1. System Introduction

HZBZ-IV automatic comprehensive test system is technically used for routing test, type test, and special test of transformers, including automatic test capability for ratio-voltage, direct current resistance, no-load loss measurement, induced over voltage withstand test, temperature rise test (11～33kV class distribution transformer). All the test items can be operated by the relevant transformer automatic comprehensive test system.

The fully automatic model adopts PLC as the control core and industrial control computer as the man-machine interaction interface, which has the outstanding advantages of high reliability, intuitive interface, simple operation and perfect protective measures.

2. Test Capability

2.1 Test Capability

1. Transformer capacity: 5KVA-2500KVA and below
   Primary voltage: transformer below 11.0 kV
   Secondary voltage: 433V

2. Transformer capacity: 15KVA-2500KVA and below
   Primary voltage: transformers below 33.0 kV
   Secondary voltage: 433V

3. Transformer capacity: 2.5KVA-10000KVA and below
   Primary voltage: transformers below 33.0 kV
   Secondary voltage: 11.0KV

2.2 Test Item

1. Insulation resistance test; (instrument independent test)
2. DC resistance test of 2 winding; (instrument independent test)
3. Voltage ratio (turn ratio) and connection group alias test;
4. no load test: no load loss, power factor measurement and no load current percentage test;
5. Load test: load loss (automatic conversion load loss), short circuit impedance percentage test;
6. Power frequency withstand voltage test (high voltage test), this test item is not comprehensive test software, and can be tested separately.
7. induction pressure test (frequency doubling pressure test);
8. transformer temperature rise test;
9. transformer capacitance and dielectric loss test; (instrument independent test)

**Type test of transformer**

10. lightning impulse test (including full wave and chopped wave test)
11. Meet the temperature rise test of the following transformers

   1. Transformer capacity: 5KVA-2500KVA and below
      Primary voltage: transformer below 11.0 kV
      Secondary voltage: 433V
   2. Transformer capacity: 15KVA-2500KVA and below
      Primary voltage: transformers below 33.0 kV
      Secondary voltage: 433V

**2.3 Design and manufacturing follow standards**

GB 1094 "Power Transformer"
GB/T 6451-2015 "Technical parameters and requirements for oil-immersed power transformers"
GB/T 10228-2015 "Dry power transformer technical parameters and requirements"
JB/T 501-2006 "Power Transformer Test Guide"
GB/T 1208—2006 “Current Transformer”
GB/T 1207-2006 "Voltage Transformer"
IEC60076 "Transformer Standard"

**3、Detailed Configuration and Technical Parameters for Comprehensive Transformer Test Bench**

<table>
<thead>
<tr>
<th>No.</th>
<th>Equipment</th>
<th>Model</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>1.</td>
<td>HZBZ-IV Master station for transformer test bench</td>
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<td>01</td>
<td>Master station for transformer test bench</td>
<td>HZBZ-IV</td>
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<tr>
<td>02</td>
<td>industrial control</td>
<td>IPC-610L</td>
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<tr>
<td>Printer</td>
<td>HP</td>
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<td>Transformer test system software</td>
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### 2. Test Instrument

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Model</th>
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<tr>
<td>01</td>
<td>Fully automatic variable ratio tester</td>
<td>GD-700</td>
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<tr>
<td>02</td>
<td>Power analyzer</td>
<td>GD-300C</td>
<td>1</td>
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<tr>
<td>03</td>
<td>Dual channel DC resistance tester</td>
<td>GD200-20A</td>
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<td>04</td>
<td>Insulation resistance tester</td>
<td>Common 3125A</td>
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<tr>
<td>05</td>
<td>Transformer dielectric loss tester</td>
<td>GD-6000</td>
<td>1</td>
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<tr>
<td>06</td>
<td>Temperature inspector</td>
<td>8 temperature passageway</td>
<td>1</td>
</tr>
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</table>

