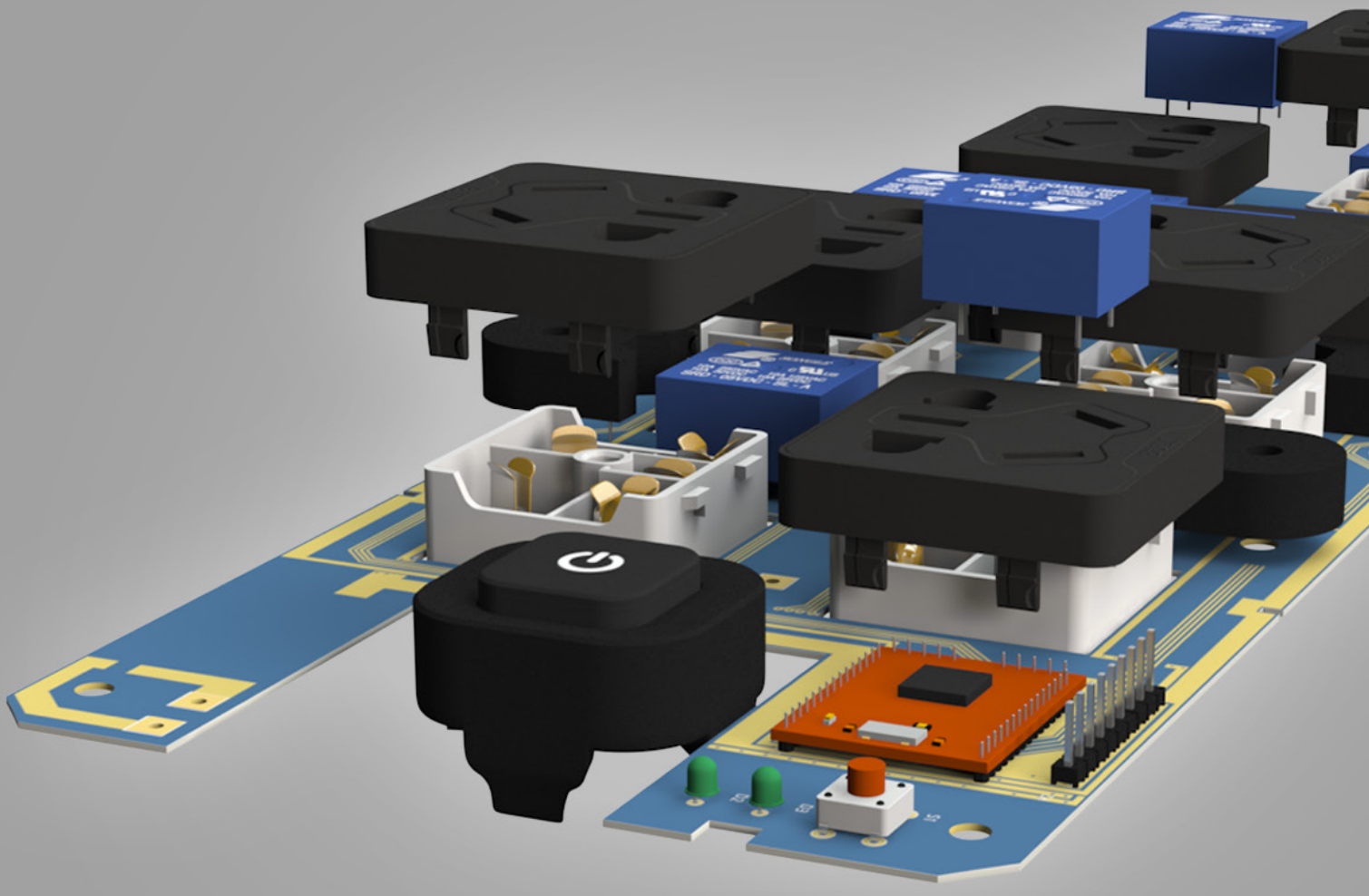
Altium

3D Modeling Has Changed Electronic Design Forever



Michael Doyon

Sr. Field Applications Engineer

3D MODELING HAS CHANGED, ELECTRONIC DESIGN FOREVER

THE WAY WE USED TO DO IT

Designing electronics in the late 1990s or early 2000s was a very different experience than it is today. Older designs often weren't limited regarding real estate. They also often didn't have as many mechanical constraints as modern designs do. While it's true that electronic components are much smaller today than they were 15 to 20 years ago, the mechanical envelopes that they must fit into have gotten smaller as well. Today, it's essential to investigate thoroughly both the mechanical aspects of a PCB and with the system that it is integrated. You can no longer do one without the other.

