

**HGQH(12)-C
Test Bench (Vertical Bench)**

USER MANUAL

Dear customer,

Thank you for choosing the Device. Before using the machine, please read the manual carefully. It will guide you to use the machine easily and skillfully.



Our aim is to improve the products with constant efforts, so there might be a little discrepancy exist between the real objects and the manual descriptions. We are really sorry for all the inconvenience it might cause and we'll inform you in the attached pages if any change is made. Please call our After-sale Service Department if you have any questions. It's our honor to be at your service.



Considering that the input/output terminals and the test column might be electrically charged, you should pay extra attention when you plug the wire and socket, for sparks may appear in the process. Please take care of personal safety in case of electric shock.

◆ Safety Requirements

Please read the following Safety Precautions carefully to avoid personal injury or damages to the machine itself and devices connecting to it. To avoid potential danger, this machine can only be used in specified regions.

Only qualified technicians are allowed to perform the repair.

To avoid fires or personal injury, please.

Use proper power cord: Only power cord that is special for the machine or of the right gauge can be used.

Connect and disconnect correctly: Please don't connect or disconnect the test wire if it is linked with charged terminals.

Ground the machine. The grounding column of the machine shell must be earthed, except when the product is earthed through the power ground wire. To avoid electric shock, grounding conductor must be connected to earth. You must make sure that the machine is correctly earthed before connecting the input or output terminals.

Pay attention to the rated values of all the terminals. To avoid fire and electric shock, please pay attention to all the rated values and marks. Before connecting, please read the User Manual for detailed information about the rated values.

Don't operate without the cover. If the cover is removed, please don't operate the machine.

Use proper fuse. Only fuse that is of the right gauge and right rated value can be used.

Avoid contact with exposed circuit or charged metal. If the machine is charged, please don't touch the exposed parts.

If there are potential bugs, stop the operation. If you suspect there is any damage, please call our staff for examination. And stop operating the machine right away.

Please don't operate the machine in humid and explosive environment.

Make sure that the machine surface is clean and dry.

Safety Terms

Warnings: Warnings point out dangerous practice or situations which might cause death and injuries.

Caution: Cautions point out practice or situations that might cause damage to the machine or other property.

Contents

I. Introduction of Transformer Calibrator	1
II. Components And Main Technical Indicators	5
III. Technical Parameters	6
IV. Load Box Introduction	11
V. Test Wiring Diagrams	12
VI. Calibrator Software Introduction	16
VII. Attention Matters	16
VIII. Three Control Methods Explanation of Transformer Calibrator	17
IX. Transformer Wiring Diagrams from Electric Power	18
X. Guarantee & Service	19

I. Introduction of Transformer Calibrator

1.1 Current Transformer

Current Transformer (CT for short thereafter) is very similar to general transformers. General transformers are used in the circuit to alter voltage, while CTs are used to alter current. And that's why CT was called converter. Now, devices that transform direct current (DC for short thereafter) into alternating current (AC for short thereafter) are named converters. And devices that are used to alter the magnitude of the current are named CT.

So why must we alter the current? That's because the needed current varies dramatically from a couple of Amperes (A for short thereafter) to thousands of A, according to the requirement. We would have to make a large number of ammeters and other electrical instruments if we want to measure the currents directly. This brings a lot of difficulty to the manufacturing. It's also dangerous because some circuits or wires may be burdened with voltage up to 220kV. And it's not permitted to measure the current directly.

However, with CT, we are able to change the various currents to a small range that is both safe and measurable. We can measure currents of all scales with electrical instruments of only one current gauge, for example, with 5A universal current.

Besides that, the structure of CT and transformer is very much alike, both with a pair of windings, one called primary winding and the other secondary winding. And both two windings are electrically insulated from each other. When the CT is working, the primary winding W_1 is connected to the circuit and the secondary winding W_2 is connected to the electrical instrument. Therefore, when measuring under high voltages, though the primary voltage is very high, the secondary voltage is pretty low. So the staff and the device are both safe.

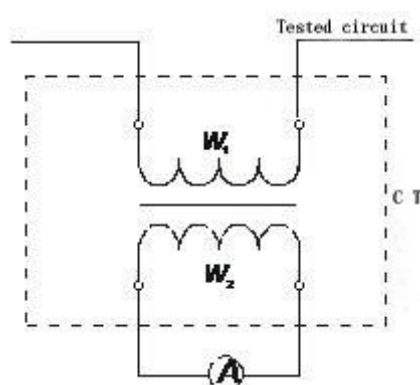


Figure 1 Current Transformer Principle Circuit

Thus, besides its convenience of changing the various currents to a small range, it also provides good insulation to ensure the safety of operators and instruments.

1.1.1 Measuring CT

Functions of measuring CT mainly involve the following 2 aspects:

(1)Security Function

Help protect the operators and instruments through insulation and isolation when measuring the current and power in circuits with high voltage.

(2)Simplicity Function

Use uniformly specified 5A secondary circuit and electrical instrument to measure large currents & power in circuits with either high or low voltage.

(3)To perform the above functions, three requests must be satisfied: first, the insulation must be reliable; second, proper precision must be achieved; third, instrument security factor F, should be small.

(4)The secondary current is converted into primary current by rated transformation ratio. But error exists in such a convert because the actual transformation ratio is not equal to the rated transformation ratio in most cases. Thus, several accuracy classes are defined according to the error. In China, the classes include Class 0.01, Class 0.02, Class 0.05, Class 0.1, Class 0.2, Class 0.5, Class 1, Class 3, Class 5 and so on. There are detailed definition and rules about the permitted error for CT of all scales. But we can take the permitted error as 0.01%...5% corresponding to Class 0.01...Class 5 roughly when the current is near the rating.

1.1.2 Protective CT

(1) In electric power system, there is a protective circuit consists of all kinds of relay controllers to ensure normal electricity supply and the safety of valuable equipment. When the system malfunctions, the protective device will react immediately to cut off the circuit; and when the bug happens just by accident, the protective device will also be able to reconnect the circuit automatically to recover normal electricity supply.

