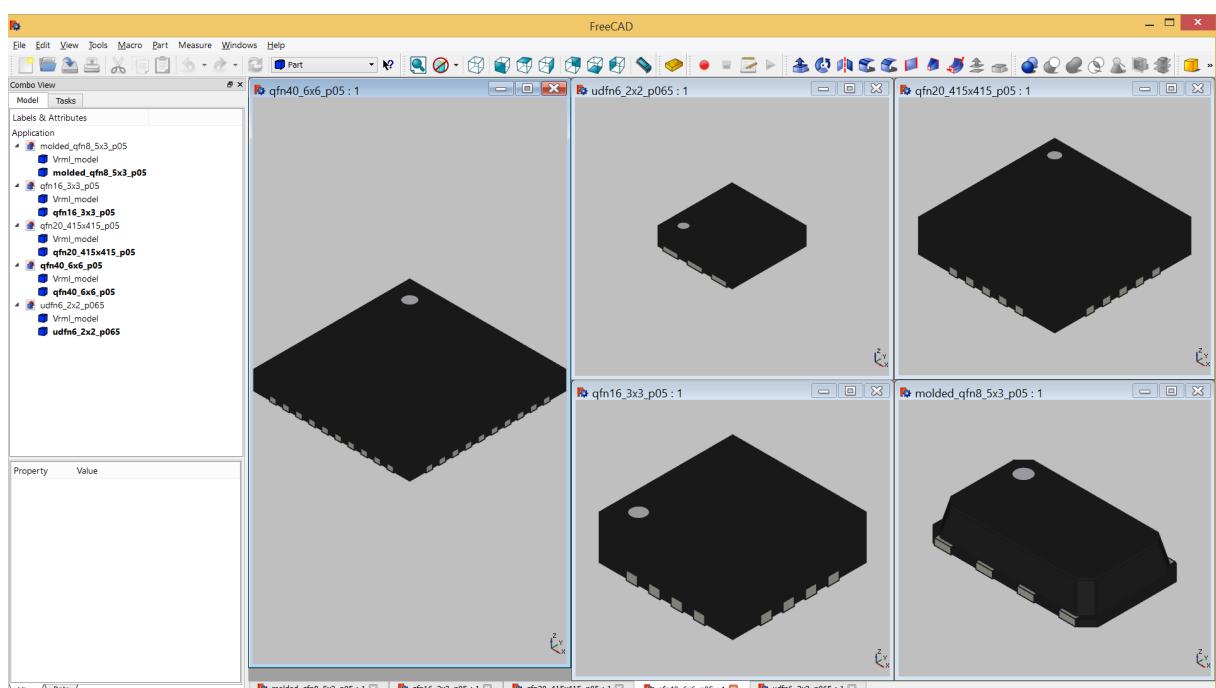


Figure 21. kicad StepUp: parametric STEP & VRML library

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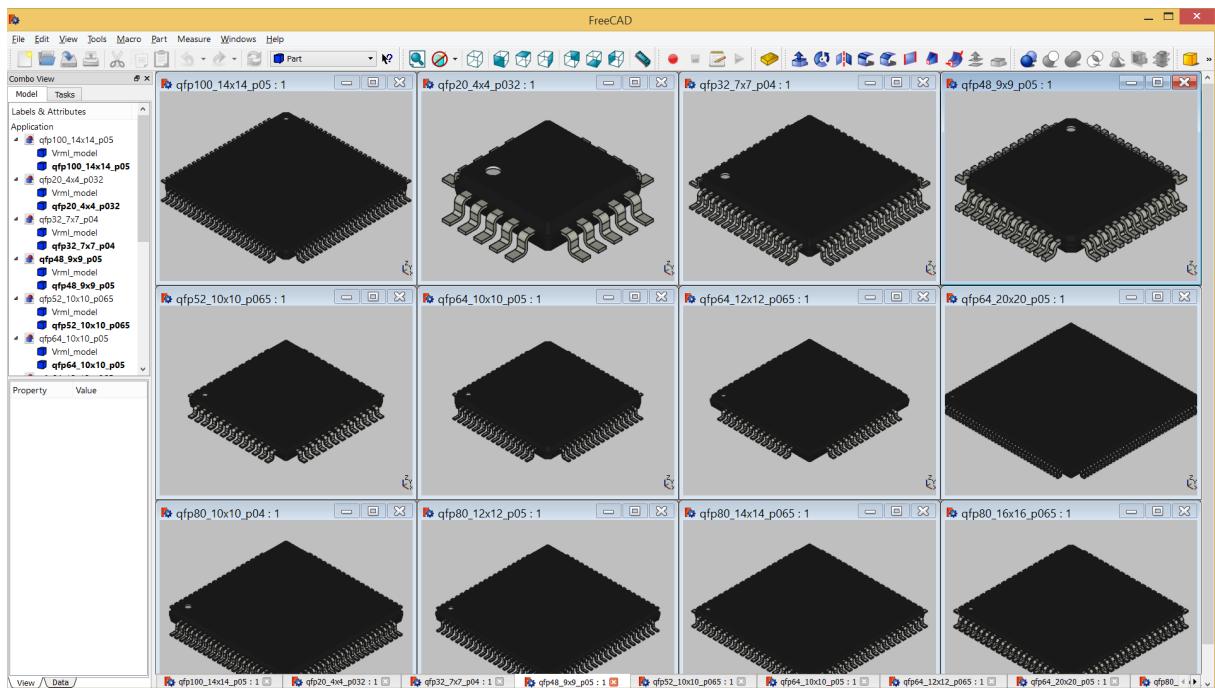


