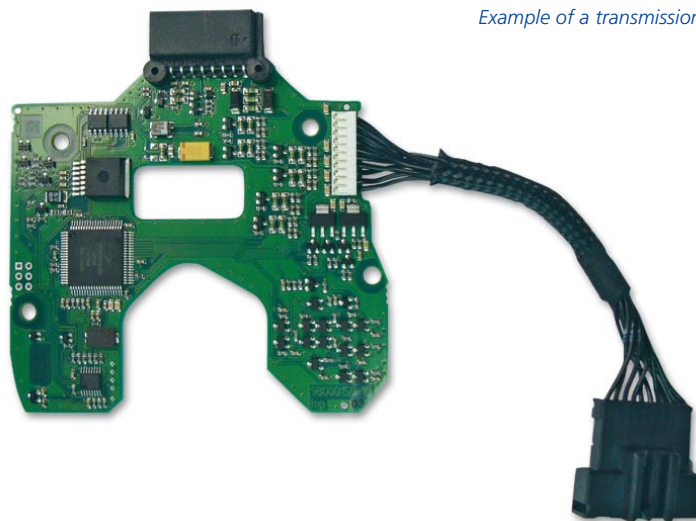Testing transmission lever electronics automatically
with dSPACE test automation

Tested and
found good

Example of a transmission lever electronics component.

A higher degree of automation, higher quality, higher efficiency, higher test reusability: These were the goals of Lemförder Electronic GmbH. The company achieved them all by using a dSPACE HIL simulator and dSPACE AutomationDesk.

Lemförder Electronic GmbH develops, produces and distributes electronic and mechatronic components, including transmission lever electronics for the automotive industry. The company has constantly to adapt to ever-tougher requirements for electronic components in vehicles, such as modules that are becoming more compact yet have more and more functions. The transmission lever systems for automatic and manual transmissions that used to be purely mechanical components have evolved into mechatronic systems with microcontroller-based ECUs. And fulfilling the requirements for functional safety plays an important role, especially with integrated shift-by-wire functionality, in which the gear shift input is transmitted via the vehicle bus.

Lemförder Electronic achieves this functional safety by subjecting all the electronics hardware and software to different test stages before shipment, conducting module, integration, system, function and release tests. All this requires a powerful test environment.

In the Beginning Was the Test Box
Up to a few years ago, Lemförder Electronic only used test boxes to test transmission lever electronics. The test boxes acted as substitute transmissions, and single assemblies were created individually. They were optimally tailored to specific test requirements, but it took longer to plan and develop them. Tests were performed by stimulating each test box, meaning each gear variant, either manually or by actuators. As the number of variants and the level of function integration grew continuously, so did the work involved. It was no longer possible to achieve precise reproducibility.

The Goal: Automated Testing
To boost the efficiency of creating and executing tests, and to simplify their reuse, Lemförder decided to introduce a new test concept. Consisting of hardware-in-the-loop (HIL) simulation and test automation, this would increase the number of tests and improve their quality. In parallel to that, the previously used test boxes would also be supplemented by the new HIL hardware.

New Test Landscape
Lemförder Electronic achieved these goals by using a HIL simulator and test automation software from dSPACE. The test automation is based on AutomationDesk® with Real-Time Testing and ControlDesk® from dSPACE, and is supplemented by the DOORS® requirements management tool from IBM Rational®. The tests are specified and managed in DOORS®. Test cases are created and executed under automatic control in AutomationDesk. The current parameter settings can be monitored during simulation from within ControlDesk.

> "AutomationDesk simplifies test creation and quickly boosts testing depth."

Knut Schwarz, Lemförder Electronic GmbH

Lemförder Electronic GmbH

Lemförder Electronic provides solutions for electronic components and systems as well as services for the automotive industry. The company develops, produces and maintains all the products itself. The range covers the entire process chain, from individual feasibility studies to development, prototype creation, strategic materials purchase, flexible production and reliable logistics.

Use in Production

dSPACE engineers were on site during the startup phase for the new system. They supported test personnel during introduction, helped put the test system into operation quickly, and sped up the learning process. Since then, the system has become an integral part of the product creation process. Configurations were set up for the different variants of the transmission lever electronics on the HIL simulator, and automated tests were developed in AutomationDesk. A layout with virtual instruments was created in ControlDesk to adjust test settings manually if required. A strict library structure with predefined test steps was introduced so that tests could easily be reused, even in projects for different OEMs and other Lemförder Electronic product groups.

