VT System
Smart HIL Testing

V1.0 2010-06-04

Agenda

> ECU Testing

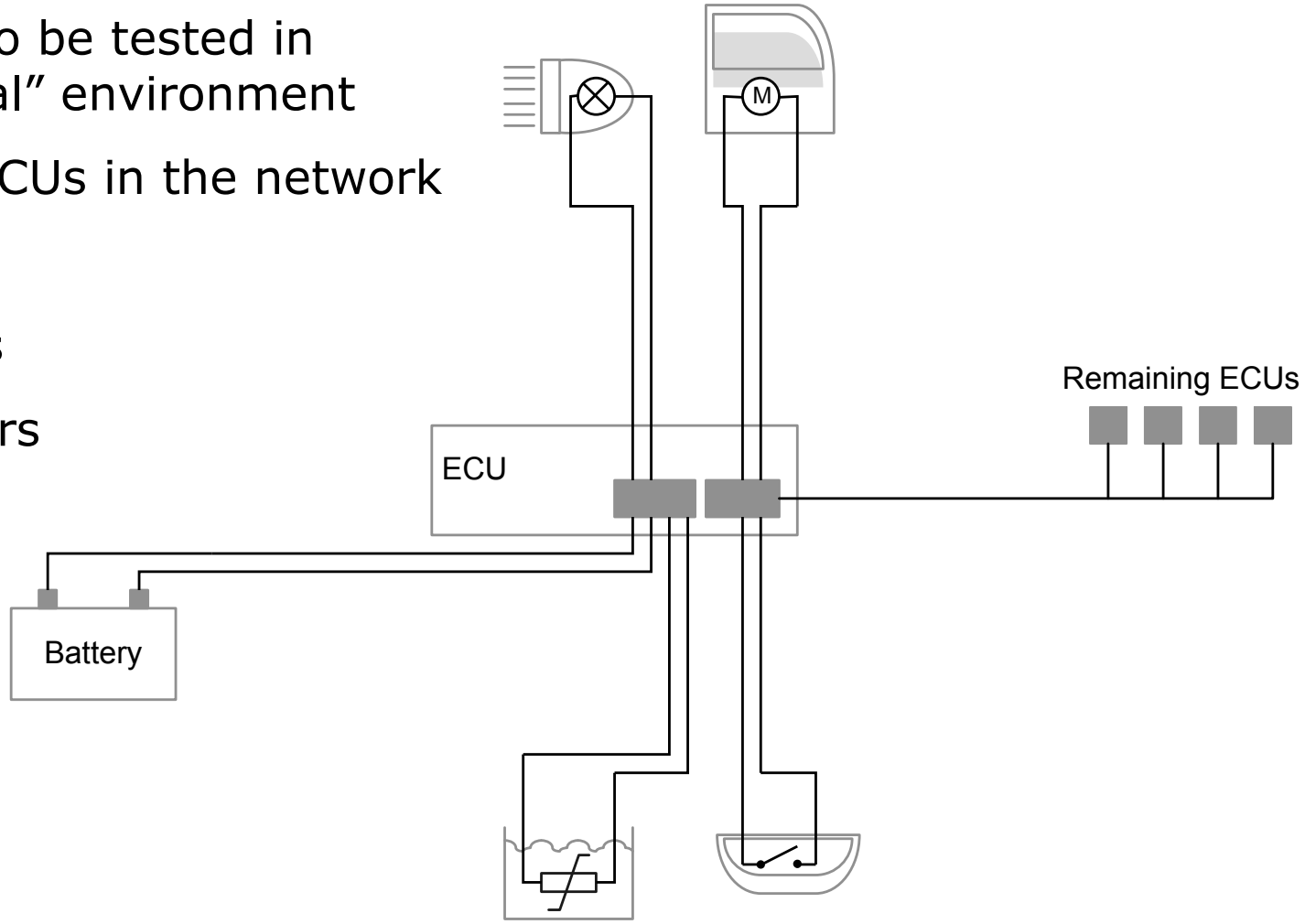
Testing a Door Control Unit

Summary and Outlook

ECU Testing

I/O Access for ECU Testing

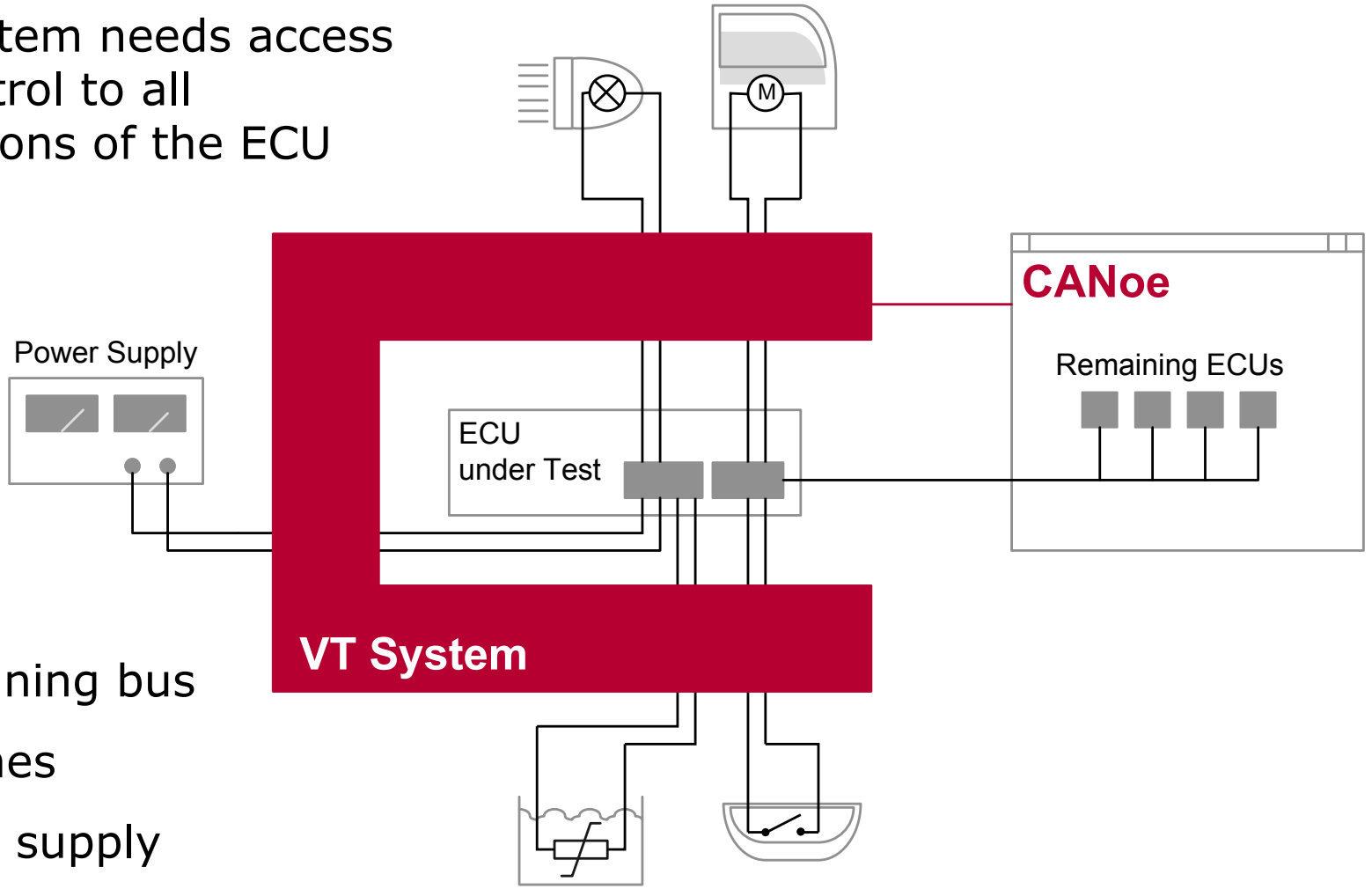
- ECU has to be tested in its “natural” environment
  - Other ECUs in the network
  - Battery
  - Sensors
  - Actuators



ECU Testing

I/O Access for ECU Testing

- Test system needs access and control to all connections of the ECU



- Remaining bus
- I/O lines
- Power supply

ECU Testing

VT System Concept

- Highly integrated modules to cover the complete testing requirements of an input or output channel
  - Stimulation
  - Measurement
  - Fault injection
- Minimal cabling, no additional hardware
  - Focus on test case development
- Modular and scalable
  - From developer‘s desk to dedicated HIL systems
- Electric characteristics suited to automotive requirements
- Connection to CANoe via EtherCAT®
  - Fulfills real-time requirements
  - Connection via standard Ethernet interface

