Design of Program Control Interface of DC Charging Pile Verification Device

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Abstract. Design and manufacture a multi-function verification device for electric vehicle DC charging pile. This device is suitable for all levels of measurement department, charging pile Use Company and DC charger manufacturer. The accuracy of the DC charging pile verification device is 0.05, which is used for full-function verification before charging pile installation. It is mainly composed of high-precision standard electric energy meter, high-power program-controlled DC electronic load, main control unit and various functional modules. The DC charging pile verification device adopts the latest design technology and has stable and reliable performance.

1. Introduction
In recent years, China's new energy vehicle applications have gradually advanced. As of the end of last year, the number of new energy vehicles in China has exceeded 120,000. In the first half of this year, China's new energy vehicles produced a total of 76,223 vehicles, with sales of 72,711 vehicles, an increase of 2.5 times and 2.4 times respectively.

On October 9, 2015, the General Office of the State Council issued the “Guiding Opinions on Accelerating the Construction of Electric Vehicle Charging Infrastructure”. The "Opinions" clarify that China will use pure electric drive as the main strategic orientation for the development of new energy vehicles, and strive to basically build a moderately advanced, intelligent and efficient charging infrastructure system to meet more than 5 million electric vehicles by 2020.

Promoting the application of new energy vehicles will help alleviate energy and environmental pressures, promote the optimization of the automobile industry structure and upgrade consumption. Recently, the General Office of the State Council issued the "Guiding Opinions on Accelerating the Construction of Electric Vehicle Charging Infrastructure", deploying vigorously to promote the construction of charging infrastructure and solving the problem of charging electric vehicles.

In response to the charging problem, this opinion is clear, adhere to the main strategic orientation of pure electric drive development for new energy vehicles, and in accordance with the requirements of "pile station first", the construction will be carried out in an orderly manner to ensure that the construction scale is moderately advanced.

In terms of construction goals, the opinion is that by 2020, a moderately advanced, intelligent and efficient charging infrastructure system will be built to meet the changing needs of more than 5 million electric vehicles; establish a more complete standard and market regulation. The system forms a unified and open, competitive and orderly charging service market.

Charging piles are generally installed on the ground or walls, installed in public buildings (public buildings, shopping malls, public parking lots, etc.) and residential parking lots or charging stations.
After the charging pile is installed, it is impossible to go to the verification department for verification and verification work. Therefore, it is particularly urgent to design a portable device or device for charging metering of charging piles or charging stations.

2. Overall design of DC charging pile verification device

The DC charging pile is powered by a three-phase four-wire system, which can provide sufficient power, and the output voltage and current adjustment range is large, which can achieve the requirement of fast charging. The charging current is large, the charging is fast, and the energy of 200 kilometers can be satisfied after charging for about 1 hour.

The AC charging pile is generally added with an AC meter at the source of the AC charging pile. All the energy flowing through the meter is calculated by the user and increases the user charging cost. The DC charging post charging voltage is generally 400-800V, and the charging current is 0-500A.

The DC charging pile verification device adopts the real load structure for verification work, and the high-power program-controlled electronic load simulates the whole process of electric vehicle charging. The system uses the platform device, that is, it is equipped with a widely applicable hardware platform. The verification of the charging pile can be expanded in the future through software upgrade.

The inspection system is equipped with a standardized charging post charging interface, and the one-time wiring can automatically complete the preset test items. Equipped with PC software for verification device, it is easy and quick to operate. The program-controlled electronic load can be programmed according to the battery charging curve to simulate the charging process of the charging pile to the electric vehicle, realize the arbitrary verification of each charging load point, and can complete the verification of various specifications of the DC charging pile.

The DC charging pile verification device realizes full-function verification and in-service inspection before and after installation of the charging pile, including energy metering, charging, accounting management, communication, reading and writing card, data storage, safety performance, etc. of the charging pile.

3. Calibration device parameter setting interface design

Complete the wiring of the power supply interface, connect the network port of the verification device to the computer network port, connect the power cable of the verification device to the three-phase power socket, and press the main switch of the verification device to confirm that the verification device starts normally.

