Model-Based Testing of Automotive Electronics

Dr.-Ing. Klaus Lamberg
dSPACE GmbH, Paderborn, Germany
klamberg@dspace.de

1. Role of Testing throughout the Development of Automotive Electronics

The increasing importance of electronics in the automotive industry is illustrated by the growing proportion of manufacturing costs taken up by electrical and electronic systems – this has now reached approx. 30%. At the same time, electrical and electronic systems are the main cause of vehicle failures in the field, accounting for approx. 30% of these. Manufacturers and also suppliers are well aware of the problems caused by the increasing number of electronic control units (ECUs). Thus, quality assurance is becoming increasingly important, as problems in quality are a liability risk, with the danger of image problems and the cost of recall campaigns and rectification. The realization is that "good quality is expensive, bad quality even more so".

Quality must not be left behind by the immense speed at which new technologies and functions are being developed. Quality is becoming a decisive factor in competition, and quality assurance is becoming a key task and a core competence; and testing is a key component of quality assurance.

To allow testing throughout the entire development process, powerful and efficient means of developing and describing tests are necessary. These also have to take into account the various requirements of the test tasks and the different development phases. This contribution gives an overview of modern test development in various phases of development and of test management throughout the overall process, using a model-based test process.

2. The Model-Based Testing Process

The model-based test process (see Figure 1) represents various tasks within function and ECU development. It essentially consists of the following test steps:

- The Function Model Test comprises the systematic and automated testing of an executable model of the function or controller under development, representing the unit under test (UUT). The test can be run in open loop or against a model of the control plant (model-in-the-loop, MIL).

- In the Implementation Model Test, the UUT is the function or controller model, including "design data",

e.g. scaling, data type, LSB and offset information for fixed-point representations.

- The next form of representation is the function code itself (Function Code Test). This can be performed either on the host PC or on a target processor.

- The individual ECU Test is usually performed by Hardware-in-the-Loop (HIL-) simulation.

- The objective of the System Test is to test the ECU in its immediate environment using HIL simulation. Therefore it is partially integrated with other ECUs.

- Finally, all ECUs in a vehicle are integrated and the entire ECU network is tested. This is called Integration Test.
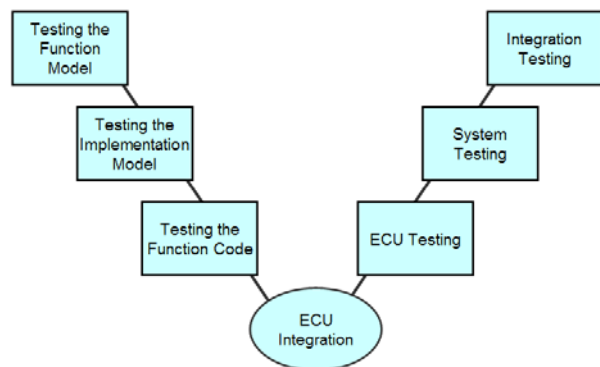

Figure 1: The model-based test process.

References

[1] Lamberg, K.; Durchgängiges, automatisiertes Testen bei der Entwicklung von Automobilelektronik (Integrated, Automated Testing in the Development of Automotive Electronics). 1. Tagung Simulation und Test in der Funktions- und Softwareentwicklung für die Automobilelektronik, HdT, Berlin, 2003.

[2] Lamberg, K., Richert, J.; Rasche, R.: A New Environment for Integrated Development and Management of ECU Tests. SAE 2003-01-1024, 2003.

[3] dSPACE GmbH: AutomationDesk and MTest Product Information: http://www.dspace.de.