



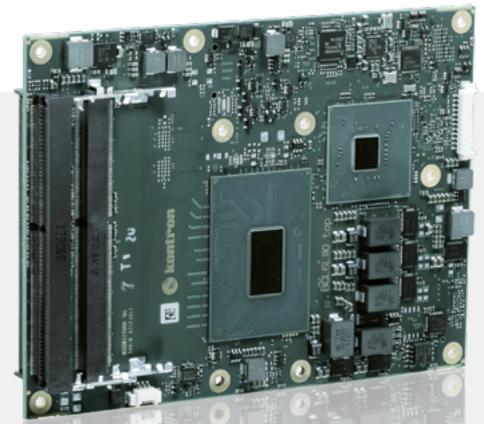
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# AUTONOMOUS DRIVING WITH RACING FEELING

Mastering the challenge with Kontron

Electric and Autonomous Driving are THE essential buzzwords for innovation in the automotive world. In Formula Student, they come to life by students supported by Kontron.

Build a real racing car yourself: This dream comes true for students who take part in the international design competition "Formula Student". With 40,000 participants from around 500 teams, Formula Student is the largest engineering competition in the world. The goal is to design, build and test a racing car within one year.



POSSIBILITIES START HERE



**kontron**  
S&T Group

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**e-gnition Hamburg e.V.**  
Technische Universität Hamburg

**Project:**  
Formula Student Team

**Kontron Platform:**  
COMe-bCL6



e-gnition Hamburg is the TUHHS's Formula Student team. Within a year, an electrically autonomous racing car will be manufactured in order to take part in the largest international engineering competition in the world and to compete with other teams.

[www.egniton.hamburg](http://www.egniton.hamburg)



#### **FORMULA STUDENT: RACING FEELING AT UNIVERSITY**

About 60 students of the TU Hamburg have been building a new electric racing car every year since 2011 under the name "e-gnition Hamburg". The students compete in two classes: the Electric and the Driverless class.

Together they create the concepts that ultimately make the vehicle light, fast and agile - and that make it driveable in the first place. The latest car uses 36 different microcontroller boards, developed entirely in-house, working in conjunction to make it run. All the necessary functions have to integrate perfectly into the overall system to create a reliable vehicle. The task of ensuring lightweight construction and the best driving performance is a challenge for the specialists for chassis, aerodynamics and suspension in the team. The cars compete against international rivals on renowned race tracks such as the Hockenheimring. In addition, the teams compete in so-called "static disciplines" and have to defend their design decisions in front of a jury of experienced engineers in the "Engineering Design Event", for example.

### AUTONOMOUS RACING: COMPUTER BEHIND THE WHEEL

Since the 2016/2017 season, humans are no longer the only ones behind the wheel. In the Driverless class, the racing cars have to find their way around the track completely autonomously. Additional sensors such as Lidars and cameras are needed for perceiving their surroundings. A built-in computer then creates a map of these surroundings from the obtained data, recognises the route marked with road cones and plans the best trajectory. Controllers ensure that the vehicle maintains the speed and direction as planned.

In this way, the computer takes over the tasks of the human driver. And like the human driver, the computer must be made fit to achieve good driving performance. Part of the task lies with the students, who work intensively on the algorithms and implementations, the other part with the hardware. It must have enough power.

### EVOLUTION AND INTEGRATION: TOWARDS VEHICLES WITH AND WITHOUT DRIVERS

e-ognition was part of the newly founded "driverless" class of autonomously driving racing cars from the very beginning, starting with the first model, the "egn17-dv". To do so, a previous year's vehicle (of the driver class) was first converted and equipped with sensors, actuators and the necessary computing power. The central computing unit, a commercially available PC mainboard, was attached to the rear like a jetpack. In the following years the PC was then transferred to a drawer in the stern. This proved successful in the competitions: right from the start, the Hamburg team won in several categories.

However, the new functionalities meant a higher weight and affected the aerodynamics, so that the team entered the competitions with and without drivers with two different cars. The "egn20" for the summer of 2021 is now the first combined EV/DV model: for the first time, no dedicated vehicle is used without a driver, but the car is competitive with and without a driver thanks to a modular design. After a few adjustments, the car is able to drive on autonomously. The overall goal is complete integration so that man and machine can hand over control seamlessly.

