preface

Before using this instrument, please read the instructions in detail. In order to make you operate the instrument skillfully as soon as possible, we have randomly equipped with detailed instructions, which will help you to use the product better. You can get the knowledge about the product introduction, use method, instrument performance, and safety precautions.

When writing this manual, we are very careful and rigorous, and believe that the information provided in the manual is correct and reliable, but it is inevitable that there will be mistakes and omissions. Please include more and welcome your corrections.

Our purpose is to continuously improve and perfect the company's products, while we reserve the right to improve and upgrade the use function of the instrument. If you find that the function of the instrument is not completely consistent with the one described in the instructions, please refer to the actual function of the instrument. If you find any problem in the use of the product, please contact us in time! We will try our best to provide perfect technical support!

In order to facilitate your use, we will introduce the company's transformer characteristic parameters- -transformer short-circuit impedance, transformer capacity analysis, transformer loss parameters and other related test instructions together. Please note the actual product features you purchased and refer to the relevant sections.

This instrument is limited to the measurement of alternating current, can not measure direct current.

catalogue

1. Instrument overview

Transformer characteristic parameters-transformer short-circuit impedance, transformer capacity analysis, transformer loss parameter test is a new generation of transformer parameter test instrument, suitable for short circuit impedance measurement of transformer winding deformation, transformer capacity analysis and transformer (three-phase or single phase) factory, overhaul, handover test of no-load and load loss parameters. The instrument is exquisitely designed, Superior performance, powerful, The latest domestic and foreign microcontroller test technology and advanced A / D synchronous AC sampling and digital signal processing technology; Built-in lithium battery working power supply, Can be connected to three-phase voltage regulating power supply; Using a large-screen LCD display, The Chinese menu prompt, simplicity of operator, Equipped with a high-speed thermal-sensitive printer, Design with a storage function, Convenient for data storage and printing; With the available data management software, The saved data is transferred to the computer through the RS232C serial port (upper computer), Save, print and other operations, Or directly through the upper computer computer operation test, The saved file format is in the WORD file format; Or store the data directly into the mobile U disk (no host machine is required). The instrument is small in size, light in weight, easy to carry, the field use is very convenient, greatly reduce the labor intensity of the test personnel, improve the work efficiency.

2. Main functions of the instrument

1. It can measure the short-circuit of transformer winding impedance, zero-sequence impedance, load loss, no-load loss, no-load current, capacity, etc.
2. Measurable voltage effective value, current, power, power factor, frequency, harmonic and other electrical parameters.
3. Compatible with the loss level data of various dry or oil-immersed distribution transformers for capacity judgment, and the database can be updated at any time.
4. All the data are measured synchronously in the same period to ensure the accuracy and rationality of the measurement results.
5. When short load test, it can be directly measured within the allowable measurement range of the instrument, and the external primary voltage transformer and current transformer can be added beyond the measurement range.
6. Automatic waveform distortion correction, automatic conversion of test results, without any manual calculation.
7. Built-in power storage memory, can store 9999 measurement data, can save long-term measurement data and can be consulted at any time.
8. A built-in micro-printer can print all the test results or store records.
9. Large-screen LCD display, all Chinese character menu and operation prompts, intuitive and convenient.
10. Do not drop the power calendar, the clock function.
11. Serial port communication function, which can upload the test data to the computer through the upper computer software.
12. Mobile U disk function, which can transfer all the test data stored in the instrument to the mobile U disk.

3. Main technical indicators of the instrument

1. Voltage measuring range: AC 10~850V
2. Current measurement range: AC 0.01~100A
3. Frequency measurement range: 40~70Hz
4. Measuring range of power factors: -1.0~0~1.0
6. Measurement accuracy:

Voltage, current and frequency: ± 0.1% ± 3 words

Power: ± 0.2% ± 5 words

Power factor: 0.05 <| cos ∅ | 0.1 ± 0.5% ± 3 words

| cos ∅ |> 0.1 ± 0.2% ± 3 words

capacity:10%

7. Ambient temperature: -10℃ ~40℃

8. Relative humidity: when the temperature is 25%, no more than 90% (no condensation)

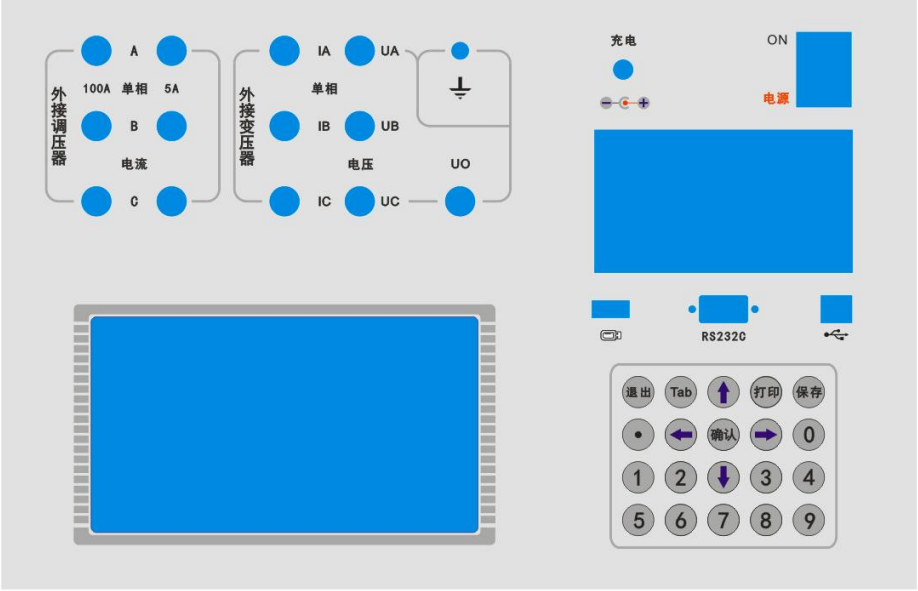
9. Charging power supply: DC25.2V / 2A

10. Overall dimensions: aluminum box 372255140mm

11. Instrument weight: 5kg aluminum box (excluding test line)

4. Instrument panel and function introduction

The panel layout is shown in the figure: the instrument model, packaging is different, the panel is slightly different.



