Research and Implementation of New Energy Vehicle Servo Motor EMC Testing System

Peipei Li*, Qingjun Deng, Yi Zhao, Jianyu Hu, Yong Liu, Ying Zhao

Chongqing Institute of Metrology and Quality Inspection, No.1, Yangliu North Road, Yubei District, Chongqing, China
Email: qingxianwawa05@126.com

Abstract. This paper studies the research status of electronic and electrical parts of new energy vehicles and analyzes the working principle of new energy vehicle servo motor electromagnetic compatibility (EMC) test device. Then developed a general EMC auxiliary test system for vehicle servo motor. The test result curve of the auxiliary test system is presented. The results show that the entire auxiliary system meets the requirements of standard test methods. And it can provide EMC testing services, technical consulting services and EMC comprehensive solutions for component manufacturers.

1. Introduction
Since the birth of the first electric vehicle in the mid-19th century, it has experienced a long and bumpy development history. In the early 20th century, with the development of internal combustion engine, pure electric vehicles withdrew from the market. In the 1960s, the oil crisis made people pay more attention to pure electric vehicles again. In the 21st century, along with the improvement of battery technology and the worldwide requirements of energy conservation and emission reduction, new energy electric vehicles have ushered in a period of rapid development [1]. Electric vehicles have evolved from a simple means of transportation to the modern new energy vehicles which focus on safety, comfort, intelligence, entertainment and information integration [2].

With the continuous implementation of domestic new energy vehicle certification, the EMC problem of servo motor of new energy vehicle is becoming more and more prominent. As the national standard does not make a unified and clear provision for the automotive electronic test status, automobile manufacturers generally formulate their own enterprise standards. The state of new energy vehicle electronic test is regulated by the manufacturer. When different manufacturers test the same servo motor, the loading state is quite different. It has a certain impact on the test results of electromagnetic compatibility radiation disturbance project, which increases the uncertainty of the test results. Especially in some extreme cases, it may lead to two different results: pass or fail. Therefore, the new energy servo motor auxiliary test system which is developed in this paper can realize uniform and accurate loading during the electromagnetic compatibility test of the servo motor. It greatly improves the repeatability of the test. The new energy servo motor auxiliary test system is used for the radiation emission test auxiliary device. The radiated emission must meet the requirement of CISPR25 standard. It should be below the limit value of 6dBμV/m [3].
2. Operating principle
The entire system is divided into three parts, the first part: power module; the second part: Electrical and measurement module; the third part: mechanical module. According to the power supply type of the tested motor, the front-end power supply which is corresponding to the system is provided. Such as DC regulated power supply, single-phase power supply and three-phase power supply could be supplied for testing. The electrical and measurement module includes test cabinet, instrument and meter device, electrical circuit and protection circuit. The measurement and control part of the system adopts high-precision electrical parameter test unit and high-precision torque and speed sensor, which can fulfil the requirements of accurate measurement for various types and grades of motors. The mechanical module includes the dynamometer host, water cooling system, dynamometer bench and installation fixture, and the test platform was set up.

According to the performance characteristics of the motor under test, magnetic-powder-type and eddy-current-type loading equipment can be selected in the part of the loading device. The system has high test accuracy, good repeatability, strong operation stability, high parallel efficiency, high durability and quality and easy to operate. It can test the no-load characteristic, load characteristic and blocking rotor performance of the motor [4]. It has manual and automatic control mode. Manual control mode is testing without the computer controlling system. And automatic control mode is that the test is controlled by computer. The auxiliary test system block diagram is shown in Figure 1.

3. Software architecture
The flow chart of the software is as follows: First, fill in the information and set the parameters. The software continuously reads the data collected by the control instrument and electrical parameter instrument and monitor whether the actual operation matches the set value.
When the deviation occurs, it can be adjusted and corrected continuously by adjusting the excitation current value, forming a closed-loop control. At the same time, all test data is recorded and stored. The final result can draw the coordinate curve of the power, current, voltage and torque data which is collected in the test process. It can be used for servo motor no-load, half-load, blocking rotor, durability and other working conditions [5]. System software diagram is shown in Figure 2.

4. Test Results
In order to ensure that the new energy servo motor auxiliary test system which is developed in this article can be used for darkroom servo motor testing, the test system is arranged in accordance with CISPR25 standard requirements. Making the auxiliary test device work at 3000r/min and set the torque to 5Nm. And Choose the most disadvantageous state that may be involved in use. Take the frequently used radiation disturbance limit level 3 as the limit and the test results are shown in Figure 3 to Figure 6.
Figure 3. 150kHz-28MHz Pk and AV test results

Figure 4. 30MHz-250MHz Pk and AV test results

Figure 5. 250MHz-960MHz Pk and AV test results
Figure 6. 1447MHz-2500MHz Pk and AV test results

From the above test results, it can be seen that the maximum external radiation disturbance of new energy servo motor auxiliary test system is much lower than the 10dB μV/m limit value so that it meets the standard test requirements [2].

5. Conclusion
This paper introduces the test situation of electromagnetic compatibility of new energy vehicle servo motor and other electronic and electrical parts, and gives the working principle and test result curve of new energy vehicle servo motor auxiliary detection device. The device can test the electromagnetic compatibility of servo motor and other auto parts, and meet the test requirements. This device is easy to operate and it provides a good technical support for the laboratory and enterprises to carry out the detection of the project.

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