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Design of Multi-station Semi-automatic Metering Transformer Testing Device

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Abstract. This paper presents a metering low-voltage current transformer integrated test bench with manually wiring and stiching structure. Through the transformer integrated test bench, it can realize the appearance inspection, insulation resistance measurement, power frequency withstand voltage test, secondary winding resistance inter-turn insulation test, magnetic saturation margin test and basic error test after manual wiring on the primary and secondary sides. Ampere error test, residual magnetic error test, error test under extreme working conditions, temperature rise test, instrument security factor test, etc.

1. Introduction

With the rapid development of China's power industry, the use of electricity in China has penetrated into all areas of society, economy, and life. China's power transformers are an integral part of the power system. Its usage increases at an annual rate. As a result, the output of transformers and the workload of verification increase dramatically [1] [2]. As a result, the workload of certified personnel increases, and the verification personnel do every day. Repeated work, and man-made operations may bring a lot of error. Therefore, if there is the assistance of automation equipment, the quality and efficiency of verification will be greatly improved.

According to the requirements of the low-voltage current transformer technical standard of State Grid Corporation, the provincial measurement center needs to perform full-performance detection on the transformer in accordance with the prescribed sampling and detection method for newly purchased batch transformers [3]. Low-voltage current transformers must pass the verification before they can be installed and put into operation on the site. Due to the large number of test items, many test instruments, and miscellaneous types, the traditional verification methods for the performance of low-voltage current transformers mostly employ workers' methods. The completion of the test on each station requires the manual handling, assembly, wiring, disconnection, and certification of the instrument and equipment to be performed many times, which consumes a lot of manpower and material resources and is labor-intensive and inefficient [4]. Pipeline verification system is mainly used for large-scale transformer verification, and only five performance tests such as insulation resistance test, power frequency withstand voltage test, secondary winding inter-turn insulation test, basic error, and magnetic saturation margin test.

Therefore, it is necessary to design a low-voltage current transformer integrated detection system that can overcome the above-mentioned shortcomings, perform sampling inspection and comprehensive performance evaluation on the arrival of low-voltage current transformers purchased through bidding, and ensure both the accuracy of measurement and the improvement of transformer verification [5]. The structure of this device should be able to be applied to the quality inspection of small batches of transformers as much as possible. In consideration of the comprehensive cost, site, and other factors, the test process is automated, but the flow of test samples and the manual completion of the wiring process are feasible and the most economical [6] [7]. Cost and space. Because the wiring and handling of small batches of test products are not the largest part of the workload, fully automated products do not have much advantages in terms of cost, space, and maintenance of future operations.

2. Design principle and mechanic structure layout

The device is mainly composed of a transformer comprehensive test control cabinet, a transformer comprehensive test test bench, a transformer comprehensive test system software platform, a desktop computer and a printer. The test bench includes a plurality of transformer tooling for placing low-voltage current transformers to be detected, and a plurality of pressing mechanisms are also provided on the test bench. The base of each transformer fixture is in contact with the base of the low-voltage current transformer and connected to the earth. Each transformer fixture provides secondary current terminals and voltage terminals. The low voltage current transformer secondary connection terminals are connected to current terminals or voltage terminals or both terminals are connected.. The module block layout schema of main test bench is shown in Fig. 1.

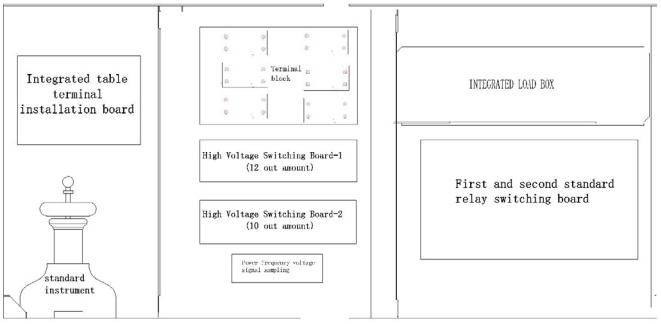

Fig. 1. The module block layout schema of the test bench.

The transformer comprehensive test test bench includes a first contractor mounting plate and a second contractor mounting plate. The first contractor mounting plate and the second contractor mounting plate are respectively provided with a plurality of relays, and one end of all the relays. All the relays are connected to the copper bar at the lower end of the pressing mechanism through a flow riser. The other end of the relay is connected to the primary terminal of the standard current transformer and the other relay is connected to the first high voltage relay driver board. The third relay is connected to the relay. The other end is connected with the second high voltage relay driver board. The structure of relay driver backplane is shown in Fig. 2.