### 3. High and low voltage control cabinet

- **(containment structure, it can be hoisted as a whole, convenient and quick, internal wiring completed at once, saving installation and commissioning time).**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Model</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>01</td>
<td>Instrument integration unit one set</td>
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<tr>
<td>02</td>
<td>PLC control device</td>
<td>SIEMENS S7-200</td>
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<tr>
<td>03</td>
<td>Test project distribution device</td>
<td>400A</td>
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<tr>
<td>04</td>
<td>High voltage current metering device</td>
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<td>High voltage</td>
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<tr>
<td>No.</td>
<td>Equipment</td>
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<td>-----</td>
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<td>----------------------------------------------</td>
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<tr>
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<th>4、Equipment</th>
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<td>02</td>
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<td>03</td>
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<table>
<thead>
<tr>
<th>5、Test transformer console</th>
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<tbody>
<tr>
<td>01</td>
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<td>02</td>
</tr>
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<table>
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<th>Accessories</th>
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<tr>
<td>Special high voltage discharge rod</td>
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<tr>
<td>High voltage test line</td>
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<tr>
<td>Grounding wire and plug</td>
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<th>6、Other</th>
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<tr>
<td>01</td>
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<tr>
<td>Lightning impulse test system</td>
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<td>-------------------------------</td>
</tr>
<tr>
<td><strong>01</strong></td>
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</tbody>
</table>

4. **Description of technical characteristics for test equipment**

4.1 **Test control console**
Transformer test bench is planar structure, wide vision, simple and generous.

Include three - phase power voltmeter, power meter, voltage regulator output voltmeter, real - time supervision of the power grid.

Equipped with emergency stop button, alarm lamp and overcurrent protection alarm device to ensure the safety of personnel and equipment.

Built-in industrial control computer, large screen curved surface display, wireless mouse keyboard operation, good stability, clear display, convenient and fast operation.

4.2 Test Control System

The whole test system adopts a combination of computer and PLC control methods. PLC is mainly used to set the logical relationship among various components, integrate and execute the underlying operation commands, and realize the basic protection functions of the system. It has flexible programming, high reliability, high-speed operation and other advantages, while the
industrial control computer is mainly used for the organization of the test flow, the release of the action instructions, the realization of the system advanced protection functions, etc. Its communication with the PLC through RS-485 and completely isolated can effectively prevent the communication signal from being disturbed and ensure the safety of the computer when the test product fails to discharge to ground;

The test system adopts the way of frequency converter to realize the multi-speed adjustment of the speed of the lifting and lowering speeds in the performance test to achieve finer voltage and current adjustment levels and more accurate data sampling capabilities.

4.3 Test software

The test software of the complete test equipment is user-friendly, easy to operate, and the alarm information is rich and complete. The interface of various components within the circuit can be displayed in real time in the software. The test software interface can be referred to as follows:
变压器变比组别试验

<table>
<thead>
<tr>
<th>产品编号</th>
<th>分数</th>
<th>变压比A</th>
<th>变压比B</th>
<th>变压比C</th>
<th>变压比D</th>
<th>变压比E</th>
<th>铁损</th>
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变压器空载试验

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<tr>
<th>产品编号</th>
<th>Hzn (V)</th>
<th>Hzn1 (V)</th>
<th>Hzn2 (V)</th>
<th>Hzn3 (V)</th>
<th>Hzn4 (V)</th>
<th>Hzn5 (V)</th>
<th>Hzn6 (V)</th>
<th>Hzn7 (V)</th>
<th>Hzn8 (V)</th>
<th>Hzn9 (V)</th>
<th>Hzn10 (V)</th>
</tr>
</thead>
</table>

9
4.5 Database and test report

At the end of each test, the test data and calculation results will be saved in the test database according to the number. The software can be generated through independent test data query and report generation. The test data can be queried by number and generated according to the user-specified format. Test reports can be saved as office excel forms or printed directly from desktop printers; test report formats can be generated based on customer requirements.