EtherCAT®

vector

Agenda

ECU Testing

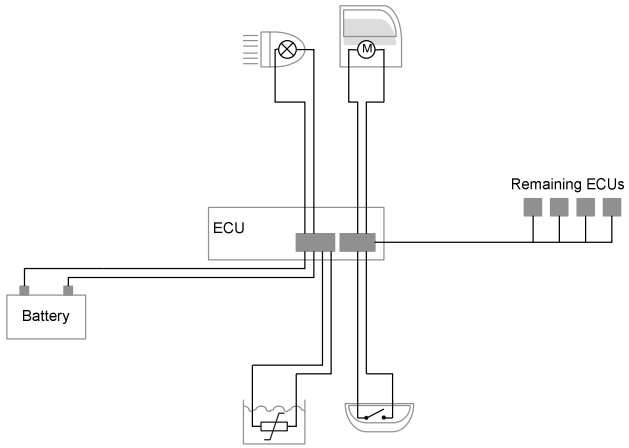
> **Testing a Door Control Unit**

Summary and Outlook

Testing a Door Control Unit

Motivation

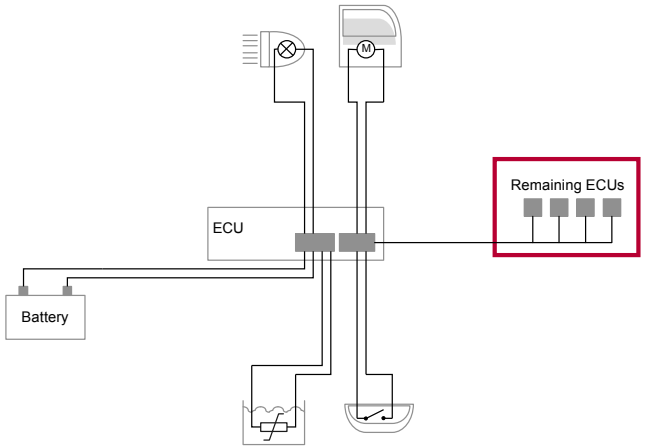
- Door control unit operates
  - Mirrors
  - Window lifts
  - Locking system
- Test requirements
  - Test of different use cases
  - Handling of failures
  - Monitoring of energy consumption
  - Test of diagnostic interface



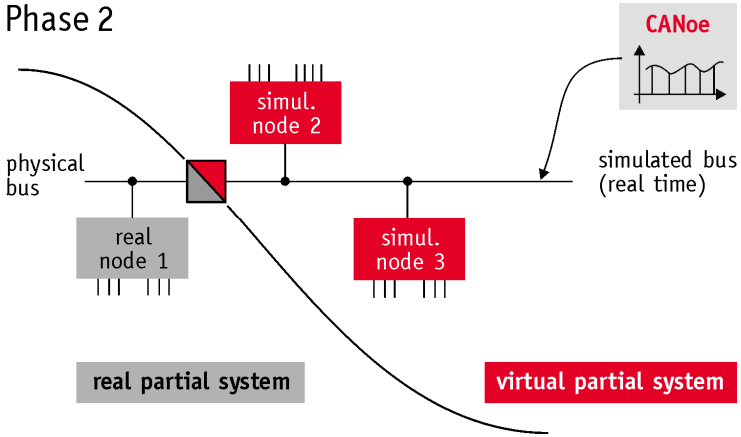
Testing a Door Control Unit

Remaining bus simulation

- ECU needs communication with other ECUs
  - Central Locking System
  - Control of mirror and windows at other door

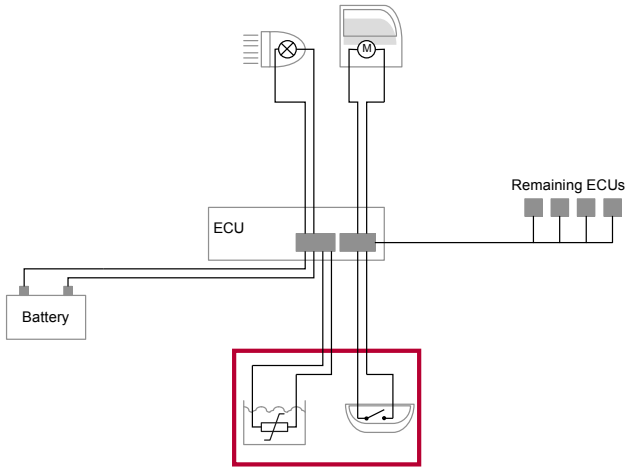


- CANoe provides means to simulate missing ECUs
  - Manual programming
  - MATLAB®/Simulink® integration
  - Generation from Communication Database