Each function is described as follows:

(1) Each terminal: used to connect the test line (see the wiring method in the following section for the specific wiring mode).

(2) Ground column: Instrument protection grounding.

(3) Thermal printer: Print out various test data.

(4) Charging base: It is used to power the instrument and charge the batteries.

(5) Power switch: used to turn on or off the instrument power supply.

(6) Nine-core serial outlet socket: serial communication interface, used for data communication with the upper computer.

(7) Square port USB socket: USB communication interface, used for data communication with the upper computer.

(8) Flat port USB socket: U disk interface, used to transfer the test data to the mobile U disk.

(9) Touch LCD screen: control and display of test status and test data.

(10) Key: used for the operation of the instrument, and data input.

5. main interface

Connect the power cord and turn on the power supply. The LCD screen display interface is as shown in Figure 3:

graph 3

Touch the LCD screen icon or press the keys "", "" "on the keyboard to select the item, and press the" confirm " key on the keyboard to enter the next menu.

Vi. Parameter setting

Before testing the transformer, it should enter the parameter setting interface to set the relevant parameters of the transformer according to the parameters of the tested transformer.

The parameter setting interface is shown in Figure 2. Touch the green area of each parameter to enter the setting of corresponding parameters; or select the keys "", "", "" and "" (the triangle cursor indicates the position of the parameter), and press "confirm" to enter the parameter setting.

graph 4

The parameters are described as follows:

(1) Equipment number: Up to 12 digits or English characters are input to identify the equipment under test.

(2) Current gear: select 100A (large terminal) or 5A (small terminal). (Note: If you are not sure about the size of the measured current, first select "100A (large terminal)")

(3) PT variable ratio: the transformer ratio of the voltage transformer.

(4) CT variable ratio: the variable ratio of the current transformer.

(5) Set capacity: Rated capacity of the transformer to be tested in kVA.

(6) Set frequency: Rated frequency of the transformer to be tested in Hz.

(7) High voltage: rated voltage on the high voltage side of the transformer to be tested in kV.

(8) Low rated voltage: rated voltage of transformer to be tested in kV.

(9) Impedance voltage: the nominal impedance voltage of the transformer to be tested in%.

(10) High voltage direct resistance: DC resistance of high voltage side winding in m Ω.

(11) Low voltage direct resistance: DC resistance of low voltage side winding in m Ω.

(12) No-load loss index: no-load loss index.

(13) Current temperature: Current temperature of the tested transformer used to correct the test temperature-related parameters from current temperature to rated temperature in ℃.

(14) Correct temperature: Reference temperature of the transformer tested, used to correct the test parameters from the current temperature to the rated temperature in ℃.

(15) Temperature coefficient: resistance temperature conversion coefficient K, related to the transformer winding material, copper K=, aluminum K=. $\frac{235+T}{235+t}$ $\frac{225+T}{225+t}$

(16) Wiring mode: the connection group standard number of the transformer.

(17) Split voltage: transformer input wiring position, unit: kV.

(18)Test article type: transformer loss level code, see Table 1.

Table 1 Level code of transformer loss

变压器类型	无励磁调压				有载调压		
	损耗水平代号						
油浸式 电工钢带	S9	S10	S11	S12	S13	S14	S20
	S22		D9	D10	D11	D12	D13
油浸式 非晶合金	SH15	SH16	SH21	SH25		DH15	
干式 电工钢带	SCB9	SCB10	SCB11	SCB12	SCB13	SCB14	SCB18
干式 非晶合金	SCBH15	SCBH16	SCBH17	SCBH19			
立体卷铁心	S13-RL	SCB11-RL		SCB12-RL		SCB13-RL	
特殊类型	其它						

7. No-load loss test operation instructions

Testing under the rated conditions

The no-load test must be conducted at the rated frequency (sinusoidal waveform) and rated voltage so that one winding reaches the rated excitation and the rest is open. Generally, the transformer low-voltage winding side is the test winding, and the quality of no-load test power supply shall meet the national standards, it is best to use the voltage regulating equipment, the voltage is zero, so that it is easy to find problems and reduce the operation overvoltage, the measured error of the no-load test data shall meet the provisions of GB / T6451 or relevant standards.(Allowable deviation of no-load loss + 15%, no-load current deviation + 30%)

If the voltage and current transformer are external in the large transformer test, its accuracy can not be lower than 0.2 level.

Testing in non-rated conditions

In the absence of a test power supply on site, If three-phase no-load loss test is conducted on medium transformer with rated voltage of 10kV, It is recommended to be an intermediate transformer such as 100.4 distribution transformer, No-load test of medium power transformers on site, That is, the no-load loss of the intermediate transformer is now measured by the instrument, Then measure the no-load loss of the large transformer after the intermediate transformer, After the no-load loss value of large transformer, However, attention should be paid to whether the current required on the low-voltage side of the intermediate transformer ensures the power supply safety of the substation, Due to the waveform distortion during the no-load test, There is some deviations in the measured results, For power supply capacity requirements, see Appendix for reference only.

