

# Efficient Test Processes

- **Mechatronic simulator for ECU tests on steering systems**
- **Process optimized by coupling AutomationDesk and DOORS**
- **Greater transparency and efficiency for everyone involved**

ZF Lenksysteme GmbH develops and produces steering systems for passenger and commercial vehicles. The company uses the requirement management tool DOORS® for drawing up software requirements and specifying ECU tests, and the test automation software AutomationDesk from dSPACE for implementing, executing, and documenting the tests. AutomationDesk and DOORS® are coupled via the dSPACE Connect&Sync Module, giving ZF Lenksysteme a very clear and simple environment for designing ECU tests.

## Optimized Test Processes

Our objective was to optimize our test processes and design them so developers who are new to the team can easily get started in ongoing projects. We chose DOORS, the requirement management tool from Telelogic, for defining software requirements and associated test specifications. Then to make the next steps in the process (test implementation/test execution) easy to track, we opted for dSPACE's AutomationDesk, the graphical test automation software. Our experience with both tools was positive, so the next logical step was to couple DOORS and AutomationDesk via the dSPACE Connect&Sync Module to increase the transparency of our workflows.

## Hardware Landscape with HIL Simulator

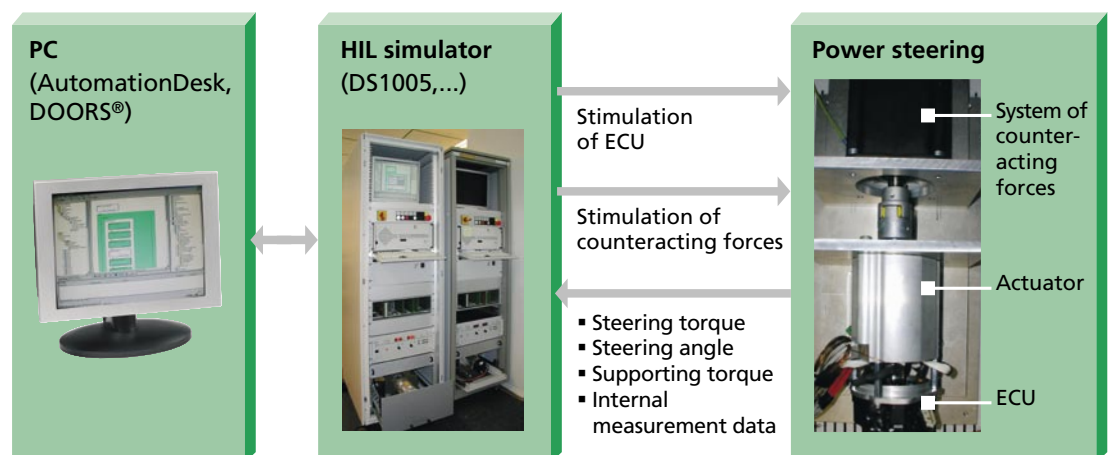
Our hardware landscape for testing power steering systems consists of a terminal PC with DOORS and AutomationDesk for accessing the HIL simulator. The HIL simulator provides the simulation data for the power steering system under test. This consists of an ECU, a motor (the actuator that generates the

steering forces) and a system of counteracting forces for introducing variables such as torques and engine speed, which in a real vehicle would affect the steering via the chassis. The power steering returns various measurement values (steering torque/angle etc.) to the HIL simulator as the result.

## Workflow with DOORS, AutomationDesk and Connect&Sync Module

The first step is to create the software requirements as well as the test specifications in DOORS. Because we do this entirely in DOORS, we can simply link each software requirement with its associated test specification to ensure that there is no ECU requirement without its own test specification.

The second step is to transfer the test specification to AutomationDesk. The Connect&Sync Module provides a set of rules for this transfer process, defining how structures and data from DOORS are mapped in AutomationDesk. The structures and data that were designed in DOORS then also appear in AutomationDesk.



▲ The hardware landscape for testing power steering systems.

