Since it is well-known that the costs of correcting an error are higher the later it is discovered, the supplier has an interest in detecting errors as early as possible and not for the first time in tests at the OEM. However, creating and maintaining the test applications needed for this requires an in-depth understanding of requirements and is also time intensive: not only due to the number of tests to be run, but also due to their complexity. Even small modifications to an ECU can require extensive adaptations in tests. Therefore, in-house implementation of tests is associated with considerable costs. An alternative is to hire a testing company. Due to the costs associated with a test run at a testing company, it is typically not possible to conduct tests continually over the course of development.

Another problematic aspect of this approach is that the test implementations of all parties – whether supplier, testing company or OEM – can diverge more or less in their details. If tests return different results when testing to the current test specifications, time-consuming troubleshooting...
ing is unavoidable. The cause of the problem does not necessarily reside in the ECU, so the unpleasant question must be clarified as to which party is responsible for the error. A test could, after all, be based on false assumptions or simply have been implemented with errors. Gaps in the test specifications are also a possibility.

Testing at the Push of a Button

Cost reduction and increased quality in ECU tests do not have to contradict one another. However, as shown by an extension of the CANoe test and simulation system from Vector that was specially designed for the Volkswagen Group. Use of the CANoe Test Package VAG enables ECU developers and testers at suppliers, test companies and, of course, in-house departments of the Group to achieve their goals with incomparable speed. Test configurations for automated conformity tests for High-Speed CAN and Network Management (NM) High can be generated at the push of a button and without further preparation effort. Version 4.0 of the test package implements tests from the latest specifications DUM.857.BE.1 and DUM.000.AC.A, and it has a test coverage that has been coordinated with Volkswagen. High-quality implementation of the conformity test according to Volkswagen requirements has been the result of many years of close cooperation with the OEM in developing the test system, and feedback from a broad user base.

In particular, the CANoe Test Package VAG includes test libraries for conformity tests and for diagnostic queries via Unified Diagnostic Services (UDS). These libraries are written in the CANoe-specific programming language CAPL (Communication Access Programming Language). If necessary, this enables to comprehend the exact test flow. Also included with the product is a generator that creates a test configuration with the relevant linked test libraries and a remaining bus simulation that has been specially adapted for this purpose (Figure 1). This step is performed by the CANoe AddOn VAG Multibus Package that is supplied free-of-charge with the product. It has a simulation generator, an interaction layer and network management.

The test system achieves full test automation with the following Vector hardware: VH1160 for voltage supply of the ECU and VH6501 as the CAN/CAN FD network interface as well as the stress module (Figure 2).

Hardware for Full Test Automation

The test system simulates different supply situations for the Device Under Test with the help of the VH1160 controllable voltage supply. The VH1160 has relays for independently switching terminals for power, ground and ignition, and it enables precise measurement of current consumption of the ECU under test. Various voltage responses and faults can be simulated via USB remote control. These elicit reactions from the Device Under Test to overvoltages, undervoltages and voltage drops.

On the other hand, the VH6501 USB hardware module is used to simulate digital and analog disturbances on the CAN/CAN FD network. At the same time, it serves as a normal CAN/CAN FD network interface. It reproducibly alters the physical properties and the logical levels. Flexible trigger and disturbance logic enables specific corruption of CAN/CAN FD messages at any bit positions.

VAG Supplies Test Basis to Suppliers

The most important prerequisites for successful configuration of the test environment include consistent communication description of the ECU in the form of test basis coordination documentation (TBAD) and the CAN network database (DBC). Both files are created by the OEM and transferred to the supplier. While OEM-specific information about the network and the remaining bus simulation are stored in the DBC, the TBAD contains detailed information about the ECU. It must be re-created for each ECU, and it offers information in XML format about Tx and Rx messages, diagnostic parameters, diagnostic trouble codes (DTCs), time settings, specification versions and much...
High. This makes the positioning of this test system unique in the market.

Modifications to the CANoe Test Package VAG to meet future requirements are already in planning. One example is the need for Secure On-Board Communication (SOC).

**Summary and Outlook**

The CANoe Test Package VAG, together with Vector VH1160 test hardware and the VH6501 form a cost-effective test environment based on standard CAN tools. The described solution gives ECU developers and testers the ability to execute the same tests as Volkswagen AG with minimal effort. Full automation of the test execution allows conformity tests to be repeated at any time, also with minimal effort. This makes it possible for suppliers to conduct extensive tests throughout the development process and thereby enables early error detection. This saves time, reduces development costs and leads to quick improvements in product quality.

The CANoe Test Package VAG has been tested and released by Volkswagen. The OEM recommends explicitly that suppliers use it for tests of High-Speed CAN and NM-