(2)The function of protective CT is to transform current along the circuit into current of certain magnitude to power the protective devices like relays. When the current rises suddenly due to short circuit or other bugs, the current in the protective device will rise correspondingly to activate itself and cut off the malfunctioning circuit. The accuracy class of protective CT is represented by 5P or 10P, which means the permitted error is 5% or 10%.

1.2 Potential Transformer

Potential Transformer (PT for short thereafter) is a necessary device in power plant and substation for electricity supply and transmission.

PT of high precision is used in labs to expand measuring range for testing voltage, power and electric energy.

PT is very similar to general transformer, both used for alter voltage along the circuit. But the capacity of a transformer is quite large, with the unit of kVA or even MVA, because it's mainly for delivering electricity. And the capacity of PT is pretty small, generally a few VA or tens of VA, with the up-limit not more than 1000VA, because it is mainly used for the

following three applications, ① provide electricity supply for test devices and relay protective device, ② measure voltage, power and electric energy of the circuit, ③ protect valuable equipment, electric machine and transformer when malfunction happens.

So why should we alter the voltage? That's because the voltage needed varies from 220V and 380V to hundreds of thousands of Volts in different circumstances of electricity generation, transmission and consumption. We would have to make a large number of voltage testers and other instruments and relays if we want to measure it directly. It's both complicated and unrealistic because it's impossible and forbidden to measure high voltage directly.

Apart from the functional similarity, PT and general transformer resemble in structure as well. Like transformers, PT also bears two windings, one called the primary winding, and the other secondary winding, with both two windings wrapping the iron core. The two windings are electrically insulated from each other and from the core. The primary winding N_1 is incorporated into the circuit in parallel, and the secondary winding N_2 is connected in parallel with instruments or relays, with the principle diagram showing as Graph 2. In this way, the secondary voltage is low despite high primary voltage, thus ensuring the safety of the operators and the instruments.

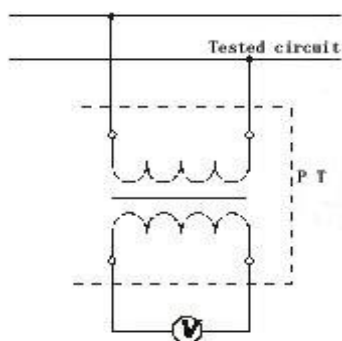


Figure 2 Potential Transformer Principle Circuit

1.3 Classification of Transformer Calibrator

Transformer Calibrator is mainly used to examine and assess the performance of PT and CT in lab or field application. To reach this goal, Transformer Calibrator must work together with certain equipment to make up a complete suit of calibrator. The performance index of the Transformer Calibrator is technically linked with the relevant equipment, so it's necessary to gain a general understanding of the Transformer Calibrator itself if you want to have an overall idea of the whole device.

In China, there are three generations of Transformer Calibrator. The first generation is with complex wiring and complicated operation. The second generation adopted relatively advanced electronic wiring, and the operation is easier; but in testing the gear has to be changed manually and the information showed is very limited. In the third generation, chips are widely used to make the machine more Intelligence; and some of them have computer interface, thus greatly improving the office automatic level.

Now let's cover the main features of the third generation.

- (1) Chips utilizing for the implementation of measurement, control and display.
- (2) Bearing computer interfaces, improving automation level, and reducing human labor.
- (3) Big screen display, friendly interfaces and abundant testing information.
- (4) Automatic transformer test and automatic switch of current and voltage load cases.
- (5) Good capturing ability, able to report bugs in the first time.

(6) Reaching Standard 2. Most calibrator in current market adopt the method of setting a phase displacement of 90° between impedance and capacitance for data test implementation. But the disadvantage of this method is that it's easily and even badly influenced by the temperature and power frequency.

In the Calibrator, we adopt unique circuit principle and DSP to avoid the above problems effectively.

Classified by the test principle, the calibrator can be divided into two categories, direct comparative and heterodyne measurement.

The early transformer calibrator are designed into the direct comparative. That is, transmit the secondary currents or voltages of both the standard transformer and calibrated transformer into transformer calibrator. After a few test circuits consisting of resistor divider, RC divider and magnetic potential comparator, we will get the current difference or voltage difference of the two transformers. And the ratio error and phase displacement between them can be obtained through processing.

The advantage of this calibrator is that the transformation ratio of the standard transformer and calibrated transformer doesn't have to be equal. We can test directly once the rated primary voltage or current of the calibrated transformer is not bigger than that of the standard transformer. And it's easy to operate.

The disadvantage of this calibrator is that it can't be applied to transformer with the secondary load under 1VA. The error of itself will be incorporated into the standard transformer, because the accuracy of the calibrated transformer is restricted by the element of the calibrator. For example, the calibrator with an error limit of $\pm 0.05\%$ can only be used to test transformers under Class 0.5, even with highly precise standard transformer. It can be easily seen how this disadvantage restrict the application.

Heterodyne measurement calibrator is to transmit the secondary currents or voltages of both the standard transformer and calibrated transformer into differential circuit. And get ratio error and phase displacement through calculation and testing.

Error of the calibrator itself has a much smaller impact on the final result because the error comes from the difference of the standard transformer and calibrated transformer. Generally speaking, it is OK for all classes if the standard transformer meet the request and the error limit of calibrator is not larger than $\pm 2\%$. This makes it easier to produce the calibrator and also reduce the cost, and the calibrator can be more widely used. Calibrator

belongs to heterodyne measurement calibrator.