Figure 22. kicad StepUp: parametric STEP & VRML library

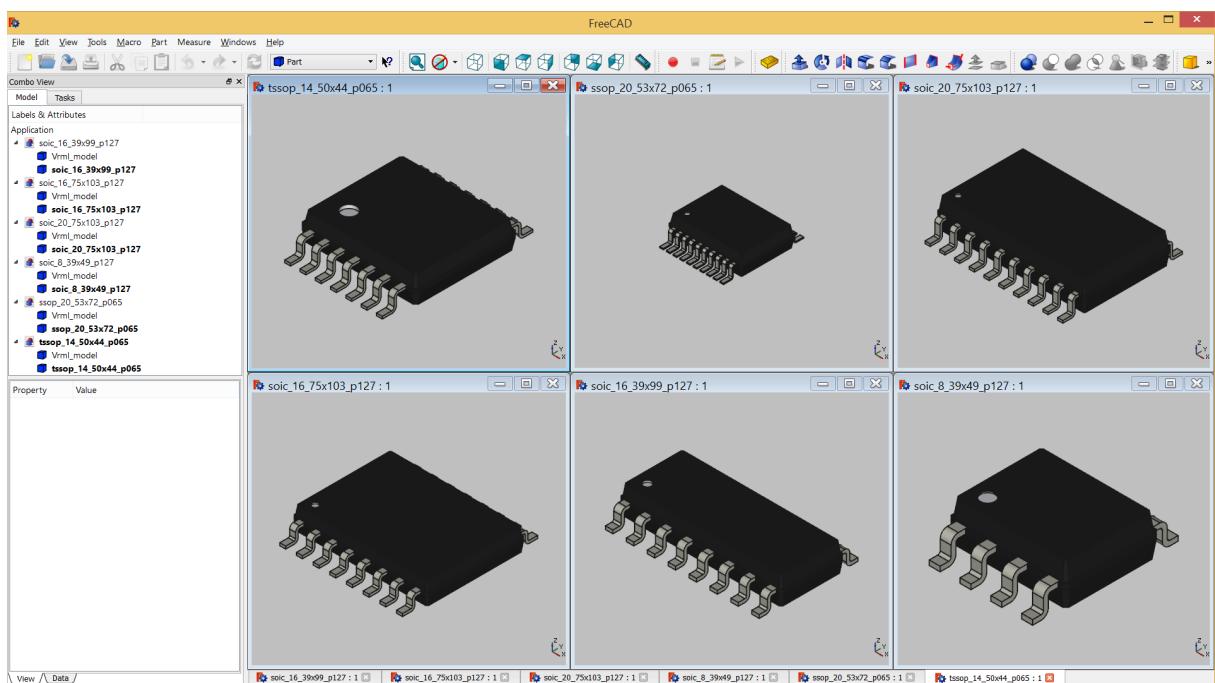


Figure 23. kicad