5、Technical Requirements for Component Equipment

5.1 Control computer and accessories

Host model: Advantech Industrial Computer IPC-610L;

Specific configuration: hard disk: 1T and more; RAM: 4G and more; 4 pcs 9-pin communication serial port; Display: curved screen; Printer: HP A4 format black and white laser printer;

5.2 Control Cubicle
Integration device for instrument and instrument PLC Control device: Siemens S7-200;
Distribution device for test item: 500A;
High-voltage current metering device: 400A;
High voltage metering device: 22/√3KV.

5.3 Test instrumentation

5.3.1 Automatic ratio tester GD-700

1. Range: 0.9~6000

2. Accuracy: ±0.1%+2 字(0.9~500),
   ±0.2%+2 字(501~2000),
   ±0.3%+2 字(2001~6000)

3. Resolution: Min 0.0001

4. Working power: AC220V±10% 50±Hz

5. Ambient temperature: -10℃~40℃
Performance characteristics

1. The output current of this instrument is large (the maximum can be output 20A), the test range is wide (maximum to 2K omega) suitable for the 35KV voltage level and the temperature rise test of all transformers below and the measurement of DC resistance.

2. Perfect dual power design. It has both high voltage and low voltage side testing and testing functions.

3. This machine has the function of AC380V power supply protection and alarm, the protection function of the broken line, the sound discharge alarm function, the clear indication, and the reduction of misoperation. Perfect protection circuit, strong reliability.

4. Color large screen, touch operation, display data clear and easy to read.

5. Temperature rise test automatically prints and stores temperature rise data according to the set time interval.
to facilitate recording.

6, the instrument has a calendar, 100 sets of conventional data storage, two temperature rise test results storage, shutdown does not lose data. And the "U disk" interface is used to facilitate the export of computer generated temperature rise curve.

7, the instrument has RS485 communication interface, with PC control software to achieve remote control survey.

8. The software can be automatically processed and the temperature rise curve can be generated.

**Technical indicators**

1. Output current:
   - High voltage CH1: 5A, 1A, 0.1A, 0.01A
   - Low voltage CH2: 20A, 10A, 5A, 2A

2. Measurement range:
   - (high pressure CH1---5A): 0 Omega - 4 Omega
   - (high pressure CH1---1A): 20m Omega - 20 Omega
   - (high pressure CH1---0.1A): 200m Omega - 200 Omega
   - (high pressure CH1---0.01A): 2 Omega - 2000 Omega
   - (low pressure CH2---20A): 0 Omega - 0.1 Omega
   - (low pressure CH2---10A): 2m Omega - 0.4 Omega
   - (low pressure CH2---5A): 4m Omega - 0.8 Omega
   - (low pressure CH2---2A): 10M Omega - 2 Omega

3. Accuracy: (high pressure CH1): 0.2% + 1 muomega
   - (low pressure CH2): 0.2% + 0.2 Omega

4. Minimum resolution: 0.1 muomega

5, temperature rise record data interval: 10 seconds, 30 seconds, 60 seconds.

6. Working temperature: -20 ~ 40 C

7, environmental humidity: less than 80%RH, no condensation

8, work power: Communication: AC220V + 10%, 50Hz + 1Hz

9, volume: long 410mm x wide 440mm x high 210mm

10, net weight: 15.7kg
5.3.3 Power Analyzer GD-300C

1. The parameters such as no-load loss, no-load current, load loss, impedance voltage, zero sequence impedance, short circuit impedance, voltage value, voltage mean value, current, power, power factor, frequency and other parameters can be measured.

2. All data are synchronized in the same period to ensure the accuracy and reasonableness of the measurement results under the condition of power supply.

3. Automatic waveform distortion correction, voltage correction, current correction, temperature correction, without any manual calculation.

4. It can be directly measured in the permitted measuring range of the instrument, and the voltage transformer and current transformer can be externally connected beyond the measuring range.

