

Tomorrow's engineers

As Formula Student competitors build cars to race other teams and gain experience they can rely on the support of a range of leading companies

▶▶ Lots of companies complain that recent graduates have little practical experience and first have to be familiarized with the practical aspects of their jobs. Addressing this issue is the core idea behind Formula Student. The competition involves designing and manufacturing a single-seater formula race car within a team to compete against other groups from all over the world.

There are two different classifications: Formula Student Combustion (FSC) for vehicles with combustion engines, and Formula Student Electric (FSE) for electric vehicles. Speed alone is not the decisive factor for winning – instead, the team whose concept can convince equally well on a theoretical level as well as in practical comparison with other vehicles in different driving disciplines, and also in economic terms, will be the winner.

One of the teams taking part in the championship is Global Formula Racing (GFR). This unique cooperation between students of Oregon State University in the USA and the Cooperative State University of Baden-Württemberg was brought into being in 2009 and has achieved remarkable successes. Every year, one vehicle with a combustion engine (FSC) and one electric vehicle (FSE) are collaboratively developed and built, despite a time difference of nine hours and a distance of 8,700km. To minimize costs and efforts, both



GFR electric vehicle 2015
Image: GFR

vehicles share central parts of the overall concept, for example the carbon-fiber body, wheel suspension and aero package.

This year, considerable changes were made to aerodynamics, body and chassis to fulfill the team philosophy of simplicity and robustness. The results show the changes as a whole have been successful – first places won last year at events in Michigan (USA), Hockenheim (Germany) and Spielberg (Austria) were defended successfully with the ICE, and the EV has also had a successful season with a fourth place in Germany and third place in Austria.

In the FSE, energy management in EVs is a core challenge, just as it is in normal road traffic. Due to the Formula Student vehicles' lightweight construction, the battery accounts for up to 30% of the total weight of approximately 200kg. In comparison, the battery pack of a Tesla Model S alone

weighs three times as much as the students' race car.

In order to dimension a vehicle for racing as optimally as possible, it is expedient to design a very lightweight battery – but this can only be effected by reducing its capacity. However, for the endurance race over 22km, which is a highlight of the dynamic disciplines in Formula Student, there has to be sufficient energy to utilize everything the vehicle has to offer. An additional challenge is generated by midsummer temperatures on the large asphalt surfaces at the venues, as for safety reasons the battery cells may not exceed 60°C.

A maximum power consumption of 80kW during the different dynamic disciplines represents another limitation for the electric vehicles in Formula Student. Breaching this rule will result in disqualification of the team in the respective discipline. As the vehicles are mostly capable of bringing

considerably more power on the road than the maximum allowed to be taken from the battery, a control system is required that prevents violations of the performance limit. In this context, you also need direct feedback to the control system, as you do with every other controller.

For this purpose, GFR has been able to count on the support of Sensor Technik Wiedemann (STW) for several years now. Due to its small dimensions, the power measurement board provided can be directly integrated into the battery housing, and convinces through its reliability. Power measurement with the STW module is a key aspect of energy management in electric racing vehicles; with a minor modification, it has also been integrated into the mandatory safety circuit for the high-voltage path.

This just one of many examples of the students' professionalism in cooperating with sponsors, and also of the need for industry support. Sponsors also benefit from the racing series: Formula Student represents an investment in the engineers of tomorrow. ☺



The entire 2015 Global Formula Racing Team – the project is a unique cooperation between students from universities in the USA and Germany
Image: GFR

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