HZBZ-IV 10000kVA/33KV

Automatic Comprehensive Transformer Test Bench

Technical Solution

Huazheng Electric Manufacturing (Baoding) Co.,Ltd

Contents

1. System Introduction

The HZBZ-IV Automatic Comprehensive Test System is designed for routine tests, type tests, and special tests of transformers. It provides fully automated testing functions, including transformation ratio and voltage measurement, DC resistance measurement, no-load loss measurement, induced overvoltage withstand testing, and temperature rise testing for 11–33 kV class distribution transformers. All test items can be performed and managed through the integrated transformer automatic comprehensive test system.

The fully automatic configuration uses a PLC as the core control unit and an industrial control computer as the human–machine interface. This architecture offers high reliability, an intuitive user interface, simple operation, and comprehensive protection functions, ensuring safe and efficient testing.

2. Test Capability

2.1 Test Capability

Transformer capacity: 5KVA-2500KVA and below

Primary voltage: transformer below 11.0 kV

Secondary voltage: 433V

Transformer capacity: 15KVA-2500KVA and below

Primary voltage: transformers below 33.0 kV

Secondary voltage: 433V

transformer capacity: 2.5KVA-10000KVA and below

Primary voltage: transformers below 33.0 kV

Secondary voltage: 11.0KV

2.2 Test Item

Insulation resistance test; (instrument independent test)

DC resistance test of 2 winding; (instrument independent test)

voltage ratio (turn ratio) and vector group test;

no load test: no load loss, power factor measurement and no load current percentage test;

load test: load loss (automatic conversion load loss), short circuit impedance percentage test;

power frequency withstand voltage test (high voltage test), this test item is not comprehensive test

software, and can be tested separately.

induction pressure test (frequency doubling pressure test);

transformer temperature rise test;

transformer capacitance and dielectric loss test; (instrument independent test)

Type test of transformer

lightning impulse test (including full wave and chopped wave test)

Meet the temperature rise test of the following transformers

Transformer capacity: 5KVA-2500KVA and below

Primary voltage: transformer below 11.0 kV

Secondary voltage: 433V

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

NO.	Equipment	Model	Quantity
1、HZBZ-IV Master station for transformer test bench			
01	Master station for transformer test bench	HZBZ-IV	1
02	industrial control	IPC-610L	1

	machine		
	Display screen	Samsung stereo screen 27 inches	1
	Printer	HP	1
03	transformer test system software	V1.0	1
2、Test instrument			
01	Turn ratio tester	HZ-700	1
02	power analyzer	HZ-300	1
03	Dual channel DC resistance tester	HZ-200	1
04	Insulation resistance tester	common 3125A	1
05	Transformer dielectric loss tester	HZ-6000	1
06	Temperature inspector	8 temperature passageway	1
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).			
01	Instrument integration unit one set		1
02	PLC control device	SIEMENS S7-200	1
03	Test project distribution device	400A	1
04	High voltage current metering device		1
	High voltage precision current Mutual inductor	400-200-100-50-20-10-5A/5A Voltage level：22/√3KV Precision grade：0.1	3
05	High voltage voltage metering devices		1

	High voltage precision voltage Mutual inductor	(22.0-11.0-6.6-3.3)/√3/0.1KV Voltage level：22/√3KV Precision grade：0.1	3
4、 Equipment			
01	Three-phase induction voltage regulator	250KVA（10-650V）	1
02	Intermediate transformer	250KVA	1
03	Frequency doubling generator	10KV	1
5、Test transformer console			
01	High voltage test transformer	50KVA/100KV	1
02	Test transformer console	50KVA(Including electric regulator）	1
03	Protection resistance	100KV	1
Accessories	Special high voltage discharge rod		
	High voltage test line		
	Grounding wire and plug		
6、 Other			
01	Cable and wire	Regulator input: 150mm^{2}3*10M Regulator output: 95mm^{2}3*10M Intermediate input: 95mm^{2}3*10M Intermediate variable output: 25mm^{2}3*10M (high voltage line) Multiplier unit input: 25mm^{2}3*10M Excitation regulation: 16mm^{2}3*10M Multiplier unit output: 16mm^{2}3*10M	1

		Test transformer input: 25mm^{2}2*10M Test line: 50mm^{2}3*10M (high voltage line)	
lightning impulse test system			
01	Lightning impulse test system	450KV/20KJ（including 300KV chopper device）	1

4. Description of technical characteristics for test equipment

4.1 Test control console

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

The transformer test bench features a planar structure with a wide field of view, offering a clean, simple, and professional design.