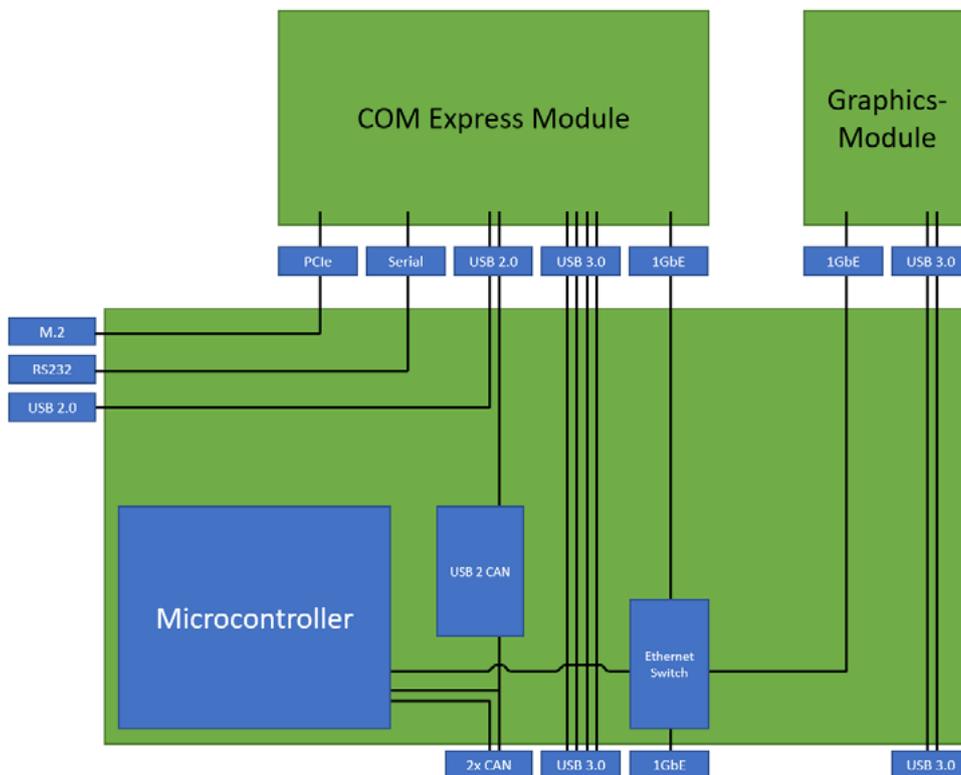


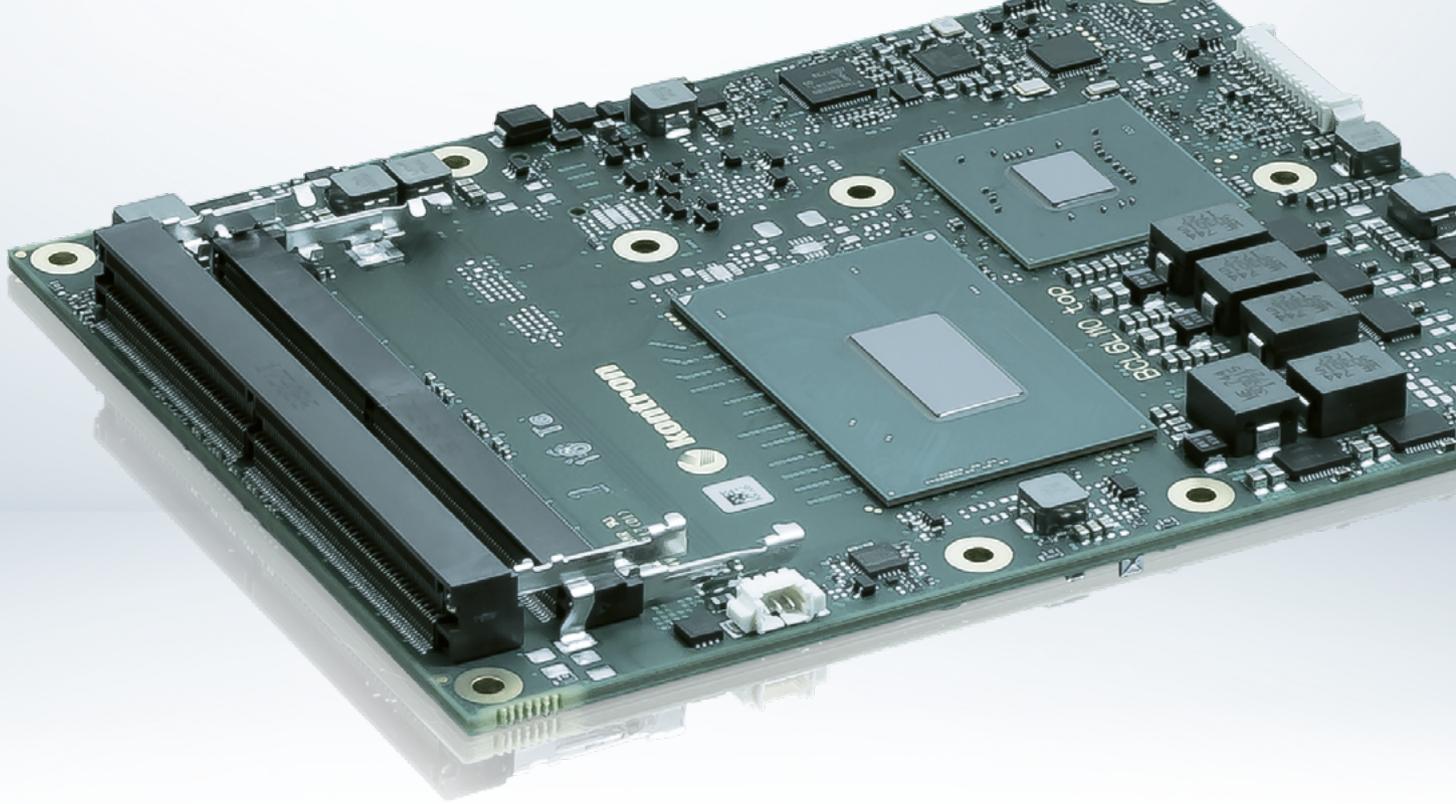


### EGN22: INTEGRATION AT THE NEXT LEVEL

While planning the next model, it was therefore decided to fully integrate the PC into the vehicle. Until now, the hardware-related real-time functionalities were located on the board computer on a microcontroller and the more sophisticated calculations for the autonomous mode on the PC. In the next development step, both units will merge into one physical unit.

Even for an experienced team in Formula Student it is unrealistic to develop a PC completely by oneself. The solution to this problem: COM Express® modules from Kontron. The carrier board developed in-house is meant to provide all the connections and the real-time functionalities, while the attached COM Express® Basic module, together with a small graphics unit, provides the computing power for autonomous driving. The module concept makes it possible to use exactly the required connections for the peripherals in the vehicle. In this way, the vehicles brain can be integrated in a compact and powerful manner. Kontron as a pioneer of COM Express® modules is therefore the perfect partner for e-ognition Hamburg. The COMe-bCL6 module with a Core i7-9850HE from Intel® offers the needed computing power and reduces the external effort with the soldered-on flash memory. External sensor technology is connected via USB and Ethernet. A direct Ethernet connection between the COMe module and the microcontroller allows fast and flexible data exchange between the two units, while the COMe module's connection to the CAN bus in the vehicle enables easy communication with all other boards.





## PRODUCT DEVELOPMENT

At the outset there was the idea for a fully integrated vehicle. With a lot of research and many discussions, this idea had to be transformed into an initial concept, which was then reviewed by former team members. We then approached Kontron and were delighted with the quick offer to support us. In several discussions we