STEP Model Support in PCB Editor

Overview

The PCB Editor products currently provide 3D viewing of a BRD (board drawing) based on the open drawings layer visibility and object selection. The 3D viewer provides a basic rendering of board geometry, conductors, via structures and component geometry with little or no detail also referred to as block style or "skyscraper" viewing. The desire by users for a solution that provides more detail in component modelling to assure proper clearances and positioning that the block style viewing does not provide has been addressed through the use of STEP models.

An update to PCB Editor 16.6 (at least S006) provides users the ability to map package and mechanical symbols to STEP models, display the STEP model in the PCB Editor 3D viewing tool, and to export the board drawing as a STEP model. The capability of including enclosures associated with the board is also provided for positioning and collision detection. (S016 introduced better mapping functionality. This App note is based on that version).

This note will cover:

- Map PCB Editor symbols to STEP models
- Use new STEP model features in the 3D Viewer
- Associate enclosure STEP models for 3D Viewing
- Exporting a PCB Editor board as a STEP model

STEP Models

STEP models are XML formatted files that describe graphical detail for a physical part. There are currently two STEP model formats that support most electrical and mechanical parts used on a PCB. The format standards are managed by ProSTEP iVip and are often referred to as AP203 and AP214. An effort by ProSTEP is underway to merge these two formats into one common format named AP242. Until completion of the AP242 standard, the AP214 format currently provides a more detailed description of a part and is most commonly preferred.

Obtaining STEP models is possible through manufacturer sites, but not all manufacturers provide STEP models. There are several 3rd part library solutions that, for a subscription or fee, will create and distribute STEP models. Some MCAD tools provide the capability to export STEP models of their libraries and their user communities provide a shared library of STEP models readily available to users. A user may search throughout the internet to locate a site that best works for them. A recommended free site (although you must register) for 3D Step Models is: - http://www.3dcontentcentral.com/Default.aspx

See the following web sites more information on STEP models:

http://www.prostep.org/nc/en.html

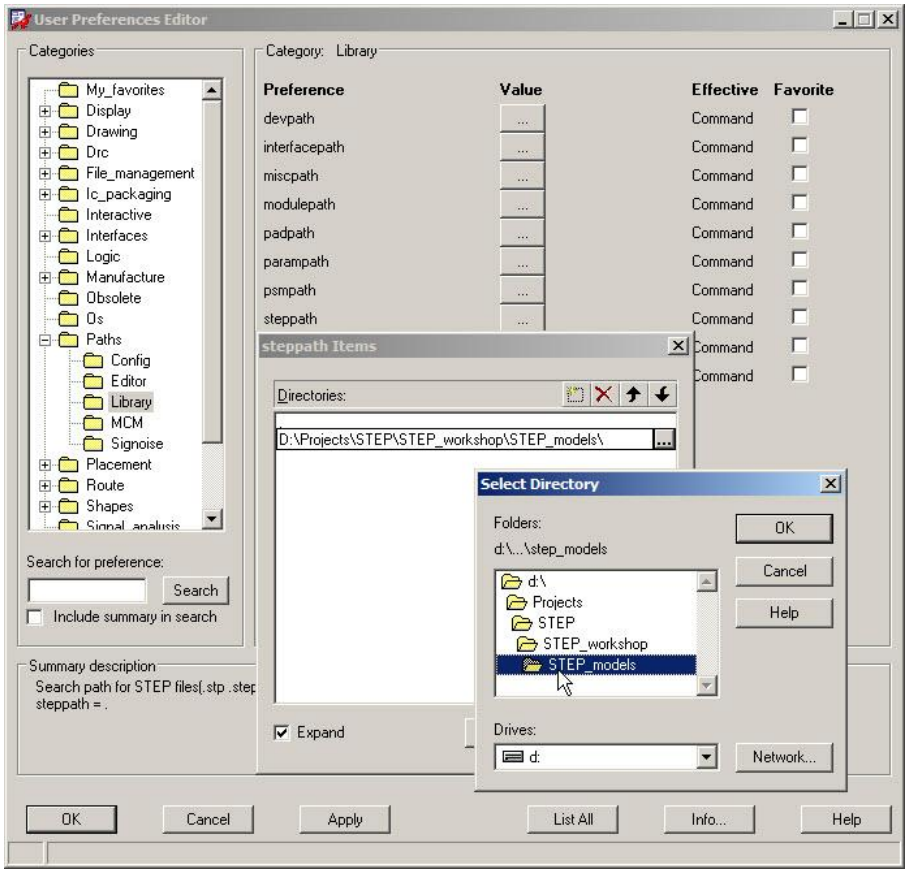
http://www.prostep.org/en/projects/step-ap-242.html

STEP Model Viewers

There are several free or trial versions of 3D STEP model viewers available by searching the World Wide Web. If permissible, locate and install one for use in viewing a PCB Editor board STEP model.

STEP Model Library

STEP models should be placed into a Library in a similar manner as other PCB Library models. A specific directory that all users have at a minimum read access permission should be defined. This path location is then assigned as a value to the PCB Editor Library path environment steppath. The steppath environment variable may be defined through Setup - User Preferences – Paths - Library - setting in the PCB Editor tool.



Symbol to STEP Model Mapping

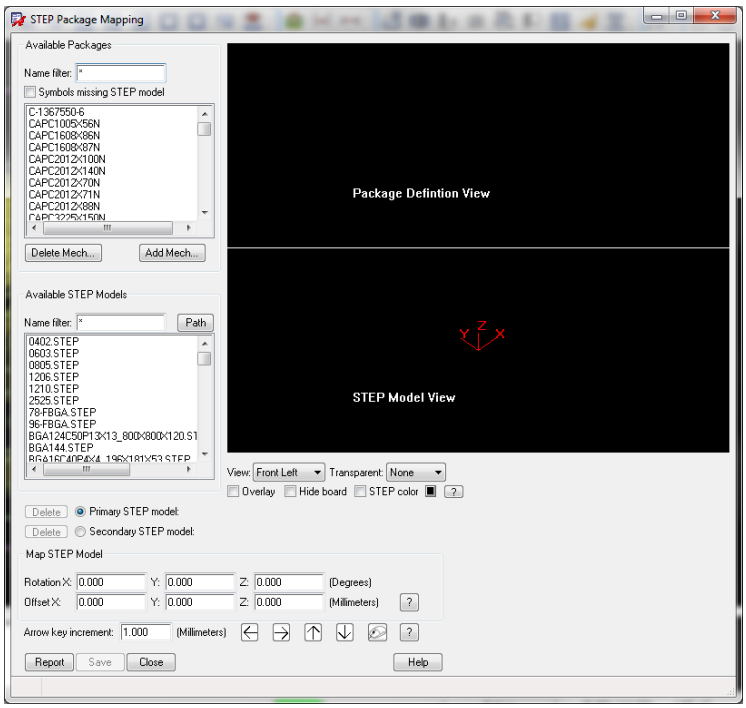
STEP models are associated to PCB Editor package and mechanical symbols through a mapping tool. This mapping tool sets the STEP model name to the symbol and defines offset information to correctly position the STEP model in the 3D viewer. The mapping data created is then instantiated into the symbol as a property.