It is equipped with a three-phase power voltmeter, power meter, and voltage regulator output voltmeter, enabling real-time monitoring of power supply conditions.

For safety, the system includes an emergency stop button, alarm indicator, and overcurrent

protection alarm device, ensuring reliable protection for both 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

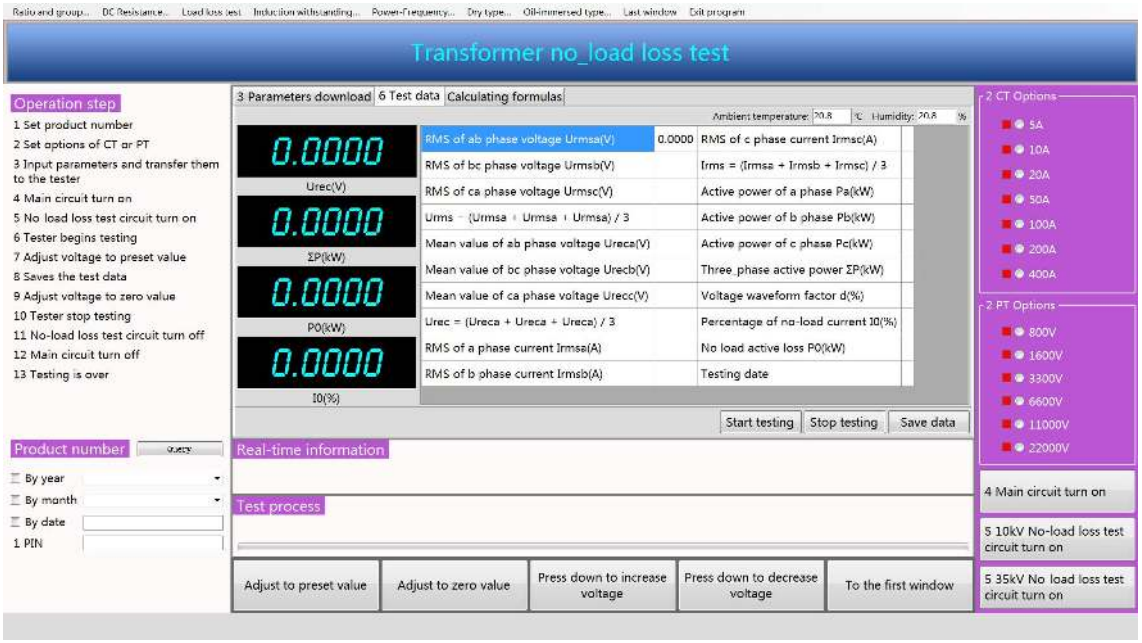
The entire test system adopts a combined computer and PLC control architecture. The PLC is mainly responsible for defining the logical relationships among system components, integrating and executing low-level control commands, and implementing basic protection functions. It offers flexible programming, high reliability, and high-speed operation.