Results

As projects were carried out, an extensive test library with hundreds of test cases grew. The test cases can be used flexibly for the ECU variants and also greatly increase testing depth. With automated HIL tests and associated test report creation, test runs can now be made overnight and on weekends. Customers can be given the automatically generated test reports whenever they need. Using the system in different development phases means that errors are detected at an early stage, and that error removal is verified by regression testing. When modification requirements are received, Lemförder Electronic can implement them faster than they used to, because only the HIL simulator and the test sequences need to be adapted. The new technologies
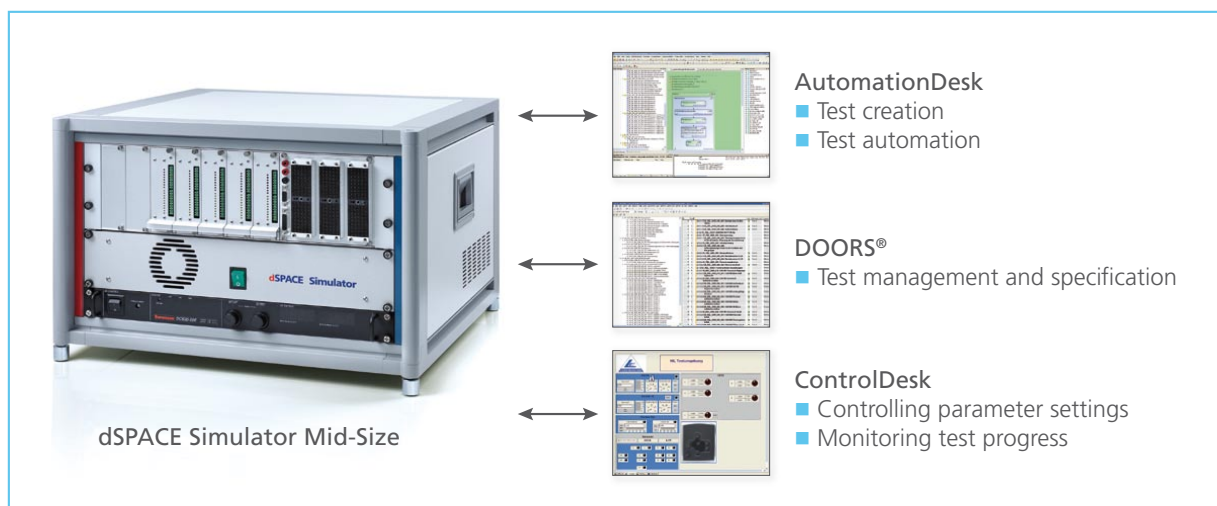

AutomationDesk
- Test creation
- Test automation

DOORS®
- Test management and specification

ControlDesk
- Controlling parameter settings
- Monitoring test progress

dSPACE Simulator Mid-Size

Figure 1: Setup of the HIL system: dSPACE Simulator with AutomationDesk, ControlDesk and DOORS®.

	Software Shipment Test/Basic System Test	Complete Function Tests	Functional Validation of Single Modules	Endurance Tests
Application Case	Testing all the function groups in the transmission lever electronics.	Testing all the function groups in the transmission lever electronics (positive and robustness tests, black box tests).	Testing individual aspects with different parameter settings in real time.	Testing transmission lever electronics in continuous operation.
Test Volume	Approx. 50 - 70 test cases	Over 1000 test cases	n.a.	n.a.
Duration	30 - 45 minutes	0.5 - 0.75 days	n.a.	Approx. 500 hours
Users	Test engineers; Software developers (version-responsible)	Test engineers; Software qualification team	Development engineers for hardware and software	Software qualification team

Figure 2: The four main areas in which dSPACE Simulator is used. The system is used by different users with different concerns.

increase overall test efficiency and ensure consistently high quality. The simulator is a great support, especially in robustness tests, in which the electronic component under test is fed with input values to evaluate whether it functions correctly even with invalid input values and in extreme environmental conditions. The functional behavior must be robust enough to always reject invalid values and call suitable error routines.

Outlook
In view of the good results obtained from HIL, Lemförder is extending the test process. Now, HIL tests will not only be used to increase testing depth, but will also be performed even earlier in each project. Easier handling means that more development software qualification team members can access the system. ∎

*Knut Schwarz,
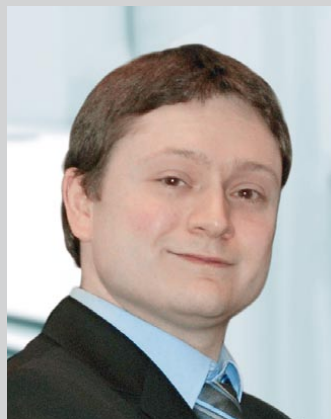Michael Eimann,
Lemförder Electronic GmbH*

Knut Schwarz
Knut Schwarz is a software team leader at Lemförder Electronic GmbH in Espelkamp, Germany.
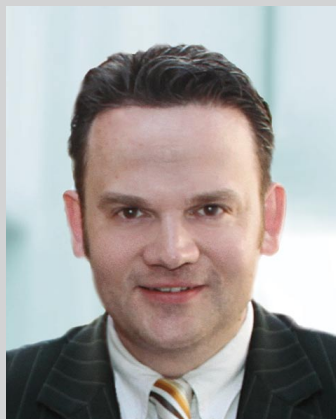
Michael Eimann
Michael Eimann is a software development engineer at Lemförder Electronic GmbH in Espelkamp, Germany.

Conclusion

Lemförder Electronic's goal was to increase the efficiency of electronic components testing and respond to modification requirements faster. They chose a test system from dSPACE consisting of a HIL simulator and test automation. Their test processes were improved by factors such using the HIL system at an early phase in the development process and by a rapid increase in testing depth.