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# ZCHG-A1

## CT/PT Testing System

# User Manual V2.0

❖KVTESTER ELECTRONICS TECHNOLOGY CO.,LTD.❖

## Dear Customers,

Thank you for purchasing our ZCHG-A1 CT Testing System. Before you use the product for the first time, please carefully read this Manual which can help you skillfully use the Tester.

Our aim is to improve our products continuously, so that the product you use may be a little bit different from the Manual. In case of any changes, we will inform you in the attached sheets! Thanks for your understanding. If anything is unclear, please contact the After-Sale Service Department in our company, and we will certainly meet your requirements.

Since the I/O terminal, testing column and etc. may carry voltage, electric spark may be produced when you insert and unplug the test lead, power socket and etc.. Please do be careful of electric shock and avoid hazards. Pay attention to your personal safety!

## Prudent Warranty

For the products manufactured by our Company, if the defects appear within 3 months from the date of delivery, we can provide the replacement; if the defects appear within one year from the data of delivery, we can provide free services and repairs; if the defects appear more than one year after delivery, we can provide life-long paid maintenance services.

## ◆ Safety Requirements

Please carefully read the following safety precautions so as to avoid personal injury and prevent the product or any other products connected thereto from being damaged. In order to avoid the possible dangers, the product can only operate within a specified range.

***Only the qualified technicians can implement the maintenance.***

### — Prevent Fire or Personal Injury

**Use appropriate power cables.** Only the dedicated power cables which conform to the specifications of the product can be used.

**Correct connection and disconnection.** When the test lead is connected to the charged terminal, please don't connect or disconnect the test lead at will.

**Earth the product.** In addition to be earthed using the power line, the earthing rod on the shell of this product must also be earthed. In order to prevent electric shock, the earthing conductor must be connected to the ground. Before the connection to the input or output terminal of the product, please make sure that the product has been properly earthed.

**Pay attention to the rated values of all terminals.** In order to prevent fire or electric shock, please pay attention to all the rated values and marks of the product. Before the connection, please read this Manual so as to gain more insight into the information on rated values.

**Never operate the product without an instrument cover.** If the cover or panel has been removed, never operate the product.

**Use appropriate fuses.** Use the fuses of the type and rated value specified for the product.

**Avoid touching the exposed circuits or charged metal.** When the product is electrified, never touch the exposed contacts or parts.

**In case of suspected failure, never operate the product.** If you suspect the product is damaged, please contact the maintenance personnel for examination and never operate the product.

**Never operate the product in a humid environment.**

**Never operate the product in an explosive environment.**

**Keep the surface of the product clean and dry.**

## — Safety Terminology

*Warning: Warning messages indicate the conditions or practices that may cause loss of life or personal injury.*

*Caution: Caution messages indicate the conditions or practices that may cause the damages to the product or other properties.*

# CONTENT

# 1 Summary

ZCHG-A1 automatic CT Testing System is a new generation of transformer automatic accuracy test system developed by our company to adapt to the fast and accurate characteristics of modern current transformer calibration. The device is composed of ZC-103 Transformer Verification meter, ZC-113B Programmable CT Load Box, ZC-123B PT Loag Box, ZCHG-A1 Transformer calibration device , computer and so on. The operator can set the type, range, accuracy level, secondary load, power factor, transformer station position and other main parameters of the transformer to be tested through the computer error verification management software. Through RS485 transmission and control, the measurement work of 12 current transformers with the same ratio can be completed at one time, which greatly improves the work efficiency.

# 2 System composition

| Name | Function |
|---|---|
| Transformer Verification meter | Current transformer technical performance verification |
| Programmable transformer Load Box | Provide various effective loads when testing transformers |
| | |
| Self-Ascending Standard CT | Provide the required high current for the test and also conduct data comparison for the transformers. |
| Standard PT | |
| Transformer verification management software | Data management, CT PT test control |

# 3 Functional Features

1) The device has three test modes: on-line automatic, single-machine automatic and single-machine manual.

2) The device adopts RS485 communication port, stable communication signal and strong anti-interference ability.

3) The primary and secondary wiring of the current standard transformer is automatically switched according to the parameters set by the computer.

4) You can choose any station for verification, and display the station in the test process synchronously.

5) The system has a variety of perfect protection functions such as over current and over voltage protection, polarity error, signal failure, etc

6) The error management software can record, print and back up the testing data according to the requirements of the verification regulations, and modify the certificate format as required

7) The device appearance design is beautiful, humanized function design, automatic function display, greatly optimize the working environment.

8) The voltage/ current load box's gear can be switched automatically through programming, eliminating the need for manual calculation and manual gear shifting.

# 4 Main Technical Parameters

## 4.1 Environmental conditions for the use of CT/PT testing system

1) Temperature: -10°C~50°C

2) Relative humidity: <80% (25°C)

3) Elevation: <2500m

4) Power frequency: 50Hz/60Hz ±10%

5) Power supply voltage (control loop and instrument power supply) : 220V±10%

6) Power supply voltage (voltage regulator input) : 220V±10%

## 4.2 CT/PT Testing system parameters

**Working range**

Current： Primary current： 5~3000A

Secondary current： 1A, 5A

Accuracy Class ： 0.02（S）

Voltage: Primaryvoltage:

(2.4KV, 4.16KV, 6.3KV, 7.2KV, 8.4kV, 13.2KV , 13.8kV, 23kV, 34.5KV, 46kV, 69KV）/$\sqrt{3}$

Secondary voltage: （100V、115、120、127）/$\sqrt{3}$

Accuracy Class: 0.02

**Measuring range**

In-phase component (%): 0.0001 ~ 200.0

Resolution :0.0001

Orthogonal component (min):0.001 ~ 700.0

Resolution :0.001

Impedance (Ω): 0.0001 ~ 20.0

Resolution :0.0001

Admittance (ms) : 0.0001 ~ 20.0

Resolution :0.0001

**Verification basis**

《JJG313-2010 Verification regulation of current transformer for measuring purposes》

《JJG314-2010 Verification regulation of voltage transformer for measuring purposes》

**Polarity error indication**

When the rated working current is more than 5% and the error is more than 180%, the polarity should be indicated.

Note: If more than 10% of the rated working current, there is still no polarity indication, indicating that there is a fault, please do not increase the current, so as not to burn the instrument.

**Ratio Error indication**

When the rated working current is more than 2%, the error is more than 30% but less than 180%, there is a ratio error indication.

**Fundamental Error**

In-phase component: $\Delta X=\pm(X\times2\%+Y\times2\%)\pm Dx$

Quadrature component: $\Delta Y=\pm(X\times2\%+Y\times2\%\times34.48)$

"X"、"Y"—— displayed value of the instrument

"Dx,Dy"—— Quantization error of the instrument

Dx=2,Dy=5

Current %: 1 class

**Workload**

Current: TO to TX＜0.12Ω cosΦ=1

Voltage: a to x＜0.25VA （100V）

## 4.3 Programmable Load box Technical Parameters

**Rated Load**

| | | |
|---|---|---|
| Current ： | 2.5VA~40VA | COSΦ=0.8（selectable） |
| | 2.5VA~10VA | COSΦ=1.0（selectable） |
| Voltage: | 1.25VA~250VA | COSΦ=0.8（selectable） |
| | 1.25VA~250VA | COSΦ=1.0（selectable） |

**Measuring range and accuracy**

Current： 1%~120%（optional 200%）

Voltage: 20%~120%（optional 200%）

Secondary current： 5A

Accuracy： ±3% ± 0.05 VA

# 5 Transformer verification meter

## 5.1 Overview

The main purpose of the intelligent transformer calibrator is to verify the technical performance of the voltage transformer and current transformer used in the field or in the laboratory. In order to achieve this goal, the intelligent transformer calibrator must be a complete transformer calibration device with related equipment. Because there is a close technical relationship between the performance index of intelligent transformer calibrator and related equipment, it is necessary to have a basic understanding of the transformer calibrator in order to correctly study and understand the overall concept of intelligent transformer calibrator.

China's intelligent transformer calibrator can be roughly divided into three generations: the first generation of electrical calibrators, the use of complex operation, complex wiring; The second generation of calibrator adopts more advanced electronic circuit, which is more convenient to use than the previous generation of calibrator, but it needs to manually switch the range gear during the measurement process, and displays less information during the test. The third generation of the calibrator mostly uses the single chip computer, so that the intelligent degree of the instrument has

been improved, some of the instruments have computer communication interface, improve the level of office automation.

Here we mainly introduce the main characteristics of the third-generation intelligent transformer calibrator:

(1) MCU is used to achieve measurement, control, display and other functions;

(2) Computer interface, improve the level of office automation, reduce labor intensity;

(3) With large screen display, provide friendly operation interface, and rich measurement information;

(4) can automatically realize transformer calibration;

(5) With good protection measures, can inform users of error information in time;

(6) The instrument can reach level 2. At present, most of the calibrators on the market use the resistance-capacitance phase shift 90° method to achieve data measurement, this method is vulnerable to the impact of ambient temperature and power frequency, once the above environment changes, its measurement data will be greatly affected.

Intelligent transformer calibrator adopts unique circuit principle and DSP technology to avoid the above problems.

From the measurement principle, the intelligent transformer calibrator can be divided into two categories: direct comparison type and difference measurement type.

The early intelligent transformer calibrator was mainly designed as a direct comparison principle, that is, the secondary voltage or current of the standard transformer and the inspected transformer were respectively sent to the intelligent transformer calibrator, and the difference voltage or current between the two was measured through the measurement circuit such as the resistance voltage divider, the resistance capacitance voltage divider and the magnetic potential comparator. After processing is the ratio difference and phase difference between the tested voltage transformer or current transformer and the standard transformer.

The advantage of this intelligent transformer calibrator is that the ratio between the standard transformer and the transformer to be tested need not be equal, as long as the rated primary voltage or rated primary current of the standard transformer is greater than or equal to the rated value of the transformer to be tested, it can be directly verified, and it is more convenient to use.