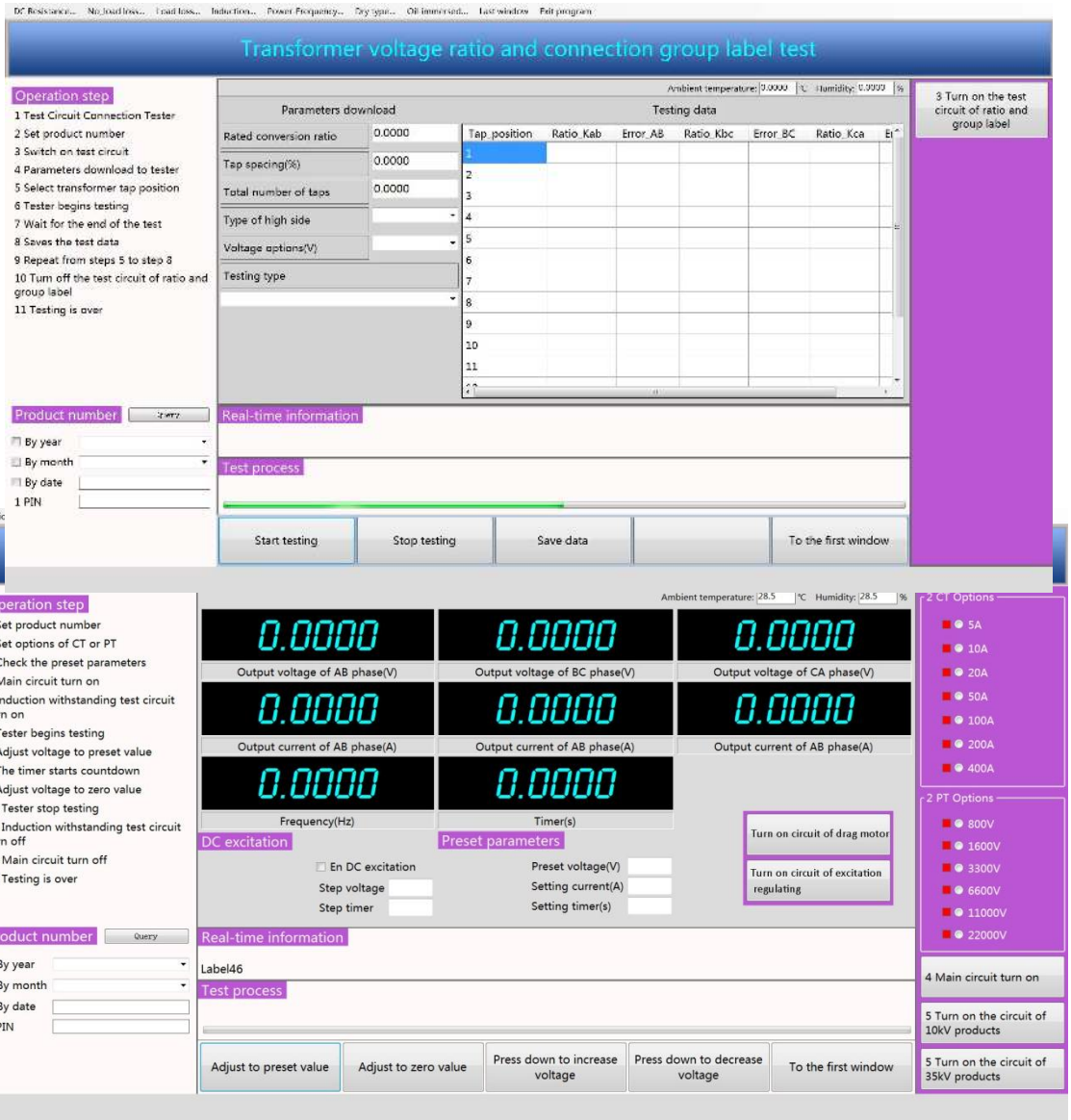
The industrial control computer is primarily used to organize test procedures, issue control commands, and implement advanced system protection functions. Communication between the computer and the PLC is achieved via RS-485 with full electrical isolation, which effectively suppresses signal interference and protects the computer in the event of a ground discharge or failure of the test object.

The test system uses a frequency converter to provide multi-stage speed control for voltage ramp-up and ramp-down during performance testing. This enables finer voltage and current adjustment, as well as more accurate data acquisition and sampling.

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:


Transformer no_load loss test
Operation step
1 Set product number
2 Set options of CT or PT
3 Input parameters and transfer them to the tester
4 Main circuit turn on
5 No_load loss test circuit turn on
6 Tester begins testing
7 Adjust voltage to preset value
8 Saves the test data
9 Adjust voltage to zero value
10 Tester stop testing
11 No-load loss test circuit turn off
12 Main circuit turn off
13 Testing is over
3 Parameters download
6 Test data
Calculating formulas
0.0000
Urec(V)
0.0000
ΣP(kW)
0.0000
P0(kW)
0.0000
I0(%)
RMS of ab phase voltage Urmsa(V)
RMS of bc phase voltage Urmsb(V)
RMS of ca phase voltage Urmsc(V)
Urms = (Urmsa + Urmsa + Urmsa) / 3
Mean value of ab phase voltage Ureca(V)
Mean value of bc phase voltage Urecb(V)
Mean value of ca phase voltage Urecc(V)
Urec = (Ureca + Ureca + Ureca) / 3
RMS of a phase current Irmsa(A)
RMS of b phase current Irmsb(A)
0.0000
RMS of c phase current Irmsc(A)
Irms = (Irmsa + Irmsb + Irmsc) / 3
Active power of a phase Pa(kW)
Active power of b phase Pb(kW)
Active power of c phase Pc(kW)
Three_phase active power ΣP(kW)
Voltage waveform factor d(%)
Percentage of no-load current I0(%)
No load active loss P0(kW)
Testing date
Start testing
Stop testing
Save data
2 CT Options
5A
10A
20A
50A
100A
200A
400A
2 PT Options
800V
1600V
3300V
6600V
11000V
22000V
4 Main circuit turn on
5 10kV No-load loss test circuit turn on
5 35kV No load loss test circuit turn on
Product number
Query
By year
By month
By date
1 PIN
Real-time information
Test process
Adjust to preset value
Adjust to zero value
Press down to increase voltage
Press down to decrease voltage
To the first window


Transformer voltage ratio and connection group label test
Operation step
1 Test Circuit Connection Tester
2 Set product number
3 Switch on test circuit
4 Parameters download to tester
5 Select transformer tap position
6 Tester begins testing
7 Wait for the end of the test
8 Saves the test data
9 Repeat from steps 5 to step 8
10 Turn off the test circuit of ratio and group label
11 Testing is over
Parameters download
Rated conversion ratio
Tap spacing(%)
Total number of taps
Type of high side
Voltage options(V)
Testing type
Testing data
Tap_position
Ratio_Kab
Error_AB
Ratio_Kbc
Error_BC
Ratio_Kca
3 Turn on the test circuit of ratio and group label
Start testing
Stop testing
Save data
To the first window
Operation step
1 Set product number
2 Set options of CT or PT
3 Check the preset parameters
4 Main circuit turn on
5 Induction withstanding test circuit turn on
6 Tester begins testing
7 Adjust voltage to preset value
8 The timer starts countdown
9 Adjust voltage to zero value
10 Tester stop testing
11 Induction withstanding test circuit turn off
12 Main circuit turn off
13 Testing is over
0.0000
Output voltage of AB phase(V)
0.0000
Output voltage of BC phase(V)
0.0000
Output voltage of CA phase(V)
0.0000
Output current of AB phase(A)
0.0000
Output current of AB phase(A)
0.0000
Output current of AB phase(A)
0.0000
Frequency(Hz)
0.0000
Timer(s)
DC excitation
En DC excitation
Step voltage
Step timer
Preset parameters
Preset voltage(V)
Setting current(A)
Setting timer(s)
Turn on circuit of drag motor
Turn on circuit of excitation regulating
2 CT Options
2 PT Options
4 Main circuit turn on
5 Turn on the circuit of 10kV products
5 Turn on the circuit of 35kV products
Product number
Query
By year
By month
By date
1 PIN
Real-time information
Label46
Test process
Adjust to preset value
Adjust to zero value
Press down to increase voltage
Press down to decrease voltage
To the first window

4.4 Database and test report

At the end of each test, all measurement data and calculated results are stored in the test database with unique identification numbers. The software supports independent data querying and automatic report generation. Test records can be retrieved by number and formatted according to user-defined requirements.

Test reports can be saved as Microsoft Excel files or printed directly via standard desktop printers. In addition, customized report formats can be created to meet specific 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;

Displayer: curved screen;

Printer：HP A4 format black and white laser printer;

5.2 Control Cabinet

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

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 Turn ratio tester

1、Range：0.9～6000

2、Accuracy：±0.1%+2word(0.9~500)、

±0.2%+2word(501~2000)

±0.3%+2word(2001~6000)

3、Resolution：Min 0.0001

4、Working power：AC220V±10%　50±Hz

5、Ambient temperature：-10℃～40℃

5.3.2 Dual Channel DC resistance tester

Performance characteristics

High Output Current and Wide Test Range

The instrument provides a high output current of up to 20 A and supports a wide test range of up to 2 kΩ. It is suitable for DC resistance measurement and temperature rise testing of transformers rated up to 35 kV.