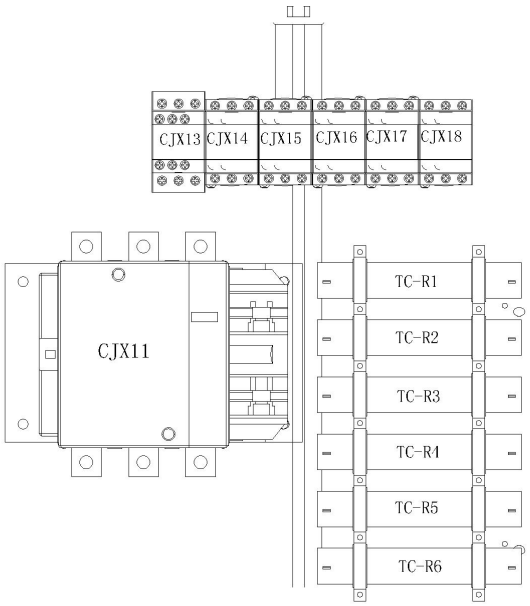

Fig. 2. The structure of relay driver backplane.

The system has also concentrated on the temperature inspection instrument, insulation resistance tester, instrument safety factor tester, DC resistance tester, voltage test circuit module, and secondary open circuit test circuit module. At this point, the system can be completed including insulation

resistance measurement, power frequency withstand voltage test, daytime insulation test, error test under room temperature conditions, magnetic saturation margin test, etc. Ampoule error test, residual magnetic error test, instrument security factor test ten electrical tests of low-voltage current transformers, including temperature rise tests and error tests under extreme conditions.

The main control chip of this system adopts floating-point arithmetic, built-in hardware multiplier, fast operation speed, and meets the requirements of high-speed collection and processing of muti-channel digital signals, ensuring the accuracy of verification data. The DSP chip expands the I/O port through the CPLD so that it can meet the requirements of LCD screen output, key signal input, signal processing control, A/D module control, and high-speed data acquisition. The SCI signal of the DSP chip is converted into a level signal by the RS485 chip, and the control of other instruments and equipment is realized through the bus. In addition, the serial signal of the DSP chip communicates with the upper computer through the network module chip. The control module block diagram shown in Fig. 3.

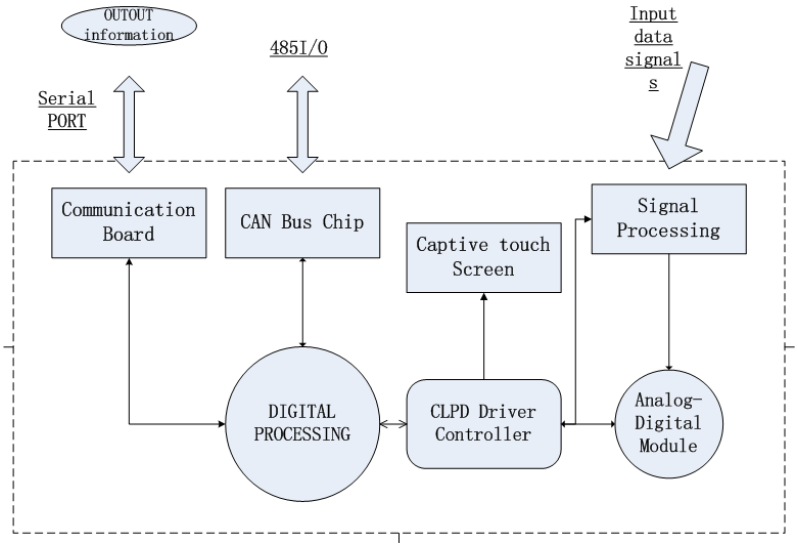

Fig. 3. The control block diagram of testing system..

3. Conclusions

This article presents a set of semi-automated current transformer test systems. The system uses automatic control technology, the use of test electrical equipment integrated control cabinet plus test bench form, to achieve the removal of manual disconnection of primary and secondary wiring transformers outside the automatic detection of performance. The actual use results show that compared with the traditional full-performance laboratories, the verification efficiency of the device is increased several times, saving manpower and financial resources.

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