STEP models, as of this writing, have no standardized origin or orientation more especially in relationships to 2D models. Most STEP model origins generally appear to have an origin located at the absolute center of the model, but this can never be guaranteed. Orientation will also vary from model to model. Correct positioning of the STEP model may require adjustment in rotation about the X, Y, and/or Z axis. Proper positioning of the 3D model may also require adjustments in the X, Y, and/or Z axis. The STEP model mapping tool assists the user in defining these offsets by visually comparing the PCB Editor symbol to the STEP model, where the user adjusts offset and rotation values to position the STEP model correctly to the symbol model.

Important: For a mapped or unmapped model to be displayed in the PCB Editor 3D Viewer, the board or package symbol MUST contain a PACKAGE GEOMETRY PLACE_BOUND_TOP or PLACE_BOUND_BOTTOM element.

Mapping a STEP model to a symbol

Open PCB Editor then go to **Setup – Step Package Mapping**, the STEP Package Mapping tool opens



The **Available Packages** pane lists the symbols in the existing board drawing, with options for filtering by symbol name or by unmapped status.

The **Available Step Models** pane lists all step models currently available in the library path specified by the steppath environment variable. Name filtering is provided to minimize the STEP model list length. Selecting the Path button allows visualization of the current steppath env value.

The Graphics pane displays the package model (based on Place Bound outline) and the Step model graphics with a graphical representation of a board section.

View: various points of view are available in a pull-down menu for example Top, Bottom, Front Left.

Transparent: Sets the selected model type to be transparent in the display.

Overlay: When selected, merges the Package and STEP model views into one view.

Hide board: When selected removes the graphical image of the board section.

STEP color: When selected uses the colours defined in the STEP model.

? : Displays the colour legend for the graphics.

Primary STEP model: Choose this option to map primary STEP model.

Delete: Deletes primary STEP model.

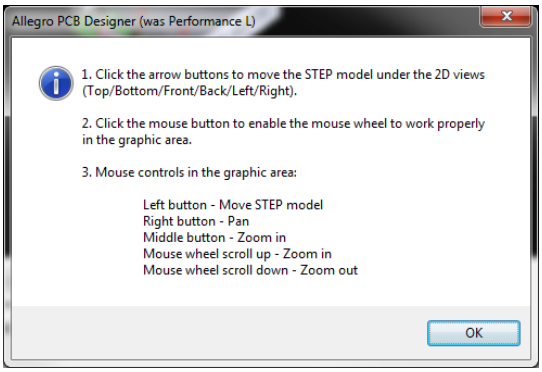
Secondary STEP model: Choose this option to map secondary STEP model.

Delete: Deletes secondary STEP model.

Map STEP Model pane provides the rotation and offset value entries to correctly position the STEP model in relationship to the package model.

Arrow key increment: The value the STEP model will move when the arrow keys  are pressed.

Mouse: button  allows users to move the STEP model in the 2D views to assist in the mapping process.



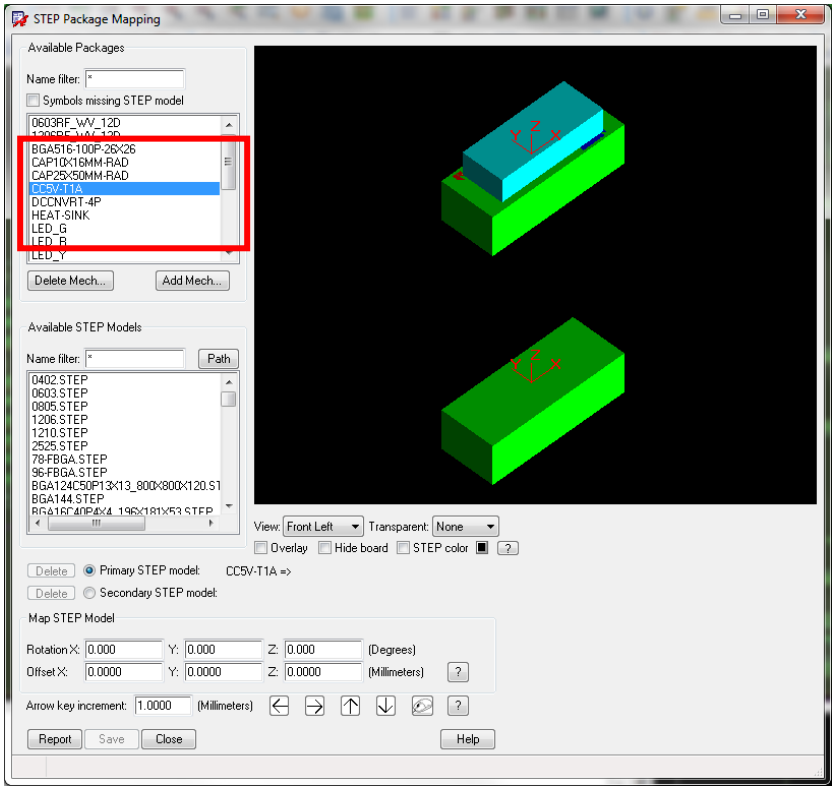
Report button displays a report detailing the package to STEP model name and mapping parameters.

Save button saves the mapping data of the current objects displayed and defined in the graphics pane.

