
START
STOP
ENGINE

IMPRESSIVE INTEGRATION

Configurable and modular test stand control and monitoring system based on M1

Test stands for combustion engines are apparatus with an extremely high level of technical complexity. They must ensure reproducible operating conditions irrespective of external factors and must protect persons and engine at the same time. They must also be highly flexible since virtually any test object requires an individual test setup.

Model Based Design

MathWorks Partner

SIMULINK Enabled MathWorks Partner

Based on the M1 automation system, GVH mbH, which is headquartered in Dortmund, Germany, has developed a configurable and modular test stand control and monitoring system – and considerably reduced development times by using M-Target for Simulink®.

» We have not only considerably minimized development times but also the non-productive downtimes of the system. «

Dr.-Ing. Tobias Musiolik
Technical manager

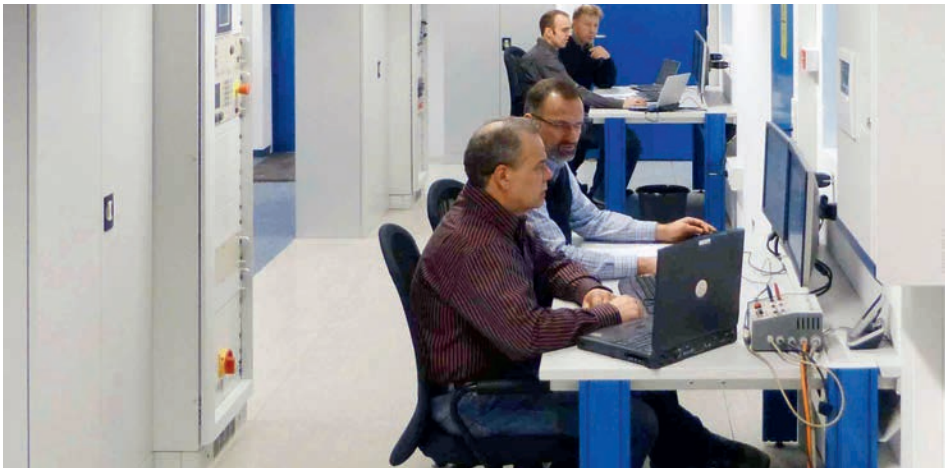
The Gesellschaft für Verbrennungsmotoren und Hybridantriebe mbH (GVH) offers development and testing support for internal combustion engines as well as the prototyping of electronic control systems. GVH specializes here in the direct injection of gaseous and liquid fuel as well as the associated exhaust gas after-treatment.

Flexibility is key

GVH operates in a field characterized by short innovation cycles, not least because new emission guidelines are constantly stipulating new and more demanding requirements for engines. Furthermore, the subsystems for combustion engines presented by different suppliers continually present the developers at GVH with new challenges: The systems have to be converted and test conditions adjusted. "The development of highly efficient and low emission drives requires short development cycles, particularly with regard to the integrated electronic real-time systems," explains Dr. Tobias Musiolik, technical manager at GVH.

In the past, similar test environments were implemented with conventional PLCs. However, these did not offer the necessary flexibility, so that the changes required couldn't normally be implemented quickly enough to meet expectations. Therefore the

▼ **Everything under control**: Technicians control and monitor test operation. The monitoring functions allow several test stands to be run automatically by only one person.



GVH Innovative Engineering

GVH mbH (Gesellschaft für Verbrennungsmotoren und Hybridantriebe) is an independent service provider for engine and component manufacturers, headquartered in Dortmund, Germany. GVH develops and builds engine test stands such as for gas engines for CHP units, truck engines or ship engines. It also offers testing and development services.

↗ www.gvh-online.de

» The outstanding integration of the M1 automation system in the MATLAB/Simulink/ Stateflow® tool chain offers much more than all the other alternatives we examined. «

Dr.-Ing. Tobias Musiolik,
Technical manager
Development of electronic systems at GVH

