

# Automatic interoperability tests

By Peter Fellmeth (Vector Informatik)



The required “unlimited compatibility” of components on the Isobus cannot be attained by performing conformity tests at the end of device development alone. Rather, sound and continual tests over the entire development phase are necessary. Efficient use of such tests can only be achieved by using tools with domain knowledge that cover a large number of tasks ranging from simulation to analysis tests as well as conformity tests. Developers of implements and tractors need a tool that covers conformity testing, cycles through the tests independently, yet offer the freedom to only test certain sections and can be extended to test the application.

The Isobus standardizes data communication between tractor, implements and farm management computers and enables system-wide data exchange. The ISO 11783 series of standards consists of 14 sub-standards; they each address different aspects of the technology, ranging from System Description (part 1), Physical Layer (part 2), Data Link Layer (part 3), Network Lay-

er (part 4) and Virtual Terminal (part 6) to Diagnostics (part 12) and File Server (part 13).

“One person’s pleasure is another’s pain” is common folk wisdom. The situation is similar with the requirement for unlimited compatibility (system and manufacturer independent) of ISO 11783-compatible products [1]. For the customer this is not only very easy to handle, it also opens up the possibility of purchasing flexibility and independence from the manufacturer. That in it is a large motivational factor in procuring such machinery. For manufacturers, however, this promise represents a great challenge in terms of development, operation and maintenance of the machines. CANoe. ISO 11783 from Vector offers a universal development and testing solution here. The ISO 11783 option for the CANoe tool provides the necessary domain knowledge and supports conformity to the ISO 11783 standard.

Experience over the past two years in the Isobus field has shown that despite a sharply rising number of devices certified by

conformity tests [2], different components, such as the Task Controller and implement, do not always harmonize in their interaction without problems. There is the potential for surprises in operation of an implement when the Virtual Terminal is used too. As well as for service technicians, in such a heterogeneous environment as the Isobus it is difficult to definitively localize the cause of a problem and correct it if necessary. Frequently, the technician

is confronted with unfamiliar devices or combinations of devices. In view of these problems, and to assure customer satisfaction, the manufacturer’s initiative AEF (Agricultural Industry Electronics Foundation) set up a project group tasked with conducting activities to improve the interoperability of Isobus devices [3].

## Worst case uniform diagnostic access

In the framework of standardization tasks, along with continual efforts to refine and extend test cases of the conformity test, part 12 of the ISO 11783 draft standard was written to create a common diagnostic interface. It is based on SAE J1939-73 diagnostics.

The section of part 12 of the ISO standard that has already been published, what is referred to as basic diagnostics, defines open diagnostic access. It provides basic functionalities and is intended to enable a system overview. This includes unique identification of the ECUs on the bus as well as information on the software version, manufacturer’s part number and the conformity test performed. Each ECU can report momentary errors, and when requested by the diagnostic tool it can



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also report previous errors. This information is intended to enable quick and reliable localization of the error causes. This is especially advantageous if a network consists of components from different manufacturers. For example, the tractor manufacturer's service technician can use an ISO 11783-12 compatible diagnostic tool to detect problems related to an implement from a different manufacturer. The technician might not be able to correct the problem, but can clearly identify its cause. If the cause lies in the implement, the tractor manufacturer's service technician – who was summoned by mistake – can call up valuable information such as error codes or part numbers of the affected components to give the implement manufacturer's service technician advance information on the problem. This keeps downtimes to a minimum and leads to a higher level of customer acceptance of Isobus-equipped machinery.

Ongoing efforts to extend part 12 of the ISO 11783 draft standard are taking the direction of a standardized description format for diagnostics. This would let each manufacturer describe diagnostic contents individually for each ECU. A prepared diagnostic application could use this description to diagnose the ECU regardless of which company manufactured it. The diagnostic description file might be downloaded from the ECU itself or over the Internet. Manufacturers with their own company-specific diagnostic tool would integrate ISO 11783 diagnostics into their existing tool. Manufacturers without their own custom tools could use future standardized diagnostic tools. One practical benefit is that a service technician would have system-wide diagnostic capability with just one tool. This enables efficient and reliable localiza-

tion of the real causes of errors and ideally to correct them right away.

### **Automated tests during development**

Introduction of uniform diagnostic access helps to quickly identify a problem on-site and possibly replace the defective part. If there is some incompatibility, however, the situation is generally very different. Replacing the electronics does not offer any help, since this does not correct the cause of the problem. In such a case, corrected ECU software would be necessary. However, it would take time to produce and test this software. In addition, distribution of the modified software is often costly, since devices must be recalled from the field. Suitable preventive actions can be taken to avoid such compatibility problems. One option is the conformity test mentioned in the introduction. However, a disadvantage here is that the application itself is not part of the test. The focus in conformity testing is to test conformity to the standard. In addition, it is difficult or impossible to use the conformity test during development, since 100 percent compatibility cannot be assumed at the beginning of development. Often just point checks of a certain aspect are desired, e.g. a check of the Transport Protocol. Such tests conducted over the course of development are generally performed very frequently, they have many alternative test sequences, and they must be flexible in their configuration. Therefore, such tests should be designed for automation. If problems occur during the test, extensive analytical capabilities are needed as well.

### **One tool for all cases**

The CANoe.ISO11783 universal development and test solution is used to verify ►

conformity to the ISO 11783 standard, providing the necessary domain knowledge. The Virtual Terminal, for example, is a fixed component of CANoe. Diagnostic messages can be visualized using the Diagnostic Trouble Code Monitor and Scanner. The integrated Test Feature Set makes it possible to define frequently recurring tests and entire test sequences. The test sequences can be easily defined by XML, for example. In such an environment, the tool set may assume the role of the test master and link to or drive other tools over various interfaces such as COM or .NET. It is also pos-

sible to integrate the tool set in an existing test environment via the same interfaces. Because of its extensive simulation and analysis capabilities, its use is not limited to just testing or simulation of individual ECUs. The tool can simulate entire networks (simulation of the remaining bus). For example, operation of an implement could be simulated via a Task Controller or the Virtual Terminal. With the help of Vector test hardware VT System, the tool set also directly drives real consumers such as actuator motors and an ECU's outputs, or reads in sensors. It can be used to utilize, analyze

and simulate the complex communication structures of the Isobus standard easily and efficiently. It is a comprehensive, universal tool for verifying conformity over all product phases: from development to operation and service of the working machinery.

[www.vector.com](http://www.vector.com)

**Literature and links:**

[1] VDMA Professional Society for Agricultural Engineering: Isobus speaks all languages. Just speak along with it. 2005, pg. 2

[2] VDMA Professional Society for Agricultural Engineering: Isobus-conformant devices per the ISO 11783 standard, [www.isobus.net/isobus\\_E](http://www.isobus.net/isobus_E)