Research on Detection and Fault Diagnosis Technology of Electric Vehicle Charging Facilities

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Abstract. This paper uses waveform analysis method and data flow analysis method to study fault diagnosis and elimination. Based on the experimental results, the data flow analysis method and waveform analysis method of the vehicle were analyzed in depth. Apply fault diagnosis to find a fast fault diagnosis scheme to determine the hidden dangers of charging pile failure. The advantages and disadvantages of various fault diagnosis methods in maintenance practice are obtained.

1. Introduction
With the continuous improvement of the degree of automation and intelligence of automobiles, the electronic control technology of charging piles has continuously developed, and higher requirements have been placed on automobile after-sales services, especially maintenance. At present, in most cases, maintenance personnel of maintenance companies use simple and rough replacement methods to replace suspicious parts, and if the fault has not been eliminated, replace the relevant parts. Until the failure disappears. [1-6] With the development of automobile technology and electronic technology, the electronic control system of the charging pile has become more and more complicated. Because the use of electronic control technology in various systems of the charging pile has a positive impact on the performance of the charging pile.

2. Basic composition of electric control system for charging pile
The charging pile electronic control system consists of sensors, control units and actuators. The sensor is responsible for measuring and collecting signal parameters under various working conditions of the charging pile, and transmitting the measurement signals to the control unit. The control unit is responsible for processing various signals sent by various sensors after acquisition, calculating control instructions, sending them to the actuator, controlling the actions of the actuator, and completing related functions. The actuator is responsible for receiving control instructions from the control unit and performing related operations. A part of the actuator is also responsible for feeding back signals to the control unit to form the closed-loop control of the electronic control system of the charging pile. The sensors and actuators in the charging pile are basically the same, and different charging piles will be different.

Electric vehicle charging piles have more complex features, which not only affect the efficiency of electric vehicle use, but also directly affect the safety of users' lives. This also highlights the importance of the testing work of electric vehicle charging piles. In the specific test object, the charging AC pile is first energized. The on-load switching circuit and the like must be inspected. At the same time, it is detected whether there is an abnormal connection between the on-load switching
circuit and the high-power AC load. Test confirmation and charging preparation are the key processes of interoperability of AC charging piles. Second, testing of non-vehicle charging piles is mainly to detect whether there is a deviation in the output voltage, to detect the current situation of the charger and other deviations in the output current. The current adjustment time detection should be compatible with AC power and DC load, and the output current control deviation detection is also the same. Finally, the non-vehicle charging communication protocol is checked for consistency, mainly to detect the charging process and related configuration parameters. During the specific test, the environment and time can easily affect it, so the above test content must be optimized appropriately.

3. Detection technology of electric vehicle charging pile
The charging pile is basically composed of a DC charging pile and an AC charging pile. In the case of a DC charging pile, the battery of the electric vehicle's battery management system and the DC charging interface can be used to directly charge the power battery. The AC charging pile is charged by the on-board charger under the application of the AC charging interface of the electric vehicle. There are differences in the testing equipment and methods between the two charging facilities. The detection system can test the interoperability, electrical performance and communication protocol consistency of DC non-vehicle chargers and AC charging piles, and is basically composed of oscilloscope, AC power, AC load, DC load, AC interface simulator, battery simulator, DC interface simulator and other equipment.

As far as safety detection technology is concerned, it usually includes: ①. Consistent charging operation, technical testing and diagnostic protocols for charging stations. Innovative research and development of automatic detection of charging piles, improving the level of safety and charging compatibility testing of cars and charging piles, can significantly reduce the influencing factors in test field preparation and testing; ②. Use of photovoltaic power plants. In terms of device mounting and power supply, features such as stability and safety are essential. During the inspection process of the outer end of the car, the inverter can apply the single crystal photovoltaic power generation solar panel to the power supply of the experimental equipment, so that the operation process can be optimized. Even if it cannot be connected to the field test power supply, it can still provide a guarantee for the smooth development of the experiment and supplement the test power supply in a timely manner.

4. Charging pile fault diagnosis instrument reads fault code diagnosis
Since the charging pile electronic control system has a vehicle self-diagnosis system, if the ECU detects abnormal data of some components during the engine operation, its self-diagnosis function will automatically store the fault code. While maintaining the dimensions, maintenance personnel can easily read with the instrument and determine the nature and approximate scope of the fault. Therefore, the fault code priority principle should always be followed when diagnosing faults in the automotive electronic control system. First, the fault diagnosis instrument should read the fault code. Commonly used troubleshooting tools are Bosch KT600 (Figure 1) and Yuanzheng X-431progt (Figure 2). For some specific brands, it is recommended to use a specific brand of diagnostic equipment.
Defects of fault diagnosis using read fault code: The fault code stored in the charging pile ECU fault code memory needs to be recorded. If the component circuit must be monitored by the electronic control system, and the signal value exceeds the standard range after the fault occurs, and the fault time and frequency reach a certain level, the self-diagnostic system will record the fault code and the relevant fault on the optical instrument panel. Some of them are unexpected failures, and the electronic control system does not store the failure code at all. Therefore, it is obviously not feasible to eliminate the fault simply by calling the fault code.

