Electronics & Electrification

APPLICATIONS FOR
INTELLIGENT SYSTEMS
YOUR ENGINEERING DEVELOPMENT PARTNER

Engineering and software development by FEV
FEV is an internationally recognized leader in design and development of powertrain and vehicle systems. Professor Stefan Pischinger, President and CEO of the FEV Group, maintains the company’s focus towards sustainable and significant contributions to the design and development of advanced gasoline, diesel and hybrid powertrains as well as alternative propulsion systems. FEV has decades of experience in calibration and, in particular, in the application of model-based methodologies. The corresponding tool-set has been incorporated into the TOPEXPERT Suite, FEV’s central platform for calibration tools.

Partner for professionalism
FEV is committed to keeping its position as a technology leader, and to maintaining that leadership. The company continually reinvests in internal R&D programs, developing value-oriented solutions to meet tomorrow’s mobility and transportation demands. These activities are strictly aligned to customer demands through focus on the individual definition and adaptation of development and business processes, while observing the highest standards of confidentiality.

Think global, act local
Our global customer support is essential to the mutual success of both FEV and its customers. With its World Headquarters and European Technical Center in Aachen, Germany, the FEV Group operates globally with its local Technical Centers in suburban Detroit in the USA, and our Asian facilities in Dalian, China and Pune, India.

FEV AT A GLANCE
>> Worldwide at your side to meet the future challenges <<

> Leader in design and development of powertrain and vehicle systems
> Founded in 1978
> Privately-owned global enterprise
> More than 35 subsidiaries on four continents
SOFTWARE DEVELOPMENT

>> Advanced Software development based on engineering expertise <<

In-depth physical, chemical and thermodynamic expertise meets excellence in software development to deliver software for embedded systems.

Our system know-how covers combustion engines, hybrid-electric powertrains, battery packs, transmissions, gearsets as well as control software applications for rail, marine and wind energy from their initial concept and rapid prototyping to production code.

Decades of control development experiences converge to software meeting your needs in series production as well as bringing to life thrilling new functionalities on demonstrator level. FEV’s PERSIST software development framework provides a standard approach to establish a stable and yet flexible software architecture to maximize maintainability and reuse. All activities are continuously and automatically monitored by a Continuous Integration approach which enables FEV to realize agile development for model-based control software in combination with flexible development and quality gates at the same time. Mature and customer proven processes improved by agile concepts are accompanied by systematic verification and validation in our FEST (FEV Embedded Systems Test Center) right from the start.

Leading edge technologies in powertrain and software development underline our capabilities to provide software solutions to meet your needs in the most efficient and reliable manner.

FEV EMBEDDED SYSTEM TEST CENTER (FEST)

>> Your turn-key partner for software solutions from concept to series production <<

YOUR BENEFITS - OUR CAPABILITIES

> Know-how covering combustion engines, hybrid-electric powertrains, battery packs, transmissions, Vehicle functions as well as control software applications
> Initial concept and rapid prototyping to production code
> PERSIST toolchain for reuse of software architecture
> FEV Embedded System Test Center – toolchain for systematic verification and validation
HARDWARE DEVELOPMENT

>> More than 25 years of experience  
in customized hardware solutions <<

With competences in engineering support of series production projects, FEV develops hardware components ranging from sensors, actuators and controllers to complete hybrid drivetrains. Our design teams are familiar with all common CAD / CAE tools to design electric and electronic hardware for demonstrator purpose as well as for production.

An example for control unit development is FEV’s Battery Management System, which was designed to meet automotive requirements right from the start. In several hybrid and electric vehicle projects FEV has engineered an complete high voltage Lithium Ion battery systems, equipped with FEV Battery Management System and assembled in our workshop.

Our experts are involved in many series production projects as technical contacts for component suppliers to specify the requirements and validate the delivered hardware at system level. For component validation FEV has state-of-the-art test benches for development, calibration and durability tests of printed circuit boards (PCB), motor/generators, batteries and complete drivetrains.

FEV’S SCOPE OF SERVICES

> Hardware components from sensors to complete hybrid drives  
> Hardware for demonstrator and production purposes  
> Multi-disciplinary teams for Lithium ion battery development
POWERTRAIN AND VEHICLE E/E-INTEGRATION

>> The whole is greater than the sum of all parts – E/E system development and vehicle integration <<

E/E Integration is all about bringing the system components together and make them work as a whole. FEV has the overall knowledge to do this, from conventional and hybrid powertrain and transmission control units to body, chassis, vehicle and driver assistance systems including its actuators and sensors. To integrate them in the growing complexity of the individualized vehicle architectures and data streams is today’s challenge.

