3.1.1 Test Case ID-492237BA: Valid Request WDBI Hardware Version Write: Failed

Send a valid WDBI request. The successful execution is verified using the corresponding RDBI service.

**Comments**

<table>
<thead>
<tr>
<th>Date</th>
<th>Author</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.04.2013</td>
<td>VECTOR</td>
<td>The DID is not implemented yet</td>
</tr>
</tbody>
</table>


**Test Case Sequence**

<table>
<thead>
<tr>
<th>Timestamp</th>
<th>Test Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.885240</td>
<td>Read1</td>
<td>Positive response received as expected</td>
</tr>
<tr>
<td>4.912232</td>
<td>Read1</td>
<td>Positive response received as expected</td>
</tr>
<tr>
<td>4.914230</td>
<td>Write1</td>
<td>Override current stored data (HardwareVersion_Write)</td>
</tr>
<tr>
<td>4.942232</td>
<td>Write1</td>
<td>Override current stored data (HardwareVersion_Write)</td>
</tr>
</tbody>
</table>

**Result**

- pass
- fail

---

**ECU Testing Solution**
Testing Overview

HIL Test Bench: CANoe + VT System
Testing Design: vTESTstudio
Test Data Management: vTESTcenter
Testing Engineering Services
Summary
What do I need for Testing an ECU?
What should be tested for ECU?

- **Application Layer Test**
  - Functionality logic test
    - Working mode
    - Control behavior
    - ......
  - Diagnostic functionality test (DTCs)

- **Communication Test**
  - Physical Layer
    - CAN/LIN Bus output voltage level
    - DUT Ground shift tolerance
    - Electric capacity and resistance characteristics
    - ......
  - Data Link Layer
    - Bit timing parameters
    - DLC check
    - Cycle time check
    - ......
  - Interaction Layer
    - Message transmission (e.g. Periodic/on event/if active)
    - Default value check
  - Network Management Test
    - Establish ring
    - Bus sleep & wake up
    - Loss of node in a running network test
  - Diagnostic Protocol Test
    - P2, P2*
    - ......

- **Electrical Test**
  - Over voltage or Under voltage test
  - Starting profile
  - ......

- **System Integration Test**
  - ECU Interaction Behaviors
  - ......
Overview Vector Test Solution

**vTESTstudio**
- Test programming (CAPL, C#)
- Table based test design
- Graphical test design (diagrams)
- Definition of parameters & curves

**CANoe + VT Modules + Bus Interfaces**
- Realtime execution of tests
- Access to SUT via
  - I/Os,
  - bus systems and
  - protocols (diagnostics, XCP, ...)
- Debug Interface
- Detailed automatic test reporting

**vTESTcenter**
- Management of testing projects: Planning & Tracking
- Configuration management of test data
- Team collaboration by multi-user support
- Requirements and test engineering
- Bidirectional traceability
- Review & rework
- Import of test exec. reports
- High-level analysis of test results and trends
Testing Overview

- HIL Test Bench: CANoe + VT System
  Testing Design: vTESTstudio
  Test Data Management: vTESTcenter
  Testing Engineering Services
  Summary
Served SUT Interfaces, Served Interfaces of HIL test bench

**HIL Test Bench: CANoe + VT System**

- **SUT Interfaces**
- **HIL Test Bench**
  - CANoe
  - VT System
- **Application Model**
  - MATLAB
  - CAPL
- **Fault Memory**
  - 01101100
  - 11001101
- **Bus systems**
  - CAN, FlexRay, Ethernet, LIN, MOST, K-Line
  - NM: AUTOSAR, OSEK, OEM specific
  - IL: OEM specific
  - XCP: over CAN, IP, FlexRay
  - Higher Layer Protocols: J1939, ...
- **IOs**
  - Digital, Analog, PWM, custom
  - (for stimulation, measurement, fault injection)
- **Power Supply**
- **Control ext. devices**
  - Ethernet, GPIB, LXI, RS232, FDX, DLL-Interface
VT System – A Modular System

Plugs for manual measurement

Status LEDs for each channel

Relays for switching and fault injection

Phoenix connectors for test harness

Backplane connector (control, supply power)

Signal conditioning

Modules for 19” racks
Load Module
VT1004A (FPGA)

Stimulation Modules
- analog VT2004A (FPGA)
- digital VT2516A (FPGA)

General Purpose Modules
- analog VT2816 (FPGA)
- digital VT2848 (FPGA)
- Relais VT2820