Testing a Door Control Unit

Sensors



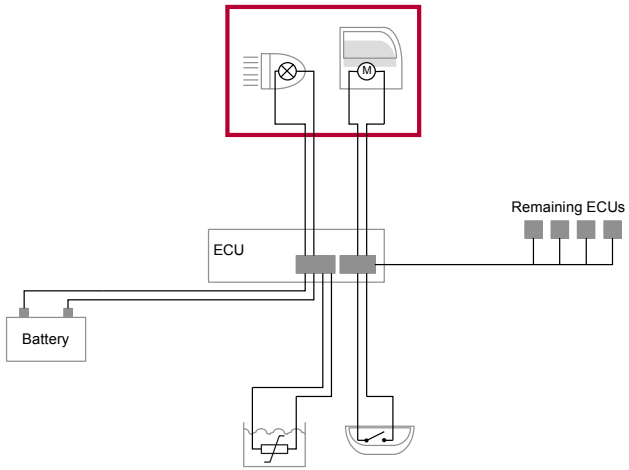
- Sensors provide information about environment and signal user requests
  - Doors closed?
  - Position of window
  - Control switches and buttons
  - …
- Test requires generation of specified sensor signals

- VT System generates sensor input
  - Constant voltage, PWM, Wave form
  - Decade resistor
  - Faults like short circuits or open circuits
  - Directly controlled from CANoe

Testing a Door Control Unit

Actuators

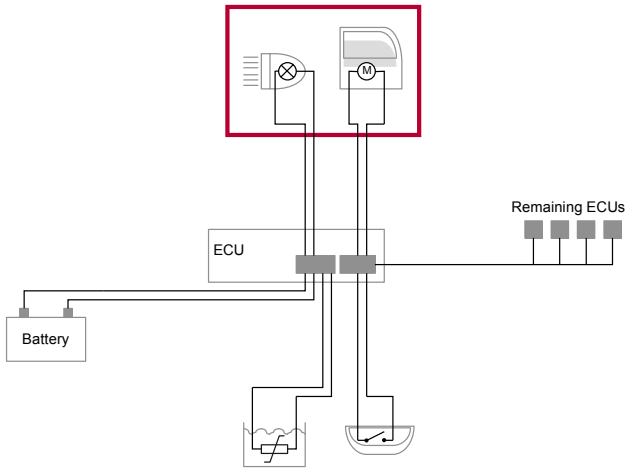
- Actuators are operated by ECU according to sensor input and internal state
  - Window lift motor
  - Mirror servo
  - Lock
- ECU detects missing actuators
- Test checks output for specified combinations of input signals



Testing a Door Control Unit

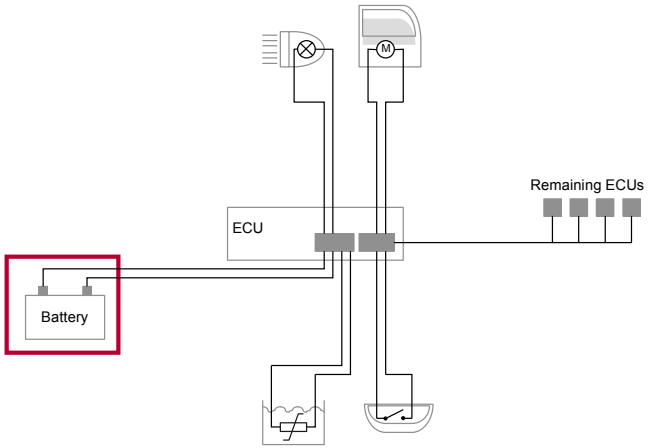
Actuators

- VT System simulates actuators with electronic load
  - Original components not needed for test
  - Efficient simulation of different situations
- VT System measures ECU output
  - Plain voltage measurement
  - Averages and RMS computed on module
  - PWM frequency and duty cycle
  - Available for automatic tests in CANoe
  - Visualization in CANoe, e.g. as graph