Test requirements and attention

If the winding of the applied voltage is split, the tap switch shall be in the main tap position; if the test winding, it shall be closed. In operation, the ground potential, line end, and shell shall be reliably grounded.

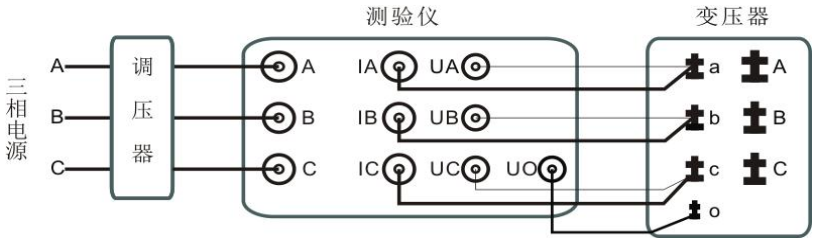
1. Parameter setting

Before testing the transformer, it should enter the parameter setting interface to set the relevant parameters of the transformer according to the parameters of the tested transformer.

2. Three-phase no-load loss test

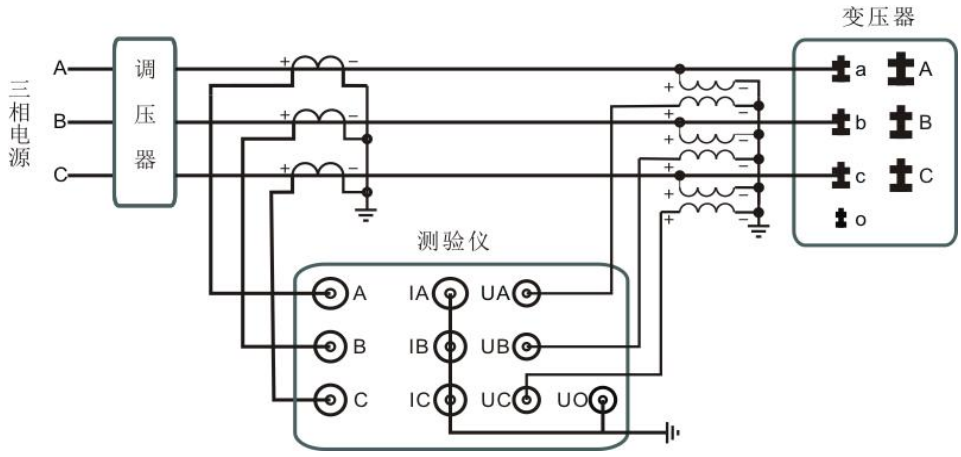
The "Ua", "Ub" and "Uc" are connected to the "A", "B", "C" (100A or 5A range) of the external side of the instrument to the "IA", "IB", "IC" and "UA", "UB", "UC" respectively connected to the low voltage side of the transformer; if there is no neutral point, the terminal to the "Uo" end of the instrument; the high voltage side of the transformer is open.

When the test voltage and current do not exceed the test range of the instrument, the wiring method is shown in Fig. 5:



graph 5

When the test voltage and current exceed the test range of the instrument, the voltage transformer and current transformer shall be connected. The wiring method is as shown in Figure 6:



graph 6

In the state of the main interface, select "No-load loss" and "three-phase no-load loss" to enter the three-phase no-load loss test interface, as shown in Figure 7.(Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)

graph 7

In this state, the three-phase test power supply is connected and the voltage regulator is adjusted to make the test voltage slowly rise to the locking voltage. After the data stabilizes, touch the "lock" or press "confirm" to lock the current test data, appear the interface as shown in Figure 8, and the instrument calculates the no-load current and no-load loss of the transformer according to the three-phase measurement data.

graph 8

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu.

The parameters are described as follows:

setup parameter:

(1) Capacity: the transformer rated capacity set in the parameter setting.

(2) Locking voltage: rated voltage set in the parameter setting,

(3) Frequency: the transformer rated frequency set in the parameter setting.

(4) Empty loss index: the no-load loss index of the transformer set in the parameter setting depends on the type of core silicon steel sheet, hot rolled silicon steel sheet n 1.8, and cold rolled silicon steel sheet n 1.9~2.

test parameter:

(1) A, B, C: represent phases A, B and C, respectively.

(2) P: represents the three-phase average, and the power is the three-phase sum.

(3) Average voltage: the average voltage after the multiplication ratio.

(4) Root mean square value: effective voltage after multiplication ratio.

(5) Difference: voltage waveform distortion rate, percentage of voltage mean value (U ') and root of square mean value (U) error, difference =100% (U' -U) / U '.

(1) Current: the effective value of the current.

(2) Frequency: Test frequency.

(3) Active power: the active power after multiplying the ratio of voltage and current change.

test result:

(1) Measured no-load current: no-load current converted to the rated voltage, no-load current

$$=()\frac{I_a+I_b+I_c}{3I_N}\times\frac{U_N}{U'}^{n}\times 100\%。$$

(2) No-load current after correction: consistent with the measured no-load current.

(3) National standard no-load current: the no-load current corresponding to this type of transformer in the national standard.