The disadvantage of this intelligent transformer calibrator is that it cannot verify the transformer with secondary load less than 1VA; Secondly, the error of the intelligent transformer calibrator is directly added to the error of the standard transformer, because the component error of the intelligent transformer calibrator limits the accuracy level of the transformer being tested. For example, an intelligent transformer calibrator is limited by its own components, and its measurement error limit is ±0.05%, even if the standard transformer with higher accuracy is used, it can only be used to verify transformers below 0.5 level. Therefore, this shortcoming limits the application range of direct comparison intelligent transformer calibrator.

The intelligent transformer calibrator based on the principle of difference measurement is to send the secondary voltage or current of the standard transformer and the tested transformer to the difference circuit of the intelligent transformer calibrator, and then send it to the measurement link through the difference taking link and compare it with the secondary working voltage or current of the transformer to give the ratio difference and phase difference between the tested transformer and the standard transformer.

Because this intelligent transformer calibrator is only used to measure the difference between the standard transformer and the transformer being tested, the error of the intelligent transformer calibrator is only the error of the difference between the two transformers, so the impact on the measurement results is naturally much smaller. In general, no matter what level of transformer is tested, as long as the standard transformer meets the requirements, and the error limit of the intelligent transformer calibrator is not greater than ±2%. In this way, not only makes the intelligent transformer calibrator easy to produce, but also reduces the cost, and its application scope is greatly expanded. The intelligent transformer calibrator belongs to the difference measurement calibrator.

The intelligent instrument transformer calibrator is a novel automatic testing instrument, which uses advanced electronic technology to directly collect and decompress the error signal of the instrument transformer, and after proper calculation, the percentage point, in-phase error and orthogonal error of the instrument transformer are displayed digitally at the same time. The instrument is easy to operate, intuitive reading, rapid measurement, can reduce power consumption, reduce labor intensity; Small size, light weight, easy to carry and field test; The instrument can be tested under 5% rated working current (voltage); In addition, it is required that the company can

also produce a voltage intelligent transformer calibrator for detecting S-class current transformers and secondary voltage of （100V、115、120、127）/$\sqrt{3}$, so that the instrument can measure the error of the current transformer at 1% rated working current; In the process of testing, the instrument can be easily self-calibrated at any time to ensure the accuracy of the instrument; The key components use imported components, stable and reliable quality, widely used in metering, power supply and other departments and transformer manufacturers, is the ideal instrument to carry out transformer testing.

Intelligent transformer calibrator, and voltage transformers with rated secondary current of 5A and 1A and rated secondary voltage of （100V, 115,120,127）/$\sqrt{3}$ V, 150V (100/3V, 220V) with accuracy level from 0.01 to 10. The measurement results are directly displayed digitally, and can be equipped with RSC232 interface for users to easily connect with the computer.

When calibrating the transformer, the instrument can measure the active and reactive components of the impedance or admittance of the transformer secondary circuit at any time.

When calibrating the transformer, the instrument can indicate the polarity automatically. When the polarity is wrong, the instrument can automatically cut off the differential current (differential pressure) circuit to ensure the safety of the instrument input circuit. And issued an alarm, prompting the verification personnel to pay attention.

The device can be used as a rectangular coordinate system AC potentiometer to measure small AC current or small AC voltage.

The device can measure the secondary voltage drop of the voltage transformer in conjunction with the isolation PT and the operating box.

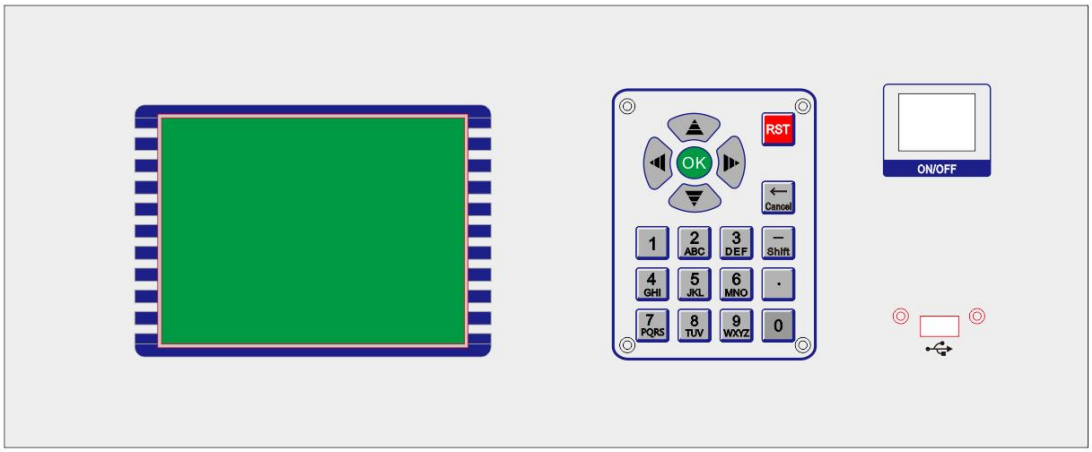
In the verification of transformer, the instrument can use standard current transformer or standard voltage transformer as the standard, but also can use two-stage current transformer, two-stage voltage transformer or inductive voltage divider as the proportion standard.

The equipment can be periodically verified by either integral method or component method.

You are welcome to choose our instrument. Although the instrument is very easy to operate, please read this manual carefully when using the instrument.

**The figure below is the panel of ZC-103 , which has the characteristics of easy operation**

**and clear display.**




ZC-103 transformer verification meter

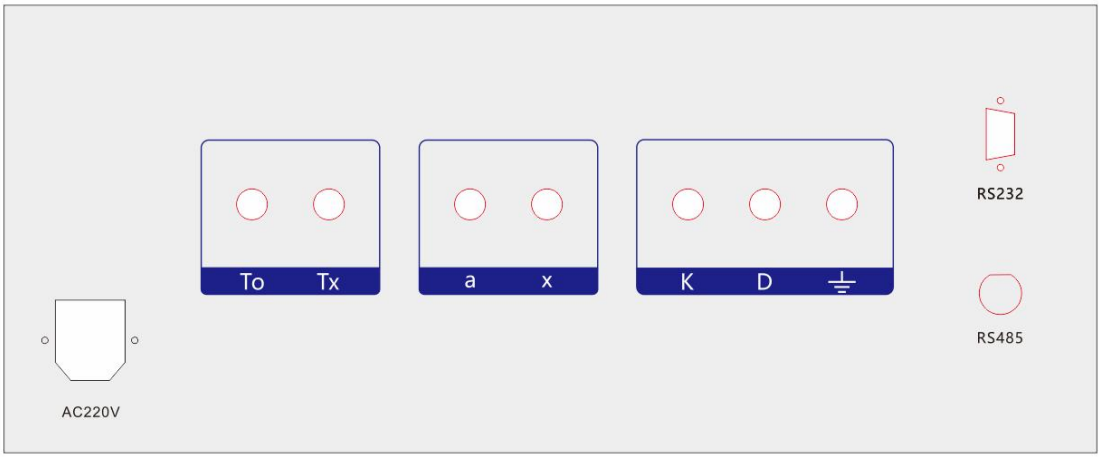
(1). LCD display, with a resolution of 320×240, showing all the testing statistics and operating indicators.

(2). Press key pad, press the OK key to select the current input, press "Cancel" to eliminate the incorrect input, and "↑", "↓", "←", "→" to move the cursor conveniently. The “Shift” key is a standby key. At the bottom of the keyboard are data keys from 0 to 9. During data input, these numeric keys can facilitate data input.

(3). Power Switch

(4). All terminals and lines are on the back panel of the calibrator, making the calibrator more beautiful and safe, convenient for users to use.

(5). USB port used to upgrade software and export data



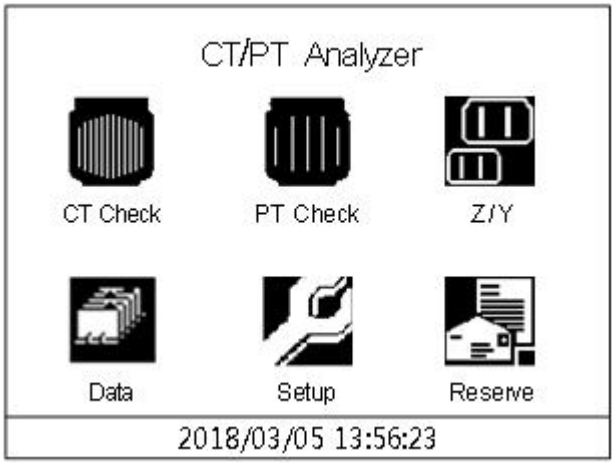
(1) Power socket (connected with 220V power supply)

(2) RS-232 communication interface, can be customized RS485 support.