Calibrator is a new automatic instrument. We apply advanced electronic technology in the design. By directly decomposing the error signal, it is able to display the percentage, phase error and orthogonal error statistically. It's quick and energy saving. And it's especially good for live testing due to its cute dimension and light weight. Also, the calibrator can work under current (voltage) that is 5% of the rated value. And we can also produce calibrator of Class S and calibrator with a secondary voltage of $100/3$ V, which can work under current (voltage) that is 1% of the rated value. Besides, the calibrator can perform self adjustment at any time to guarantee the precision. And we use imported elements with reliable quality which are widely used in this field. Calibrator can be applied to potential transformer with secondary voltage 100V, $100/\sqrt{3}$ V, 110V, $110/\sqrt{3}$ V.

The result will be shown statistically, and we can equip the calibrator with RS232 interface for computer linkage.

The calibrator is able to detect the active component and reactive component of the impedance and admittance in the secondary loop.

The calibrator can indicate the polarity automatically. When the pole is reversed, the machine will cut off the differential current loop to ensure the safety of the input device, and alarm to inform the operator.

The calibrator can be used as AC potentiometer in orthogonal coordinate to test small AC current or small AC voltage.

The calibrator can cooperate with isolated PT and the operating box to test the secondary voltage of PT.

The calibrator can be normalized using standard CT or standard PT, bipolar CT, bipolar PT or inductive voltage divider.

The calibrator can take wholeness method or element method for periodic verification.

Thank you for choosing the calibrator. Though it's easy to operate, please read the instructions carefully.

II. Components And Main Technical Indicators

2.1. Main components

HGQA-C transformer calibration device mainly consists of a HGQA-C type transformer calibrator, FY98 current and voltage load box, voltage regulating control part, special test lines, large current wires, self-boosting current standard, self-boosting voltage standard, special on-line lines, transformer calibration software etc.

Specific instructions for each part are as follows.

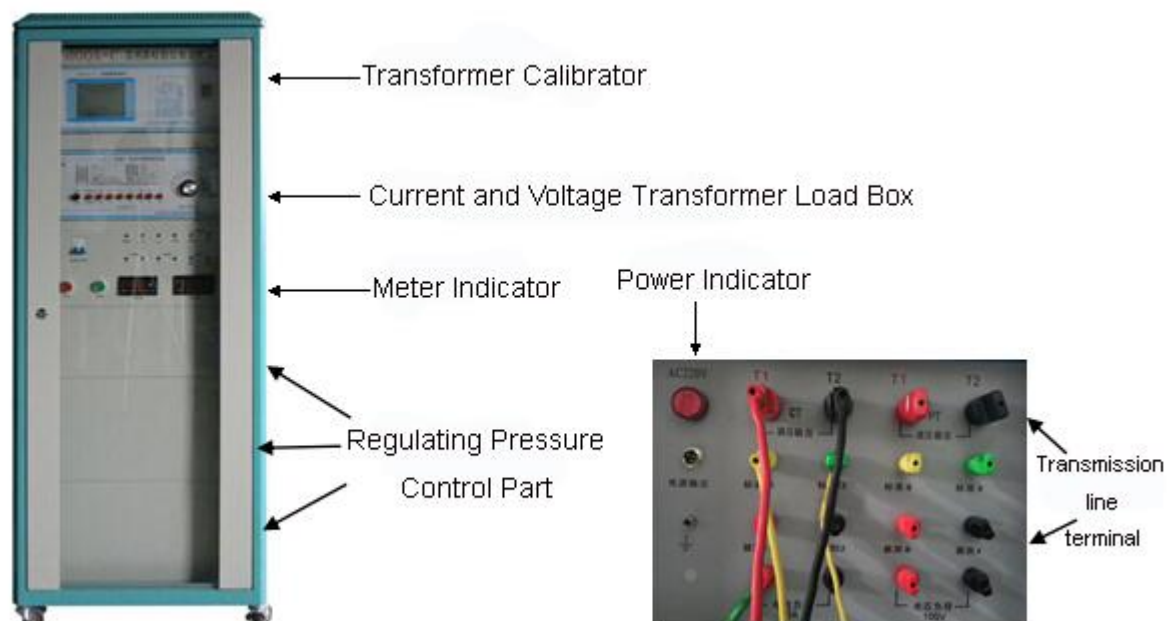


Figure 3 HGQA-C Automatic Transformer Calibrating Device

2.2. Main technical indicators

Working power supply: AC220V $\pm$ 10% 50Hz $\pm$ 10%

Working environment: temperature 0 $^{\circ}$ C $\sim$ +40 $^{\circ}$ C

Relative humidity: $\leq$ 85% (25 $^{\circ}$ C)

Voltage regulating control output capacity: 7kVA (250V 30A) expand according to requirement

Regulating fineness of regulator: Better than 0.04V

III. Technical Parameters

1、HGQA-C Image of a transformer calibrator



Figure 4 HGQA-C Transformer Calibrator Panel

3.1 Working Condition:

(1)Temperature: 5 $^{\circ}$ C-40 $^{\circ}$ C

Altitude: <2500m

Relative humidity:<80%(25 $^{\circ}$ C)

Power Frequency: 50Hz $\pm$ 0.5Hz

- (3) Extra—large display of percentage, ratio error and phase error, easy to observe.
- (4) Automatic sampling, rightly meet the need of JJG314—1993 and JJG314—1994.
- (5) Automatic identification of polarity fault and ratio error mistake.
- (6) Software can be upgraded with time.
- (7) Completely solve the testing problems that Class S encounters.
- (8) Automatic switch of measuring range.
- (9) Perfect combination of advanced circuit technique and DSP; ultimately avoid the instability of the impedance phase differential circuit.
- (10) Power consumption:
 - <15VA (with micro-printer)
 - <25VA (without micro-printer)
- (11) Harmonic Suppression Ratio: >40db

