OrCAD

CADENCE PCB SOLUTIONS

OrCAD and PSpice Solutions Put Electric Bike Project on Road to Success

Electric Superbike Twente and OrCAD

About Electric Superbike Twente

In September 2017, 15 students from the University of Twente decided to take a year off from their studies and develop an electric superbike. The goal? Learn on the job, make an electric superbike as exciting as a petrol-fueled one, and win the European MotoE competition. With only nine months on the clock before the very first race, did they succeed?

Challenges

The students had a tight schedule to complete the electric superbike with big challenges in both mechanical and electrical engineering. They needed to develop a highly efficient 100kW motor unit with a custom automotive-compliant control unit. And most important, the bike had to be safe. They had to deal with high currents, high voltages, and high speed. The bike's power is delivered through several lithium-ion batteries that can become unstable if not treated well. To save time, a "first-time right" approach was required — endless creation of prototypes would kill the schedule.
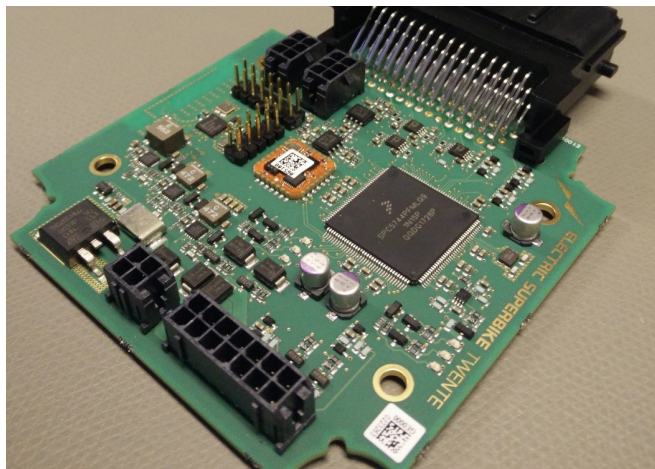

Figure 1. Control board

Key Challenges
- Only nine months to complete development
- Product needs to be automotive compliant and safe

Cadence Solutions
- OrCAD® Capture
- PSpice®

Result
- Achieved first-time right design accuracy to meet their aggressive delivery date

The 100kW motor driven by an 8kHz PWM drive produced a lot of electromagnetic interference (EMI). Due to this noise, sensor readings can be negatively impacted. They needed to carefully design the filters at each sensor input to cancel out the noise, ensuring the control unit makes the right decisions. The design also required a custom-made control unit incorporating only automotive-grade parts plus redundant software execution to make sure it didn't get fooled.

Solutions

That is when they turned to OrCAD products. OrCAD products offered an extensive model library, which is pre-configured during installation and extendable over the web. The well-known schematic entry tool, OrCAD Capture, made them productive quickly. The powerful PSpice simulation technology helped them analyze critical design pieces and solve potential problems. One of the designs that they created from scratch was the overvoltage protection unit, making sure the power cutoff is quick and safe when overvoltage occurs. This protection unit saved the other circuitry many times.

> " *Thanks to the OrCAD complete software package, it is possible to create schematics and PCBs on the go. This is essential for the development of prototypes and different iterations.* "
>
> *– Jeroen Goudswaard, Head of Powertrain & PR*

Overall the OrCAD Capture and PSpice flow enabled the team to do virtual prototyping. This saved them both time and cost without sacrificing quality. "The OrCAD tools helped us find problems early in the design phase, instead of the testing phase. They saved us a lot of debugging time and money in the end," said Remi Jonkman, electrical engineer.

The tightly integrated Cadence® tools allowed the team's designers to move quickly from the "design and analysis" phase to the implementation phase. All custom PCB designs were created with OrCAD PCB Editor to handle up to 250A at 592V. PCB Editor's powerful constraint manager ensured that, for example, creepage distance and all other clearances and trackwidths could be entered and checked. This allowed the complex boards to be created in an efficient way. Finally, 3D step models were used to verify if the footprints on the PCB were correct and the PCB and components fit their enclosure.
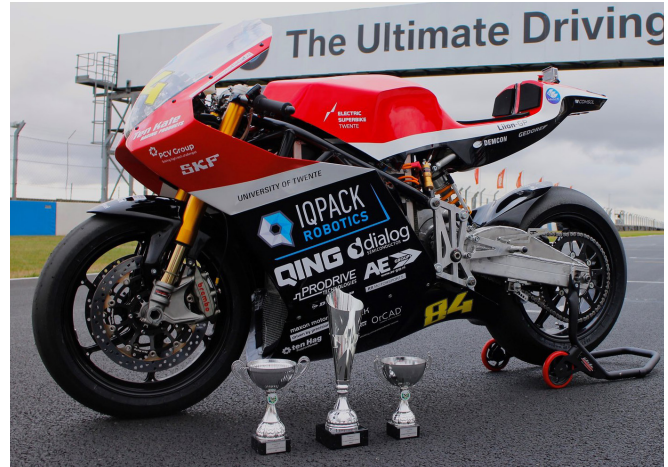
Results

The superbike turned out to be reliable and safe—but most important, it's fast. With tremendous torque of 1000Nm (737 ft-lbf) on the rear wheel, massive acceleration times were possible. Electric Superbike Twente became European champion of the MotoE competition in their first year they attended. Another example of OrCAD enabling winners.

Further development:

See the Electric Superbike Twente homepage:
https://electricsuperbiketwente.nl/

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