(3) Input terminal

## 5.2 Interface introduction

Connect the test cable to the host power supply and turn on the power supply. The main menu interface is as follows:




ZC-103 main menu interface

**CT check:** Check the current transformer

**PT Check**: Check the voltage transformer

**Z/Y**: test CT secondary impedance or admittance;

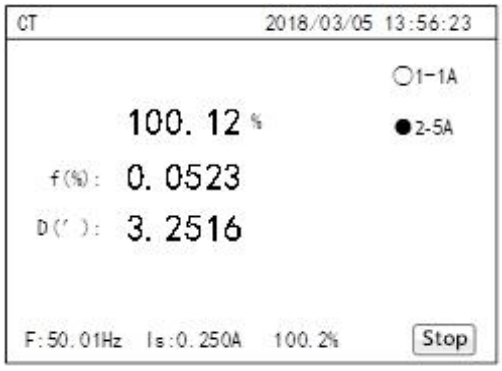
**Data** : view the history saved to the machine;

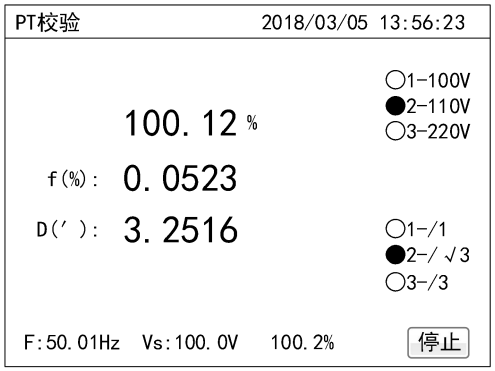
**Setup**: Set the function;

**Reserve:** Factory calibration test function

## 5.3 Check interface introduction

Press "CT check" or “PT check”to enter the calibration test setting interface, the setting test interface of the intelligent transformer calibrator, as shown in the following figure:




Measurement object:

1) Measurement object: current transformer, Voltage transformer, impedance, admittance

2) Secondary current: 1A, 5A

3)Secondary Voltage: （100V、115、120、127）/$\sqrt{3}$ V

4) Transformer accuracy level: 1, 0.5, 0.2, 0.5S (CT), 0.2S (CT), 0.1, 0.05, 0.02, 0.01

## 5.4 Set parameters when testing the current transformer

When measuring the current/voltage transformer, you can use the digital shortcut key on the side to quickly switch the transformer parameters or move the cursor to the corresponding parameter and press "OK" to confirm. If it is a touch screen, you can directly touch the corresponding parameter to complete the switch.

Note: The parameters are correctly set on the nameplate of the transformer to be tested, and then the booster is slowly raised, so that the measurement object, level, accuracy and related information can be clearly displayed. The dial indicator, ratio and Angle difference are displayed in large font for easy observation. To this interface, it can be seen whether its error is within the accuracy range.

After the test is completed, slowly return the booster to the zero position, and then press the "RST" reset key to return the intelligent transformer calibrator to the main interface, turn off the host power supply, and disconnect the voltage regulator input power. Remove the test wire and put it back in the instrument for next use.

Before testing, please read the relevant wiring diagram and connect the cables by qualified

professionals.

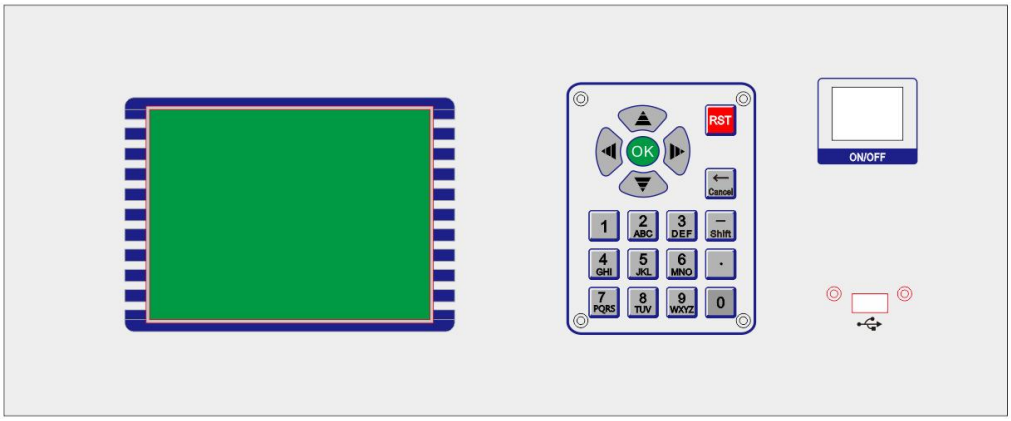
If you are not clear, please call the manufacturer first, and then operate.

# 6 Transformer load box

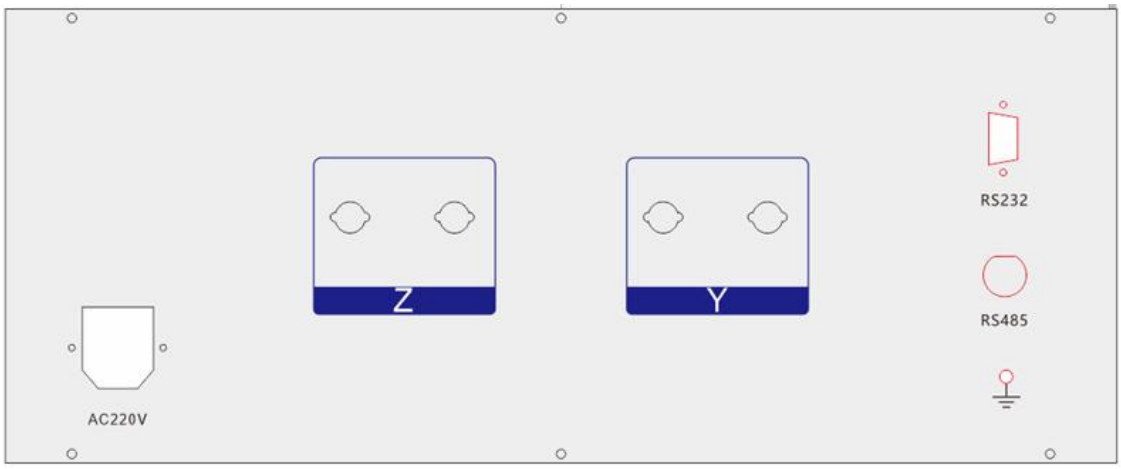
## 6.1 General description

The current load box is a kind of equipment specially provided for various loads when testing the current transformer. It is an ideal instrument for automatic transformer calibration station and field transformer error test.

The following figure is the panel of the calibrator, which has the advantages of easy operation and clear display.




load box front panel




load box rear panel

1) Screen LCD display, resolution is 320×240 points, all measurement data and operation tips are displayed in it, can be customized according to user needs to use the touch screen.

2) Press the key pad, "OK" key to select the current input, "Cancel" can eliminate the wrong input, "↑", "↓", "←", "→" can easily realize the cursor movement. The “Shift” key is a standby key. At the bottom of the keyboard are data keys from 0 to 9. During data input, these numeric keys can facilitate data input.

3) Power switch.

4) All terminals and connection lines are on the back panel of the calibrator.

5)USB interface for software upgrade and data export. Computer interface, the default support RS232 interface, can be customized RS485 support.

## 6.2 Current transformer load box usage

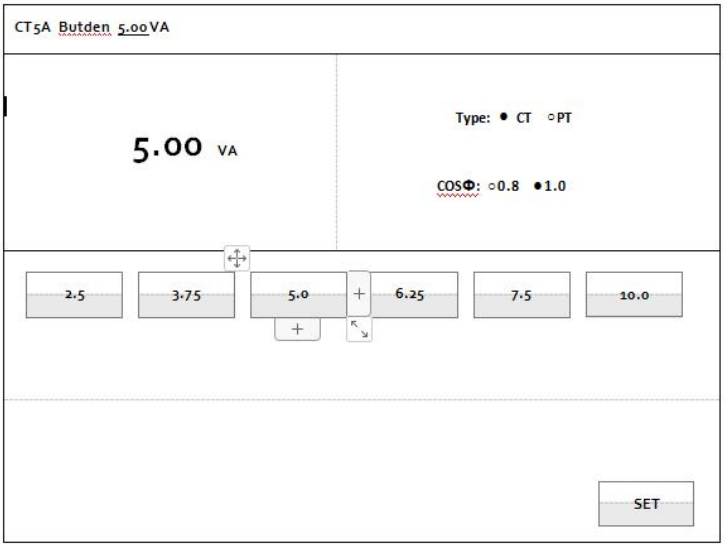
Note: If the load box is integrated in the calibration station, it is generally not necessary to operate the load box during automatic testing.

1) Connect the device in series between K2 of the tested current transformer and TX of the calibrator.

2) Adjust the load to the actual secondary load of the tested current transformer. The load box is compatible with Test bench, and can also be used for field test.

3) The current load box should deduct the resistance of the external wire 0.06Ω, which means that when the load box is actually used, the load of the tested transformer in addition to the load box has the resistance of the connecting wire. If cos=1, 0.4Ω, the actual resistance of the load box is 0.34Ω; cos=0.8, 0.4Ω, resistance of the actual load box R=0.4*0.8-0.06=0.26Ω, reactance X=0.40.6=0.24Ω.

4) Turn on the power switch, the power indicator lights up, and the LCD display enters the main interface:




In the current interface, there are two ways to set the load, one is to enter the required load value directly by pressing the keyboard in the upper left corner, and the other is to select the current required load value by selecting the button.

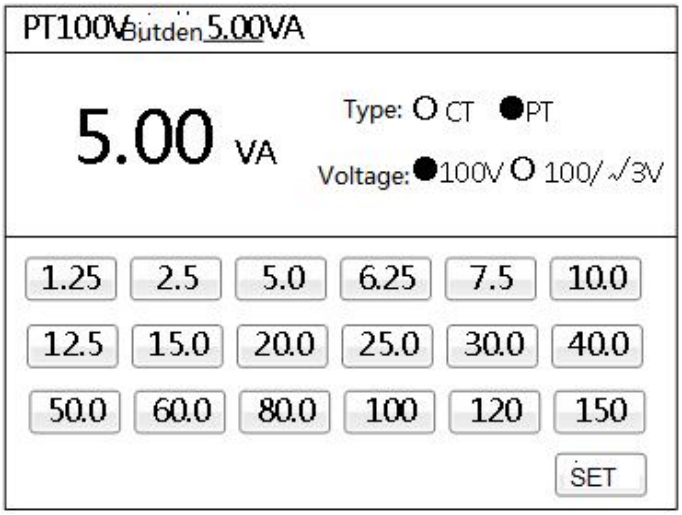
## 6.3 Voltage transformer load box usage

1) Connect this device between terminals a and x of the test voltage transformer.

2) Adjust the load to the actual secondary load of the test voltage transformer.

3) This load box is compatible with the test bench and can also be used for on-site testing.

4) Refer to the current current transformer load box usage for details.