Extension Module
VT7900

Real-Time Modules
ATOM VT6010
Core™ i7 VT6051A

Network Interface Module
VT6104
VT6204

Power Module
VT7001A

Backplanes & Chassis
VT8006
VT8012
Open Environment CANoe

HIL Test Bench: CANoe + VT System

Logging
- ASCII
- Binary
- Standard Formats e.g. MDF

Application Layer
- MATLAB/Simulink®
- Graphical Signal Representation
- User defined Panels
- Interaction Layer (OEM Specific)
- Application Languages / Panels (Signal Based)

Diagnostics / TP / NM Layer
- Protocol Observers
- Application Language Layer Specific (OEM Specific)

Communication Layer
- Trace / Scope
- Application Language / Generators (Frame Based)

Test Support
- Application Language Wait Functionality
- Test Execution Control
- Report Generation

Hardware Layer
- CAN FD
- CAN
- LIN
- MOST
- FlexRay
- Ethernet
- K-Line
- others
- I/O
- Test HW

CANoe.SCOPE, CANoe.XCP, CANoe.AMD, CANoe.DiVa......
HIL Test Bench: CANoe + VT System

Fully CANoe Integration

- Graphical user interface to control all VT module settings
- Relay switching apply directly on the schematic + code generation
- Display current state, settings and measurement values

![Graphical user interface to control all VT module settings](image_url)

![Relay switching apply directly on the schematic + code generation](image_url)

![Display current state, settings and measurement values](image_url)
HIL Test Bench: CANoe + VT System

CANoe.SCOPE

- Decode/analysis of bus voltage signals: CAN, CAN-FD, FlexRay, LIN
- External triggering via sync line of bus interface
- Typical use cases: protocol error analysis, automated physical layer tests
**HIL Test Bench: CANoe + VT System**

**CANstress**

- Disturb on CAN protocol level (Digital) – **Bit** level & **BTL** (Bit Timing Logic = tq) cycles

![Bus-off Test](image1.png)

![Sample Point Test](image2.png)

- Disturb on CAN physical level (Analog)

<table>
<thead>
<tr>
<th>CAN1</th>
<th>CAN2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_n$ (in Ohm):</td>
<td>$R_n$ (in Ohm):</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>$R_{wl}$ (in Ohm):</td>
<td>$R_{wl}$ (in Ohm):</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>$R_L$ (in Ohm):</td>
<td>$R_L$ (in Ohm):</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
HIL Test Bench: CANoe + VT System

Test Run with CANoe

- Possibility to observe and analyze a test during the test run in the Test Trace Window
- Detailed information about executed test cases and test steps
- Automatic Report Generation
HIL Test Bench: CANoe + VT System

Data Logger

► **GL1000 Family**
  ► Compact fleet logger for 2 CAN, 2 LIN and I/Os
  ► GL1010 as waterproof IP65 variant

► **GL2000**
  ► Handy fleet logger for 4 CAN, 2 LIN and I/Os
  ► Fast wake-up to record the first message
  ► Slim and cost-efficient GPS receiver

► **GL3000/GL4000 Family**
  ► Flexibly expandable multi bus fleet logger for 9 CAN, 2 LIN, 2 FlexRay, 1 MOST150 and I/Os
  ► 2 independent logging memories for separate configuration
  ► High storage capacities on CF card, SSD or external USB hard disk
  ► Wireless data exchange via WiFi
Agenda

Testing Overview
HIL Test Bench: CANoe + VT System

- **Testing Design: vTESTstudio**
- Test Data Management: vTESTcenter
- Testing Engineering Services
- Summary
Testing Design: vTESTstudio

Comfortable Design of Automated Test Sequences for Embedded Systems

- Vector vTESTstudio is a test design environment that enables the user
- to simplify test design by combining different programming languages and graphical notations in one integrated design environment
- to efficiently increase test coverage by specific test design features
- to define and reuse test cases for and across product lines by supporting parameters, ECU variants and test variants
- to track test coverage from system requirements to test reports
Schematic Overview: vTESTstudio and CANoe

Testing Design: vTESTstudio

- **Schematic Overview:**
  - **vTESTstudio** and CANoe
  - **Testing Design:**
    - **vTESTstudio**
    - **CANoe**
  - **Build**
  - **Load**
  - **Test Units**
    - Code
    - Parameters
  - **Common Symbol Databases:**
    - dbc, fibex, arxml, cdd, odx, a2l, ...
  - **Stimulation Curves:**
  - **Test Tables, Diagrams:**
  - **C#, CAPL:**
  - **Parameter Files:**
  - **Test Editors:**
    - Test Table Editor
    - Test Diagram Editor
    - C#/CAPL Editor
    - Parameter Editor
    - Stimulation Curve Editor
  - **Symbols:**
  - **Project View**
  - **Libraries View**
  - **Interface Function Explorer**
  - **Symbol Explorer**
  - **Test Reports**
  - **Test Automation**
Test Table Editor:

- Easily define test sequences without programming knowledge
- Comfortable support of test step parameterization by drag & drop
- Direct calls to CAPL, and C# test cases and functions possible
Test sequence diagram for an clear and concise representation

Direct calls to CAPL and C# test cases and functions possible

Test coverage easily to be reviewed

Easy reuse of test sequence parts
vTESTstudio: Parameters and Test Vector Editors

- Define parameters separated from test sequences
  - ECU parameters
  - Test vectors
- Standard file format (CSV), also directly editable in MS Excel
- Use parameters directly in code e.g. for value assignments, comparisons and variant decisions

```csharp
foreach (double temperature in SysPars.LockingTests.TemperatureList.GetVal)
{
    EngTemp.Value = temperature;
    DoMotorCheck1(SysPars.LockingTests.Tolerance1.GetValue());
}
```

Parameter access in coding editors

Parameter definition in Excel-style editor

Parameter overview in Symbol Explorer

Parameter access in table-style editor
vTESTstudio: Stimulation Curve Editor

- Define curves graphically with the Waveform Editor
- Predefined segment types (sinus, pulse, ..) enable easy definition of e.g. voltage curves defined by test standards like LV124 norm
- Use curves for the stimulation of the system under test
- Multiple curves can easily be synchronized within the design and for test execution
Quick definition of a large number of test cases to increase test coverage

- Combinations
  - Sequential
  - All possible permutations

- Value definitions
  - Lists of values
  - Value ranges

- Direct use of parameters from parameter files as test case parameters

```java
[TestCase]
public void CheckMotor(int temperature, double voltage) {
    // ...
}
```
vTESTstudio: Traceability

**REQM/TDM-System**

- vTESTcenter
- IBM DOORS
- ...
- Define requirements and/or test specifications
- Perform test coverage analysis

**Trace Item Exchange Format**

- Export items for test traceability
- Import

**vTESTstudio**

- Build executable test units
- Link trace items (requirements or test specifications) to test case implementations

**CANoe**

- Generate
- Test Execution Engine
- Contains information on trace items

**Report**

- Import test execution results
- Contains information on trace items

**Executable test unit**

- Configure
- Contains information on trace items
# vTESTstudio: Traceability Matrix

**Test Specifications**

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Test Item 1</th>
<th>Test Item 2</th>
<th>Test Item 3</th>
<th>Test Item 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic Wiping</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Default Wiping</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rain Detected</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch Engine Off while Wiping</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch Wiping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interval Wiping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interval Wiping in Start Position</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tip Wiping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wash Wiping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wash Water Sprinkling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Design coverage of trace items:** 75%
Agenda

Testing Overview
HIL Test Bench: CANoe + VT System
Testing Design: vTESTstudio

Test Data Management: vTESTcenter
Testing Engineering Services
Summary
Major Market Challenges

- **Tons of data:**
  - 1000’s of requirements,
  - 100’s of test scripts,
  - many SUT versions, many test executions
  - Allow / detect changes

- **Address relevant roles**
  - Stakeholders external & internal: Customers, Requirements Engineers, Management
  - Project members: Project leaders, Test Designers, Testers, Quality Engineers, ...
  - External contributors: Suppliers, service providers, ...

- **Collaboration – all users access the same data**
  - Consider roles & rights to derive permissions for viewing / editing
  - Different locations
  - Configuration management with versioning

- **Tracking of progress & quality**
  - Review & release of each data element (→ ‘artifact’)
  - Informative reports with flexible level of details, graphical representations
Test Data Management: vTESTcenter

vTESTcenter: Information Flow

Specification of Requirements & Tests → Design & Implementation → Planning → Execution & Documentation → Evaluation & Analysis

- Requirements Source (opt.)
- Test Design & Implementation Tool
- Test Execution Tool

- Test plan, test tasks
  - Report
  - Check

- Test implementations
  - Manual test sequence
  - Test Script

- File System
  - Metrics
  - Report

- Requirements Source (opt.)
  - Vector
- Test Design & Implementation Tool
  - Vector
- Test Execution Tool
  - Vector

- Traceability information
- Check-in & check-out test scripts
- Check in, parse for verdicts and req-/ test spec associations
- Import & update

- Manual test sequence
- Test Script

- Requirement Source (opt.)
- Test Design & Implementation Tool
- Test Execution Tool

- Report
- Check

- Check in, parse for verdicts and req-/ test spec associations

- File System
vTESTcenter: Example Analysis of Test Results
Agenda

Testing Overview
HIL Test Bench: CANoe + VT System
Testing Design: vTESTstudio
Test Data Management: vTESTcenter