(4) No-load current error: the tested no-load current (I_0') and gb current (I_0) Percent of error, error = (I_0'- I_0)/ I_0。

(5) Measured no-load loss: converted to the three-phase active power and at the rated voltage,

$$P_0=P_0'\times()\frac{U_N}{U'}^n$$

(6) No-load loss after correction: the measured no-load loss is converted to the no-load loss under the rated frequency and voltage waveform distortion.

$$\text{No-load loss after correction} = P_0\times\left(1+\frac{U'-U}{U'}\right)\times\frac{f_n}{f}[0.5\ (\ )+0.5()\frac{f_n}{f}^2]$$

N. No-load loss index

U'- -voltage mean U- -voltage root Rvalue

The ratio of P1-hysteresis loss to total core loss is 0.5

P2--The ratio of the eddy current loss to the total core loss is 0.5

f_n--Transformer rated frequency

fThe frequency of ovulation test

(7) National standard no-load loss: the corresponding no-load loss of this type of transformer in the national standard.

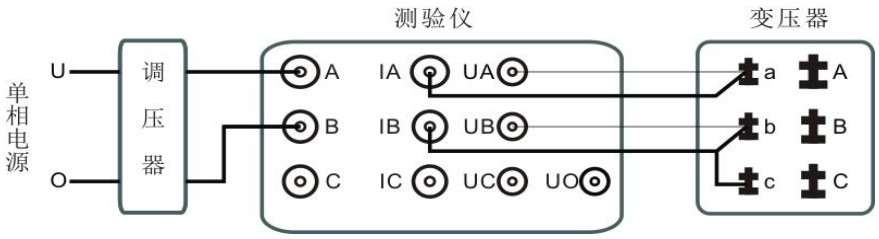
(8) No-load loss error: No-load loss after correction (P_0') and gb no-load loss (P_0) Percent of error, error = $(P_0'- P_0)/ P_0$。

3. Single-phase no-load loss test

A. For the three-phase transformer with pressurized side winding d and YN, Y or D connection, when measuring the single-phase power supply, the ab, bc and ca, and the non-pressurized winding shall be short circuit in turn, to measure the no-load current and no-load loss of the transformer.

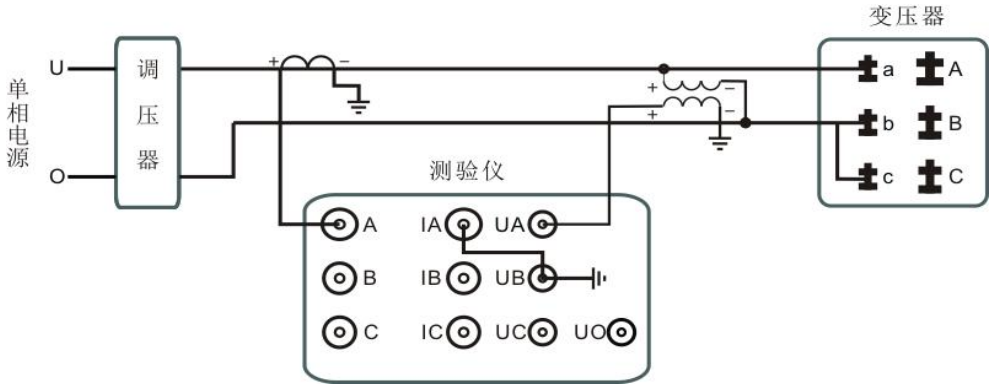
Connect "U" and "O" of the single-phase adjustable power output to the "A" and "B" (100A or 5A range) of the instrument, connect "IA" and "UA" of the external side of the transformer to the low voltage side A end of the transformer, and connect "IB" and "UB" to the low voltage side b of the transformer, bc; open of the high voltage side of the transformer.

When the test voltage and current do not exceed the test range of the instrument, the wiring method is shown in Figure 9:



graph 9

When the test voltage and current exceed the test range of the instrument, the voltage transformer and current transformer should be connected. The wiring method is as shown in Figure 10.



graph 10

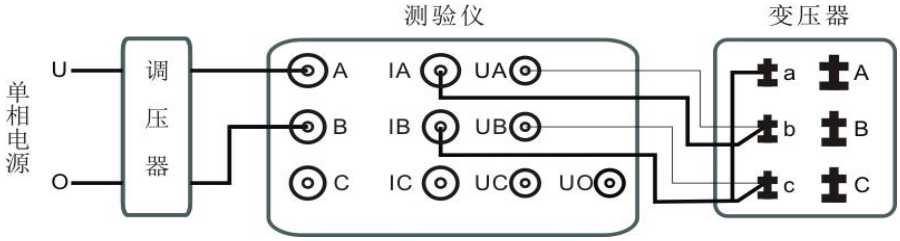
In the main interface, select "No load loss" and "single phase no load loss" to enter the single phase no load loss test interface, as shown in Figure 11.(Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)

graph 11

In this state, turn on the test power supply and adjust the voltage regulator to slowly raise the test voltage to the lock voltage (rated voltage). After the data stabilizes, touch "lock" or press "confirm" to lock the current test data, appear the interface as shown in Figure 12, and enter the bc phase measurement.

graph 12

In this state, do not exit the measurement state, zero the output voltage of the regulator, change the wiring to bc phase, and ca between the short connection, as shown in Figure 13.