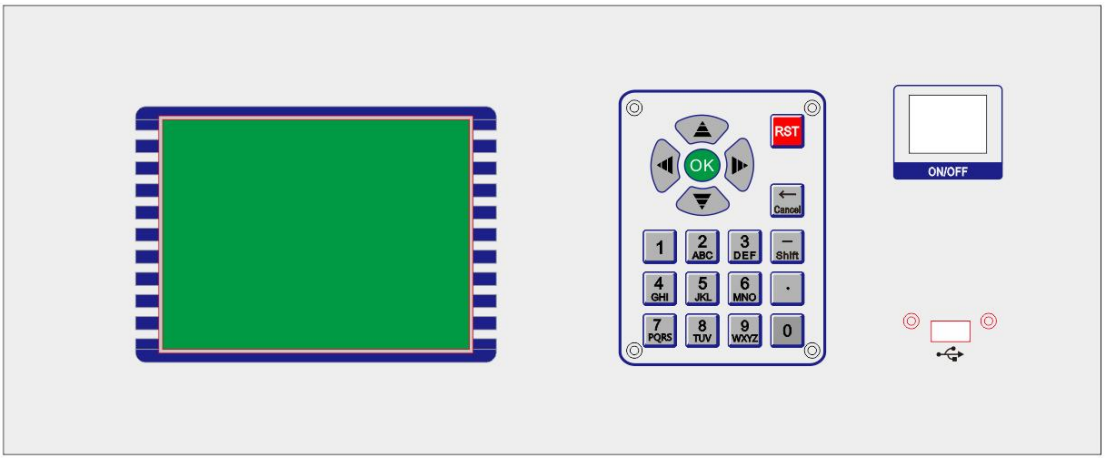


# 7 Transformer Calibration Device Control Console

## 7.1 General description

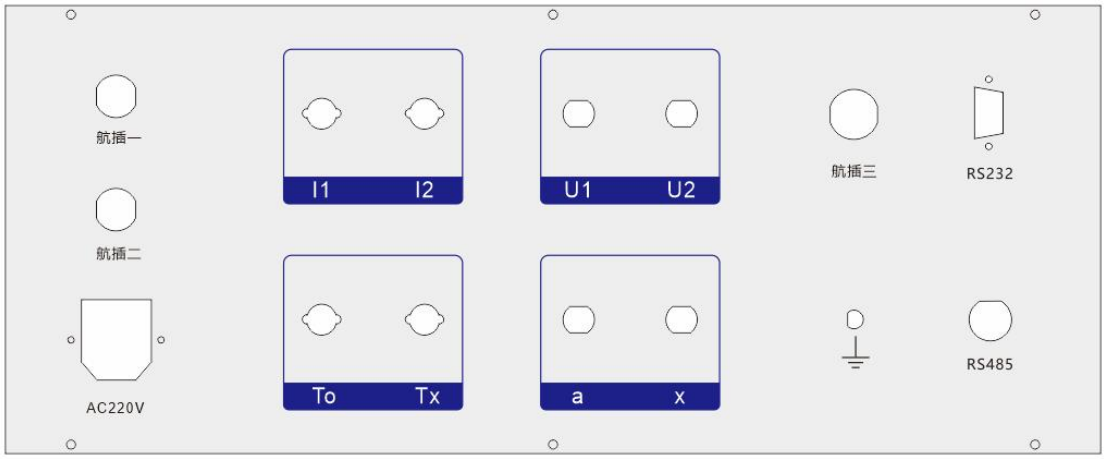
The control console of the transformer calibration device plays the roles of control and detection in the entire calibration system. In the computer-based operating system, the console can receive the information transmitted from the calibration system in the computer, mainly including transformation ratio, capacity, accuracy, etc. Based on the transformation ratio, it automatically sets and controls the voltage regulator, current booster or voltage booster to calibrate current transformers or voltage transformers. In case of unconventional tests, it can also directly perform automatic, semi-automatic or manual operations on the console without the need for computer participation. The console can detect the distortion of the power supply and has a complete overcurrent output protection function. The console window is a touch-type liquid crystal display with a friendly interface, facilitating manual operation.

The following figure shows the panel and back panel of the console, which has the advantages of convenient operation and clear display.




Control console Front panel

From left to right, they are the LCD screen, the keyboard, the power switch, and the USB interface.




Control console Rear panel

1) Aviation connector 1 and aviation connector 2: voltage regulator ports, used for controlling the voltage regulator inside the console;

2) AC220V: Power input port;

3) I2 I2: Current sampling port for the voltage regulator output;

4) U1 U2: Voltage sampling port for the voltage regulator output;

5) To Tx: Secondary current sampling port for the standard transformer;

6) a x: Secondary voltage sampling port for the standard voltage transformer;

7) Aviation connector 3: Console control port;

8) RS232/RS485: Communication port, used for communication during online automatic testing;

## 7.2 Functional Features

1) During the verification process, the output voltage and current of the regulator can be detected in real time.

2) Real-time detection displays the current test percentage and can automatically control the current increase or voltage increase required for the current test.

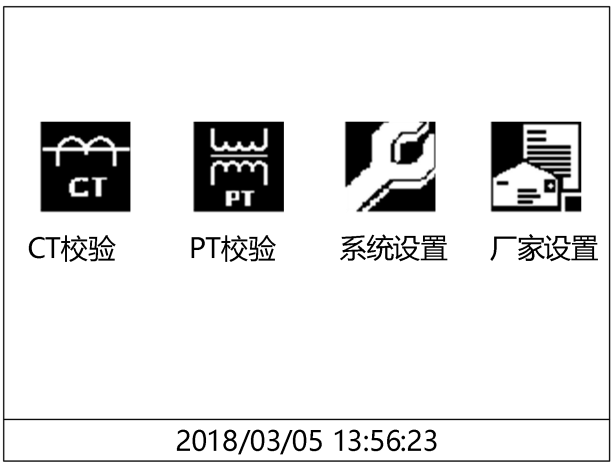
3) It has a complete overcurrent protection function. The overcurrent protection value can be set manually or automatically during the test process.

4) It supports manual (semi-automatic) and fully automatic operation. During automatic operation, no manual intervention is required.

5) The independent 4U cabinet interface can be separated from the control console for easier maintenance.

## 7.3 Operation Instructions

Connect the console power supply and turn on the console switch to enter the main interface as shown in the following picture:




**Console main interface**

1) CT Check: Start CT verification;

2) PT Check: Start PT verification;

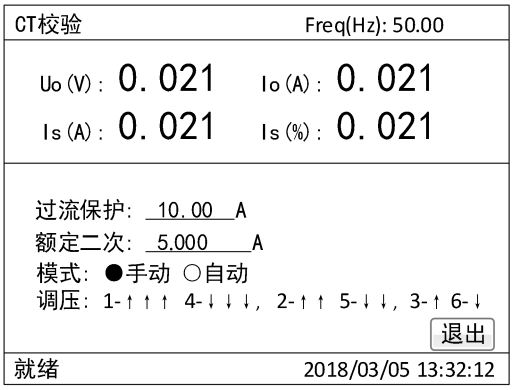
3) System Settings: Set system parameters;

4) Manufacturer Settings: For manufacturer calibration and debugging purposes;

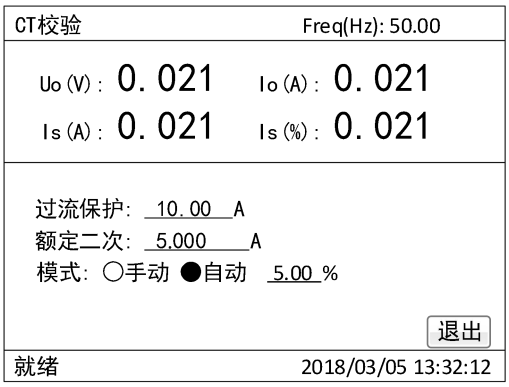
During the fully automatic testing process, there is no need to operate this equipment. The following mainly introduces the operations during manual or semi-automatic testing. For the fully automatic testing process, please ignore these instructions.

### 7.3.1 Manual (semi-automatic) CT check

Press the button to enter the CT check mode, and the following interface will be displayed:




Manual testing interface




Semi-automatic test interface

On this interface, the upper half mainly displays the current test information:

1) Uo(V): The output voltage of the current regulator in the current control console;

2) Io(A): The output current of the current regulator in the current control console;

3) Is(A): The secondary current of the current standard transformer;

4) Is(%) : The secondary current percentage of the current standard transformer;

The lower half of the interface is the control section:

1) Overcurrent protection: Set the overcurrent protection value for the output of the current regulator. During the test, if the current of the current regulator exceeds the set current, the control console will automatically cut off the main power supply of the voltage regulator and prompt an error;

2) Rated Secondary: Set the rated secondary current or rated secondary voltage of the current transformer being detected at present;

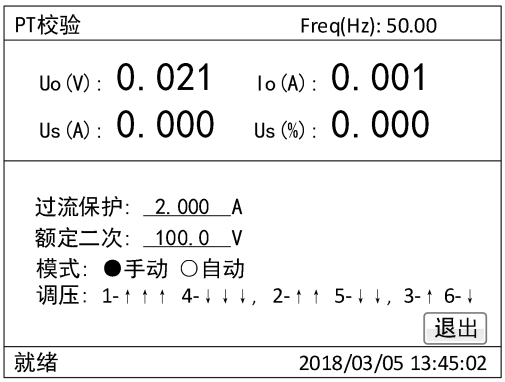
3) Manual: Manual mode. In this mode, manual control is required; the voltage regulator adjusts the voltage to achieve the effect of controlling the current booster or voltage booster. At this time, the data keys on the keyboard can be used to perform voltage adjustment operations: Key 1 is for rapid voltage increase, Key 4 is for rapid voltage decrease, Key 2 is for medium-speed voltage

increase, Key 5 is for medium-speed voltage decrease, Key 3 is for slow-speed voltage increase, and Key 6 is for slow-speed voltage decrease;

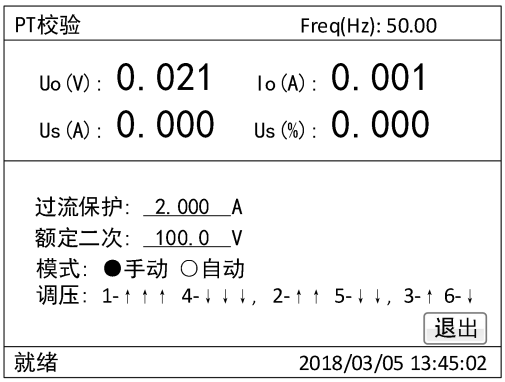
4) Automatic: Semi-automatic mode. Compared to the manual mode, no manual voltage adjustment is required. Just set the value; the secondary percentage control will automatically adjust to the user-defined value and remain constant. After recording the current measurement, the percentage can be changed to test the next point;

### 7.3.2 Manual (semi-automatic) PT Check

Press the button on the main interface to enter the PT check mode. The following interface will be displayed:




Manual testing interface




Semi-automatic test interface

On this interface, the upper half mainly displays the current test information:

1) Uo(V): The output voltage of the current regulator in the current control console;

2) Io(V): The output current of the current regulator in the current control console;

3) Us(A): The secondary voltage of the current standard transformer;

4) Us(%) : The secondary voltage percentage of the current standard transformer;

The lower half of the interface is for setting the reference CT check function for control.