Testing Engineering Services

Summary
Testing Engineering Services

Range of Engineering Services

**Customer specific: Test Design & Reporting**
- Test programming / test patterns (CAPL, XML,.NET,C#)
- Test reports

**Customer specific: Simulation and Protocols**
- CAPL / NodeLayer DLLs
- .NET panels

**Customer specific: Hardware Connection**
- Access to customer Hardware & Interfaces

**Customer specific: Housing & Wiring**
- Individual wiring, connectors, front panels
- Integration of 3rd party hardware

---

**Design & Implementation**
- Test Specification
- Test Modules

**Execution & Reporting**
- Report

**Other HIL Systems**
- Test & Measurement Equipment
- Interfaces

**Measurement & Test Hardware**
- Vector VT System
  - Measurement Equipment
  - Customer Hardware

**System under Test (SUT)**
- I/O, Power
- Digital/Analog I/O
- Memory
- Fault Memory
- Bus Interface

**Interfaces**
- GPIB, RS232, UDP, TCP
- DAQ, IOpiggy, ...
- XCP
- VN1640, VN8900, ...

**Remainig Bus Simulation**
- Test Feature Set

**Bus communication (CAN, LIN, Ethernet, FlexRay, MOST, K-Line, ...)**
We support you with various kinds of tests

- Functional Tests of ECUs with stimulation / measurement of IOs
  > Integration of network communication and electronic signals

- Gateway Tests
  > Routing of messages and signals

- Diagnostic Tests (ECU functional behavior)
  > E.g. check of fault memory entries

- Conformance Tests
  > For standard protocols, based on OEM specific specifications

For various application areas

- Interactive Tests
  > With graphical user interface

- Automated Tests
  > With monitoring of test progress

- Endurance Tests
  > E.g. with different environmental conditions (control of climate chamber)
Functional ECU Tests with VT System

VT System Extensions
- Specific modules (e.g. relay modules for connection of measurement devices)
- Industrial PC
- 19” rack with connectors for SUT, wiring

Test Report

VT System
- CAN, LIN, FlexRay
- EtherCAT

SUT
- Analog/Digital IO

Power Supply SUT

CANoe
- Test Cases

Vector Testing Engineering Services
VT System Based Test Solutions For...

- Energy / Battery Management Module
- Braking System
- Wiper Module
- Electric Sunroof Control Unit
- Passive Safety Module
- Headlights Control Unit
- ABS Control Unit
- Tire Pressure Control Unit
- Power Steering Module
- Multiplex System
- Rain Sensor Module
- Park Distance Control Unit
- Valve Control Unit
- Central Body Component
- Cockpit Module
- Exhaust Door
Gateway Tests / Conformance Tests

Common Symbol Databases: dbc, fibex, arxml, cdd, odx, a2l, ...

Test Case Generator

Routing Information & Test Requirements

Test Cases

Gateway ECU

CANoe

CAN
LIN
FlexRay
Ethernet

Test Report

Development of Test Package and Test Case Generator
Example VAG Test Package Cover VW80118 & VW80119

ECU Test Base Documentation

Test Configuration Generator

CAN Database

GUI Interface

CANoe Test Package VAG

CAPL Test Library

CANoe Configuration

CANoe Test Execution Platform

XML

CANoe Test Report
Automated Test Process With CANoe.DiVa

Enhance quality, reduce cost!
Automated Test Process With CANoe.DiVa

VT System

Temp. Sensor

IO Control

Read (19, 22)

control

measure

control

check

ECU

System under Test

CANoe IL

txMsgTemp

CANoe IL
CANoe.XCP - Comprehensive ECU Access for Testing and Analysis
1. Creation of XCP devices, assign an a2l
2. Select parameters directly from the a2l file

3. Configure selected parameters with DAQ, OnConnect or polling mode
4. CANoe system variables are created implicitly
Test bench with VT System example
Agenda

Testing Overview
HIL Test Bench: CANoe + VT System
Testing Design: vTESTstudio
Test Data Management: vTESTcenter
Testing Engineering Services

Summary
Vector Test Solution in the V-Model

- **Customer Requirements**
- **System Requirements**
- **System Architecture**
- **Component Design & Impl**
- **Simulation & Debugging**
- **Test Design: vTESTstudio**
- **Realtime HIL HW: VT System + VN's**
- **Test Execution: CANoe**
- **Component (ECU-) Test**
- **Integration Test**
- **System Test**
- **Validation**

Legend:
Traceability (in color of tool where it is created)

Not visualized:
System artifacts and traceability there

Report

MC Hardware: VX 1000

for AUTOSAR: vVIRTUALtarget

Test Data Management & Test Management: vTESTcenter
Visit our Website:

vector.com/vTESTcenter
vector.com/vTESTstudio
vector.com/VTsystem
vector.com/CANoe

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Vector China