3.8 Transformer Calibrator Panel Introduction

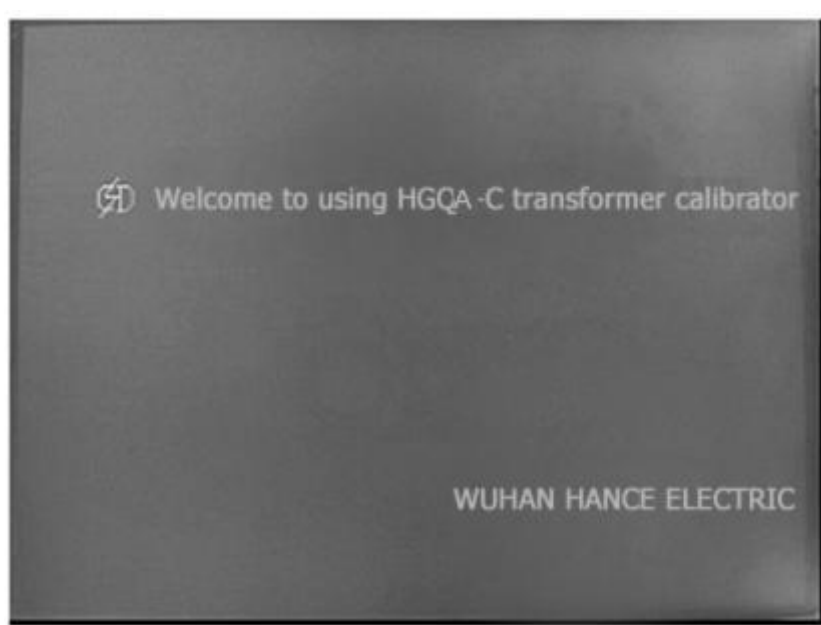


Figure 5

- (1) Test object: CT, PT, impedance and admittance.
- (2) Secondary Current: 1A、 5A
- (3) Secondary Voltage: 100V、 100/ $\sqrt{3}$ V、 110V、 110/ $\sqrt{3}$ V
- (4) Accuracy Class of the Transformer: 1、 0.5、 0.2、 0.5S (CT) 、 0.2S (CT)
- (5) Current secondary load: $\cos \phi = 0.8$, 2.5VA、 3.75VA、 5VA、 7.5VA、 10VA、 15VA、 20VA、 25VA、 30VA、 40VA、 50VA、 60VA; $\cos \phi = 1.0$, 2.5VA、 5VA; which can select demagnetization gear, the function uses closed-circuit demagnetization, after current rising from 0.0% to 120% even, dropping to 0.0%. K file is short connection(that is 0VA), the calibrator can't select K file.

(6) Voltage secondary load: 1.25~158.75VA

(7) Protective current: When there is operation or abnormal faults or bench output current exceeds its protective current value, the bench will be off AC contactor, to protect the external equipment and calibrator. When test current transformer, current transformer power supply below 2kVA protects current value is less than 20A; current transformer power supply above 2kVA selects less than 10A when test below 300A primary current transformer, above 300A selects more than 20A protective current value. Voltage transformer or pressure test usually uses 2A protection. In the actual operation, the protection of the current value can be set up again if it's wrong.

3.9. Measuring interface introduction

The following diagram is measuring interface, in which shows a tested object, class and other related information. Output current and output voltage of stand are displayed in the interface. The dial gauge, ratio error and angle error are displayed with large font, which is convenient for observation.

测量对象	CT		
二次电流	5	A	
等级	0.2	%	
百分表	0.000	%	
比差	0.00000	%	
角差	0.00000	分	
	5.000	26214	4095.

Figure 6

When the output voltage is less than 5V, zero is display; when the output current is less than 0.5A, zero is displayed.

3.10. Operation manual

HGQA-C integration transformer calibrator is "fool" type, the specific operation is using mouse and keyboard to operate directly through the displayed content presentation.

1) Input and save the basic data on HDH-DI virtual process control transformer calibration management software, calibrator automatically modify, no need to manually modify calibrator's object and so on, which greatly improves working efficiency, and reduce the working strength and manual operation error.

2) The user input related parameters and options, press the on-line measurement button on the HGQA-C interface, and then you can test full load and light load. In process of measurement, testing data are transmitted to the computer automatically, the computer software integrate, rounding, judge over proof automatically.

- 3) On the main interface of calibrator, you can also choose the measuring object, measurement method, overcurrent protection value in measurement, class and secondary load of transformer.
- 4) On the upper part of calibrator, output current and output voltage are displayed, on lower part, dial indicator value, ratio difference and angle difference value are displayed.
- 5) In the measurement interface of calibrator, different measurement methods have different operation: manual mode press ↑ key, rough tune regulator output rise, press ↓key is on the contrary; "9" is a minor regulator rise, "0" is a minor pressure drop.

3.11. Stand control circuit

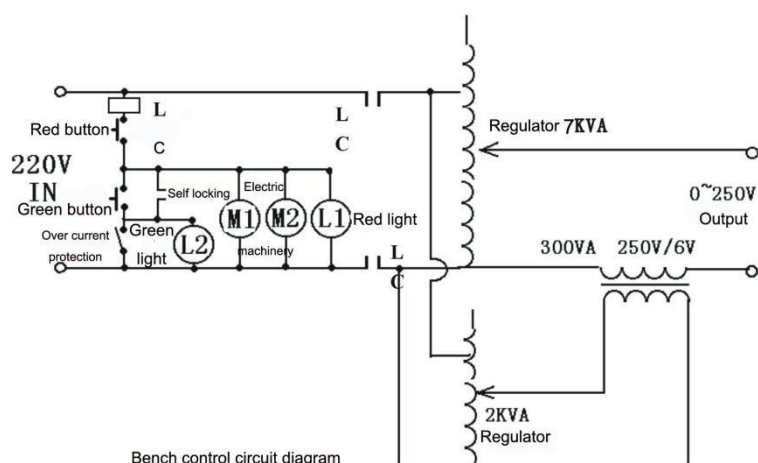


Figure 7

- 1) As above diagram: control part has button and protection contact. Red button is pressed, the motor and red light will be power on, calibrator control the motor through travel switch feedback signal so that the voltage regulator back to zero; the green button is pressed, AC contactor is actuated and self-locked, regulator input and power, the green light on.
- 2) 7kVA regulator is the main output source, use rough tuning to regulate; 2kVA regulator is used as fine tuning. For example, rise current transformer's 20% which secondary current is 5A, first of all, large regulator adjust 16% and the remaining 4% is minor regulator. The advantages of this method are high fineness of regulating, accurate positioning, fast, easy to use.