## 7.4 Usage Notes

1) During the test, it is strictly prohibited to open the secondary circuit of the current transformer and short-circuit the secondary circuit of the voltage transformer.

2) Before the test, it is necessary to repeatedly check the wiring and the connection lines between each device.

3) Before the test, it is necessary to take protective isolation measures.

4) When calibrating large current transformers with a current of 600A or more, since the primary current of the transformer is too high, it will generate a large magnetic field interference. There will be slight resonant sounds inside the test cabinet, and the computer display screen and the instrument display screen may have irregular screen flashing phenomena.

# 8 Notes for Attention

## 8.1 Functional Features

1) Based on the parameters set by the computer, the standard primary and secondary wiring can be automatically switched.

2) Up to 12 current transformers with the same transformation ratio and grade can be connected at once. Under the control of the PC or panel buttons, the transformers are sequentially switched to the test circuit, and the automatic test is completed according to the test points as per the regulations.

3) The digital display panel is used to show the transformation ratio and position of the current transformer being measured at the moment.

4) The current transformer test bench can conduct fixed-point tests on any one of the multiple current transformers being measured.

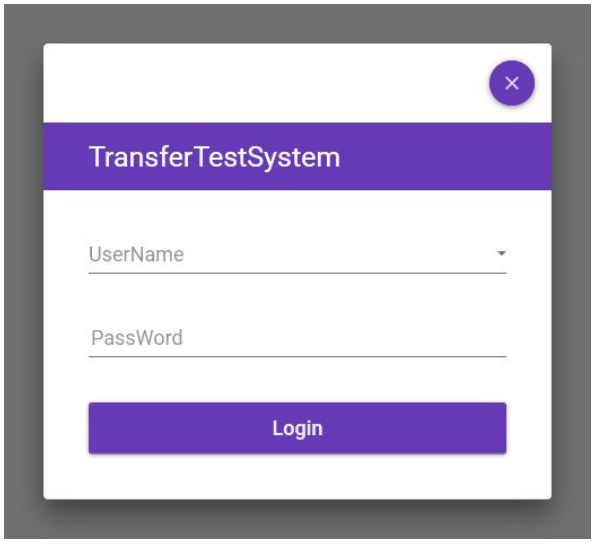
5) On the PC software, it is possible to select whether to demagnetize the measured current transformers.

## 8.2 Functional characteristics

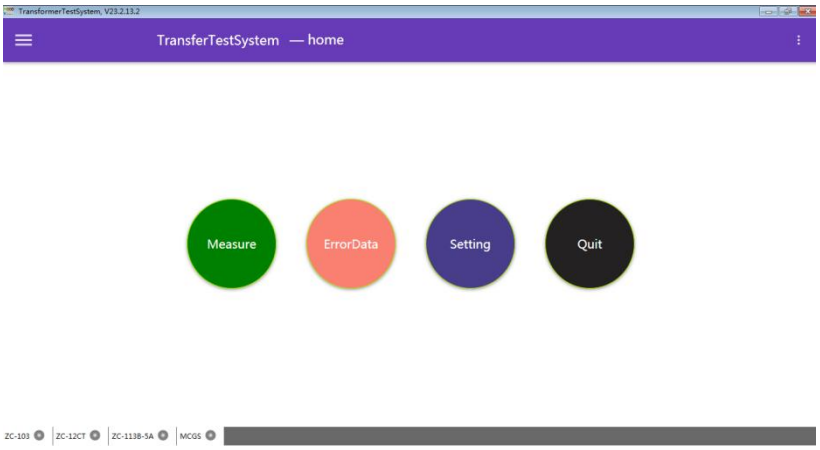
*Note: All ground marker terminals must be firmly grounded*

# 9 Instrument transformer verification management software

## 9.1 System Login

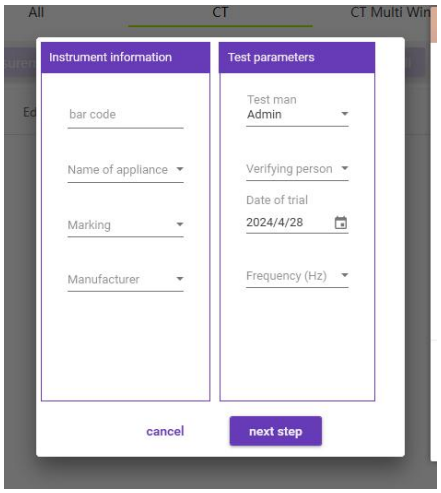


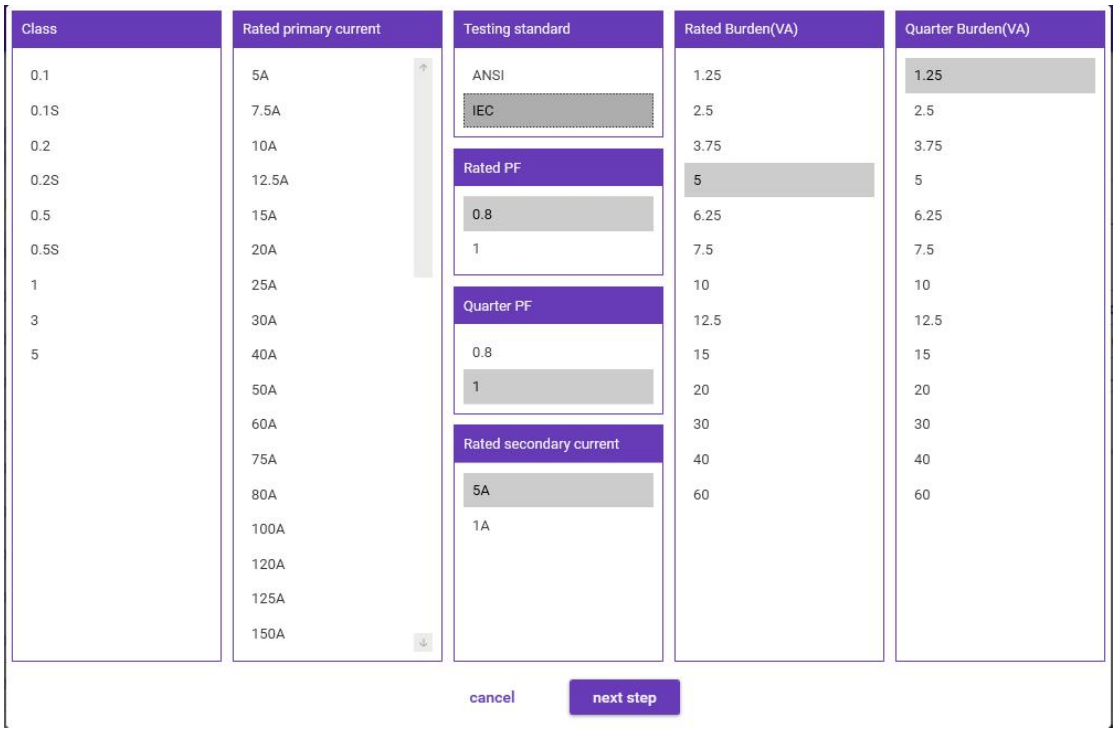

Initial login information: Account 1001, password: None. After the first login, create new user information for easy management. If the login succeeds, the main window of the system is displayed




## 9.2 Transformer measurement

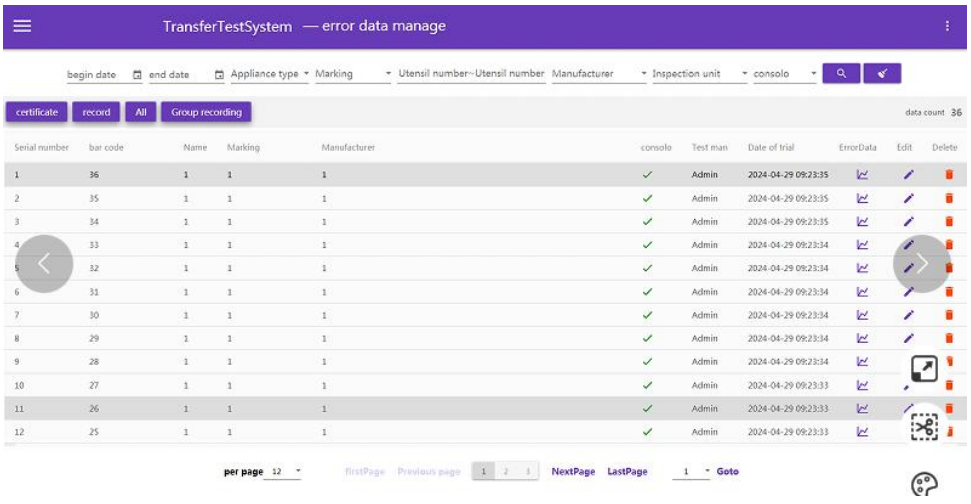
### 9.2.1 Input basic information of the current transformer






When selecting the transformer power factor, click on the corresponding load and power factor according to the IEC standard.