Testing a Door Control Unit

Power Supply

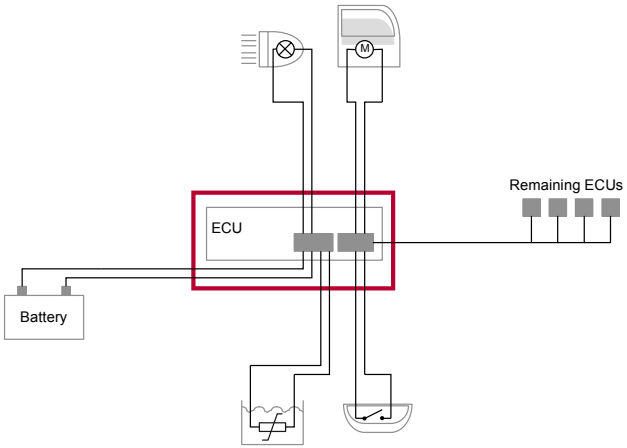


- Low energy consumption is an important requirement, especially for vehicles with electric drive
- ECU must be able to compensate certain fluctuations of supply voltage
- Handling of failures

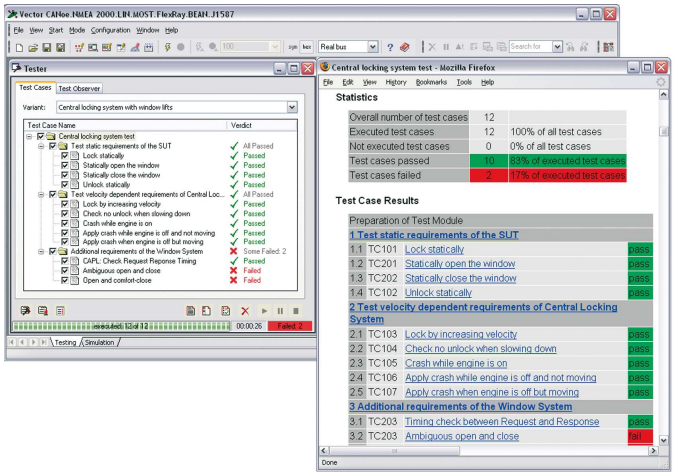
- VT System measures supply voltage and current
  - Handles high currents up to 70A for one supply line
  - Low currents can be measured with µA resolution to check sleep states
- Simulation of different scenarios
  - Control of external power supply via analog signal or RS232 port

Testing a Door Control Unit

ECU Access and Test Control



- Test of diagnostic functions
- CANoe provides diagnostic framework
  - Support for CANdela and ODX databases
  - VT System can be used in automated diagnostic tests with DiVa e.g. for fault injection
- White Box testing with direct access to internal values of the ECU
  - CANoe provides CCP and XCP interface
- Test control with CANoe Test Feature Set
  - Test sequences can be created using XML, CAPL or .NET
- Automatic generation of test reports



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ECU Testing

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> Summary and Outlook

Summary and Outlook

Benefits

- Integrated all-in-one hardware interface for ECU I/O testing
  - All basic test components included (relays, decade resistor, …)
  - Fills gap between standard I/O card and ECU under test
- Fulfills automotive test requirements concerning voltage, currents, latency, through-put, …
- Simplifies wiring of even complex test stands
- Fully integrated in CANoe: direct and simple control of I/O for test, simulation, and analysis
- Scalable test solution: from compact off-the-shelf I/O box at developer's desk to component HIL racks in the lab

Summary and Outlook

Upcoming Extensions

- Dedicated PC Module for real-time part of CANoe
  - Atom or Core 2 Duo CPU on highly flexible COM Express module
  - Improvement of real-time capabilities
- Network Interface Module VT6104
  - 4 channel CAN, LIN
  - Based on well-established CANcard XLe technology
  - Contains relays for short circuit, open wire, termination
- Extension Module VT7900
  - Base board for the realization of application-specific VT System modules
  - Digital and analog I/Os allow simple application boards

Thank you for your attention.

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www.vector.com

Author:

Vector Informatik GmbH
Ingersheimer Str. 24
70499 Stuttgart