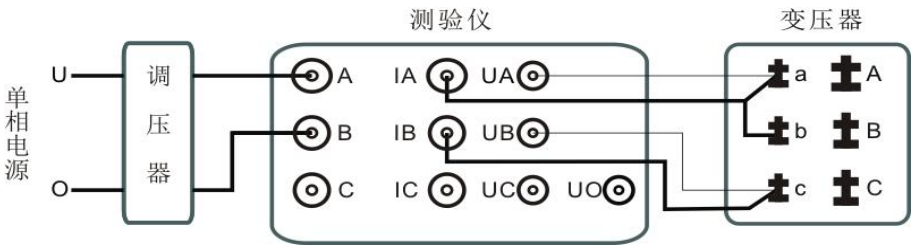


graph 13

After the line is connected, the regulator pressurizes the bc phase, so that the test voltage slowly rises to the lock voltage (rated voltage). After the data is stable, touch the "lock" or press the "confirm" key, the bc phase measurement ends, appear in the interface as shown in Figure 14, and enter the ca phase measurement.

graph 14

In this state, do not exit the measurement state, zero the output voltage of the regulator, change the wiring to ca phase, ab short connection, the wiring as shown in Figure 15:



graph 15

After connecting the line, adjust the regulator to pressure the ca phase and make the test voltage slowly rise to the locking voltage (rated voltage). After the data is stable, touch the "lock" or press the "confirm" key to end the ca phase measurement, and appear the interface as shown in Figure 16. The instrument calculates the no-load current and no-load loss of the transformer according to the three-phase measurement data.

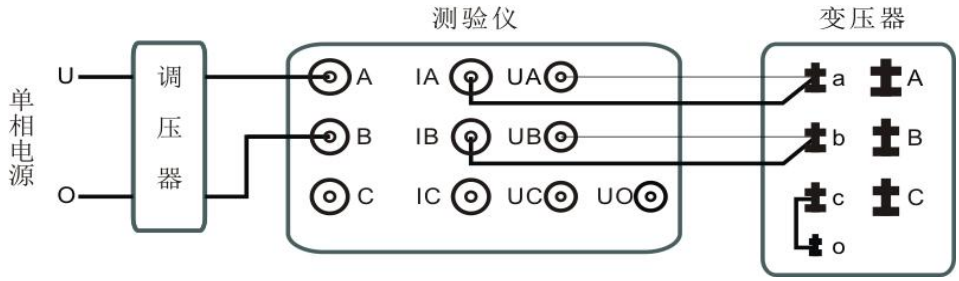
graph 16

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu.

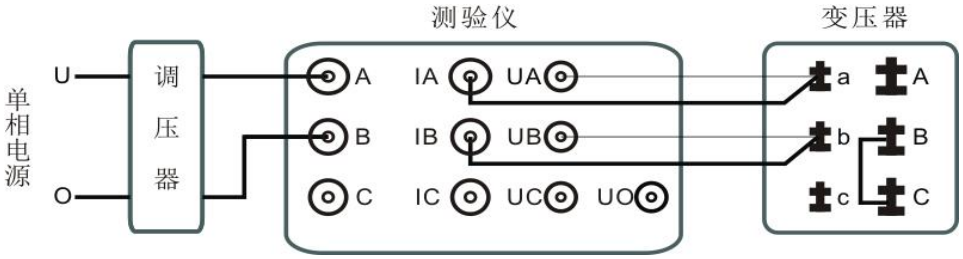
B. For the three-phase transformer with y, y and Y or D connection on the other side, when single-phase power supply is used, ab, bc and ca phase shall be pressurized phase and o (if the non-pressurized phase cannot be connected, the corresponding phase of the secondary winding must be connected) to measure the no-load current and no-load loss of the transformer.

Connect the "U" and "O" of the single-phase adjustable power supply to the "A" and "B" (100A or 5A range) of the instrument, connect the "IA" and "UA" of the transformer side to the LV side A end of the transformer, connect "IB" and "UB" to the LV side b end of the transformer, co or BC, and open the high voltage side of the transformer.

When the test voltage and current do not exceed the test range of the instrument, the wiring method is shown in Figure 17 and Figure 18:

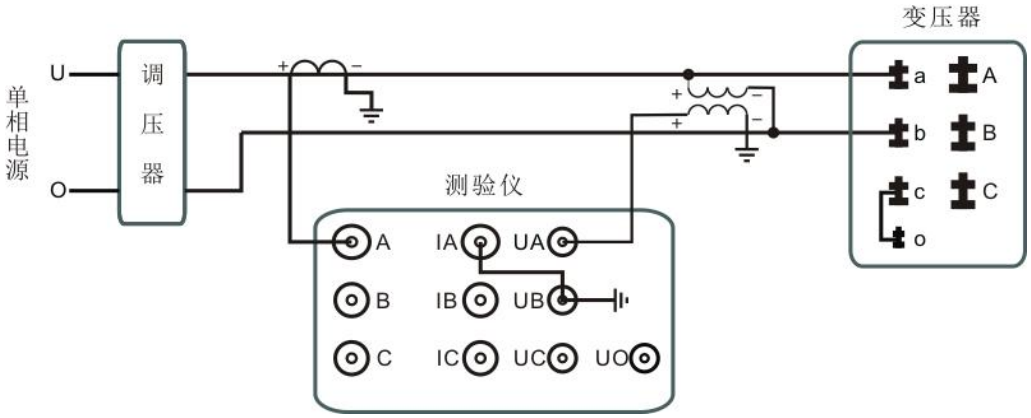


graph 17



graph 18

When the test voltage and current exceed the test range of the instrument, the voltage transformer and current transformer shall be connected. The wiring method is as shown in Figure 19:



graph 19

In the main interface, select "No load loss" and "single phase no load loss" to enter the single phase no load loss test interface, as shown in Figure 20.(Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)

