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Vehicle CAN network communication function conformance test

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Abstract

With the rapid development of pure electric vehicles, more and more ECUs (Electronic Control Unit) are applied to the entire vehicle to form a network. In the process of network development, in order to ensure the integrity and correctness of network operation, verify the actual network system the degree of compliance of a specification or agreement, multiple tests are required. This article is based on the Controller Area Network protocol ISO11898-2 and the vehicle communication protocol formulated by the OEM. From the perspective of black box testing, test cases are designed, and the test tool CANoe from Vetor is used to build a test platform. The test method has completed the CAN network communication function consistency test of an electric vehicle.

Keywords

Controller Area Network , Vehicle function test, CANoe, Conformance test.

1. Introduction

In recent years, electric vehicles with low noise, high efficiency and energy saving have become the development trend of the automotive industry[1]. CAN bus technology has also been increasingly used in pure electric vehicles. At present, CAN bus is also between the various ECUs The main network for communication, so the vehicle network test based on CAN bus is also essential.

At present, V-model development processes are used in domestic and foreign vehicle network design models. In the V model design process, verification and confirmation always run through each design step, and testing plays a very important role in the entire development process. In order to ensure the correctness and efficiency of CAN network development and reduce its development cost, we often need to use special tools to strictly test its development link. We must check whether the developed CAN bus node device meets the design specifications and check the integration Whether the subsequent CAN bus system meets the initial requirements can enter the market only if the test and evaluation of each link meets its requirements.

Reference [2] tests only one node of electric power steering (EPS). Reference [3] only tests the power of electric vehicles and pays more attention to the performance of a single node. When a single node is connected to form a complete CAN network, the integrity and correctness of the entire network cannot be guaranteed. This article mainly tests the communication function of the CAN network of a pure electric vehicle. It uses CANoe, CANScope and other test tools to build a test platform, tests on the real vehicle, analyzes the test results according to the vehicle protocol specifications, and verifies the vehicle network Consistency with protocol specifications.

2. Overview of vehicle CAN network function conformance test

Network conformance test is a test of the conformity of an actual network system with its given specifications or protocols. It is a black box test, that is, it does not care about the internal procedures of the system under test during the test process, analyzes and observes the preconditions, and implements Process and post-conditions, the tester does not need to consider the program coding structure, but only needs to understand the relationship between the program input and output, or the

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function of the program. After the formulation of the network protocol is completed, each development department independently develops network components according to the formulated protocol. During the development process, due to differences in the understanding of the developers by the protocol, the components cannot communicate properly during networking. The mutual communication capabilities of components produced by different units need to be tested for consistency to ensure the normativity and correctness of component development.

The vehicle CAN network test has a wide range. According to the test content, it can be divided into two categories: functional test and performance test. This article is mainly a test of the communication function of the CAN network, that is, detecting whether all nodes in the CAN network can receive and send data normally. The vehicle CAN network function test mainly refers to the network protocol test, that is, to test whether each CAN node in the network can complete its communication according to the communication protocol, and reversely verify the correctness of the communication protocol design in conjunction with the ECU functional requirements. There are three main functional test methods: manual test, semi-automatic test, and automatic test. Among them, manual testing means that the tester gradually operates the test object according to the test specifications, observes the test results, and records and analyzes them; Automatic testing refers to the test developer designing and writing test cases, and then the testers implement all functional tests according to the test cases. The test system automatically records the test results and generates a document in a specified format, that is, a test report. Finally, the test report is analyzed for communication. Provide the reference basis for the improvement of the protocol and the functions of each node in the CAN network; The semi-automatic test is between manual test and automatic test, and the test system takes part of the tester's work. When the number of nodes and signals in the network under test is small, manual testing is sufficient to complete the test task.

3. Test case design

Many small test cases can form a complete test. How to properly design test cases is a very important part of the entire test work. When designing test cases, you need to analyze the requirements specifications, determine the test data input to the system under test and the data output from the system under test, and perform a comparative analysis based on the output data and the protocol to verify whether the system functions properly. There are not only correct inputs but also wrong inputs in test cases to verify the system's ability to handle error conditions. Therefore, the designed test cases are divided into normal use cases and abnormal use cases. However, to test the vehicle CAN network communication function, the test tool only connects to the network as a monitoring tool and does not send messages to the CAN bus. Instead, it reads the messages sent by each node directly from the actual network. Trace in the software is displayed and compared with the protocol to see if the packets sent by the actual network are in accordance with the protocol.

4. Test

4.1 Test platform setup

This article uses a model of the network topology of a vehicle model to build a test platform. The PC is used as the execution environment of the vehicle CAN network test system. The USB-CAN1 interface card is used to connect to the actual network of the electric vehicle to test the function of the vehicle CAN network test system. In this network topology, the CAN network baud rate is: 250kbps, including BMS, MC, Charger, INFO, INS, This model uses a high-speed network without a gateway.

4.2 Test item execution

Test tool: Network test simulation tool CANoe

Test steps: (1) Connect CANcase and USBCAN2 to the vehicle and PC on the test platform. The CAN1 port of CANcase is connected to the CAN bus line of the real vehicle through the DB9 interface.

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The CANcase is connected to the USB interface of the PC through the USB cable. Finally, check if the network connection is correct.

(2) Open the Configuration window in the CANoe software and configure the network hardware. The communication port is set to CAN1 and the baud rate is set to 250kbps.

(3) Turn on the ignition switch of the real car and start the software reception, open the Trace window, and observe the message data in the Trace window.

After connecting properly, follow the steps to run and read the vehicle data.

5. Conclusion

This article studies and analyzes the CAN bus system conformance test. According to the test specification of a pure electric vehicle, according to the defined CAN bus protocol, the test scheme and use case are designed, and the test case is executed. After the communication function consistency test, according to the protocol specification, the message communication function of the ID defined in the pure electric vehicle network meets the vehicle protocol communication specifications and requirements.