IV. Load Box Introduction

4.1. Introduction

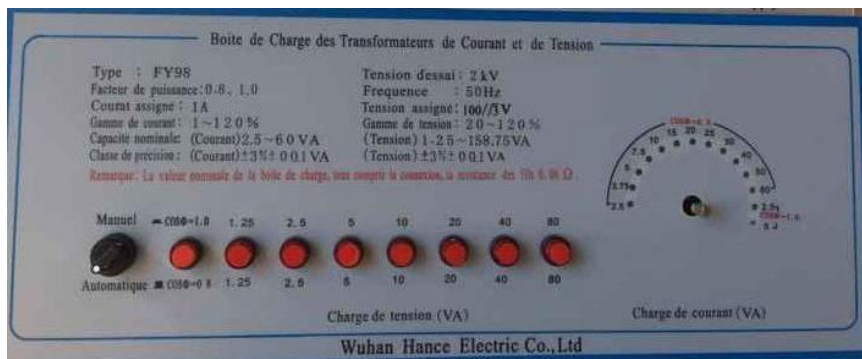


Figure 8

1) When using voltage transformer load box, parallel connects it between a and x.of tested voltage transformer.

2) When using current transformer load box, Series connects it between K2 of current transformer and TX of calibrator.

3) Adjust load to actual secondary load of test transformer.

Notes: secondary load of partial current transformer is expressed with capacity, the unit is VA.

Load of current transformer load box is expressed with resistance, the unit is Ω . A conversion relation between them is:

$$\text{Capacity (VA)} = \text{resistance value } (\Omega) * \text{two current (A)} * \text{two current (A)}$$

4.2. Main technical indicators of load box

Model: FY98

Test voltage: 2kV

Power factor: 0.8, 1.0

Frequency: 50Hz

Rated current: 5A(1A) Rated voltage: 100V($100/\sqrt{3}$ V 、 110V, $110/\sqrt{3}$ V)

Current range: 1% ~ 120%

Voltage range: 2% ~ 120%

Rated capacity(current): 2.5~60VA

(voltage): 1.25 ~ 158.75VA

Accuracy: $\pm 3\% \pm 0.01$ VA

4.3. Main characteristics of FY98 load box

- 1) Operate load box by computer software;
- 2) With light promotions, allow users directly observe gear;
- 3) Adopt imported standard chassis, elegant appearance.

