MINDA CREAT Uses Autodesk Solutions to Overcome Thermal Management Issues in Electric Vehicle On-board Charger

COMPANY
UNO MINDA LIMITED

LOCATION
Haryana, Delhi, India

SOFTWARE
Autodesk CFD Ultimate

Image courtesy of CREAT UNO MINDA

> "EV is a relatively new sector. The biggest challenge is the constantly changing guidelines and regulations. It is important to have enough R&D facility to keep up with the changing requirements from the Government and OEMs,"
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> **Shantaram Jadhav**
> Head CAE,
> CREAT UNO MINDA

UNO MINDA is a technology leader in Auto Components Industry and a leading Tier-1 supplier of proprietary automotive solutions to OEMs. The group has over 50 manufacturing plants globally. With the vision of self-reliance and technology leadership UNO MINDA has facilities for advance technologies called CREAT (Center for Research, Engineering and Advance Technologies). The Center works on embedded electronics products related to connected vehicles, telematics, ADAS, infotainment, EV technologies, controllers and sensors, advance lighting and technologies related to next generation automotive needs.

CREAT works in collaboration with other entities of the MINDA group as well as external technology providers. Specializing in software, hardware, mechanical and creative design, the team of engineers and designers at CREAT work on the various product spaces for global & domestic automotive market.

Challenges

EV is making a big impact in the way the world travels and will be the future of commuting. Industry is working on finding mobility solutions with lower environmental impact. The changes demanded by the transportation market necessitate radical innovations. OEMs are looking for long-term partnerships with suppliers, are ready to take responsibility to invest and work together and have quick response and turnaround times for the requested components. As Technologies, regulations, standards, and customer requirements are evolving quickly in the EV sector.

Recently a client approached CREAT

"Autodesk CFD Ultimate simplifies your workflow and reduces time-to-solution. At run time it automatically generates a mesh based on a few simple user defined parameters, effectively eliminating all user meshing time no matter how complex a geometry you are working on, and gives accurate results."

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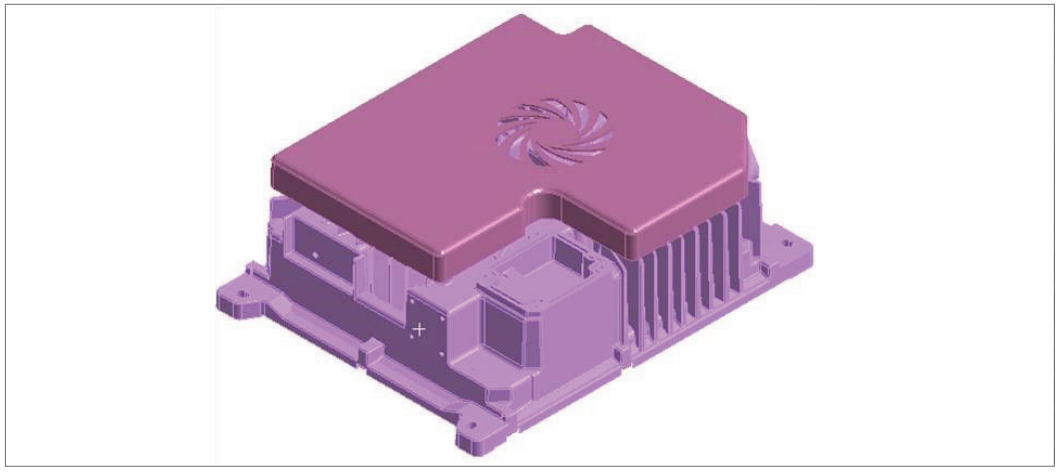

Image courtesy of CREAT UNO MINDA

for on-board charger (OBC) for their newly developed electric vehicle. The project was challenging as it includes mechanical, electrical, electronic and software components. These components are required to be placed and controlled in such a way that they achieve a charging capacity of certain KW while keeping the temperature of the charger assembly and magnetic components below 100˚C respectively. The EV has different types of heat loads than the IC engine vehicles, particularly in the batteries and on-board charger for power conversion and management. The OBC requires heat removal from tightly packed concentrated heat loads. Designing of critical components like thermal pads, conduction, convection, variable component modeling, PCB components and heat transfer path plays important role in thermal management of the on-board charger. The charger electronics here need to be packed inside an enclosure which has to be sealed to prevent environmental contamination. This requires the heat loads to be thermally connected to the enclosure wall to dissipate the heat. The enclosure has to be designed and simulated to function as a heat sink to dissipate the heat to outside air. Also, it is important to select a suitable thermal interface material which provides good thermal conduction, the required insulation, and is light in weight.

Solution

CREAT team with varying backgrounds in mechanical, electrical and electronics engineering with expertise in design and simulation worked together on this project. Batteries and OBC are susceptible to heat and require temperature control through better cooling. It is difficult to improve cooling performance using conventional engineering knowledge and testing is limited to the number

"Autodesk CFD Ultimate has enriched the scope of work and sparked a great deal of innovation at CREAT UNO MINDA. It helped us to better understand client's need and ensure that all thermal requirements for On-board Charger are met in line with IP65 regulatory standards and eliminated the need for costly and inefficient redesign cycles,"

Shantaram Jadhav
Head CAE,
CREAT UNO MINDA

of test vehicles. For these reasons, CREAT uses Autodesk CFD Ultimate as it delivers wide range of physics modeling options in a flexible and easy-to-use package.

The primary goal in this project was the thermal management of the OBC. As shown in Fig 1. in such projects CFD has become a routine part for CREAT Team. Using Autodesk CFD Ultimate the engineers were able to identify dominant parameters that impact the OBC system, select the best design and find optimal adjustment of various system parameters.

Autodesk CFD Ultimate was used to determine the temperature distribution of the design. The parameters that were affecting the temperature distribution in the system were identified and design changes were suggested. Heat load was removed by forced air convection from outer side of the wall by adding fan, fins and cooling pads as shown in the Fig.2. After 4-5 iterations engineers were able to find the optimal system parameters for the OBC.

Results

Maintaining OBC within a specific temperature range is essential in ensuring performance and safety. The changes in final design reflected in the simulation results. Design changes in the outer casing with fan, fins and pads facilitated heat transfer, proving to be effective. Simulation enabled engineers to visually evaluate the impact of the heat sink shape, observe the effect of heat dissipation, the difference in heat distribution and other temperature critical problems. This helped engineers to understand the thermal contributions from each component and identify the optimal design. The virtual results matched 90% when physical test was performed for the on-board charger.