Dual Power Testing Design

The instrument features a complete dual-power design, supporting testing on both the high-voltage and low-voltage sides of the transformer.

Comprehensive Protection and Alarm Functions

The system includes AC 380 V power supply protection, open-circuit (broken line) protection, audible discharge alarms, and clear status indications to reduce the risk of misoperation. The complete protection circuitry ensures high reliability and safe operation.

User-Friendly Touchscreen Interface

A large color touchscreen provides intuitive operation, with clear and easy-to-read data display.

Automatic Temperature Rise Data Recording

During temperature rise testing, the instrument automatically records and prints temperature rise data at user-defined time intervals, facilitating accurate documentation.

Data Storage and Export

The instrument includes a built-in calendar, storage for 100 sets of standard test data, and two complete temperature rise test records. Data is retained after power-off. A USB interface allows easy export of temperature rise curves to a computer.

Remote Communication Capability

An RS-485 communication interface is provided, enabling remote monitoring and control through dedicated PC software.

Automatic Data Processing and Curve Generation

The software automatically processes test data and generates temperature rise curves for analysis and reporting.

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 Ω - 4 Ω

(high pressure CH1---1A): 20m Ω - 20 Ω

(high pressure CH1---0.1A): 200m Ω - 200 Ω

(high pressure CH1---0.01A): 2 Ω - 2000 Ω

(low pressure CH2---20A): 0 Ω - 0.1 Ω

(low pressure CH2---10A): 2m Ω - 0.4 Ω

(low pressure CH2---5A): 4m Ω - 0.8 Ω

(low pressure CH2---2A): 10M Ω - 2 Ω

3. Accuracy: (high pressure CH1): 0.2% ± 1 μΩ

(low pressure CH2): 0.2% ± 0.2 μΩ

4. Minimum resolution: 0.1 μΩ

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

6. Working temperature: -20 ~ 40℃

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

8, work power: AC220V ± 10%, 50Hz ± 1Hz

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

10, net weight: 15.7kg

5.3.3 Power Analyzer

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% (COSφ >0.1), ± 1% (0.01<COSφ ≤ 0.1).

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

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

5.4 Current transformer

Accuracy level：0.1；

Insulation class：22/√3KV；

Measuring range：0-200A；

Transformation ratio：(5,10,20,50,100,200,400)/5A；

Adjustment method：Computer controlled secondary adjustment；

5.5 Voltage transformer

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

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

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.

