From manual to digital

Manuel Rei highlights the shortfalls in flexible printed circuit board design today and explains how manufacturers can revolutionise their approach

Over the last decade, electronic products have become increasingly complex and dense as they support more functions. Their physical forms have also reduced dramatically as a result of evolving technologies.

In line with this trend, the need for flexible circuit boards (PCBs) has increased exponentially. Compared to rigid planar boards, not only can they bend to fit in the most cramped environments, but they also weigh less and are easier to manufacture, reducing total assembly time while driving down cost and errors. Flexible PCBs also provide greater system reliability through their proven suitability for handling more than 25 point-to-point wires connections.

These reasons make flexible PCBs suitable for use in almost all electronic equipment, from consumer products such as digital cameras, computers and hard drives, to internal medical devices and military equipment. Thanks to flexible PCBs, we have seen generations of notebooks, tablet computers and a myriad of other devices reduce in weight and size, while their features and functions have increased dramatically. Whatever the industry or the type of electronic product, the chance of encountering flexible PCBs is very high.

Despite the advances in PCB development and design, there is still considerable room for improvement. When Dassault Systèmes started working with a leading Japanese worldwide consumer electronics company, we quickly realised that its design process was slow, extremely complex and time consuming.

At this company, the first steps of the development process were purely manual. Paper PCBs were made by hand, and position checking was carried out manually throughout the product's physical mock-up stages. Following this procedure, 2D drawings were generated and shared with the ECAD designer for component placement and routing. Within this outdated methodology, mechanical and electronic design processes were conducted separately and exchanging design data between MCAD and ECAD systems at critical stages only became possible late in the development cycle. Limitations in data exchange and lack of co-design functionality resulted in the need for additional design iterations, driving up development time and cost.

Designing a flexible PCB and making it fit into a complex mechanical housing is a significant challenge. It requires using a sophisticated application of mechanical and electronic CAD tools in order to address design challenges and remove data exchange limitations.

However, using Dassault Systèmes' CATIA 3D Flexible PCB Design, the end-to-end process is 100 per cent digital. There are no workflow breaks or manual operations. A typical use case scenario is:

1. Initially, the mechanical housing, including the shape of the flex board, is designed using CATIA. Hardware assemblies containing rigid and flexible boards, and mechanical components are developed. The flexible PCB board outline is created by mechanical designers using CATIA, which also acts as unified a repository for evolving designs. This means that PCB board designs created in CATIA remain as digital models throughout their development cycle

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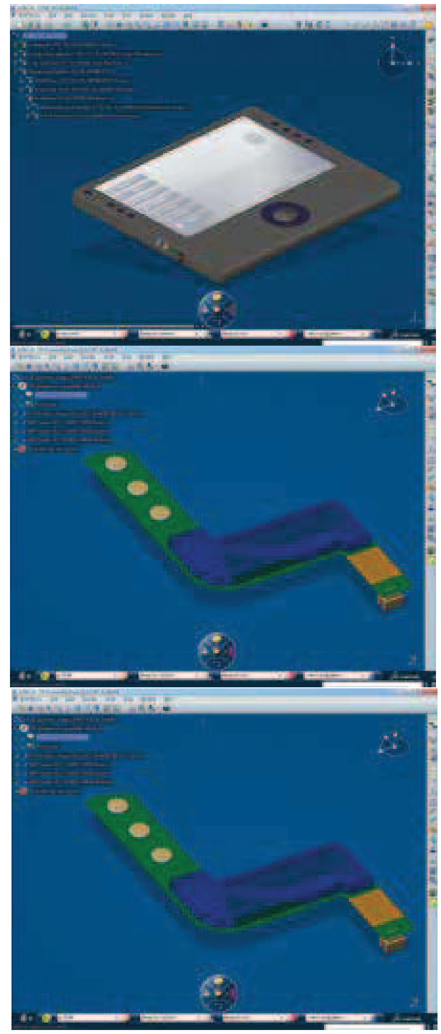

Dassault Systèmes customers have experienced numerous benefits with CATIA Flexible PCB Design

2. PCB board outlines can be flattened and folded back to their original 3D position
3. Critical components are placed in 3D and thereby benefit from a 3D virtual mock-up of the product. This allows them to be located on the board in the correct location, first time
4. In many cases, stiffeners will be added to the 3D virtual board model
5. Constraint areas are added in 3D
6. The flexible PCB board is flattened using CATIA. This flattened view contains all 3D design information, along with the components and constraint areas. Data is exchanged with the electronics designers
7. The flexible PCB model is translated to ECAD via an IDF file
8. All remaining electrical components are placed and coppers/wires are routed in ECAD. Electronic circuit design and electrical constraints are forward-annotated to the flex board shape and the board outline is created. Automatic placement of electronic components and routing is available
9. After completion of the board layout, design rule checking is applied, and the board layout is forwarded to the MCAD system. Comparing this new design to the previous one and updating the MCAD session is key to increasing user efficiency. Components and copper traces are imported and added to the design and then folded back to their 3D position. Finally, the flexible PCB can be validated against the full 3D virtual mock-up.

Dassault Systèmes customers that have implemented this design approach using CATIA Flexible PCB Design have experienced numerous benefits. Primarily, having a digital design process delivers drastic design time reductions. Customer testimonials claim time savings of up to 80 per cent. Concurrent mechanical and electronic design of flexible PCBs facilitates optimum floor planning and routing on flexible boards, potentially reducing their size. In addition, designing the flexible PCB in context with the 3D virtual product mock-up minimises design iterations between MCAD and ECAD. This makes right-first-time design possible and reduces the need for physical prototypes. The 3D and flattened views of the flexible PCB can also be used in downstream applications such as drafting and manufacturing. In case of design changes, modifications are propagated seamlessly, leading to significant development cost reduction.

Together, these benefits allow flexible PCB design users to achieve a quick return on investment and significantly reduce the design process. Using CATIA Flexible PCB Design, one of our customers, a global cell phone manufacturer has succeeded in reducing the time it takes to design a new flexible PCB from five days to less than one day.

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