5. Can lock the display data and store or print all the measurement results. The instrument can not drop the electric memory and the micro printer. It can keep the measured data for a long time and can check and print at any time.

6. Large screen blue screen LCD display, all Chinese menu and operation tips, intuitive and convenient.

7. No electricity calendar, clock function.

8. Has a RS-232/485 interface, which can communicate with the computer.

Main technical indicators:

(1) Basic measurement accuracy: voltage, current + 0.1%
The power is + 0.2% (COS >0.1), + 1% (0.01<COS towel is less than 0.1).

(2). Range of voltage measurement: AC 0~800 V

(3). Current measurement range: AC 0-5A

5.4 High voltage current transformer with precision measurement

Accuracy level: 0.1;
Insulation class: 22/√3KV;
Measuring range: 0-200A;
Transformation ratio: (5,10,20,50,100,400)/5A;

Adjustment method: Computer controlled secondary adjustment;

5.5 Voltage transformer with precision measurement

Accuracy level: 0.1;
Measuring range: 22/√3KV;
Transformation ratio: (3.3,6.6,11.0)/√3KV/0.1KV;
Adjustment method: Computer controlled secondary adjustment;

5.6 Induction Regulator 100KVA
The regulator has the characteristics of non-contact voltage regulation, easy to use, and can operate reliably for a long time. Widely used in industrial and mining enterprises, agriculture and scientific research units as a universal device for regulating voltage. When the input voltage is constant, it can steplessly adjust the output voltage under load. The regulator is used in conjunction with the inverter control to achieve automatic voltage regulation.

Three-phase input voltage 380V, output voltage 10-650V

Features

(1) Set interlock protection of test items; over-current and over-voltage protection; test operation control; Full monitoring for voltage, current and frequency; Voltage resistance timing; test reminding and other functions.

(2) Electric buck-boost, current range, voltage range can be arbitrarily switched within the console.
5.7 Intermediate transformer 250KVA

Capacity: 250KVA
Input voltage: 600V
Output voltage: 1.5/3.0/6.3/11.0KV

5.8 frequency multiplication generator 50KW

(Pictures are only for information, take practicality as standard)

Capacity: 50KW
Input voltage: three phase 380V
Output voltage: 800V
Output frequency: 150HZ
Intermediate frequency generator configuration:
Model: YR--8 Winding medium frequency Rated power: 50KW
Rated voltage: 800V
Nominal frequency: 150Hz

Phase: 3ph

The waveform distortion rate of the no-load line voltage is less than 5%

Manual voltage regulation range

Rated power: 22KW

Ralated voltage: 380V

Nominal frequency: 50Hz

Connection: △Connect 6 lines

Protection level: IP44

Insulation class: F

Model: Y - 4 Three-phase squirrel cage

Work system: S1 continuously working. The unit consists of a synchronous generator and a three-phase squirrel-cage asynchronous motor connected via a coupling and placed on a common bottom.

5.9 Power frequency withstand voltage test system

5.9.1 Power frequency pressure operation console  50KVA

5.9.2 High voltage test transformer  YDG (J)–50KVA/100KV

YDG(J)-50KVA/100KV Technical parameters for transformer test

Rated Capacity:  50KVA
Input voltage: 400V,  Input Current: 50.0A  
Output voltage: AC100KV,  Output current: 500mA  
Ratio: 250,  Measuring ratio: 1000  
Connect groups: I,I0  

6、System protection  

6.1 Emergency button  

In order to disconnect the power supply quickly when an emergency is detected during the test, an emergency stop button is provided on the operation panel, and the test circuit can be quickly broken by pressing it for emergency use.  

6.2 Warning Light  

The system is equipped with a warning light, in which the warning light is lit up after the test starting to show the reminder;  

The system is equipped with an alarm bell, and the tester can manually or automatically control the system to sound a reminder.  