### 9.2.2 Data browsing

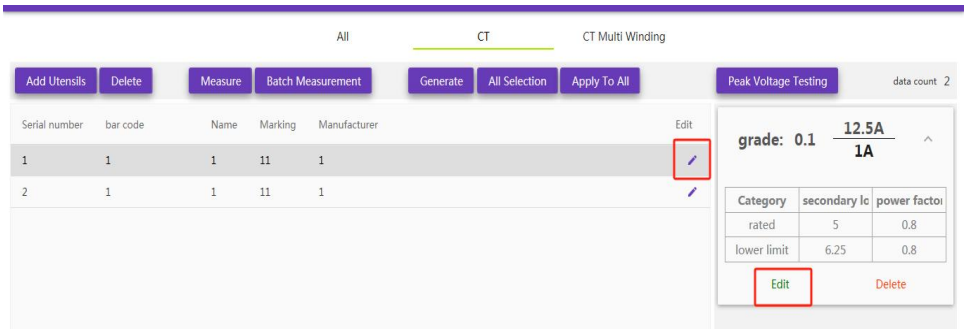



### 9.2.3 Data Management

a) Add a new record, select the utensil type and click “Add utensils” to enter the new equipment

b) Delete this record

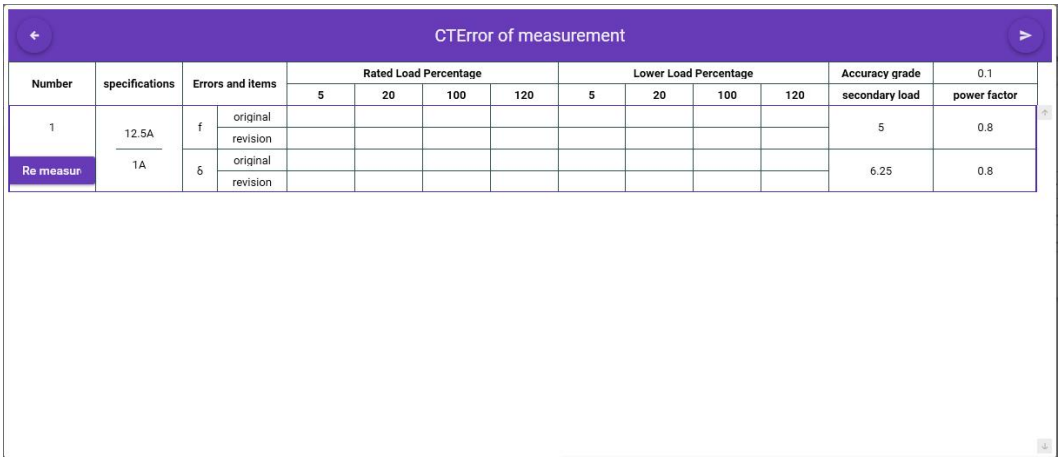
c) Select and delete. Edit this record




After selecting the record to be edited, the basic information of the transformer can be modified on the entry. The green edit button on the right can edit the parameter information of the transformer.

### 9.2.4 Measurement

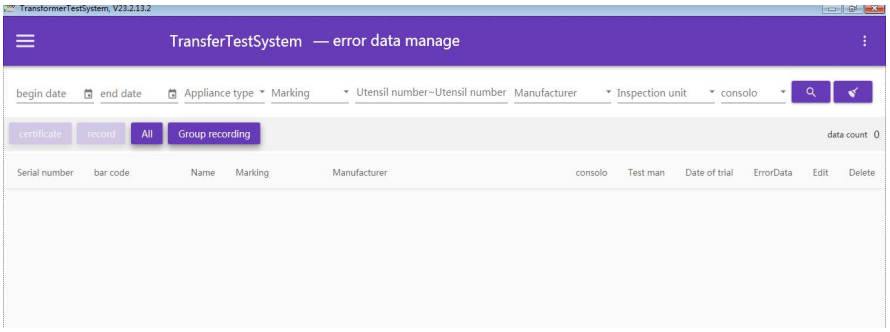
Click the measurement button to enter the measurement interface. Click the right-most triangle button to start measurement.




### 9.2.5 Exit interface

Click this button  to exit the measurement

### 9.2.6 Error data




Home page Click Error data button to view error data management. By default, you can view information about all devices.

### 9.2.7 Data management

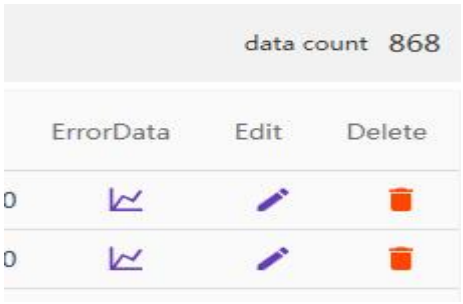
#### A. Data browsing

a) Click the toolbar button to browse


b) Data screening


This column filters the data according to the corresponding parameters

#### B. Data management




a) Error data viewing

b) Click the icon under data to view the error data

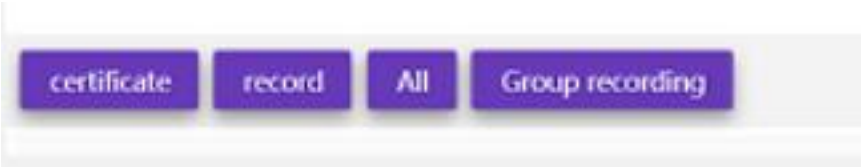
c) Edit this record

d) After clicking the icon below Edit, the parameters section is editable. You can modify some recorded parameters as required.

e) Delete this record

**f) Delete the error record for the current article. A message indicating whether to confirm the deletion is displayed before the deletion.**

**C. Report printing**




Select the record you want to print, select the report type, and press the Print button to print

## 9.3 Menu description


### 9.3.1 Function realization

A. Measure

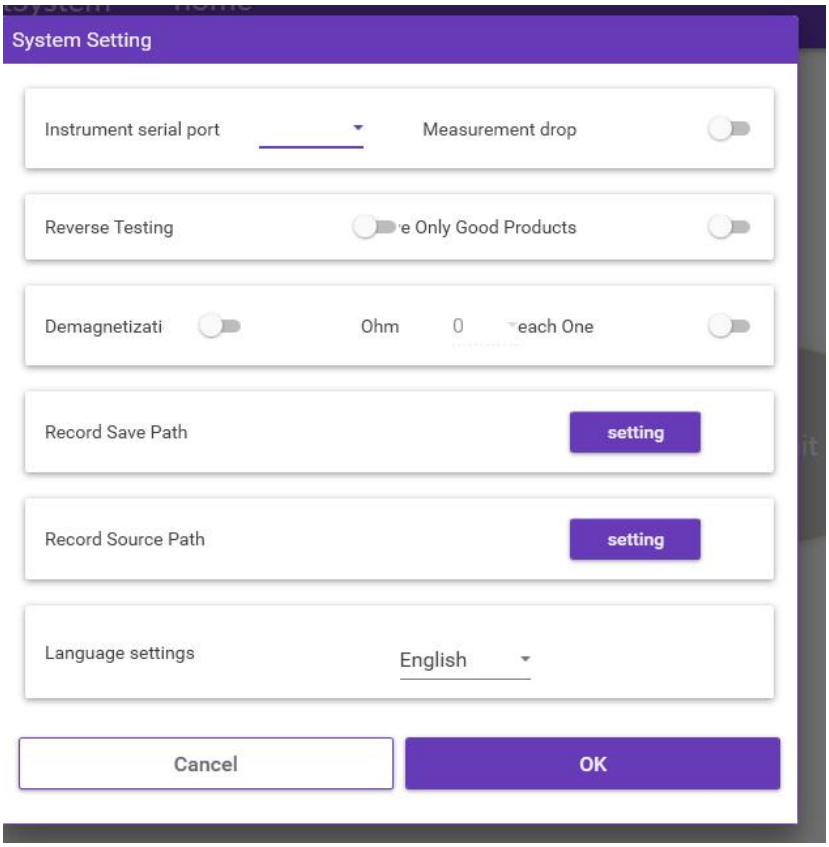
For CT tests, see "II. Transformer measurement"

B. Error data

For specific use, see ". Error data"

C. Setting

Set this parameter based on the device information and device requirements




**"Reverse Testing"** refers to reverse testing, in which the test points are tested by 120%, 100%, 20% and 5%

**"Measurement"** is preservation rate of good products, open the switch test data will only save the data that passed, and the data that does not pass is not saved.

**Instrument serial port:** Serial port number for the software to communicate with the device

**Demagnetization** : If the subject needs to do demagnetization test, the alternative option will be selected. After this option is selected, [Ohm] and [each One] will be activated.

**Ohm** : Ohm value set 0, 2, 4, 8, 12 these several gears, if you do not know how to set, you can set to 0, the program automatically calculates the value of ohm according to the test parameters.

**Each One**: Before the test, each subject performed a demagnetization operation

**Record Save Path**: directory for saving the exported report

**Record Source Path**: Path for saving the data template of the exported data

**Language setting**: Switch between Chinese and English

### 9.3.2 Exit System

Close this software

# 10 Appendix

## 10.1 Error calculation of current transformer

According to the equivalent circuit and phasor diagram of the current transformer, due to the existence of the excitation current $\dot{I}_0$, the actual primary current $\dot{I}_1$ and the secondary current $-\dot{I}_2$ rotated 180° and converted to the primary side are different in value and phase, so there are ratio difference and phase difference, where the ratio difference is calculated using the formula $f=(K_N I_2 - \dot{I}_1) / \dot{I}_1$. $K_N$ is the rated current ratio, and $\dot{I}_1$ and $\dot{I}_2$ are the actual primary and secondary current RMS. In addition, the phase difference between the secondary current phasor $-\dot{I}_2$ and the primary current phasor $\dot{I}_1$ after rotation of 180° is called the phase difference, expressed by δ, and the unit is ′ or crad . If $-\dot{I}_2$ is ahead of the $\dot{I}_1$ phase difference is positive; If the lag, the phase difference is negative, the error of the transformer can also be expressed by a complex symbol, denoted as $K = \dot{I}_1 / \dot{I}_2$ and $\varepsilon = f + j\delta$, δ in radians. The complex symbol method is a very useful tool in calculating the comprehensive error of measurement results.