In the past, electrical and mechanical engineers often operated independently of one another, in their own silos. A mechanical engineer may have sent a paper drawing to the electrical engineers, outlining the basic board size and shape for each PCB within the product assembly. There may have existed a few email chains passing information back and forth in the form of MS Word® documents or MS Excel® spreadsheets. But often, those few notes back and forth were the full extent of the interaction between the electrical and mechanical teams. The mechanical engineers would continue modeling and designing the mechanical chassis, and the electrical engineers would go off and design the PCBs. Then, hopefully, when the first prototype was ready to be assembled, all of the PCBs would fit within the mechanical chassis without interfering with any mechanical components, or other electronic components on adjacent PCBs. If on the other hand, a problem was discovered at this point, it would often cause extensive schedule delays and significant cost overruns, as either the board, the mechanical components, or both, were sent back for redesign. And the cycle would begin again, with more quick exchanges of paper drawings and MS Excel® spreadsheets.

To be fair, mechanical and electrical engineers both did their best to design things correctly the first time. Unfortunately, technology was not yet on their side. For one thing, any mechanical CAD design had to be performed on very expensive workstations or UNIX-based CAD systems, which didn't even support interaction between electrical or mechanical files, much less electrical and mechanical CAD systems. So electrical engineers were left to come up with their own methods for avoiding board to board interference. 3D component to component design rule checks (DRC) in 3D were often accomplished using Visio Drawings of tallest component outlines, converted to Millars, which were then compared manually, to uncover potential issues. You also may have heard stories of the infamous paper models, from old timers who used them to ensure mechanical compliance. These solutions were very time-consuming, and were a poor substitute for what was needed: Interaction between electrical and mechanical design tools.

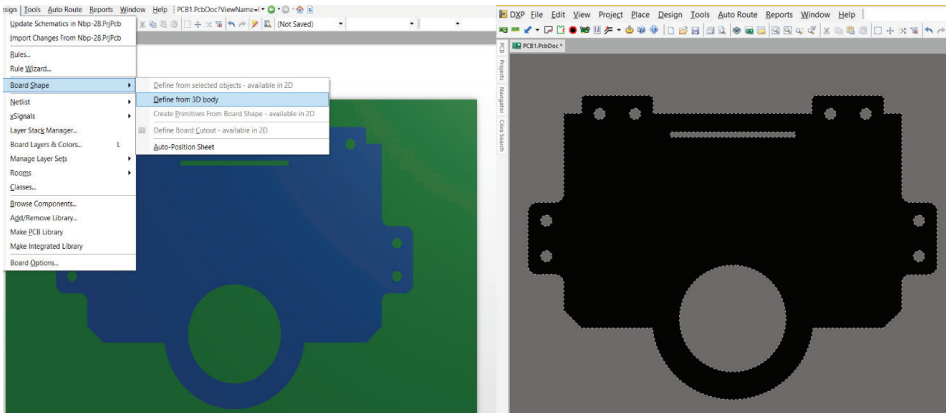
THE ALTIUM WAY - INTRODUCING ALTIUM DESIGNER 3D

Welcome to the modern world. About 10 years ago, Altium introduced 3D technology to the electronic workspace, by making 3D integration available within the Altium Designer Unified development platform. And the rest, as they say, is history. Altium has continued to enhance its 3D capabilities since, and our competitors continue to try and catch up. Altium Designer is now capable of importing and exporting mechanical CAD files such as STEP. We've also taken steps to create direct interaction between Altium Designer and SOLIDWORKS®, allowing for real Electrical and Mechanical interaction using either Parasolid models or SOLIDWORKS® part models.