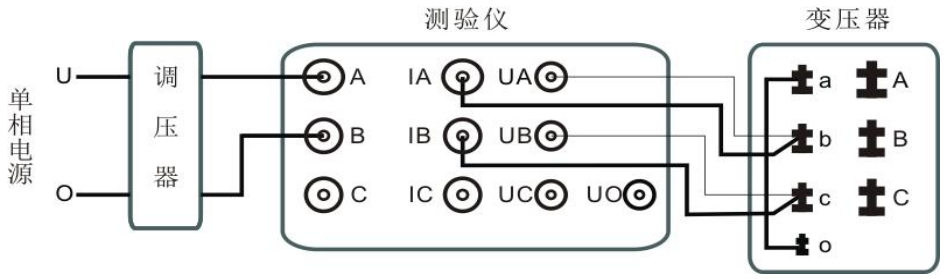
graph 20

$\sqrt{3}$ In this state, turn on the test power supply and adjust the voltage regulator to raise the test voltage slowly to the locking voltage (2 / times the rated voltage). After the data stabilizes, touch "lock" or press "confirm" key to lock the current test data, and the interface appears as shown in Figure 21.

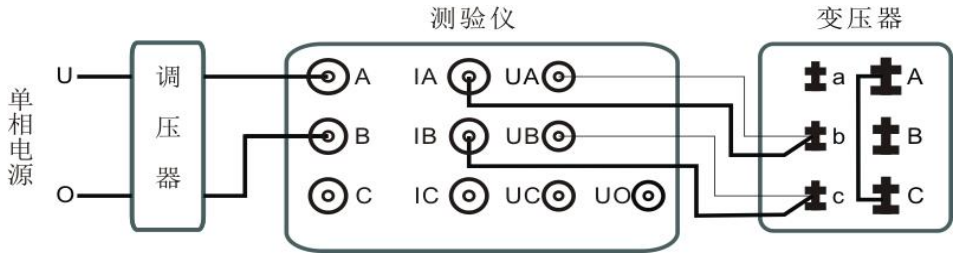

单相空载损耗
返回
设定参数：
容量：30.0kVA
锁定电压：0.400kV
频率：50.0Hz
空损指数：2.000
测试参数：
电压平均值
方均根值
差 值
电 流
频 率
有功功率
A
0.00V
0.00V
0.00%
0.000A
0.000Hz
0.000W
B
0.00V
0.00V
0.00%
0.000A
0.000Hz
0.000W
锁定

graph 21

In this state, do not exit the measurement state, zero the output voltage of the voltage regulator, and change the wiring to bc phase, ao or AC phase short connection, and the wiring is shown in Figure 22 and Figure 23:



graph 22

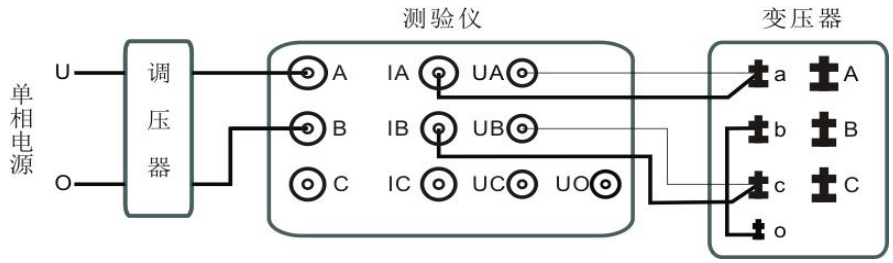


graph 23

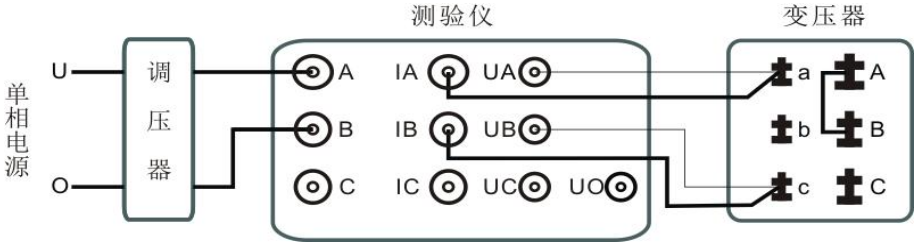
$\sqrt{3}$After connecting the line, the regulator pressurizes the bc phase, so that the test voltage slowly increases to the locking voltage (2 / times the rated voltage). After the data is stable, touch the "lock" or press the "confirm" key, the bc phase measurement ends, appear the interface as shown in Figure 24, and enter the ca phase measurement.

graph 24

In this state, do not exit the measurement state, adjust the regulator output voltage zero, change the wiring to ca phase, bo or AB phase short connect, the wiring is shown in Figure 25 and Figure 26:



graph 25



graph 26

$\sqrt{3}$After connecting the line, adjust the voltage regulator to raise the test voltage slowly to the locking voltage (2 / times the rated voltage). After the data is stable, touch the "lock" or press the "confirm" key to end the ca phase measurement. The interface as shown in Figure 27, calculate the no-load current and no-load loss of the transformer according to the three-phase measurement data.

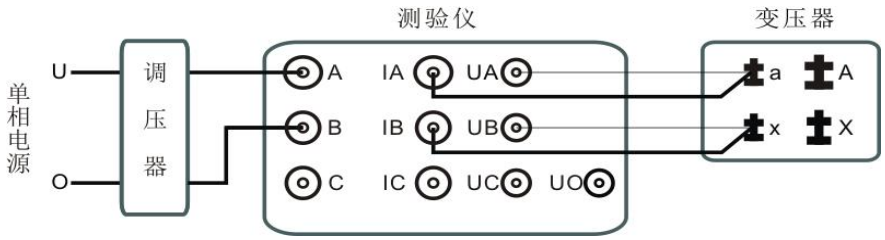
graph 27

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu.

