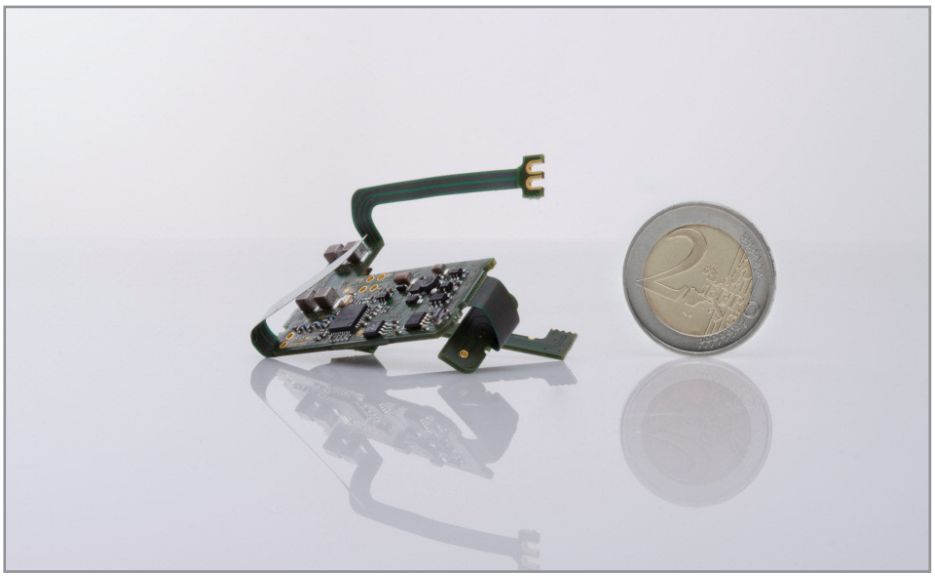
WITTENSTEIN | electronics

FlowCAD

Medical Implant



Size Comparison of a Medical Implant with rigid flex PCB and Embedded Components

Active Medical Implant

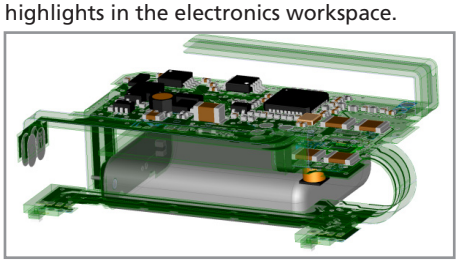
When you talk to patients in hospitals about medical implants, what matters most to them are basically two criteria; reliability and the size of the implant. With these two major design constraints WITTENSTEIN electronics was looking for new ways to improve their products. But with given functionality a certain amount of electrical components are required and the implants should get smaller.

This was the moment when two suppliers to WITTENSTEIN announced that they support a new technology: Embedded Components. One supplier was FlowCAD, where the support of Embedded Components was introduced in the current release of Allegro PCB Designer.
At the same time the PCB fabrication supplier Würth also introduced innovation in the area of Embedded Components.

WITTENSTEIN saw this technology as an opportunity to reduce the PCB size for its implants and started a discussion with both suppliers. After exploring what-if scenarios the technical possibilities were understood as well as their impact on pricing for the final assembled PCB.

A new research and development project was initiated for a new 3D-printed circuit board from WITTENSTEIN intens GmbH, another company of the group which specializes in miniaturized motion controls for usage inside a human body. After the global success of complete implanted length adjustable nails FITBONE® inside a bone to help unbalanced length growth deficit of bones, the company is now working on new active implants with wireless energy and data transfer.

To enable these innovative applications a lot of mechatronic functionality is enabled by a combination of electronics and mechanics and needs to be implemented in a limited 3D solution space. The challenge is for the designers to find trade-offs in the electrical and mechanical domains by concurrent engineering. Technologies like rigid-flex printed circuit boards, embedded components and printed RF antennas are the most obvious technical highlights in the electronics workspace.



Investment in the future: The WITTENSTEIN Innovation Factory at the company's headquarters in Igersheim

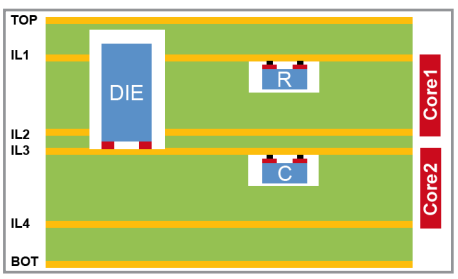
Michael Matthes, Senior PCB Designer

Design Challenges

"When stepping into new areas of technologies, it is crucial to have competent partners who support you on your way ", said Michael Matthes, Senior PCB Designer at WITTENSTEIN electronics GmbH. "Innovation is only possible when you can research outside of your comfort zone. With Embedded Components inside PCBs we expect to have an important size reduction at a reasonable cost increase."

Versatile challenges need to be overcome when using new technology. First you need to understand how the technical manufacturing process works and what are the design rules required. The next step is that you need to understand the new features in the Allegro PCB Editor to implement these rules. Important for Embedded Components is the definition of the Stack-Up which defines on which inner layer the components will be placed together with the component orientation (body up / body down) on a layer.

If embedded components are mounted with SMD technology onto an inner core, before the outer layers are laminated, solder masks for inner layers are straight forward. But when you embed a part inside the core, you need to use laser drilled single layer vias to metallize a pad to the layer. The component itself are also critical, since the possible part library is limited. Not all parts are suited to be used inside a PCB. So after verifying the availability of capacitors and resistors, the electric circuit was adapted in its parameters to match the selected set of approved components.



Stack up for Embedded Components

The main functionality of the circuit is in an ASIC, which was available as a bare die. But the height of that ASIC was still too high so the silicon was thinned before it could be used. For attaching it to the core golden STUD bumps were used in a flip chip technology.

Since the decoupling capacitors and resistors were placed inside the PCB the spacing was minimal and this helped to improve the electrical behavior and resistance against EMI.

Embedded Components require space inside a PCB and need to be specified in the design tool as cavities. The dimensions of cavities need to follow the design guidelines from the PCB manufacturer and need to be big enough to place the part and not too big so it can be filled with resin during the manufacturing process. Cavities are not only located in the FR4 between two inner layers, but for tall components the cavity needs to protrude through adjacent layers. Cavities come of course with a set of keep out rules for traces and vias.

The final prototype had proven the technical capabilities and reliability at total dimensions of 39 x 25 x 7 mm equivalent to the size of a little finger.

PCB Design Award 2012

The German association of electrical designers FED e.V. honored this innovative design with its PCB Design Award 2012 during its annual conference in Dresden in September 2012.

Tools used to design

WITTENSTEIN uses Allegro PCB Editor for High-Speed signals, differential pairs and PCB layout of Embedded Components. The Constraint Manager contains all design rules of the board. Nextra® was used to design the flexible parts of the PCB and made collision checks.

About WITTENSTEIN

WITTENSTEIN electronics GmbH develops, produces and markets electronic and software components for intelligent mechatronic and drive solutions. WITTENSTEIN´s Headquarters is located in Igersheim, Germany.
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