E/E-Integration projects not only become successful by interconnecting control units but also by establishing the optimal communication between the project partners. For this, FEV is not only experienced in all existing protocols (LIN, CAN, MOST, FlexRay, Ethernet), but also masters many languages due to its worldwide presence. As a full service provider in both supplier management and project management, FEV offers complete communication network and wiring harness development from rapid control prototyping to series production development.

Diagnostics by embedded software and by off-board testers is completed by drive-by-wire development and calibration to support the latest OBD and safety standards, like 3-level EGAS safety according to FMVSS124. Extensive climate controlled test facilities, E/E laboratories and the direct proximity to a test track complete the service portfolio of FEV’s E/E-competence.

SERVICE PORTFOLIO

> Full service provider in supplier and project management
> Rapid control prototyping to series product development
> Drive-by-wire development
> Climate controlled testing facilities
> Direct proximity to a test track
POWERTRAIN CALIBRATION

>> Calibration efficiency increase
of up 80% by utilizing
FEV’s TOPEXPERT Suite <<

The complexity of modern control units, the increasing diversity of powertrain applications and the need for shortened development cycles requires novel approaches towards calibration. A model-based calibration process aiming at transferring major parts of the calibration work from the vehicle to the calibrator’s desktop is an answer to these contemporary challenges. FEV’s decades of experience in calibration and especially in the application of a model-based methodology have been incorporated into the TOPEXPERT Suite, FEV’s central platform for calibration tools. The usage of TOPEXPERT facilitates the optimal planning of measurement campaigns, enables the automatic execution of test maneuvers in the vehicle or at the test bed, provides numerous routines for an efficient data analysis and offers the possibility of an automated data set optimization. With these tools costly engine and vehicle tests can be minimized and several manual iteration loops can be avoided. Tasks that needed several days of testing, data evaluation and verification in the past can now be accomplished within a few hours. The TOPEXPERT Suite is commercially available and is delivered with calibration guidelines, individual training courses, service and maintenance and can be customized to accommodate customer requirements. Utilizing TOPEXPERT allows our customers to benefit from the cutting-edge methodology in order to reduce development time and increase calibration quality.

BENEFITS OF TOPEXPERT SUITE

> Apply advanced model-based calibration approaches
> Minimize costly engine and vehicle tests
> Shorten development time
> Increase calibration quality
> Standardize calibration procedures
> Unique workflow-based user guidance
FUNCTIONAL SAFETY

>> Solutions for functional safety based on outstanding automotive engineering expertise <<

Our competence center for functional safety consists of technical experts with long-term experience in the development of electronic hardware and software, who:

> Provide training and consultancy related to functional safety and ISO 26262
> Act as an independent third party for audits and reviews
> Develop customized solutions for all kinds of tools and templates related to functional safety
> Support development projects with safety managers to assure conformity to the relevant standards

State-of-the-art vehicles are controlled by electronic components and software. From active safety systems like ABS/ESP, driver assistance like adaptive cruise control or park pilot up to torque monitoring of conventional and hybrid drivetrains, reliability and accuracy of hardware and software is essential for product maturity.

The introduction of ISO 26262 standardizes on one hand the requirements and the understanding of how to achieve a safe system. On the other hand OEMs, system and component suppliers are forced to adapt their quality processes to comply with the standard. FEV has a long experience in the development of components and systems following standards related to functional safety.
Electrified powertrains have resulted in lower emissions and reduced carbon footprints for passenger cars and light-duty vehicles. FEV has been responsible for a large number of development programs for hybrid and all-electric powertrains as a turn-key development partner for international customers. Starting with start/stop systems, our experience comprises micro, mild, full and plug-in hybrids as well as battery electric vehicles (with and without range extender modules). FEV also engages in internal R&D projects to evaluate fuel cell technology for our clients. In combination with our transmission system experts, FEV has contributed to a considerable number of advantageous hybridized transmission solutions. In all of our global development centers, we have employed rapidly growing teams and continuously extended our test facilities to meet these needs.

**BENEFITS**

- Long lasting track record in development of hybrid and hybrid-electric technologies
- Efficient development of Range Extender and fuel cell solutions
- Development of package optimized transmissions as well as powerful yet small sized e-motors
FEV offers the development of entire battery systems, including the Battery Management System (BMS) and battery testing. While FEV can access standard modules and its own BMS (FEV LiIONMAN), it also offers the services of new product development. Within the framework of a safety agenda according to ISO 26262, all of the required steps are taken from the technical specifications through the scheduling, completion and documentation of validation activities and reviewing of suppliers of safety-relevant parts. The FEV Battery Management System battery control unit (FEV LiIONMAN) combines the surveillance of all critical values with operational strategies to create a performance projection. This enables safe operation and optimized utilization of the cell’s capabilities.

**BENEFITS**
- Development of entire battery systems, including the Battery Management System (BMS) and battery testing
- Product development services from technical specifications through scheduling to completion and documentation
- Multi-disciplinary teams for Lithium ion battery development