6.3 Equipment protection  

In order to protect the safety of equipment operation, the system is provided with four levels of protection, input protection, output protection, measurement protection and test protection to ensure that the test item or test equipment can be promptly alerted and quickly implemented during the test process. After a protection action, the system will give a corresponding prompt to determine the cause of the failure.  

6.3.1 Input protection  

An over-current relay protection is provided at the input of the voltage regulator, which is set according to the input rated current of the voltage regulator to ensure that the current at the input of the voltage regulator is not excessive, and can be used as backup protection for output protection;  

A motor protector is installed on the starting side of the traction motor of the generator set, and is
set according to the rated current of the motor to ensure the safe start of the generator set.

6.3.2 output protection

Over-current relay protection is provided at the output of the voltage regulator and generator set, and the rated output currents of the voltage regulator and the generator set are set separately to ensure that the current at the output of the voltage regulator is not excessive;

The voltage and current signals are measured at the output of the voltage regulator and the generator set. The voltage and current signals are converted into RS/485 signals by a digital sensor into the PLC, and then the rated voltages and current at the output terminals of the voltage regulator and the generator set are set within the PLC. This protection is used as backup protection for overcurrent relays.

6.3.3 measurement protection

The test software is provided with protection for the measuring equipment. In the test process. If the measured voltage or current value exceeds the voltage and current range of the precision measuring transformer or power analyzer, the system will be in a certain safety margin at the first time. A warning is issued and the step-up operation is suspended. If the voltage and current measurement exceeds this safety margin, the system immediately will perform an emergency stop operation immediately, and cut off all loop control components and gives a prompt.

6.3.4 Zero boost protection

In order to ensure that the system can be boosted and powered up from zero, the system will automatically return the voltage regulator to zero (low limit) after disconnecting the output power. And if the voltage regulator is not in the zero position before power transmission, the regulator should be reduced to zero position, and then the power transmission operation is performed. If the voltage regulator cannot reach the zero position, the system prompts that the power transmission operation cannot be performed.
6.4 Subject protection

In accordance with the rated voltage and current value of the input terminal of the tested transformer, overvoltage and overcurrent protection are set up. After the protection action, the test software gives the corresponding hints. This protection belongs to the protection set in the computer program. It fails in the test of the small transformer but can not reach the higher level protection. Fixed value can be used as an effective means to protect the tested transformer.

6.5 Other protective measures

The system can reserve multiple contact points for special purpose (user defined, such as protective door or emergency stop button in test area).

7. Delivery time and other

7.1 Delivery time

Delivery date is 50 days, The delivery date shall be calculated from the date of payment.

7.3 Quality assurance

The supplier implements the product's lifetime warranty policy, one year's free warranty period in foreign countries, and the free warranty period starts at the date when the purchaser checks and accepts the complete set of equipment.

7.4 Installation and commissioning

1. After the production of complete sets of equipment is completed, preliminary installation and commissioning work shall be carried out to reduce on-site installation and commissioning time. The on-site installation and commissioning shall require the necessary assistance from the purchaser, and the supplier shall provide training to the demand side in order to be able to operate the equipment proficiently. The contents include: system overview, basic working principle of the system, operation and usage of equipment, inspection and maintenance of equipment, failure analysis and processing.

2. After trial operation or normal operation, technical personnel of both parties will test the technical indicators of the equipment.
7.5 Precautions

1. The equipment demander only needs to provide three: power distribution cabinet with frequency 50Hz±0.1 and current not less than 500A;
2. The grounding resistance of the installation site shall not be greater than 0.5 ohms; in order to maintain the integrity of the site, it is better to pre-ditch the cable trench in the control room and equipment area during the civil construction;
3. Delivering the equipment should also provide detailed technical documents, instructions for use, electrical installation plans and related information;
4. The unfinished matters are negotiated and resolved by the two parties.

Annex 1: Comprehensive transformer test system diagram（Test product transformer for 33kV and the below）
1.案例