Here are some of the typical usage models for our 3D technology:

- **Create PCB Board Shape from a 3D Model**

  An electrical engineer can now import a mechanical STEP model into an Altium Designer PCB. The model would detail the required PCB board shape and scale created by a mechanical engineer in a mechanical CAD package, including board cutouts, fillets, and mounting holes. Once the electrical engineer has this, they can create the PCB board shape directly from the 3D model, ensuring compliance with all mechanical requirements.



- **Model PCB Footprints in 3D**

  3D models can be attached directly to a PCB footprint and positioned as required on a footprint within a PCB library. This linking is probably the most important step in ensuring a clean working design. When the footprint is placed onto a PCB, it can be displayed in 3D and used for 3D DRC interference checking.

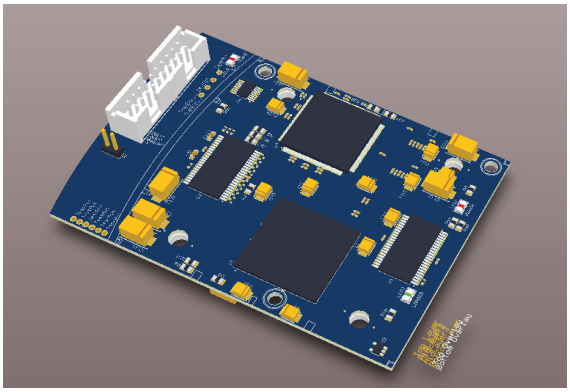
  Altium Designer can create a 3D step model of a PCB footprint on the fly as information is entered into the appropriate fields in our IPC-Compliant footprint wizard. The resulting footprint can then either be embedded into the PCB footprint, or saved to an external PCB library.

  Altium.com hosts a vast library of components in our cloud-based Altium Content Vault. There are currently over 350,000 components in the vault, and every one of them has an associated 3D model. Our customers can download both the components and the 3D models as needed.

- **Export to Mechanical**

  After completing the placement of a footprint on a PCB, the designer can then model the board in 3D within Altium Designer to ensure that it appears as expected and is ready to start routing signal traces. However, we feel there is another important step that should be added here, before routing the PCB. One of the most frustrating things for a PCB designer is to be in the middle of routing a PCB and then find out you need to move components around for mechanical reasons. Therefore, it would be in your best interest to use the Altium Designer export capabilities to export a 3D STEP model of your PCB and all its components in 3D and send it to your mechanical team. Your mechanical team can then do a 3D analysis to ensure that none of the components on your PCB, interfere with any mechanical components or interfere with any components of any adjacent PCBs. Once they've approved the placement, you can start routing the PCB. Remember, placement is the most important aspect of PCB layout. You only want to have to do it once.

  Some of the 3D analysis can be accomplished directly within Altium Designer, as described in the sections below.

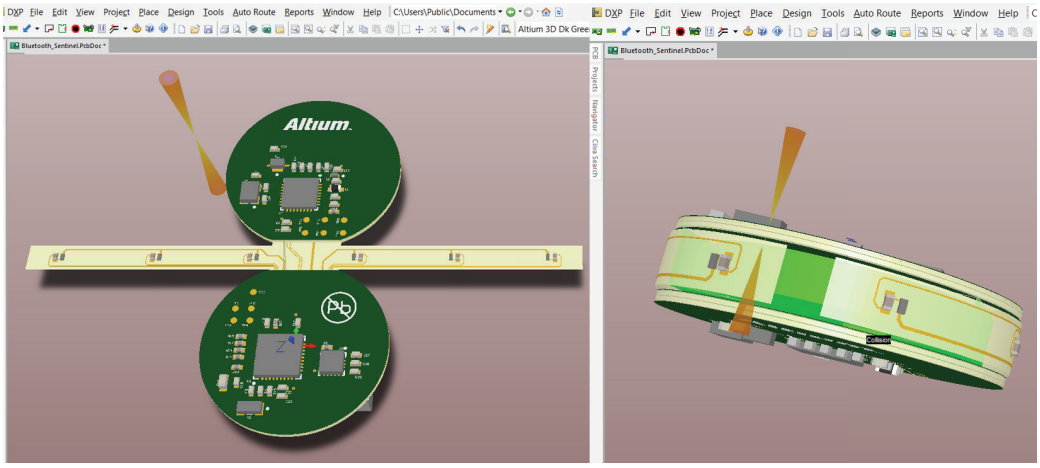


- **Board to Board DRC checking**

  Just as you can save a STEP model of your PCB and export it to mechanical CAD, you can also import one or more STEP models of your colleagues' PCBs and orient and align the boards in 3D as they will be in the final system configuration. Altium can then perform live 3D DRC checking between all of the different models and components for all of the different PCBs. You can then move components to resolve conflicts and get immediate visual feedback that the problem has been fixed. For the best results, this step should be accomplished before routing.