V. Test Wiring Diagrams

5.1 Wiring diagram for CT calibrating CT

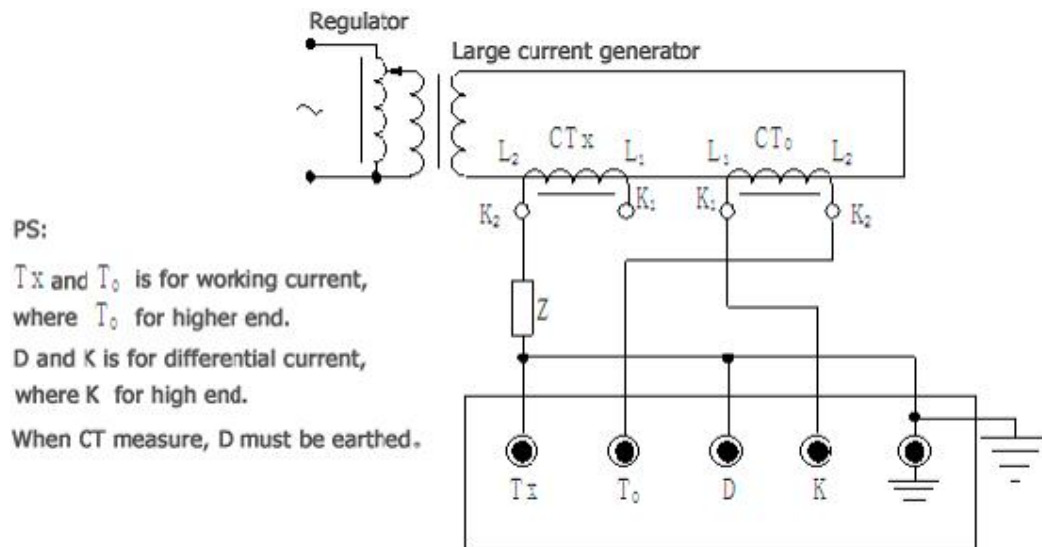


Figure 9

5.2 Wiring diagram for CT self calibration

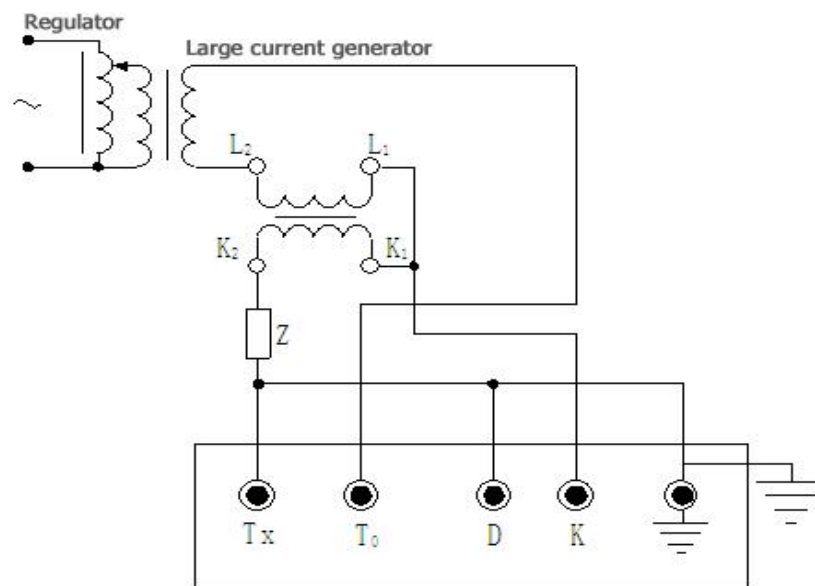


Figure 10

5.3 Bipolar CT calibrating CT

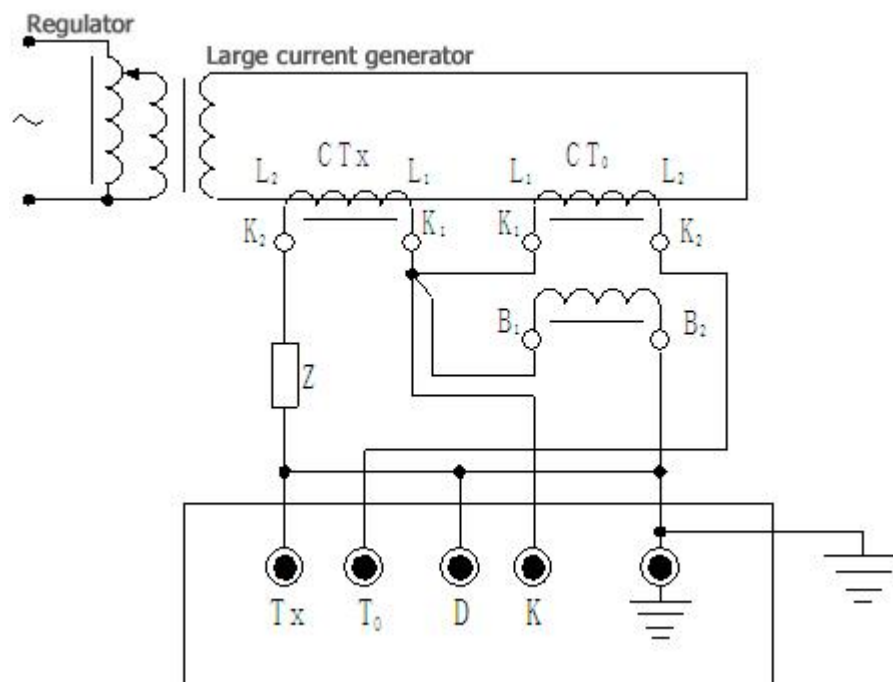


Figure 11

5.4 Wiring diagram for PT calibrating PT(Low potential port wiring)

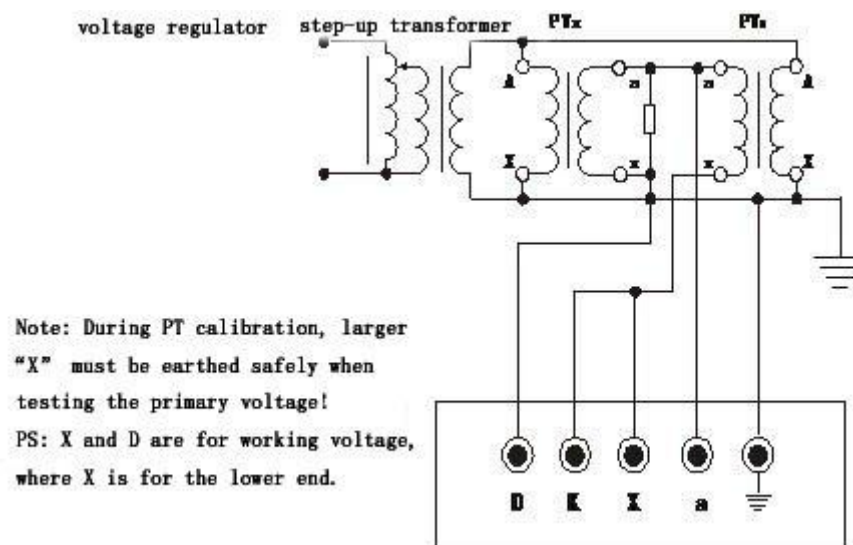


Figure 12

5.7 Wiring diagram for PT calibrating PT (High potential port wiring)

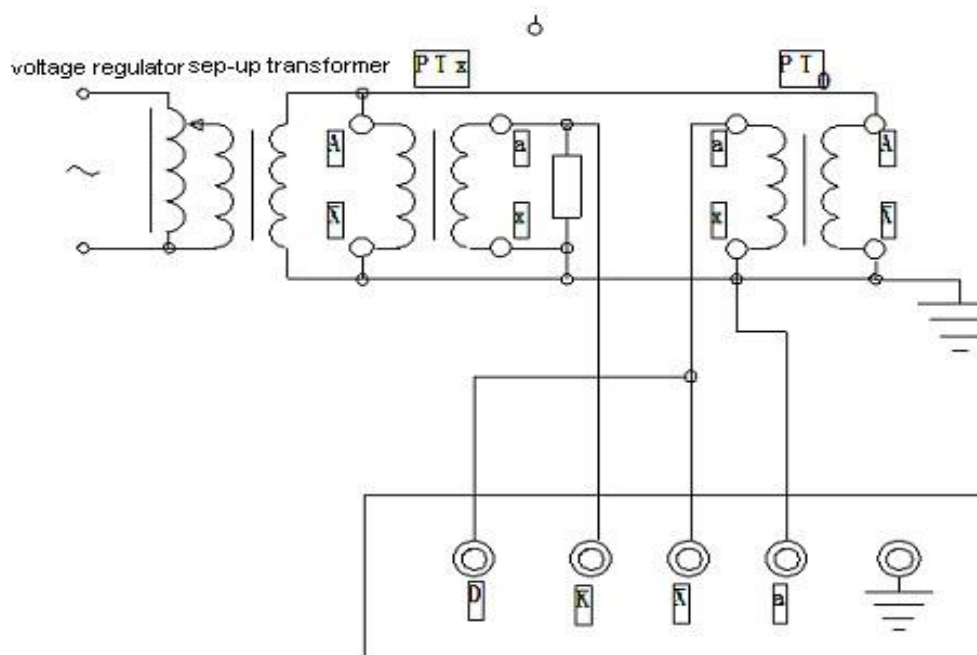


Figure 15

5.8 Impedance Test

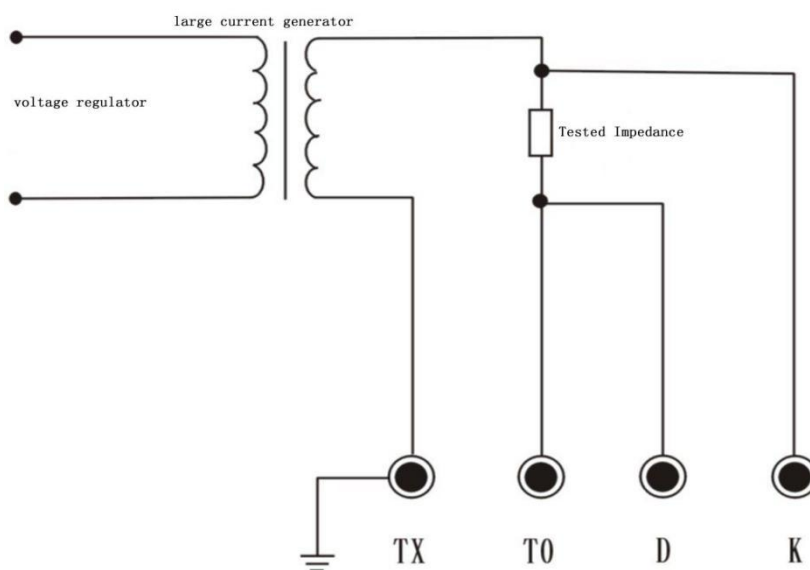


Figure 16

Precaution: Never change the load value before voltage regulator returns to zero. Or the instrument will be damaged.

5.9 Admittance Test

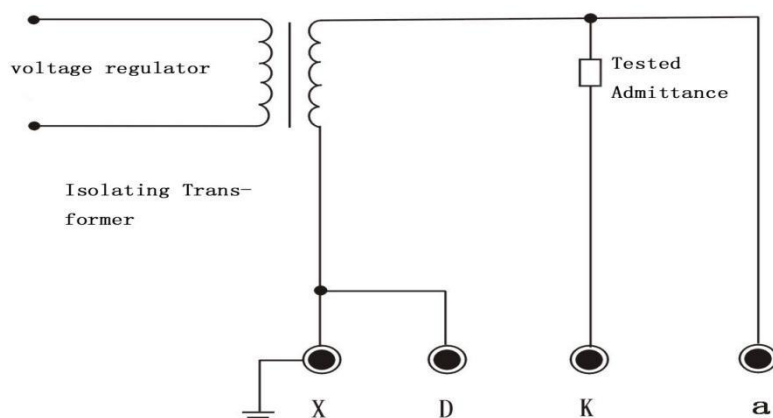


Figure 17

Precaution: Never change the load value before voltage regulator returns to zero. Or the instrument will be damaged.

VI. Calibrator Software Introduction

6.1 Introduction to the management system

The aim of transformer error management system is to perform transformer test, data search and statistical reports management according to *National Metrological Verification* with the help of basic transformer data.

6.2 Main Features:

- (1)Transformer management follows *National Metrological Verification*.
- (2)You can type in the data manually or to choose the testing data of our unified calibrator to combine calibration and management.
- (3)Calibrator control and automatic transformer test.
- (4)Able to print all the records, certificates and analysis reports according to the regulations.
- (5)Abundant statistical functions, able to search and integrate the conditions of instruments under test during a certain period of time, also able to summarize and assess the performance of some operator in a specific time period.
- (6)Backup and recovery features.
- (7)Complete teaching course and online help for users.

VII. Attention Matters

- 7.1 Before the test, please read the relevant wiring diagram, and wiring through professional.
- 7.2 If not clear, please contact manufacturers, and then operate.