4, single-phase transformer no-load loss test

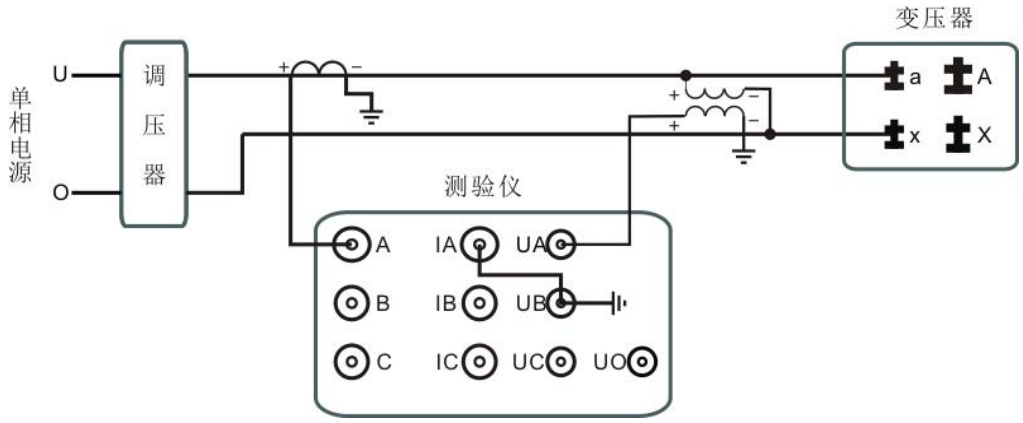
Connect the "U" and "O" of the single-phase adjustable power supply to the "A" and "B" (100A or 5A range) of the instrument, connect the "IA" and "UA" of the instrument to the low voltage side A end of the transformer, and connect "IB" and "UB" to the low voltage side x end of the transformer, and the high voltage side of the transformer will open the circuit.

When the test voltage and current do not exceed the test range of the instrument, the wiring method is shown in Figure 28:



graph 28

When the test voltage and current exceed the test range of the instrument, the voltage transformer and current transformer shall be connected. The wiring method is as shown in Figure 29:



graph 29

In the main interface, select "No load loss" and "single phase no load loss" to enter the single phase no load loss test interface, as shown in Figure 30.(Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)


单相空载损耗
返回
设定参数：
容量：30.0kVA
锁定电压：0.400kV
频率：50.0Hz
空损指数：2.000
测试参数：
电压平均值
方均根值
差 值
电 流
频 率
有功功率
A
0.00V
0.00V
0.00%
0.000A
0.000Hz
0.000W
锁定

graph 30

In this state, turn on the test power supply, adjust the voltage regulator, so that the test voltage slowly rises to the lock voltage (rated voltage). After the data is stable, touch the "lock" or press "confirm" key, the measurement, the interface as shown in Figure 31, the instrument calculates the no-load current and no-load loss of the transformer according to the measurement data.

graph 31

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu.

VIII. Operation instructions of transformer load loss test

Testing under the rated conditions

The test must be conducted under the rated frequency (sinusoidal waveform) and rated current, generally choose the transformer primary side winding for the test winding, secondary side (large current side) artificial short circuit, short circuit wire cross-section area should be not less than the cross-sectional area of the transformer wire, the length should be as short as possible, and ensure that the contact resistance can be ignored, so as not to affect the test results.

Testing in non-rated conditions

Due to the actual situation of the site, limited by the conditions, it is impossible to apply the rated voltage at the rated frequency to the tested transformer, especially for the large and medium-sized transformer test, which is more difficult to do in the field. It is suggested to use the small current for test and testing. According to the requirements of the national standard, the test current can reach 25~50% of the rated current to meet the test requirements.

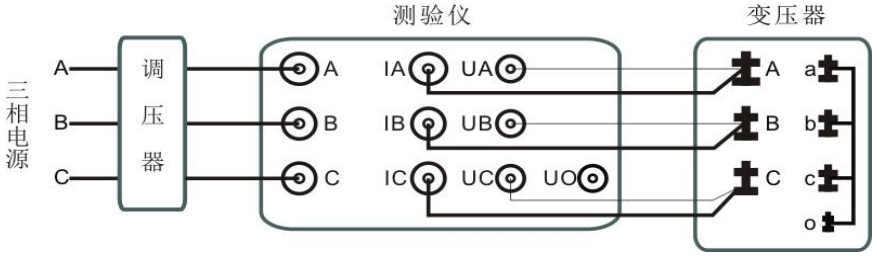
Test requirements and attention

Before the test, the winding temperature of the tested transformer shall be measured accurately. The oil-immersed transformer shall take the oil surface temperature as the winding temperature, and the average temperature of different parts of the coil (not less than three points) as the winding temperature. For the power supply capacity requirements, see the appendix, for reference only.

The load test of the double winding transformer supplies the rated current from one side of the transformer and the short circuit on the other side, and shall be conducted at the two limit separation positions. The measurement results shall be made between paired windings, and other windings are open. Measurement between high voltage winding and low voltage winding; measurement between high voltage winding and low voltage winding; measuring between medium voltage winding and low voltage winding; and open circuit of high voltage winding. Autotransformer can be regarded as double-winding transformer, for the autotransformer with independent third winding, can be regarded as three-winding transformer.