Fault code diagnosis relies on the automatic diagnosis function of the engine's electronic control system. By reading the fault code recorded by the electronic control unit during the engine operation, the fault location can be initially determined by the fault diagnosis instrument. Generally speaking, the fault codes recorded by the system only indicate the diagnostic direction of reference for fault diagnosis. For example, if the fault code reported by the electronic control system is the fault code of the oxygen sensor signal, does this mean that the oxygen sensor itself is damaged? At this time, it cannot arbitrarily draw conclusions. In this case, the sensor itself may be damaged, but other fault causes may also cause the engine electronic control system to record the fault code of the oxygen sensor. This will lead to a misjudgment of fault to a certain extent. If maintenance personnel blindly believe that the fault code tells them to perform maintenance without intentional judgment, they may inevitably make the wrong direction. This requires maintenance personnel to be familiar with the vehicle, to have solid professional knowledge, and to be able to use the knowledge they have learned to analyze faults. The fault code memory usually stores only some common faults of the electronic control system and cannot be issued. Includes fault information for all parts of the motor. Sometimes the fault code only gives a vague range, even if the maintenance personnel read the information, it will not help. Due to the contagious nature of the faults in the electronic control system, some fault codes were recorded. It is necessary for maintenance personnel to further diagnose the fault by combining professional knowledge.

5. Troubleshooting using data flow analysis
Data flow generation Data flow refers to the electrical signals transmitted between the sensor actuator of the engine's electronic control system and the ECU, which reflects the real state information of the engine system at work, and changes in real time as the engine operating conditions change. Use the fault diagnosis instrument to connect the engine computer or access the circuit to obtain the data stream, and the fault information can be analyzed by comparing with the standard data range.

Figure 1. Kindergarten KT600

Figure 2. Yuanzheng X-431pro
Data flow analysis

Data flow is generally divided into numerical parameters and state parameters. Generally, numerical parameters have a normal parameter range. By comparing the data flow parameters collected in real time, abnormal data can be found, and the fault range can be determined from the abnormal data. Status parameter information, such as on or off, yes or no, high or low. From the data flow, we can see whether it is consistent with the normal state, and the inconsistency is the fault information.

6. Troubleshooting for waveform analysis of each sensor actuator

The basic situation of Kingdee KT600 automotive oscilloscope is a specialized automotive oscilloscope independently developed by Bosch Automotive Test Equipment (Shenzhen) Co., Ltd. Waveforms from sensors for ignition, fuel injection, and electronic control systems can be collected in real time. By analyzing the waveform of the sensor, it is possible to accurately diagnose the fault of the sensor. By analyzing the ignition waveform, it is not possible to diagnose only the faults of ignition system components such as spark plugs, high-voltage wires, and ignition coils. It can also analyze the possible faults of the car charging pile, and provide a scientific basis for the operation and fault diagnosis of the car.

Basic function: The development of KT600 oscilloscope function has realized the real-time display of the secondary ignition waveform for the first time in China. The 32-bit main control CPU + high-speed digital processing chip is an industry-leading device, ensuring that signals can be processed in real-time at a sampling frequency of up to 20 MHZ. High-speed five-channel automotive oscilloscope that can store reference waveforms. Vehicle primary and secondary ignition waveform analysis; there are many secondary waveform display modes, such as vertical, three-dimensional, array, single cylinder, and display ignition breakdown voltage, closing angle, combustion time, etc. Accurate ignition synchronization, automatic detection of the polarity of the ignition signal, whether it is distributor ignition, independent ignition, double-end ignition can be reliably detected, which is equivalent to a handheld engine analyzer. It has the function of a universal oscilloscope. _ Logger function. Oscilloscope connection (Figure 3) Using an oscilloscope: After the oscilloscope is connected to a power source, you can select an oscilloscope probe cable. The end of the oscilloscope has five interfaces, four channels for oscilloscope signal input, CH1, CH2, CH3, CH4, CH5 and channel 5 (CH5) are the trigger signal source interfaces. The oscilloscope probe is placed in the X10 or X1 gear according to the operation interface prompt.

![Oscilloscope connection diagram](image)

Figure 3. Oscilloscope connection diagram

The advantage of using an oscilloscope to diagnose faults is that some signal faults are unexpected faults, and not all problems can be found by reading the data stream. But the use of waveform analysis can show every minute of data changes on the waveform, which has a considerable advantage in eliminating difficult diseases. For example, when a sensor is worn at a certain position, when the
throttle is opened, the instantaneous voltage suddenly becomes 0V, and other periods are normal. In this case, the failure cannot be found by using data flow analysis. By using the waveform analysis method, abnormal waveforms can be found immediately by comparing normal waveforms. The data collected by the oscilloscope are all collected online. The data stream is the second-hand data obtained from the ECU after the sensor or actuator is transmitted to the ECU and connected to the ECU through the fault diagnosis instrument. Sometimes, if the data is incorrect due to a partial failure of the ECU or a related circuit failure, in fact, the sensor data is normal. At this time, the sensor and its circuit problems may be misjudged, resulting in time and effort. But at present, through the combination of data flow and oscilloscope diagnosis, it is not difficult to find local faults of ECU or related circuit faults.

At present, the development speed of the electric vehicle and charging pile industry is increasing. Because the charging pile interface is relatively complicated and there are many detection items, there is a long detection time and the detection efficiency is affected. Adding more than one million charging piles, in the future development, we should focus on how to shorten the testing time and improve the detection efficiency. To achieve this goal, standard institutions, testing institutions, manufacturers, etc. must work together, Work together.

7. Conclusion
This article introduces the composition and working principle of the charging pile electronic control system, common fault diagnosis methods, and tools and equipment used in fault diagnosis. The shortcomings in the application of fault diagnosis methods such as multi-meter test, fault diagnosis instrument reading fault code, data flow analysis, and oscilloscope waveform analysis in charging pile fault diagnosis and the problems that should be paid attention to introduce the charging pile electronic control system.

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