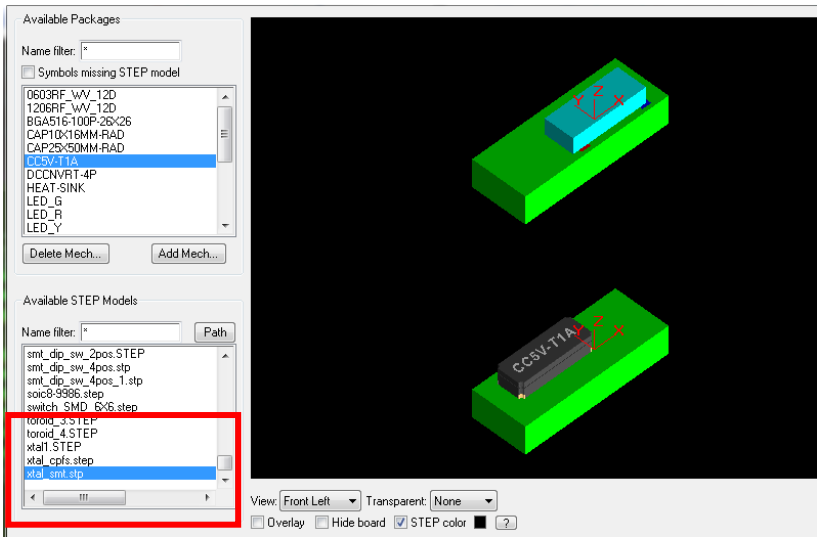
Delete button removes mapping data from the package symbol displayed in the graphics pane.

Close button ends the mapping session (without saving) and closes the STEP Package Mapping tool.

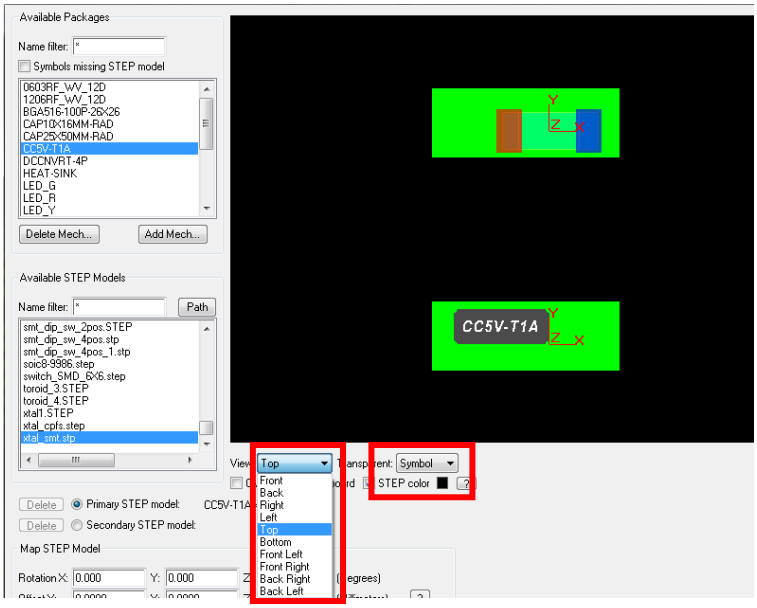
To map a 3D STEP model, In the Available Packages list, scroll to locate and then select the required package symbol name to map a 3D STEP model to or select the required symbol in PCB Editor and with the mapping tool open, navigate in the drawing to locate the required symbol and left-click on it. The graphics for this are displayed in the display panel.



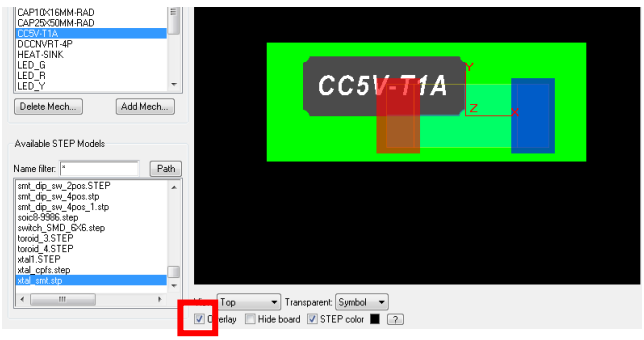
In the Available STEP model pane list, scroll to locate and then select the required STEP model name. The STEP model graphics are now displayed. This is an example of an AP-214 STEP model. Notice the detail and color features that are available. If the STEP model is one single color this is normally an example of an AP-203 STEP model, some detail but one single color. This color is derived from the STEP model.



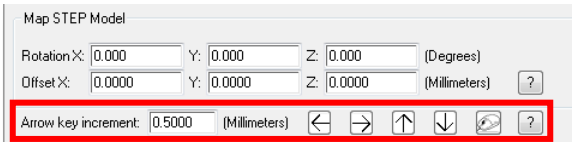
At first glance we can see that the symbol origins are not the same. To further observe the differences, first set the Transparent value to **Symbol**, then set the view to **Top** and notice how the packages differ in their origin.



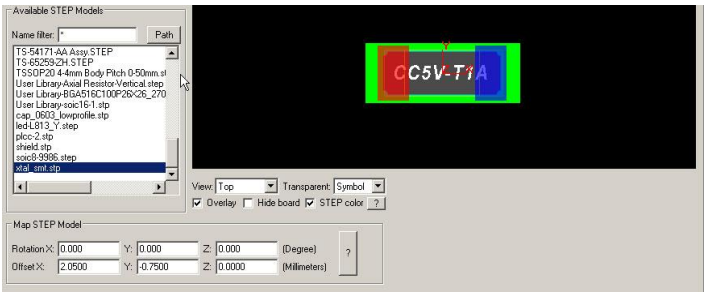
Now overlay the two symbols by selecting the **Overlay** checkbox to further see the differences.



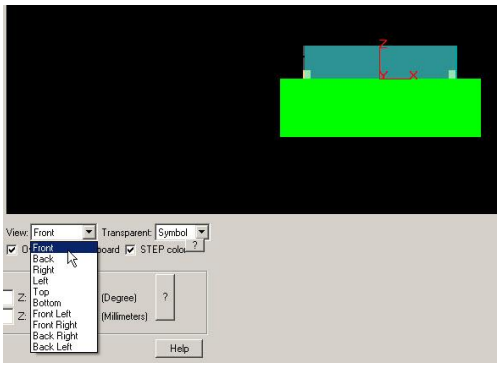
In this view, we can see that the X and Y offset values need to be set. When Setting offset values, use the **Tab** key to complete the entry, or using the **LMB**, select the next field. **DO NOT use the Return key as this will close the Mapping tool.** The STEP model can be mapped either by entering values or using the arrow key increment buttons at the bottom of the Map STEP model area.