According to the definition of the error of the current transformer, The ratio difference of the current transformer is the ratio of the error current $\dot{I}_0$ projected on the $\dot{I}_1$ phasor to $\dot{I}_1$, and the phase difference is the delta Angle δ. Since the δ Angle is small, it is negligible compared to the ψ and α angles. Therefore, the Angle between $\dot{I}_0$ and $\dot{I}_1$ can be thought of as 90°-ψ-α, and the radian value of δ Angle can be replaced by the sine function value of δ Angle, resulting in

$$f=-(100\,\dot{I}_0/\dot{I}_1)\sin(\psi+\alpha) \quad (\%)$$

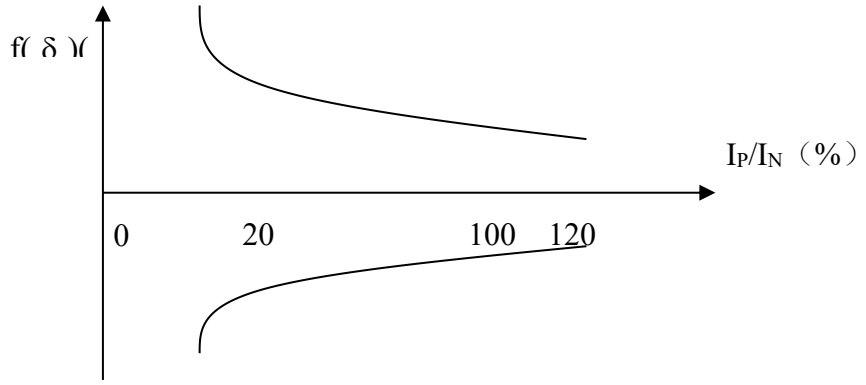
$$\delta=(3438\,\dot{I}_0/\dot{I}_1)\cos(\psi+\alpha) \quad (')$$

The above equation indicates that the ratio error and phase difference of the current

transformer are related to the ratio of the excitation currents I0 and I1, as well as the size of the ψ angle, and also to the size of the impedance angle α of the secondary circuit.

## 10.2 Error characteristics of current transformer

The relationship between the error of the current transformer and the primary current is called the current characteristic, as shown in Figure, In the small current region, due to the low magnetic density of the core (tens of mtex), the value of $I_0 / I_1$ is relatively large, the ψ Angle is relatively small (30° -40° ), the ratio difference is negative, and the phase difference is positive. With the increase of primary current, the magnetic density of the core increases (hundreds of mtex), at this time $I_0 / I_1$ decreases, the ψ Angle becomes larger (50° -60° ), the ratio difference changes in the positive direction, and the Angle difference changes in the negative direction

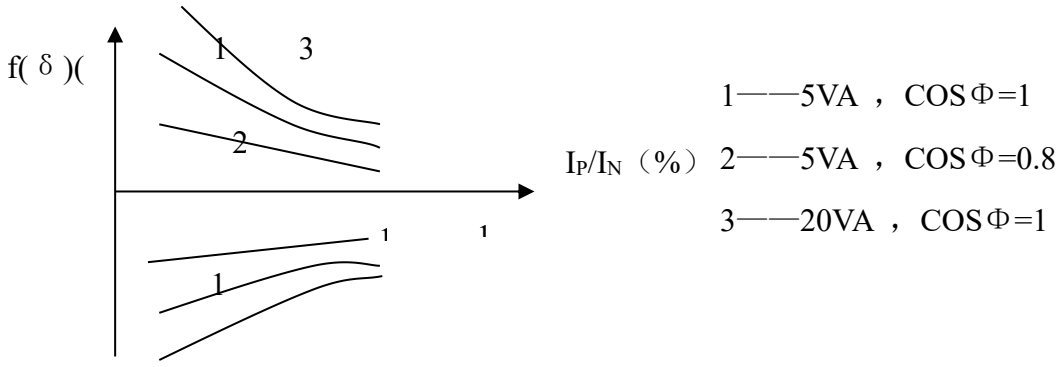



Current characteristic curve of current transformer

The relation between error of current transformer and secondary load is called load characteristic. The curved load characteristic curve is shown in Figure. As the secondary load increases, the value of $I_0 / I$ also increases. The ratio difference of the current transformer changes in the negative direction, and the Angle difference changes in the positive direction. When the power factor of the secondary load decreases, both the ratio difference and the Angle difference of the current transformer change in a negative direction as the delta Angle δ increases, as shown in Figure.

## 10.3 Load characteristics of current transformers

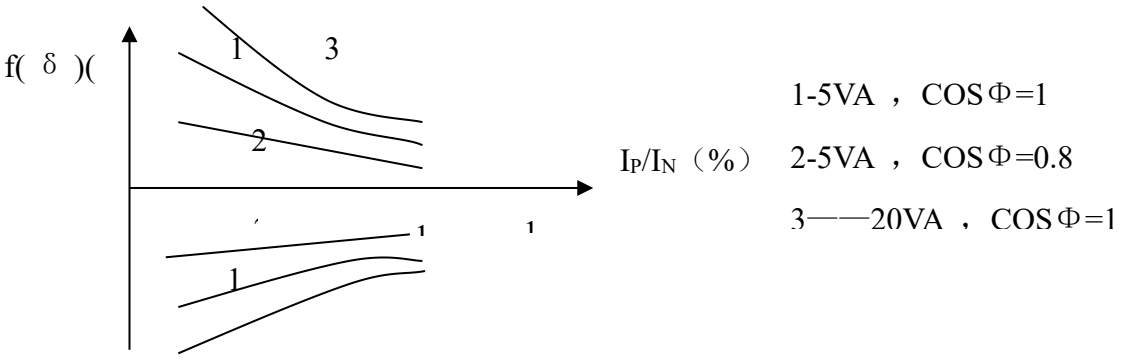
The current transformer can be regarded as the power equipment excited by the current source, and its output voltage depends on the size of the secondary load. Therefore, the current transformer in use does not allow the secondary side of the open circuit, if the secondary coil is open, the primary current $I_1$ becomes an exciting current, its value is hundreds of times more than the normal $I_0$, the magnetic flux in the core from the normal tens of milliteslas to the saturation of 1.4 to 1.8 Tesla, inductive voltage peak up to several thousand volts, endangering equipment and personal safety. In addition, the magnetic density is too high, the core will be seriously heated, the transformer is easy to burn, and the core is also easy to produce residual magnetism, resulting in the current transformer overshoot. If the core of the current transformer has remanent magnetism, its average magnetization curve will no longer pass the origin, then harmonic distortion will be generated, and the ratio difference will change in the negative direction. The change direction of the phase difference is related to the magnetic characteristics of the core. Under normal circumstances, the iron-nickel alloy core changes in the negative direction and the silicon steel sheet core changes in the positive direction.




Load characteristic curve of current transformer

## 10.4 Error Calculation of Voltage Transformer

From the equivalent circuit and vector diagram of the voltage transformer, it can be seen that due to the existence of the excitation current and the load current, there is a certain difference in value and phase between the actual primary voltage and the secondary voltage converted to the primary side. The ratio difference is calculated using the formula: f = (KN * $U_2$ - $U_1$) / $U_1$, where KN is the rated voltage ratio, $U_2$ and $U_1$ are the effective values of the actual secondary and primary voltages. Additionally, the phase difference between the secondary voltage phasor rotated by 180° - $U_2$ and the primary voltage phasor $U_1$ is called the phase difference and is denoted by δ, with units of degrees or centi-radians. If -$U_2$ leads $U_1$, the phase difference is positive. If it lags behind, the phase difference is positive.




## 10.5 Voltage Transformer Error Characteristics and Curves

The error of the voltage transformer and its relationship with the primary voltage are called the voltage characteristic. When the primary voltage is much lower than the rated voltage, the magnetic flux density of the core is low, the value of $I_0/U_1$ is relatively large, the ψ angle is small, and the ratio difference is slightly negative, while the phase difference is slightly positive. As the primary voltage increases, the magnetic flux density of the core increases, the value of $I_0/U_1$ decreases, the ψ angle becomes larger, the ratio difference changes in the positive direction, and the phase difference changes in the negative direction. When the secondary voltage continues to increase,

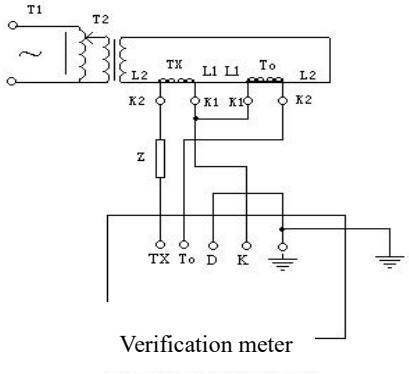
after the magnetic flux density of the core exceeds a certain value (0.8-0.9 tesla), the value of $I_0/U_1$ increases again, the ψ angle decreases again, the ratio difference changes in the negative direction, and the phase difference changes in the positive direction.

The relationship between the error of a voltage transformer and the secondary load is called the load characteristic. The load error is caused by the voltage drop on the primary and secondary coil resistances and leakage reactance of the load current. If the ratio difference $f_0$ and phase difference $\delta_0$ under no-load condition of the voltage transformer have been measured, and then the ratio difference and phase difference $\delta$ e under rated load $Z_E$, with $\cos\Phi = 1$, are measured, the ratio difference f and phase difference $\delta$ under any load $Z_b$ can be calculated through calculation.