- 7.3 Before wiring or clearing, must ensure that calibrator is power off, power supply is power outage, operation box is power outage;
- 7.4 Before starting up please check carefully, confirm that wiring is correct and

reliable, ground connection;

7.5 When testing current transformer, please note that the secondary cannot be open circuit, including not switch current load box gears arbitrarily;

7.6 When testing voltage transformer, please note that the secondary cannot be short circuit, must wiring strictly in accordance with the diagram wiring, and reliable grounding, also should be enclosed test site to keep enough safe distance, prevent others breaking into and avoid accidents;

7.7 When testing current transformer, according to the nameplate requirements, must use gear with provisions, select large current wire and special test line with provisions;

7.8 There must be professional (or through effective training) staff to operate device, non-professional personnel are avoided;

7.9 Please do not open any part of this device or you will loss effectively repair services, but also dangerous;

7.10 When maintenance and cleaning equipment, please use a soft cotton cloth wipe it;

7.11 Handle with care; avoid rain or long-time sunshine irradiation.

VIII. Three Control Methods Explanation of Transformer Calibrator

Transformer calibrator in boot operation, there will be three measurement control modes for the user to choose. Three control modes are: computer control measurement, station control measurement, manual control measurement. The following are explanations of three control modes:

8.1. Computer control measurement:

In this method, the whole process is automatically controlled by PC (computer) software, the user just select parameters in the PC software, click "start measurement" in software interface, station will automatically finish transformer's (CT, PT) rise, fall, full load and light load test according to the user's selected object, and automatically switch current and voltage load box according to user's selection, this method is suitable for the majority of users, because it is simple, it can generate the database corresponding software, issued by the various data report, avoid wrong behavior of users.