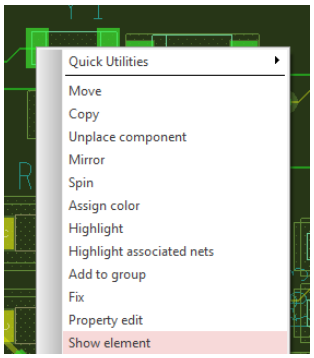
Enter a value for the increment and move the part in the required direction by clicking on the relevant arrow. If you wish to move the STEP model manually select the Mouse button icon then click and drag the STEP model to its required location. Then if required you can fine tune the values for Offset afterwards. For this part the values are Rotation X, Y and Z 0, Offset X 2.05, Y -0.75, Z 0.



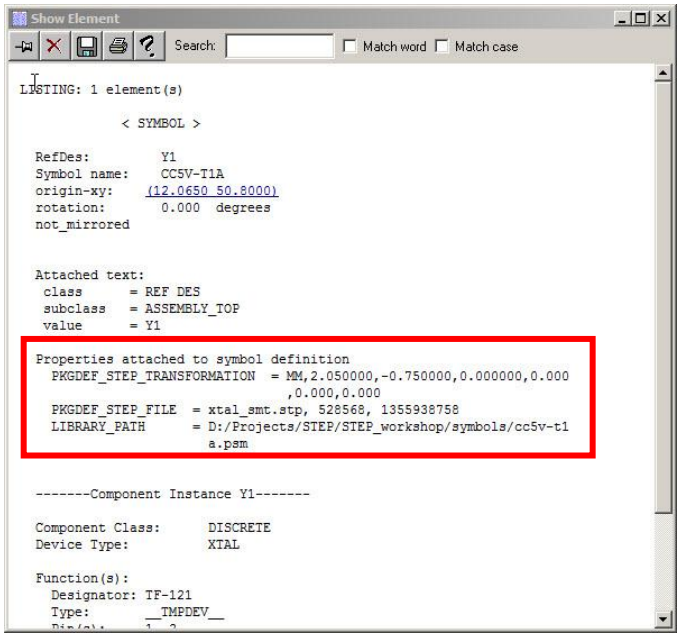
As each value was entered, the graphics displayed the change in the mapping showing the alignment of the STEP model to the package model. Change the **View** to **Front**.



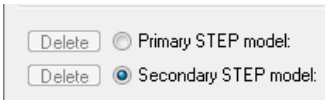
This view shows that the STEP model is properly seated on the board in the Z axis, requiring no Z Offset. (A Z Offset might be required for other models). Select the **Save** button to preserve the current mapping for this package model. Once the save is complete, the Save button is disabled. **Close** the STEP Package Mapping tool. In the PCB Editor, locate the symbol (Y1 in this reference) that has been mapped and hover RMB - Show element



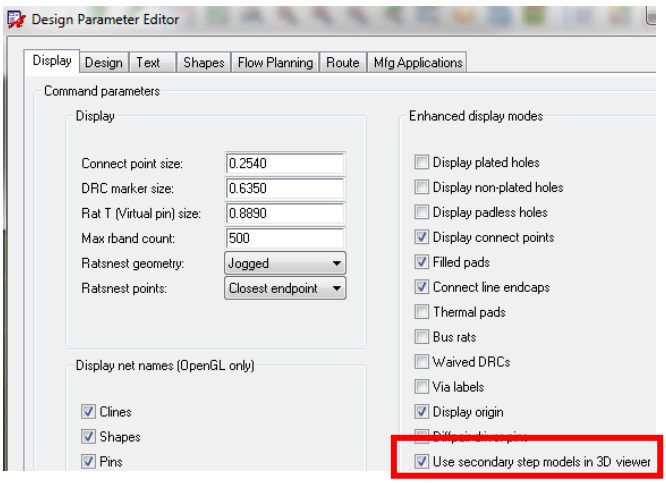
In the Show Element form, the STEP model mapping properties are displayed. These properties become part of the symbol definition and cannot be modified outside of the STEP Package Mapping tool. You can see all X, Y and Z rotation and offsets are stored as part of the package symbol.



There are also options to map a Primary STEP model and a Secondary STEP model for each symbol. This gives users the ability to have a detailed and non-detailed model for each part. The secondary model is mapped by selecting the secondary step model checkbox then mapping the STEP model using the steps mentioned above.



If both are defined there is an option to display the 3D view in the secondary mode (the default is to always show the Primary model view). Go to Setup – Design Parameters – Display tab and check the option for “Use secondary step models in 3D viewer” and the secondary model will be shown.



You can also open the relevant Package Symbol file (filename.dra) and repeat the steps above to map STEP Models directly to the library of package and mechanical symbols. Once complete, any drawing that loads this symbol will also have the mapped data included.

3D Viewer with STEP models

Once STEP model mapping is completed, the PCB Editor 3D viewer will display the graphical representations of the STEP models. The 3D viewer relies on the currently visible layers in the PCB Editor to determine what is displayed in the viewer. To view the 3D STEP models, the following CLASS/SUBCLASSES must be visible in the PCB Editor window:

PACKAGE GEOMETRY/PLACE_BOUND_TOP

PACKAGE GEOMETRY/PLACE_BOUND_BOTTOM

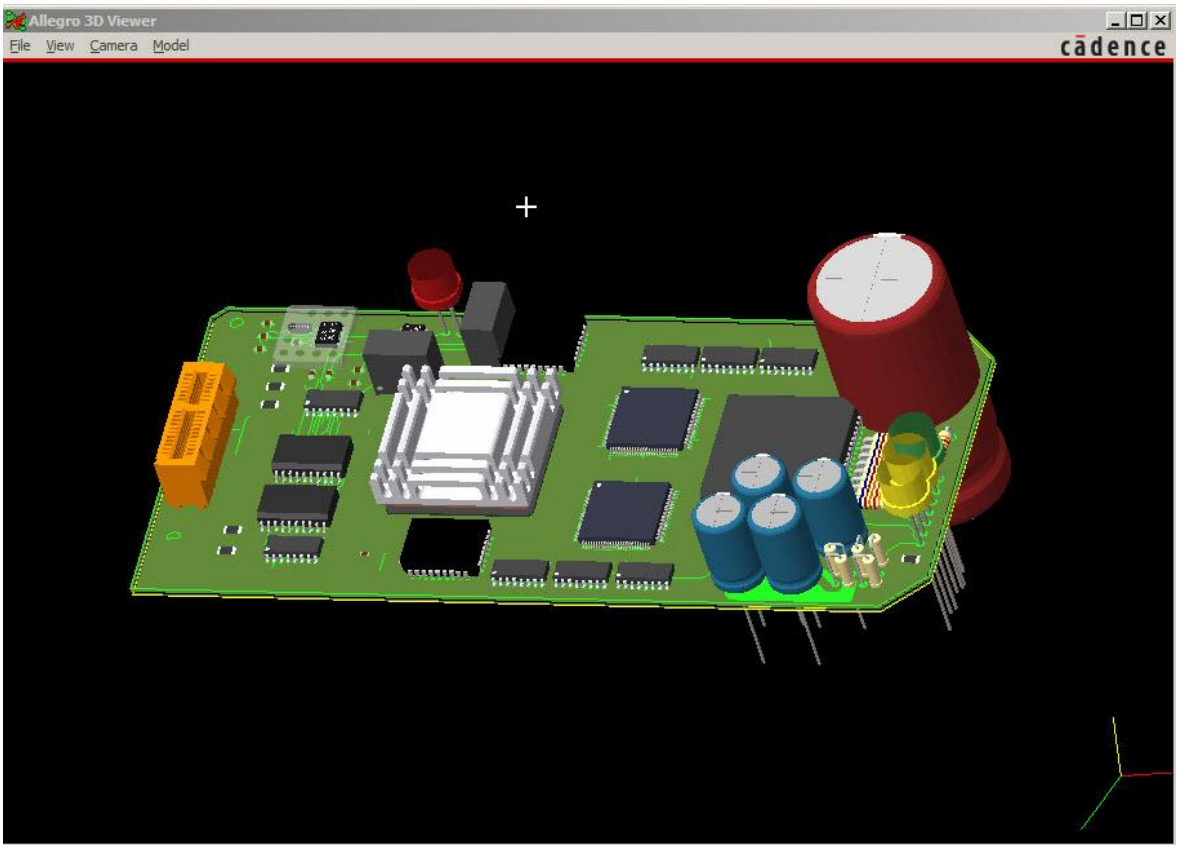
MANUFACTURING/STEP3D_ASSEMBLY_ENCLOSURE

Open the Color Dialog and verify that the subclasses for PACKAGE GEOMETRY/PLACE_BOUND_TOP, PACKAGE GEOMETRY/PLACE_BOUND_BOTTOM, and MANUFACTURING/STEP3D_ASSEMBLY_ENCLOSURE are set to visible.

Select the 3D viewer icon in the PCB Editor toolbar 

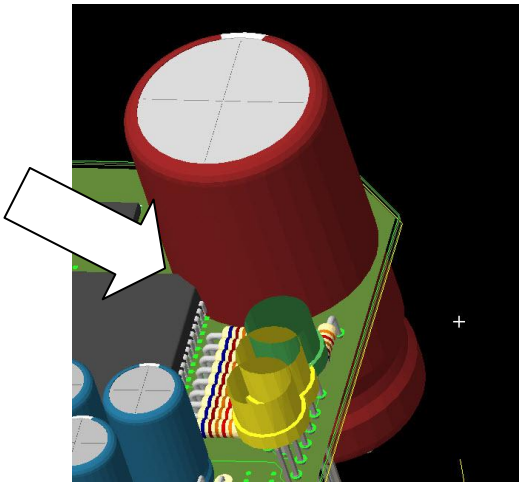
, or from the menu select View - 3D View.

When the 3D viewer opens, the symbols (with mapping associated) are now replaced by STEP models. Rotating and panning through the 3D image, placement of devices can be viewed for possible issues in the design.



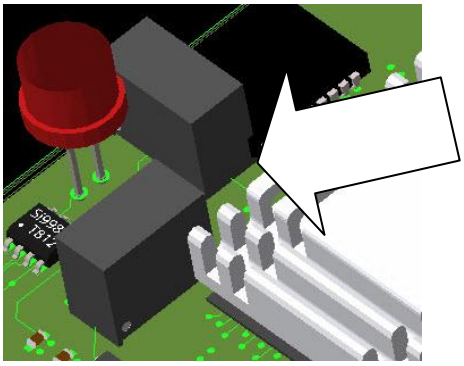
For this example, the large radial capacitor has two issues:

- Mapping for model is incorrect and should be corrected.
- There is a collision with the 68 pin PLCC device.

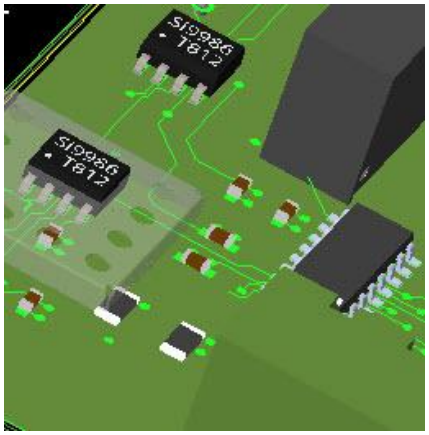


With mapping Z offset set to actual mounting on the board for the LED, as in this example, the resistor positioned in the LED's shadow does not appear to be colliding.

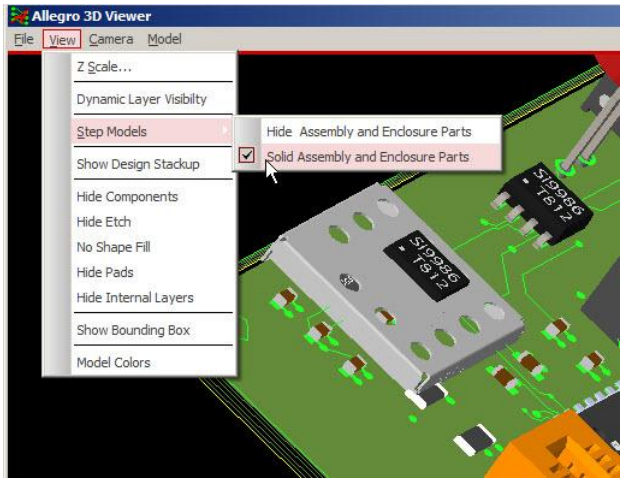
This is an example of a part that may be incorrectly defined in the library as the pins align, but the bodies do not.