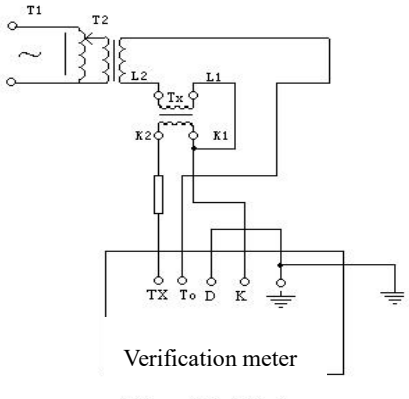
Generally speaking, when the load of a voltage transformer increases, the ratio difference changes in the negative direction. The phase difference, depending on the specific circumstances, may change in the positive direction or the negative direction. When the power factor of the load of a voltage transformer decreases, the ratio difference does not change much and its direction can be either positive or negative. The phase difference changes in the positive direction.

## 10.6 Current transformer verification wiring diagram

### 10.6.1 The wiring diagram when the verification meter is used in a single machine

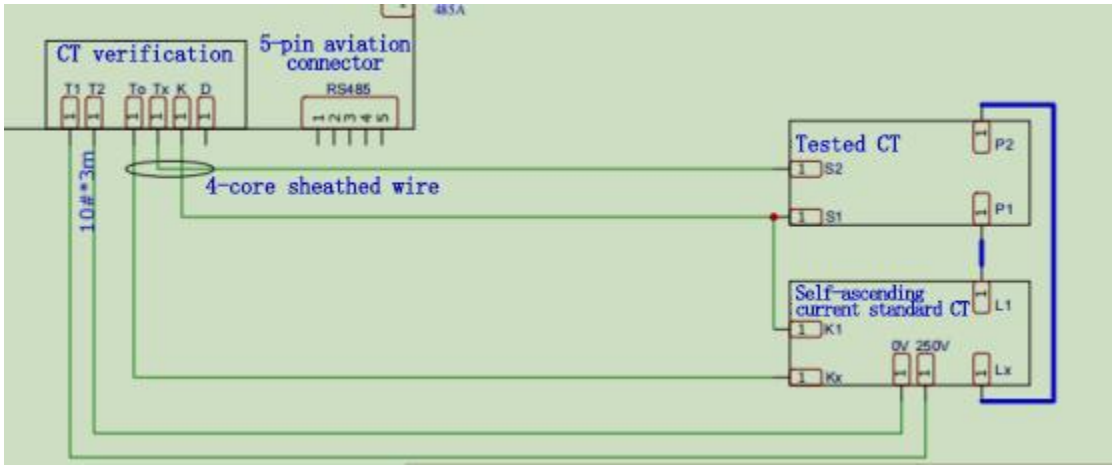



Current transformer error test diagram



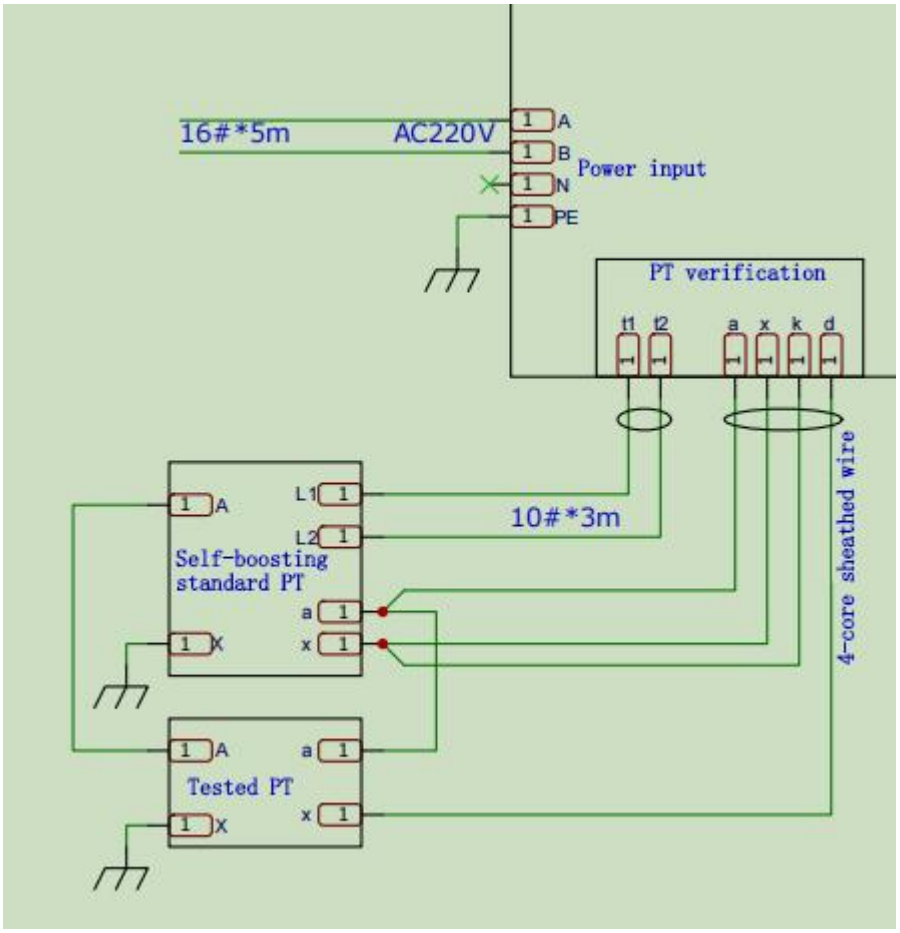

Current transformer self-calibration test diagram

### 10.6.2 Wiring diagram for the use of the online console




CT Test Wiring Diagram

1. T1 and T2 are connected to the 0V and 250V of the standard CT.
2. The T0 connection standard CT Kx and Kx is variable. Kx refers to the secondary terminal, for example, 20/5. The primary terminals are L1 and L5, and the secondary terminals are K1 and K3. At this time, Kx represents K3. Please refer to the nameplate for specific details.
3. Connect the Tx terminal of the tested CT to terminal 5 of S2.
4. The K connect the S1 of test CT and K1 of standard CT , and they are common terminal.
5. D suspended;
6. Primary connection, the L1 of the Standard CT is connected to the P1 of the tested CT, and the Lx of the standard CT is connected to the P2 of the tested CT. At this time, Lx is determined by the primary current. For example, 20/5, the primary connection is L1 and L5, then Lx corresponds to L5. The specific connection is determined by the nameplate.




PT test wiring diagram

1. t1 and t2 conect the 250V, 0V of the Self-boosting standard PT, or as shown in the figure, L1 and L2;

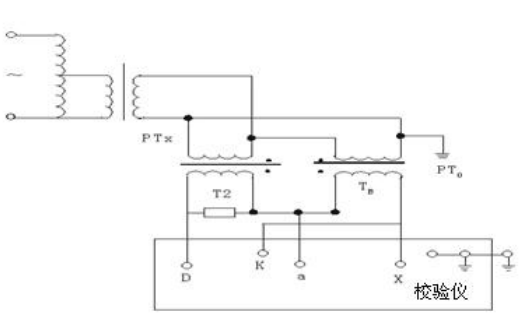
2. a connect to the secondary terminal of the self-boosting standard PT and connect a of test PT

3. x and k are connected to the x of the self-boosting standard PT;

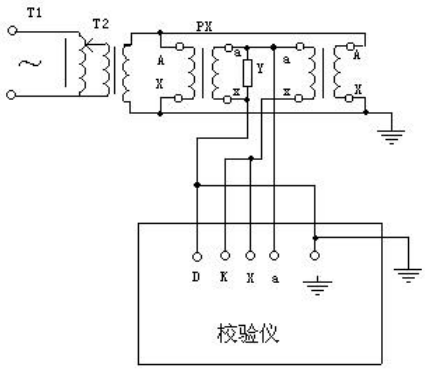
4. d is connected to the secondary terminal of the tested PT

5. Connect the A terminal of the self-boosting standard PT to the A terminal of the tested PT, Connect the X of the booster standard PT with the X(B) of the tested PT and then ground them together.

## 10.7 Voltage Transformer wiring diagram




电压互感器误差试验图




电压互感器自校试验图

# 11 Transportation and storage

## 11.1 Transportation

This product must be packed during transportation. The packing cases must be packed in wooden cases with foam shock-proof layers. The packaged products should be able to be transported by road, railway and air, and should not be placed in the open compartment or inverted during transportation. The warehouse should pay attention to rain, dust and mechanical damage prevention.

In the transportation of instruments in daily use, anti-shock and anti-impact measures must be taken.

## 11.2 Storage

The ambient temperature of the warehouse where the device is stored is -10 ~ 60, the relative humidity is not greater than 95%, and there should be no acid, alkali and corrosive gas in the room, and no strong mechanical shock and vibration.

# 12 Warranty and after-sales

The warranty period of the products sold by the company is one year. Repair period free maintenance, maintenance period only charge cost.

During the warranty period, if any of the following situations occur, only the cost of maintenance will be charged:

1) Failure or damage caused by falling during user use or handling;

2) Failure or damage caused by other units entrusted by the user;

3) Equipment failure or damage due to abnormal voltage;

4) Failure or damage caused by force majeure (such as fire, flood, natural disaster, etc.);

5) Failure or damage caused by not connecting other equipment according to the requirements of this instruction manual;

*The company has the final interpretation of the above! !*

KVTESTER ELECTRONICS TECHNOLOGY CO.,LTD.

- Web site: WWW.KVTESTER.COM
- Address: No.120, Guanggu Road, East Lake New High-tech Development Zone, Wuhan, China
- Email: SARA@KVTESTER.COM
- Tel: 0086-27-81778799
- Fax: 0086-27-81778799
- Mobile: 0086-13638669429
- Skype: 0086-13638669429
- Whatsapp/wechat: 86-13638669429