



# FlexRay Expansion Board for Universal Prototype ECU Platform

Electronic systems in future vehicles set completely new challenges for the development of Electronic Control Units. The intensive degree of networking makes it necessary to use new bus systems for the communication between the components. Higher data rates are required, availability and redundancy also. FlexRay is such a time-controlled bus system that provides a scalable system error tolerance, a flexible use of the bandwidth, various network topologies and a deterministic communication with a high rate of real-time data transfer.

In spite of the increasing complexity of vehicle electronics the development of network ECUs and their relevant functions, the different development steps

and the production time must be cost efficient. The different stages of development must also be easily reproduced. GIGATRONIK GmbH has developed the uniECU

to be a part of a modern ECU development process which meets the mentioned requirements. This article introduces the uniECU which is a universal microcontroller based prototype ECU platform with its optional FlexRay expansion board and shows the use of modular hardware in a modern development process for automobile ECUs.

Based on the Motorola communication controller MFR4200, the FlexRay expansion board is designed as a two channel communication module. With its node configuration it provides all the advantages of the FlexRay bus system. Philips TJA 1080 bus drivers are used

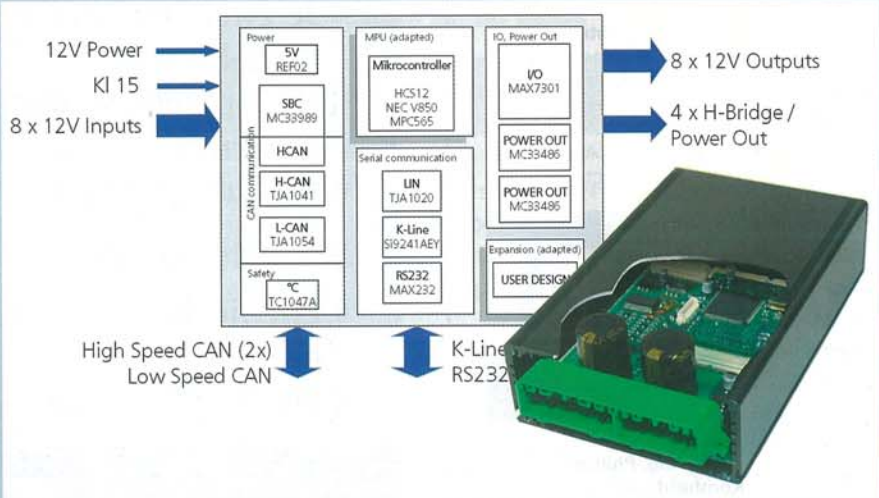


Figure 1. uniECU hardware

for the physical layer and make 10 Mbit/s transfer rate available for each channel. The user is free to use the two channels to create a redundant transmission channel or to increase the transfer rate up to 20 Mbit/s. The connection to the vehicle wiring system or to the different analyzing and measuring tools is done with SUB-D (9 pin) connectors. The power modes and the bus activity are indicated with status LEDs. The FlexRay module can be attached to the uniECU expansion port and is connected asynchronously with the data and address bus to the used microcontroller. The uniECU is a universal vehicle ECU which allows through the use of different microcontroller boards a scalable processor and/or arithmetic performance. At the moment several 16 to 32 bit processors with or without floating point unit are available. The range of processors is expanding permanently. The power supply is developed for use directly on the vehicle battery and reads the ignition signal back, so it provides all known ECU supply configurations (ignition ECU, ECU operation after ignition power down, delayed power down...) with wake up possibilities over CAN and LIN. Different bus systems are available for inter ECU communication (2 x CAN HS, CAN LS, LIN, K-line, 2 x RS 232). An ECU-typical signal conditioning is implemented for the connection to external sensors on the 12 V input lines. Realization of input capture on the input signals is possible. In addition 12 V outputs are integrated for the connection to external actuators. Some of them have integrated power drivers and can also be used as H Bridge. The uniECU is provided with a processor external watchdog.

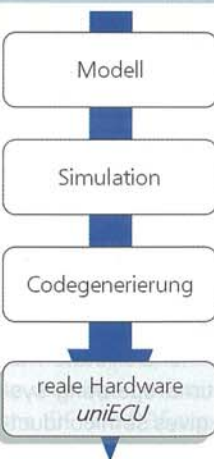


Figure 3. Development process

© automotive

For diagnostic reasons the supply voltage, the operating temperature and the power driver's output current can be monitored. The signals from the processors can be implemented for project specific applications through a connector bay with pluggable expansion boards. The electronic is mounted in a solid housing suitable for vehicles.

The respective ECU software guarantees complete hardware independence by the decoupling of application and driver level using a hardware abstraction layer. The software framework provides the hardware specific BIOS functions and supplies the application with the different in-

put signals and controls all hardware outputs. In addition it takes over the whole communication on the different bus systems. Within the hardware abstraction layer a signal conditioning can take place to make all necessary signals available for the application or to process their output signals. Several diagnostic protocols like CCP or KWP are available and software updates can be done by an internal bootloader via CAN or K-Line.

This flexible approach is based on standard software modules like communication drivers or operating systems e.g. OSEK and ensures the complete reuse of the functional software up to the serial ECU.

Gigatronik GmbH established a development process according to the common V model in which the uniECU is used as a universal prototype which can be fitted with the desired microcontroller. With the help of custom tailored and standardized

software tools an integrated tool chain was developed, almost making a complete automated process possible for the development of ECU functions.

With that the reproducibility of all design stages is ensured from the model based algorithm development along with the automatic production code generation up to the implementation on the uniECU. This method considerably increases the products degree of quality and also minimises the development time and costs.

The user is able to implement the ECU software at an early stage of the development on a close to production prototype ECU which is vehicle suitable. This is especially beneficial when at that stage of development the series ECU hardware is not completed yet. Quantization effects, code execution time and storage requirements can be analyzed on the uniECU. With this information a specification of the final microcontroller could be done. Furthermore the uniECU prototype serves as an executable specification for the development of the series ECU.

The uniECU closes the gap in the tool chain from the model based developed functional software to the setting into operation near to production in a vehicle. With plug-on expansion boards like the FlexRay module introduced above it offers a universal solution that does not require a lot of space and is therefore suitable for use on a larger number of vehicles. Thereby the uniECU is a reasonably priced solution and closer to series than known rapid prototyping solutions.

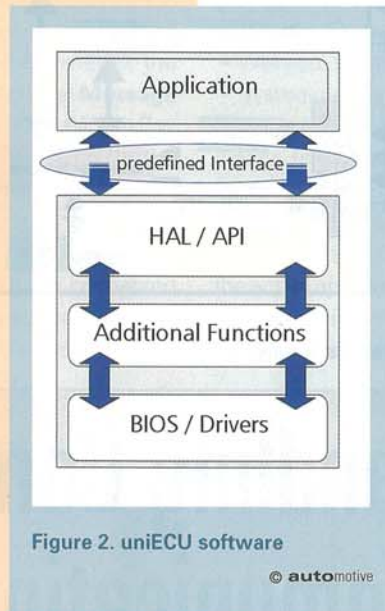


Figure 2. uniECU software

© automotive



**Armin Farrenkopf** leads the Development group for Algorithm, HiL-Simulation and Rapid Control Prototyping (FS/AH) at GIGATRONIK, Gaimersheim.



**Roman Starbek** leads the Development group for Algorithm and Rapid Control Prototyping (FS/AP) at GIGATRONIK in Stuttgart.