finalised the selection of the appropriate board and had the chance of having our circuit diagrams checked professionally. In the next few months, our board will be fully developed and produced. We can hardly wait to bring both parts of the new unit together afterwards, installing them in the latest generation of Hamburg's electric racing car!

Without Kontron's generous support with the board and their competent advice, this challenging project would hardly have been possible. We are grateful to have such a great partner at our side. Moreover, it is an honour for us that the integration of COM Express® modules into an autonomously driving racing car is also an exciting and outstanding project for Kontron itself: "It is always amazing to see the diverse applications in which our products are used. It was fun to support the students in this complex task and I look forward to seeing the race car live one day," says Philipp Bader, Junior Product Manager at Kontron.



The COMe module enables us to develop an extremely powerful individual computing solution. Due to the excellent hardware and the extensive expertise, Kontron is exactly the right partner for us.

Felix Scheikowski, on-board & DP computer, e-gnition Hamburg e.V.



## About Kontron – Member of the S&T Group

Kontron is a global leader in IoT/Embedded Computing Technology (ECT). As part of the S&T technology group, Kontron offers individual solutions in the areas of Internet of Things (IoT) and Industry 4.0 through a combined portfolio of hardware, software and services. With its standard and customized products based on highly reliable state-of-the-art technologies, Kontron provides secure and innovative applications for a wide variety of industries. As a result, customers benefit from accelerated time-to-market, lower total cost of ownership, extended product lifecycles and the best fully integrated applications.

For more information, please visit: [www.kontron.com](http://www.kontron.com)



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