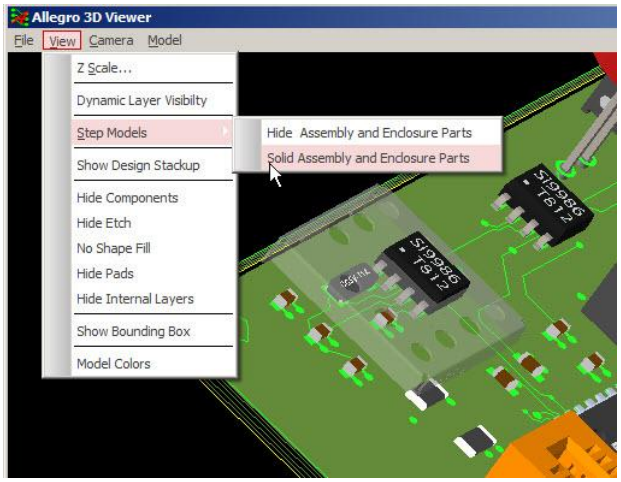
In the next example, a component appears to be protruding through a shield.



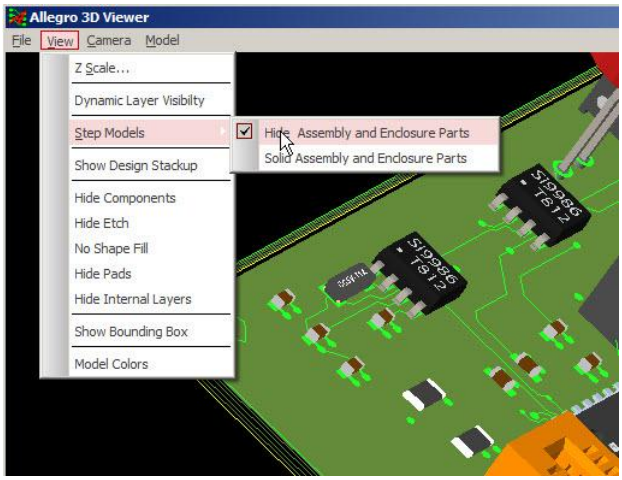
Mechanical models added to the board drawing as mapped STEP models are transparent by default. The 3D viewer **View** menu provides two options for managing the display of these model types. Select **View - STEP Models - Solid Assembly and Enclosure Parts.** The mechanical STEP models that were transparent are now solid.



Selecting **View - STEP Models - Solid Assembly and Enclosure Parts** again will toggle the same models to transparent.



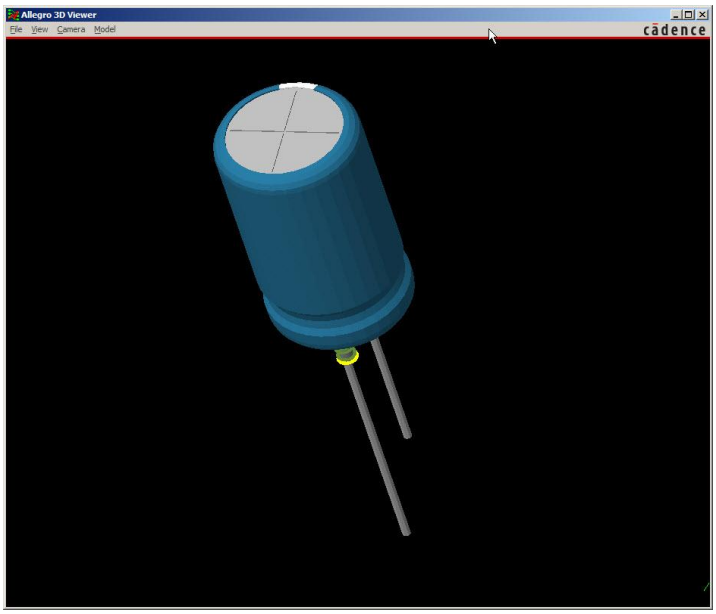
Select **View - STEP Models - Hide Assembly and Enclosure Parts**. The mechanical STEP models are now hidden from the display.



Selecting **View - STEP Models - Hide Assembly and Enclosure Parts** again will enable display of the hidden mechanical STEP models. Close the 3D Viewer **File>Exit.**

Individual components or groups of selected components may be viewed in PCB Editor, locate a symbol; place the cursor over the symbol and **RMB - 3D View**

The 3D Viewer opens and displays the STEP model for this package symbol. The STEP model and pad stack (if set to be visible) are displayed in the 3D Viewer.



Mapping Mechanical STEP Models

Viewing STEP models in the PCB Editor 3D Viewer provides a more accurate representation of on-board symbols. The user can view component placement and visually determine one component's proximity to another to decide if a violation has occurred. The ability to view other objects, such as shields and housings is possible if those objects are represented by STEP models. PCB Editor STEP model support provides the ability to map these other type of objects. Once mapped to the board design, the 3D viewer will display these models where the user can then visually check for any collisions or other component placement issues.

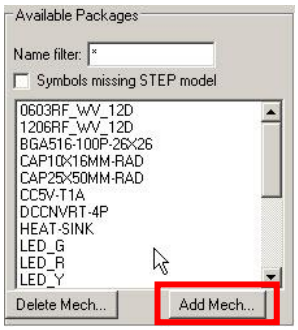
Mechanical STEP models must be placed within the path defined by the steppath (same location as your STEP Models). The STEP Package Mapping tool will list the mechanical STEP model as an entry in the Available STEP Models list. The mapping tool contains two buttons, Add Mech… and Delete Mech…

Add Mech: Creates a board or mechanical symbol that represents the mechanical model (enclosure) that the STEP model is mapped to. This board symbol used for mapping is placed on the board drawing origin. The offset values defined in the mapping tool position the enclosure STEP model onto the proper location and orientation in the board drawing.

Delete Mech: Deletes the selected mechanical model from the Available Packages list and removes the mapping.

Mapping a Mechanical STEP Model to a Board.