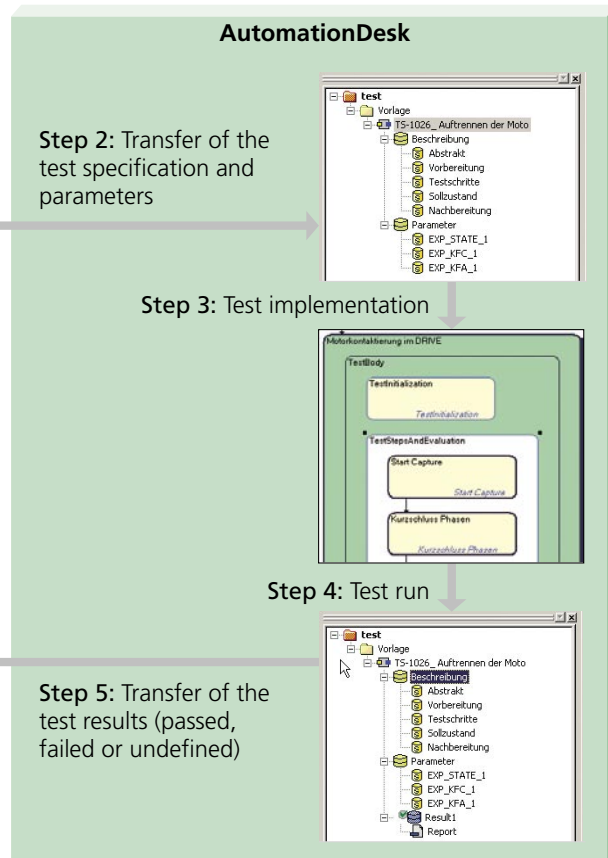
**DOORS**

Step 1: Creation of software requirements and test specification

ID	Status	Object Heading and Object Test	Uebersetzung
TS-104	in Bearbeitung	105 Vorlage	Laborento
TS-106	beendet	105.1 TS-1026: Auftreten der Motorphase U im Drive	Laborento
TS-107	beendet	105.1.1 Beschreibung	Laborento
TS-108	beendet	Abstrakt: Motorphase U wird im DRIVE-Mode aufgetrennt.	Laborento
TS-109	beendet	Vorbereitung: SO aus PDP aus	Laborento
TS-100	beendet	Teststrategie: (A) System aufsetzen in den Drive-Modus (A) Motorphase U über Relaisbox aufsetzen (A) Vorgabe Leuchtwegung (Leuchtwegung): Status, 20', 0.5Hz, Dauer 2s (A) SO2 Leuchtwegung und Status HBC während Leuchtwegung aufsetzen (A) Status HBC aufsetzen (A) Fehlerpeicher aufsetzen	Laborento
TS-101	beendet	Sollzustand: Solange keine Leuchtwegungen stattfinden befindet sich das SO in der Stillstehende-Aberrichtung. Der Phasenstoß kann hier nicht erkannt werden. Erst wenn eine Motorbewegung angefordert wird und die Phase betreten werden, soll der Phasenstoß erkannt werden. KPC_SMCURR / KFA_MCURR SO 2s nach der ersten Leuchtwegung im Mode ERROR	Laborento
TS-102	beendet	Nachbereitung: Motorphase U wieder verändern. Fehlerpeicher löschen	Laborento
TS-103	beendet	105.1.2 Parameter	Laborento
TS-104	beendet	EXP_STATE_1 = HBC_ERROR	Laborento
TS-105	beendet	EXP_KPC_1 = KPC_SMCURR	Laborento
TS-106	beendet	EXP_KFA_1 = KFA_OC	Laborento

**DOORS** Test results

ID	Status	Object Heading and Object Test	Uebersetzung	dSPACE AUD.
TS-104	in Bearbeitung	105 Vorlage	Laborento	Passend
TS-106	beendet	105.1 TS-1026: Auftreten der Motorphase U im Drive	Laborento	
TS-107	beendet	105.1.1 Beschreibung	Laborento	
TS-108	beendet	Abstrakt: Motorphase U wird im DRIVE-Mode aufgetrennt.	Laborento	
TS-109	beendet	Vorbereitung: SO aus PDP aus	Laborento	
TS-100	beendet	Teststrategie: (A) System aufsetzen in den Drive-Modus (A) Motorphase U über Relaisbox aufsetzen (A) Vorgabe Leuchtwegung (Leuchtwegung): Status, 20', 0.5Hz, Dauer 2s (A) SO2 Leuchtwegung und Status HBC während Leuchtwegung aufsetzen (A) Status HBC aufsetzen (A) Fehlerpeicher aufsetzen	Laborento	
TS-101	beendet	Sollzustand: Solange keine Leuchtwegungen stattfinden befindet sich das SO in der Stillstehende-Aberrichtung. Der Phasenstoß kann hier nicht erkannt werden. Erst wenn eine Motorbewegung angefordert wird und die Phase betreten werden, soll der Phasenstoß erkannt werden. KPC_SMCURR / KFA_MCURR SO 2s nach der ersten Leuchtwegung im Mode ERROR	Laborento	
TS-102	beendet	Nachbereitung: Motorphase U wieder verändern. Fehlerpeicher löschen	Laborento	
TS-103	beendet	105.1.2 Parameter	Laborento	
TS-104	beendet	EXP_STATE_1 = HBC_ERROR	Laborento	
TS-105	beendet	EXP_KPC_1 = KPC_SMCURR	Laborento	
TS-106	beendet	EXP_KFA_1 = KFA_OC	Laborento	



▲ Typical workflow in the tool landscape consisting of DOORS, AutomationDesk and the Connect&Sync Module. Because the two tool worlds are linked, test results can be tracked from one to the other.

The third step is test implementation in AutomationDesk. This is based on the structures and data that were generated, which greatly facilitates our work. The

*“Coupling AutomationDesk and DOORS via dSPACE’s Connect&Sync Module has greatly simplified ECU testing at ZF Lenksysteme.”*  
**Heiko Hägele, ZF Lenksysteme GmbH**

fourth step is the test run, while in the fifth step the test results (passed, failed, or undefined) are transferred back to DOORS via the Connect&Sync Module.

**Advantages of Coupling DOORS and AutomationDesk**

➤ **Clearly organized working environment**

The Connect&Sync Module keeps the data and structures synchronous in DOORS and AutomationDesk, resulting in high consistency throughout the process.

- **No need for additional management files**  
 We no longer have to keep work-intensive and error-prone lists to synchronize test specification and implementation. Lists are also not needed for statistical evaluations, as that can all be done in DOORS.
- **Better quality assurance**  
 DOORS contains the current test results as well as the requirements, so tests are more transparent for the management level, which greatly facilitates quality assurance.

Heiko Hägele  
 ZF Lenksysteme GmbH  
 Schwäbisch Gmünd  
 Germany