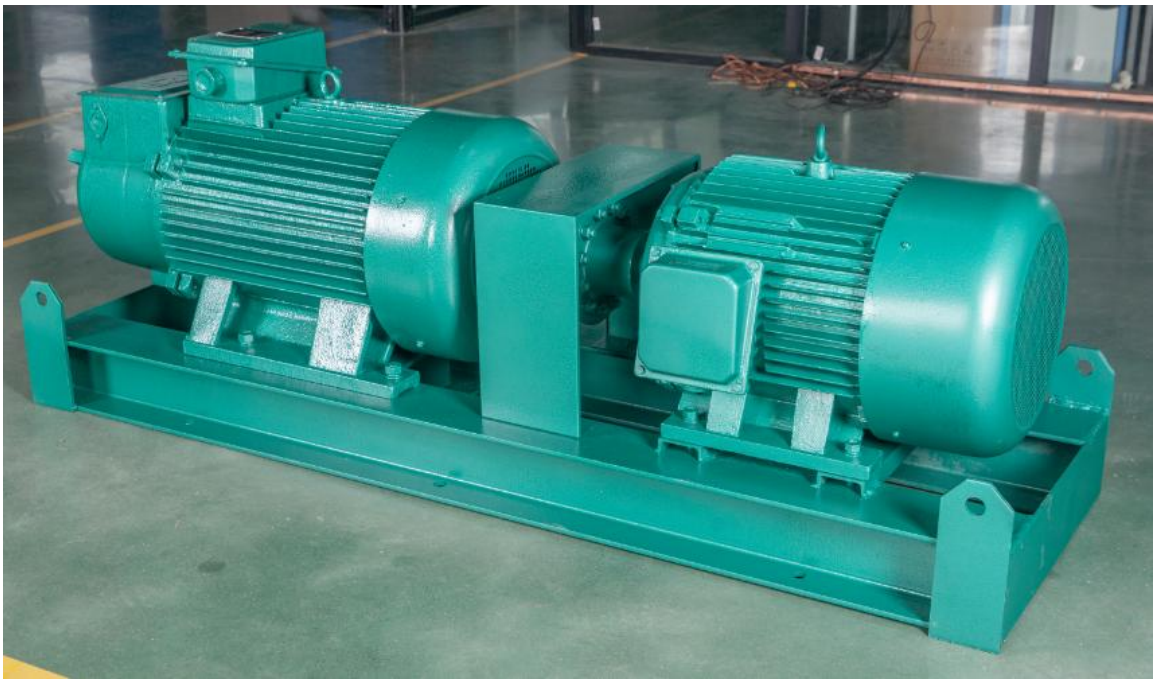
5.7 Intermediate transformer

Capacity: 250KVA

Input voltage: 600V

Output voltage：1.5/3.0/6.3/11.0KV

5.8 Frequency multiplication generator



（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 generator

Rated power：50KW

Rated voltage：800V

Motor configuration:

Model：Y - 4 Three-phase squirrel cage

Rated power：22KW

Ralated voltage: 380V

Nominal frequency：150Hz

Phase：3ph

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

Manual voltage regulation range

Nominal frequency：50Hz

Connection：△Connect 6 lines

Protection level：IP44

Insulation class：F

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 Control Unit 50KVA

5.9.2 High voltage test transformer HZQ-50KVA/100KV

HZQ-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

Conncet 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 rotection, 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 rotection

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 amd 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.

7.2 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.

7.3 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.

7.4 Precautions

1. The equipment demander only needs to provide three : power distribution cabinet with frequency 50Hz±0.1 and current not less than 500A;

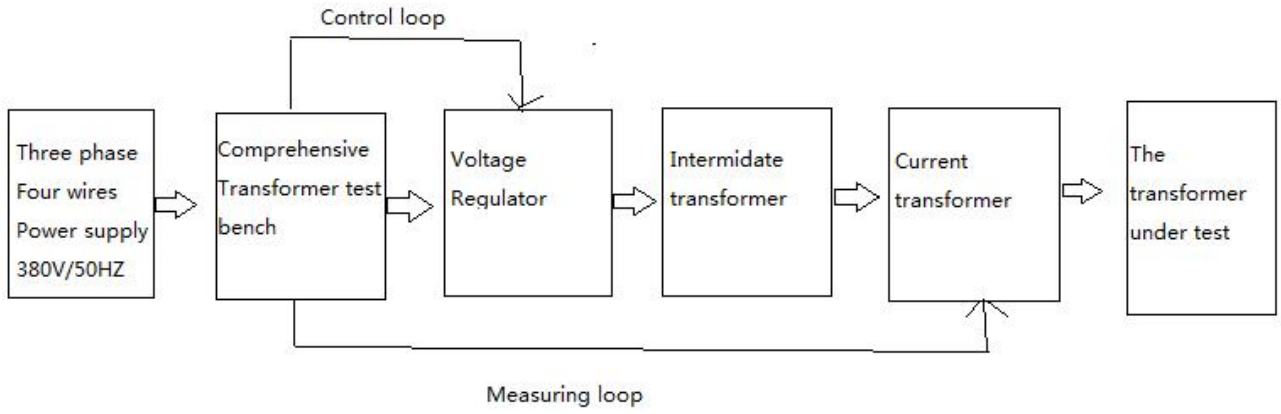
2 The grounding resistance of the installation site shall not be greater than 0.5 ohms; in order to maintain the integrity of the site, it is better to pre-ditch the cable trench in the control room and equipment area during the civil construction;

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）


Control loop
Three phase
Four wires
Power supply
380V/50HZ
Comprehensive
Transformer test
bench
Voltage
Regulator
Intermidate
transformer
Current
transformer
The
transformer
under test
Measuring loop

1.


50KVA