8.2. Station control measurement:

In this method, the whole measuring process is controlled by transformer calibrator, calibrator test rise, fall, full load and light load of transformer (CT, PT) according to the user's selection of parameters. And the measurement data are transmitted to the computer (does not judge whether computer received data), this measuring method

does not need automatically closing, and requires users to manually press the "start" button on body panels. The measurement method is not automatically switch full load box and light load box, also requires the user to adjust load box to "manual" mode, and manually switch load box numerical value.

Station control measurement method is suitable for the factory inspection, a simple test for user.

8.3. Manual control measurement:

In this method, body measurement is controlled by the user, user manual control platform internal motor rise and fall, the whole measuring process need to manually press the "start" button on body panels, manually switch load box.

The method is suitable for the simple test, inspection calibration of verification institutions personnel, manufacturer debugging.

IX. Transformer Wiring Diagrams from Electric Power

9. 1 CT Test

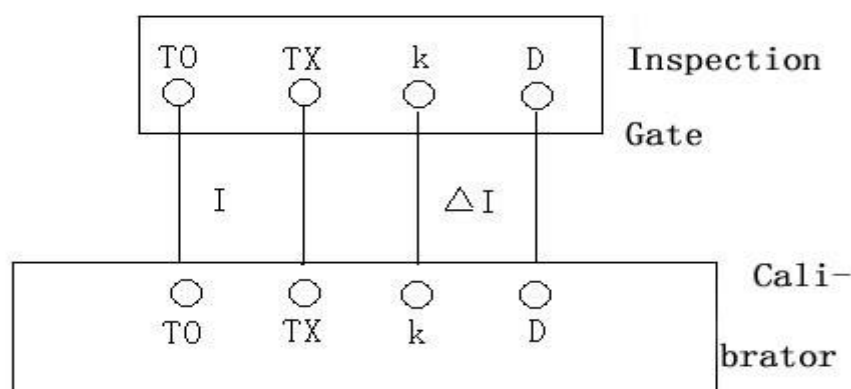


Figure 18

9.2 PT Test

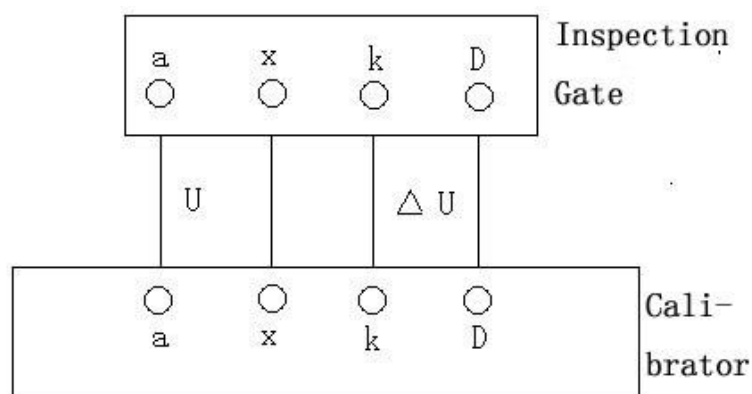


Figure 19

9.3 Impedance Test

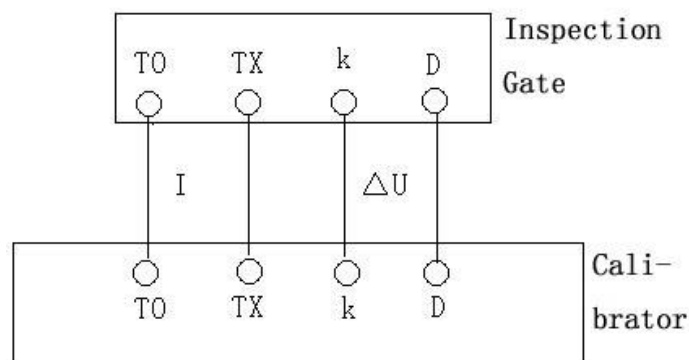


Figure 20

9.4 Admittance Test

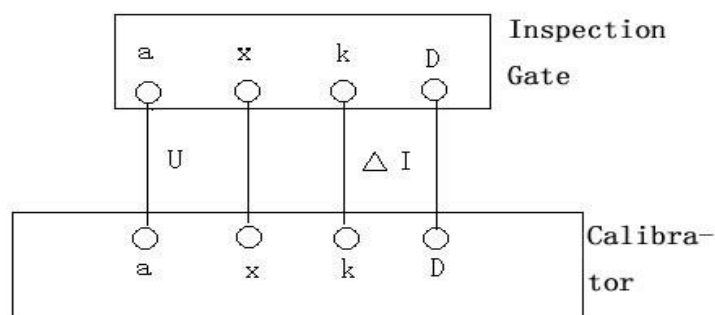


Figure 21

9.5 Operation Steps

After correct wiring referring to the wiring diagram

1. Wiring must strictly follow the wiring diagram.
2. Turn on the power.
3. Press "OK" to select "manual measurement".
4. Select the right "Secondary Voltage/Current"
5. Select "GO" to begin the test.

Note:

1. Wiring must strictly follow the wiring diagram.
2. Before change the wire, first bring down the percentage meter, shut off, and then you can change the wire.
3. You cannot choose "computer control measurement" or "station control measurement" these two methods, the specific reason is seen the front.

X. Guarantee & Service

1. The calibrator should be maintained in environment where temperature is between

+5℃--40℃, relative humidity is below 85% and corrosive gases is not present.

2. Calibration period for the calibrator itself is one year.
3. Generally, our guarantee holds for 12 months after the date of manufacture. And we provide repair and replace service for free within the 12 months, if anything goes wrong due to quality defect rather than improper operation.
4. Only qualified and experienced technicians are allowed to perform repair after reading the User Manual and getting clearly aware of the circuit. Others are not supposed to open the calibrator or perform the repair.