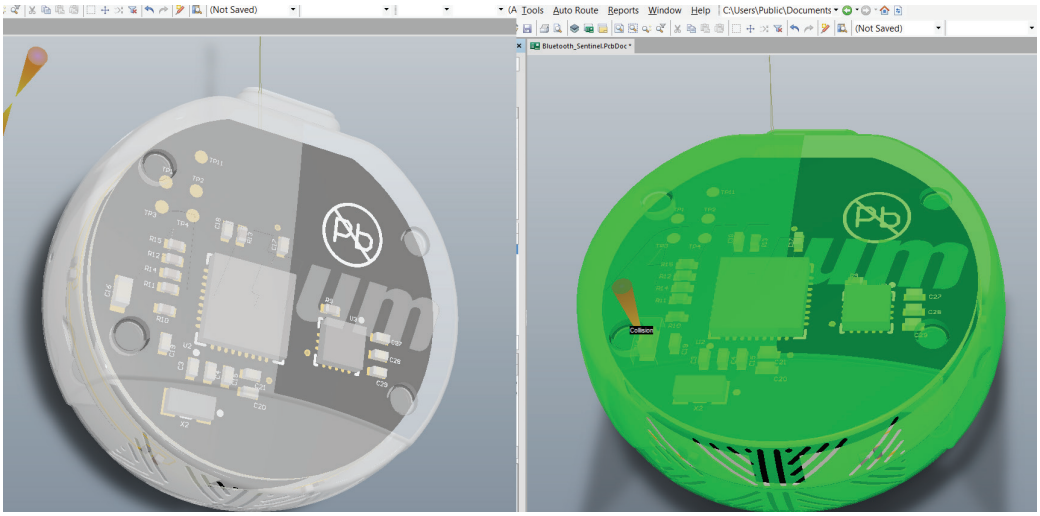
- **Rigid Flex**

  Altium Designer supports Rigid Flex design and allows you to model the complete Rigid Flex assembly in 3D, to ensure mechanical compliance. It is also possible to export a 3D model of your Rigid Flex in its final orientation.



- **Model the Entire System in 3D with DRC in 3 Dimensions**

  As mentioned earlier, it is possible to import multiple 3D models in Altium Designer and orient and position those models as they will be in the final assembly. We can take that a step further by importing a 3D model of the mechanical housing and placing one or more PCBs within the housing. We can then model the 3D integration, and run a 3D DRC check of our complete system, before committing to PCB routing, creating any prototype PCBs, or any mechanical plastic 3D models.



THE NEW PCB FLOW

As we've seen, there are some great 3D enhancements in Altium Designer that can help you create high-quality products faster and cheaper. Here is a typical design flow for a product designed within Altium Designer with multiple PCB's that all need to fit into a mechanically constrained chassis or housing.

1. Complete the schematic designs for each PCB. Ensure that the footprints for each of the components you are using have 3D models attached; especially any critical components such as connectors, sensors, or larger components.
2. Add a PCB to each project and create the board outline. This can be accomplished by importing the 3D STEP model that was created by your mechanical team and creating the PCB directly from that model.
3. Run ECO to update the PCB with footprints for all components in the project.
4. Complete board placement. Check your placement in 3D and export a 3D mechanical model of your PCB to your mechanical team for analysis.
5. You can also perform board to board analysis in Altium designer, either alternatively or in parallel to the above step. Or do a DRC check of your whole assembly in Altium Designer.
6. When you have determined that there are no mechanical interferences in your system, then and only then should you route the PCBs.

Following these steps will help you reduce board spins, create fewer prototypes, help you to complete your designs on schedule, and save your company time and money on every product that you design.