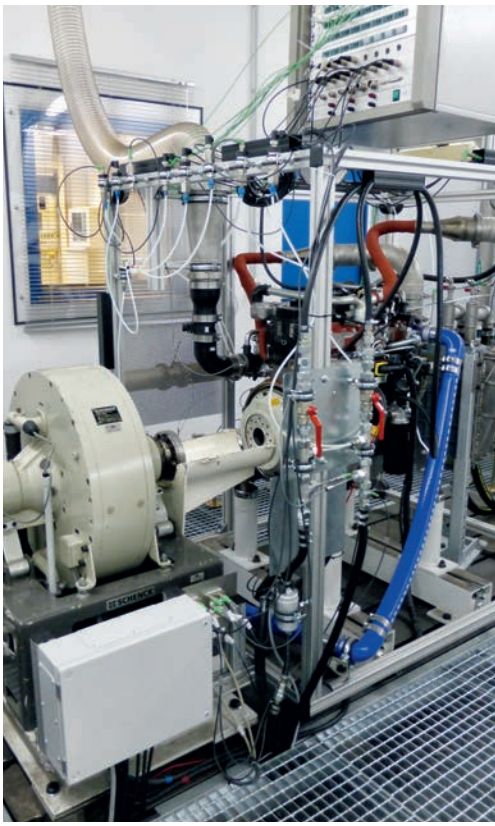
constraints soon came quickly for GVH when a new test bay had to be built with three engine test stands for utility vehicles and industrial engines with a rated output of up to 700 kW: "We wanted to develop an individually configurable and modular test stand control and monitoring system that also handles additional test stand automation tasks," Dr. Musiolik describes the most important parameters of the project. "At the same time we needed an environment in which we could develop and adapt the necessary control functions without any dependence on external service providers, in the shortest possible time, and flexibly to meet requirements."

M-Target for Simulink® made an impression

Different solutions available on the market were examined as a result. It was ultimately the Bachmann M1 system that made an impression at GVH: "The outstanding integration of the M1 automation system in the MATLAB/ Simulink/Stateflow® tool chain was the key factor, since it offers much more than all the other alternatives we examined," Tobias Musiolik confirms. Changes to test conditions often require the implementation of solutions at short notice, which can virtually only be performed by internal personnel. In future, any necessary adaptions are tested using physical models of the environment system on the development PC fully in line with the model-based development process in virtual prototyping. "Parts of them can now even be parameterized before they are implemented on the test stand. Not only the development times but also the non-productive downtimes of the system are considerably kept to a minimum," Dr. Musiolik continues.

Complex system – with enough power reserves

The test engine is run under load on a combustion engine test stand with a power brake. This enables the different applications to be examined and the key operating condition values measured. The operating conditions here have to be known and reproducible in order to minimize environmental factors on the measuring results. "Coolant, fuel and exhaust air, for example are regulated at a specific temperature and pressure before they are fed to the test engine," Dr. Musiolik explains. On the one hand, the control loops have to balance out considerable disturbance factors, while test conditions have to be adapted flexibly on the other. This requires the integration of a wide range of sensors and actuators as well as monitoring functions. ▶▶



▲ **A lot of peripherals**: Supply and measuring equipment take up a lot of space inside test stands. The automation is mostly installed outside of the test stands.

▲ **Impressive**: Test bay of GVH with three test stands and the power supply equipment (ventilation, cooling, exhaust gas extraction, fuel supply) on the roof.

▶▶ These last devices ensure that operating personnel on the test stand as well as the technical equipment and test engine are protected reliably.

The openness of the Bachmann M1 system therefore also plays an important role at GVH: "Our in-house measured data acquisition system, the development environment and the different subsystems of suppliers present a wide range of different communication requirements. CANopen, Profinet or OPC – all were established on the M1 in a short time," says Markus Bock, project engineer for the development of electronic systems at GVH. The M1 system handles here both the described closed-loop control tasks for the conditioning of the ambient conditions in the test stands as well as the monitoring functions: "The MX213-CPU now allows us to run several test stands in three-shift operation with few personnel needed," a delighted Markus Bock describes the successful implementation.

Mains power under control

The GMP232 grid measurement and protection module was also integrated in the automation system. "We use it on the one hand for consumption measuring and also for managing the dynamic distribution of mains power to power components, such as the frequency inverters," Markus Bock describes the use. "This is particularly important if test objects are put under load using electrical machines. This may require more power on the one hand, but also the feedback of energy to the grid," Markus Bock explains. The GMP232 enables the controller and the operator to respond accordingly to the situation.

Reliable and future proof

Previously, the test stands were always set up with a distributed intelligence. This prevented the conversion or the failure of plant sections to result in downtime for all test stands. "Due to the high availability of the M1 system we can now use a single central processing unit instead of the previous distributed solution. This considerably reduces the requirements for communication and wiring," a satisfied Dr. Musiolik explains.

He continues: "With Bachmann we simply feel safe: The long availability of the hardware, the guaranteed upward compatibility and a technical support that is second to none in the sector, ensure the future proof capability of the new test stand."

» The wide range of communication requirements were established on the M1 in a short time. «

M.Sc. Dipl.-Inform.(FH) Markus Bock, project engineer in development of electronic systems at GVH