StepUp: parametric STEP & VRML library

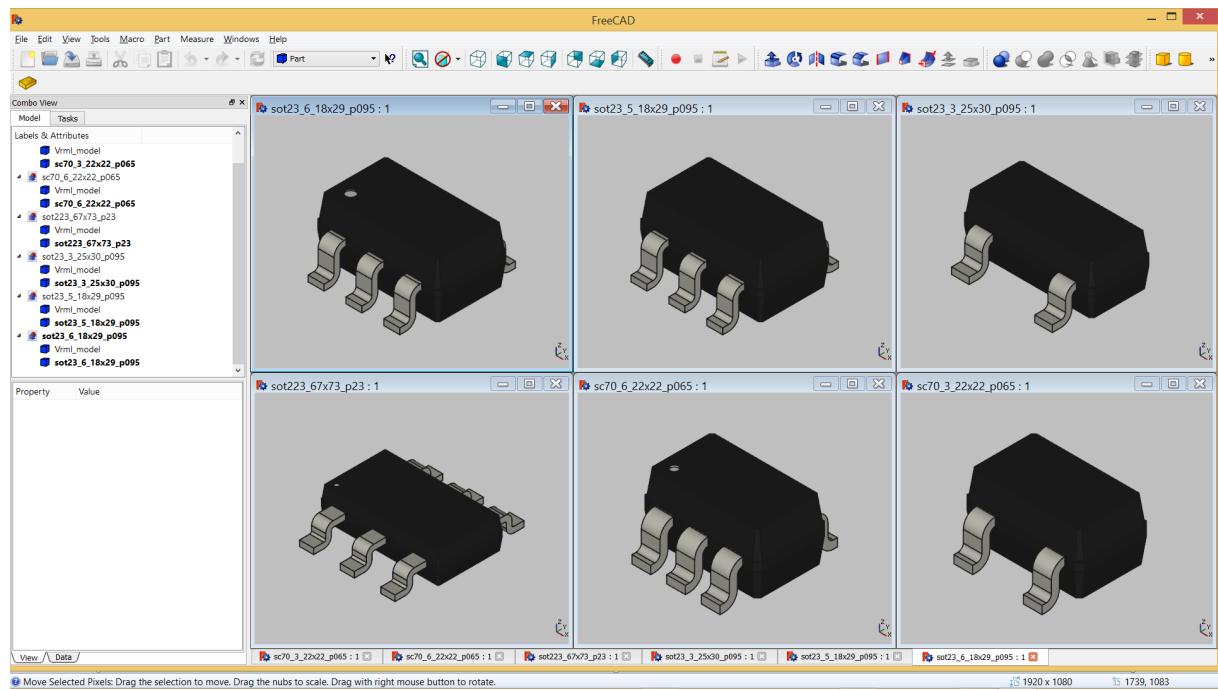
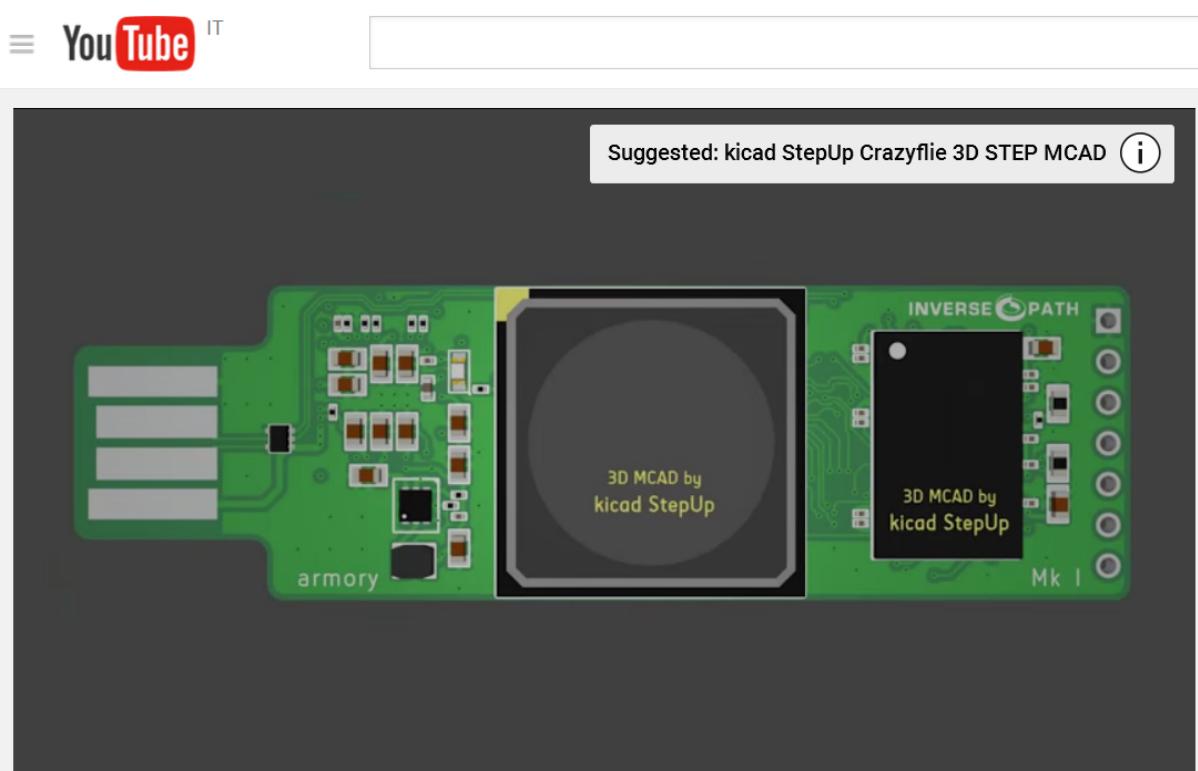