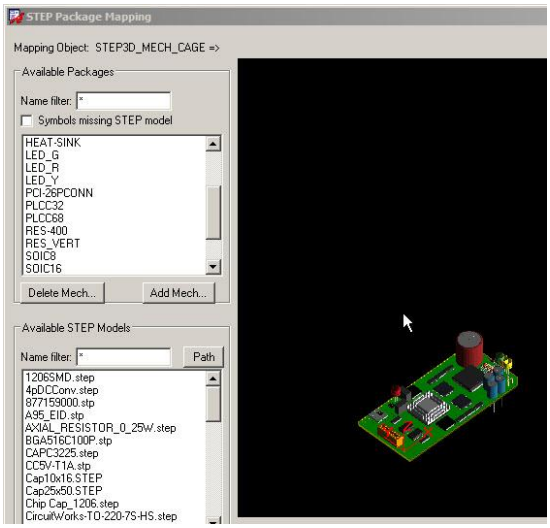
Open the board file that requires the mechanical STEP part. Start the STEP Package Mapping tool from the PCB Editor menu. **Setup - Step Package Mapping.** In the Available Packages pane, select the **Add Mech..**. button.



A prompt will display asking to enter a name for the mechanical part. The name of the model is prefixed with **STEP3D_MECH_** and cannot be modified. The value entered into the name field will be appended to the prefix.

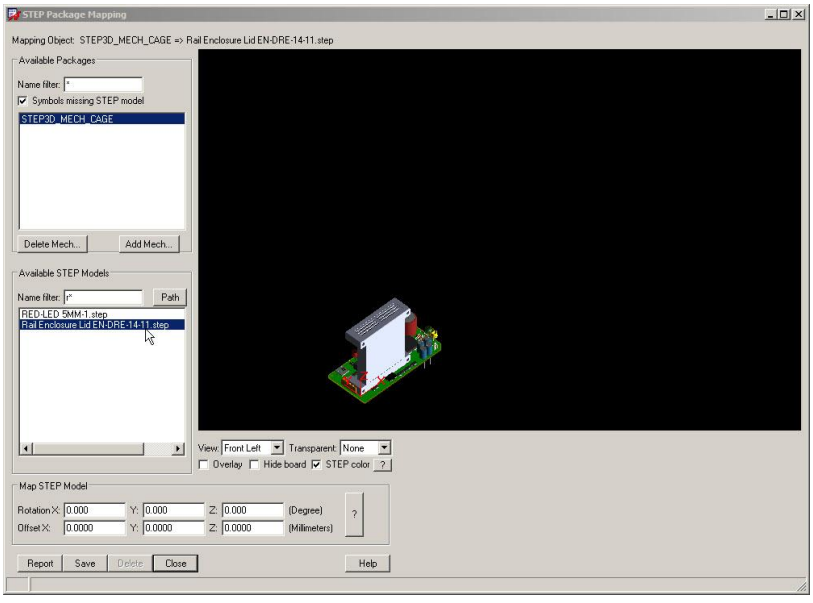
Append a suitable name, in this example cage has been added to the name field and then select OK.

The mechanical model name is now included in the Available Packages list. You can either browse the list for the newly created package or check the box for **Symbols Missing STEP Models**. To map a STEP part select the **STEP3D_MECH_CAGE** in the available packages list, the complete board drawing is now imported into the Package definition view window.

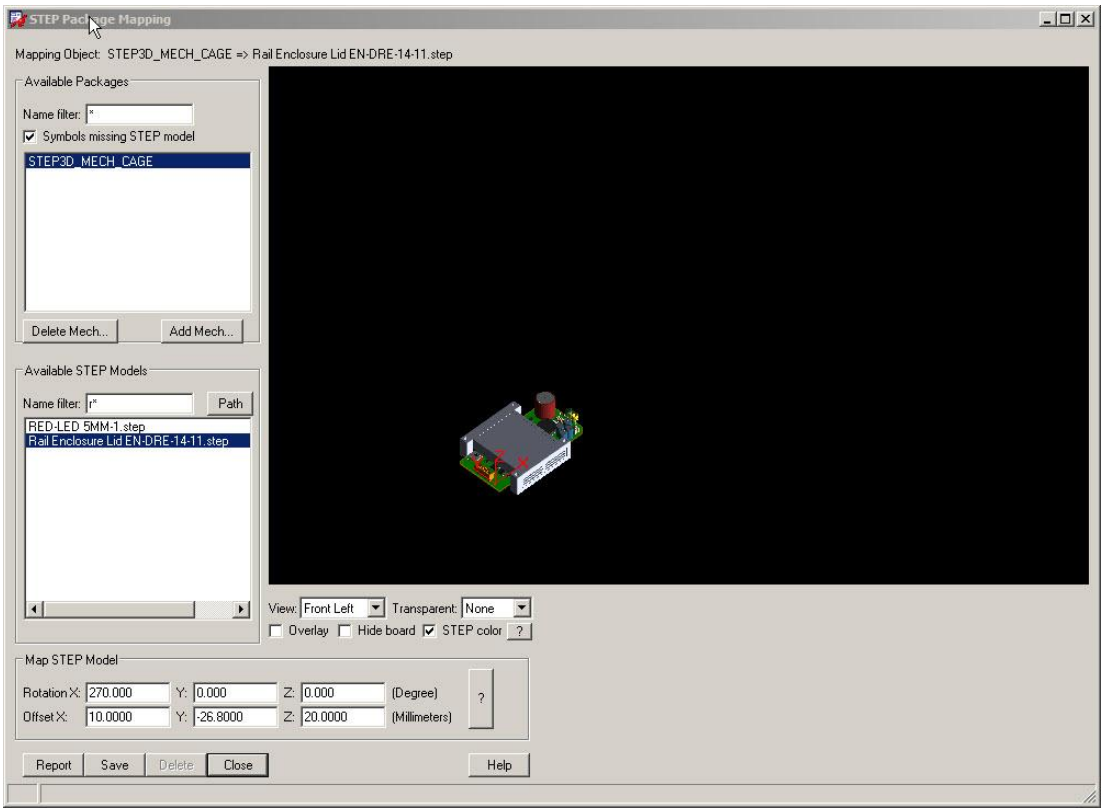


In the Available STEP Models pane locate the relevant Mechanical STEP Model. In this example we are looking for the Rail Enclosure Lid. The filters can be helpful when looking for specific parts, r* followed by a Tab key filters the list accordingly.