Open the user program control software of the DC charging pile verification device and enter the main interface of the detection system. First click on the “Parameter Setting Button” to set various communication parameters of the verification device and the verification scheme of the charging post. The charging pile communication parameter setting interface and the verification scheme setting interface are respectively shown in Fig. 1 and Fig. 2.

The user can complete the setting of communication category, network IP, network port, baud rate and other parameters in the charging post communication parameter setting interface.

Before the user can use the DC charging pile verification device for verification, the calibration plan must first be set. The system provides the user with a default solution for a wide range of charging pile verification, and will continue to increase the verification scheme in future software upgrades to meet the needs of different users, so it is recommended to use the default scheme for verification work. The default scheme cannot be changed and deleted.
If the user wants to customize the scheme, click the “Setting Scheme” button to set the size, time and sequence of the verification current to verify the charging pile. The custom scheme can be saved, changed and deleted, as shown in Figure 3.
After completing the parameter setting, click the “check device” button, the initialization icon box appears, set the parameters of the charging pile, confirm the verification plan, and click the “Complete the recruitment” button. The verification device initialization interface is shown in Figure 4.

![Figure 3. Parameter custom scheme interface.](image)

![Figure 4. Verification device initialization interface.](image)

After clicking Finish, you will be prompted to raise the source. Please make sure to stay away from the connection between the charging post and the verification device and click “OK” to prevent electric shock, as shown in Figure 5.

At this point, the power indicator of the charging post should be illuminated and the charging post starts normally.
Figure 5. Initialization completion prompt interface.

4. DC charging pile verification interface design
After correctly setting the parameters of the DC charging pile verification device, the DC charging pile verification work is performed. The system verification interface is shown in Figure 6.

The basic functions include communication test, metrology verification, and billing verification, all of which are mandatory items. The expandable feature is optional and can be added as needed by the user. However, because the acceptance criteria cannot be determined, the initial version of the software may not include scalable features and will be added to the software upgrade after the acceptance criteria are determined.

Click the “Start Calibration” button to start the DC charging pile verification process. After starting the verification, the communication check is automatically completed first, as shown in Figure 7.

Figure 6. DC charging pile system verification interface.
After the communication verification is completed, the system enters the measurement verification step. Before the measurement verification, the system prompts to ensure that the charging pile is in the charge ready state before the measurement verification can be performed. Otherwise, the verification device will alarm, as shown in Figure 8.

The system starts the metrology verification according to the preset scheme. Click "Hide Source Data" to hide the data of the standard table. The DC charging pile system metrology verification interface is shown in Figure 9.

After the measurement verification is completed, the charge verification operation is performed. Click the "OK" button to start the billing check. The billing verification user interface is shown in Figure 10.
The verification process is then completed, the verification results are displayed, and the data is saved, as shown in Figure 11.

Click the “Check Details” button to display the data for the metrology verification, as shown in Figure 12.
There will be a prompt before the measurement verification to prevent the user from disoperation of the charging pile. It is necessary to confirm that the charging pile enters the charging state and then click the "OK" button.

At any time after the start of the verification, you can click the “Stop Calibration” button to end the verification. However, due to the uncertainty of the interruption test, the system will not save the verification result of the interruption verification.

If there is an abnormal situation during the verification process, click the “emergency source” button, the system will cut off the power of the charging post, and the verification device stops working. Do not insert the charging post during the verification process to avoid damage to the verification device.
Before charging the check, you must first perform the charge settlement operation on the charging pile.

After the verification process is finished, the verification software will save the data, including: the model of the charging pile, the manufacturer, the verification result, the verification time, and the process data of each verification item, etc., for the user to view. After the verification data is saved, it can be viewed in the data management and exported as a table file.

5. Conclusion

The standard of charging facilities is not uniform, which will not only cause repeated construction, but also affect the user experience. This opinion clarified the principle of “unified standards and universal openness”, and proposed to speed up the revision and revision of key technical standards for charging and replacing, and promote the interconnection and interoperability of different charging service platforms to improve the versatility and openness of facilities.

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