Figure 24. kicad StepUp: parametric STEP & VRML library

16. OLD Blender patch for loading FreeCAD generated VRML files

kicad StepUp rendered with Blender¹⁸



kicad StepUp rendered with Blender (MCAD parts converted to VRML)

Figure 25. kicad StepUp: video rendered with Blender

Recently I've worked with hyOzd to include in kicad-SteUp-tools.FCMacro an exporting function to create VRML smaller in file size and **fully compatible with Kicad and Blender**

so there is no need to load the workaround :)

Here the old workaround for completeness Note: Blender has a limited VRML import support

[freecad forum: blender vrml import limits discussion¹⁹](http://forum.freecadweb.org/viewtopic.php?t=10815)

¹⁸ <https://youtu.be/oq-w532Qmlo>

¹⁹ <http://forum.freecadweb.org/viewtopic.php?t=10815>

so FreeCAD VRML exported models are not rendered well in standard Blender import routines...

hyOzd has developed a python patch plugin that fills the gap...

[freecad forum: blender VRML patch plugin²⁰](#)

Then you will get a clean scene in blender with VRML files exported from FreeCAD

²⁰ <http://forum.freecadweb.org/viewtopic.php?t=10815#p103529>

NB the new config file is in home user dir

Linux and OSX:

~/ which is \$HOME

Windows:

%HOMEPATH%

Kicad-StepUp-tools.FCMacro has a Config Button to display the **ksu-config.ini** file and a button for a small Help

17. OLD config file: ksu-config.cfg

the conversion between kicad pcb and MCAD can be configured with the parameters included in the ksu-config.cfg file; the parameters are as followings:

```
## each line starting with a # is a comment
## put here your KISYS3DMOD path or 3D model path
./
## put here your model names that you don't want to load
## separated by a comma (none means all the models will be parsed)
## (volume=1 all models with a vol<1mm3 will not be included)
## (height=1 all models with a height < 1mm wont be included)
#r_0603,r_0402,c_0402,c_0603
none
## pcb color r,g,b e.g. 0.0,0.5,0.0,light green
0.0,0.298,1.0,lightblue (0,76,255)
## bounding box option LIST=>whitelist (not converted to bbox)
#bbox LIST dpak-to252,sod80
#bbox ALL
bbox off default
## placement options
## useAuxOrigin, useBaseOrigin, useBasePoint;x;y, usedefault,
## +AutoAdjust
#placement: useAuxOrigin
#placement: useAuxOrigin +AutoAdjust
#placement: useBasePoint;37.0;50.0;
#placement: useBasePoint;37.0;50.0; +AutoAdjust
#placement: useBaseOrigin #place board @ 0,0,0
#placement: useBaseOrigin +AutoAdjust #place board @ 0,0,0
#placement: usedefault
#placement: usedefault +AutoAdjust
placement: useBaseOrigin #place board @ 0,0,0
```

```
## virtual modules to be or not added to board
#addVirtual
noVirtual
## fuse modules to board, please use bbox or blacklist small objs
## fusion can be heavy or generate FC crash with a lot of objects
#fuseAll
nofuse #default
```

18. List of files

kicad_StepUp-Tools.FCMacro = Load kicad Board, Load Footprint, Move, Rotate, Scale, export wrl, check Collisions; GUI Macro to easily manage ALL MCAD conversion for board and manufacturers STEP modules and kicad VRML

kicadStepUp-starter-Guide.pdf = *kicad StepUp* starter Guide kicad_StepUp.FCMacro = OLD *kicad StepUp* 3D MCAD exporter script/plugin

ksu-config.cfg = OLD configuration file

kicad_StepUp_vrml_export.FCMacro = OLD STEP to scaled VRML script

19. credits

kicad StepUp script author is Maurice easyw@launchpad²¹

Guide Doc Version is 2.0.1

[Kicad EDA](#)²²

- IDF export for kicad (Cirilo Bernardo)

[FreeCAD](#)²³

IDF import for FreeCAD

- Milos Koutny (milos.koutny@gmail.com²⁴)

[CadQuery module](#)²⁵

- CadQuery FreeCAD module

[hyOzd freecad macros](#)²⁶

- hyOzd parametric script

FreeCAD-PCB

- marmni <marmni@onet.eu²⁷>

²¹ <https://launchpad.net/~easyw/>

²² <http://kicad-pcb.org/>

²³ <http://freecadweb.org/>

²⁴ mailto:milos.koutny@gmail.com

²⁵ <https://github.com/jmwright/cadquery-freecad-module/archive/master.zip/>

²⁶ <https://bitbucket.org/hyOzd/freecad-macros>

²⁷ mailto:marmni@onet.eu

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