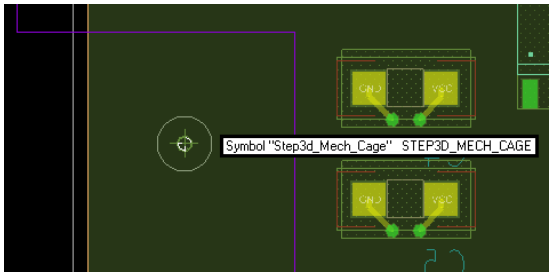
In the filtered list results, select the required STEP model. The mapping tool graphics will display with the selected STEP model place in the design at the board drawing XY Origin, TOP layer.



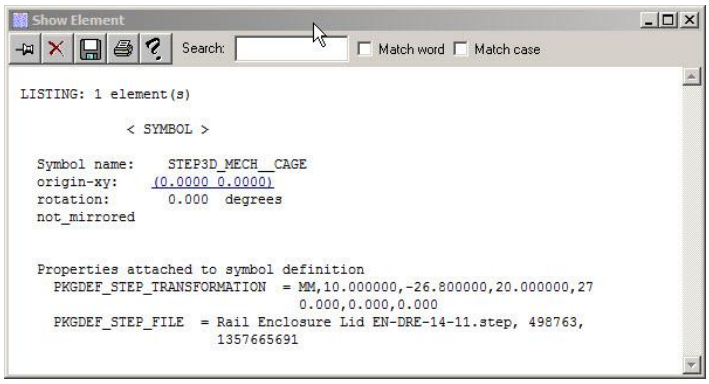
Using the Map STEP Model fields as mentioned on page 6, position the mechanical model on the PCB. In this case the required values are: Rotation X: 270.0, Offset X 10.00 Y: -26.8 Z: 20.00.



Once satisfied with the position of the mechanical model, select the Save button to preserve the offset. The mapping tool may now be closed. A board symbol with the name STEP3D_MECH_CAGE is placed on the drawing origin.



Using **RMB – Show Element** will display the symbol details and mapping properties.



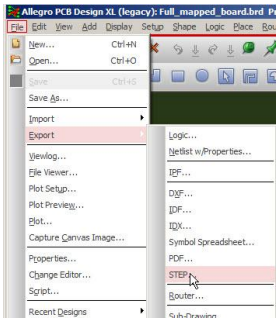
Launch the 3D Viewer, The mechanical model is now mapped into the 3D Viewer. Exit the 3D Viewer.

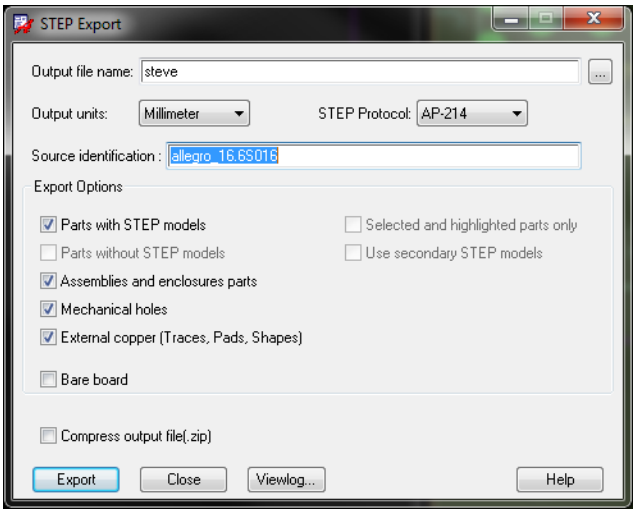
Exporting a Board Drawing to a STEP Model.

STEP models are used in various ways in the mechanical design environment such as checking for form and fit. PCB Editor STEP model support provides the ability to export a PCB Editor board drawing as a STEP model for use in a mechanical design environment.

STEP model export supports AP203, AP204 and AP242 protocols, standard units, and various output options to minimize or maximize STEP model data. **Potential for very large STEP model files exists when exporting STEP Model Parts and external copper data.**

Open the board file that you wish to create a STEP model from, then From the PCB Editor Menu, select **File - Export - Step**.





Output File Name: The name is defaulted to the current open drawing name. The user may specify the path and file name for the STEP file to be written.

Output Units: the user specifies the units to be used for the STEP model export. The three available values specified by the STEP model standards and Protocol are **Millimeter, Micron**, and **Inch**. The default value is based on the current drawing user units.

STEP Protocol: There are three possible output protocol formats available, **AP-203**, **AP-214**, **and AP-242**. AP-214 is the recommended default.

Source Identification: The source identification field is data stored within the STEP model to identify the tool of origin within the STEP model data. The current release of Allegro is the default value.

Export Options

Parts with STEP Models: Includes the STEP models mapped in the current drawing.

Selected and highlighted parts only: Exported STEP file will only include symbols that are selected and highlighted in the board file.

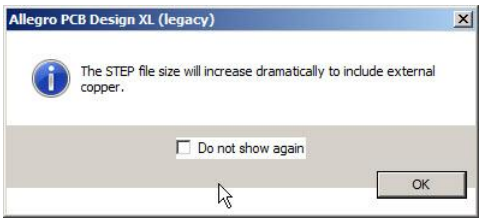
Parts without STEP models: If symbols without mapped STEP models exist in the drawing, the symbols are exported as defined by the PACKAGE GEOMETRY/PLACE_BOUND_TOP/BOTTOM.

Use secondary STEP models: If symbols have a secondary STEP model defined, this is STEP Model exported.

Assemblies and Enclosure Parts: Exports the STEP3D_MECH models created in the STEP Package Mapping tool.

Mechanical Holes: Includes export of mechanical hole defined in the current board drawing.

External Copper (Traces, Pads, Shapes): Export external traces, pads, and shapes on the ETCH/TOP and ETCH/BOTTOM layers. *When this option is selected, the user is warned that the STEP model to be export may become very large.*



Bare board: This option allows the export of the physical board, mechanical holes and external traces only. All other Export options are unselected.

Compress output file (.zip): Compressed the exported STEP file into a .zip file.

Export: Starts the export Process

Close: Closes the STEP Export tool

Viewlog: Views the current STEP Export log file.

Set the required options for the STEP file you wish to create and click on **Export.** A STEP file is saved to the current working directory. If a STEP model viewer is available, this file may be loaded into the viewer.