1. Three-phase load loss test

The "Ua", "Ub" and "Uc" of the three-phase adjustable power output are connected to the terminals "A", "B", "C" (100A "and" C "on the external side of the instrument to the transformer" IA "," IB "," IC "," "UA", "" UB "," respectively " to the high voltage side of the low voltage side reliable short circuit and ensure that the contact resistance can be ignored. Connect the zero-phase "Uo" of the three-phase power supply to the "UO" terminal of the instrument. The wiring method of the tested transformer and the instrument and the three-phase power supply is shown in Figure 32. (Note: Three-phase transformers have the same test wiring mode during the three-phase test.)



graph 32

In the main interface, select "short-circuit test" and "three-phase load loss" to enter the three-phase load loss test interface, as shown in Figure 33. (Note: Before the test, you should enter the parameter setting

interface to set the relevant parameters of the tested transformer.)

graph 33

In this state, turn on the three-phase test power supply, adjust the voltage regulator, and make the test voltage rise slowly raised. After the data is stable, touch "lock" or press "confirm" to lock the current test data, and the interface as shown in Figure 34:

graph 34

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu.(Note: at the end of each test or in the middle of the test, always zero the output voltage of the regulator and disconnect the test power supply to prevent electric shock).

The parameters are described as follows:

setup parameter:

(1) Capacity: the transformer rated capacity set in the parameter setting.

(2) Locking current: rated current on the high voltage side of the transformer, calculated from the transformer capacity and high voltage set in the parameter setting, $I_N=S_N/(U\sqrt{3}_N)$。

(3) Frequency: the transformer rated frequency set in the parameter setting.

(4) Temperature resistance coefficient (K): calculated from the current transformer temperature (t), correction temperature (T) and temperature coefficient set in the parameter setting, copper K=,

aluminum K=. $\frac{235+T}{235+t}\frac{225+T}{225+t}$

test parameter:

(1) A, B, C: represent phases A, B and C, respectively.

(2) P: represents the three-phase average, and the power is the three-phase sum.

(3) Voltage: the effective value of the voltage after multiplying by the voltage variable ratio.

(4) Current: the effective value of the current.

(5) Frequency: Test frequency.

(6) Active power: the active power after multiplying the ratio of voltage and current change.

test result:

(1) Measured short-circuit impedance: average three-phase voltage (U_K) And the pressurized winding rated voltage (U_N) The percentage of the ratio is converted to the short-circuit impedance at the rated current.

(2) Short circuit impedance after correction: the measured short circuit impedance is converted to the short circuit impedance at the rated frequency and reference temperature.

(3) National standard short circuit impedance: the corresponding short circuit impedance of this type of transformer in the national standard.

(4) Measured load loss: the measured three-phase average active power.

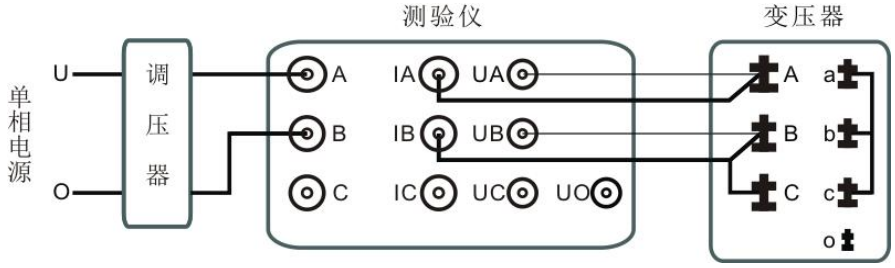
(5) Corrected load loss: the measured load loss is converted to the load loss at the rated current, rated frequency and reference temperature.

(6) National standard load loss: the load loss corresponding to this type of transformer in the national standard.

2. Single-phase load loss test

A. For the three-phase transformer with the pressurized side winding D and the other side yn, y or d, when using single-phase power supply to measure the three-phase transformer, AB, BC and CA should be pressurized successively, and the non-pressurized winding should short circuit in turn, while the other side winding three-phase short circuit to measure the relevant parameters of the transformer.

The wiring method is shown in Figure 35. Connect the "U", "O" to the "A", "B" terminal "(100A or 5A range) of the voltage regulator, connect the" IA "and" UA "to the high voltage side A of the transformer," IB "and" UB " to the high voltage side B end of the transformer, and BC. Low voltage side short circuit.



graph 35

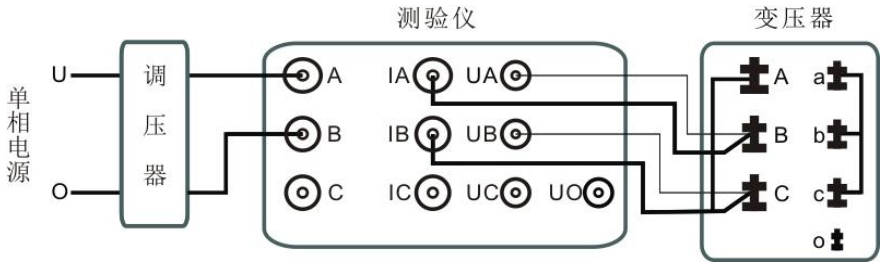
In the state of the main interface, select "short circuit test" and "single phase load loss" to enter the single phase load loss test interface, as shown in Figure 36.(Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)

graph 36

Turn on the test power supply, adjust the voltage regulator to raise the test voltage slowly. After the data is stable, touch "lock" or press "confirm" to end the AB phase measurement, appear in the interface as shown in Figure 37, and enter the BC phase measurement.

graph 37

In this state, do not exit the measurement state, zero the output voltage of the regulator, and change the wiring to BC phase, and the wiring is shown in Figure 38.

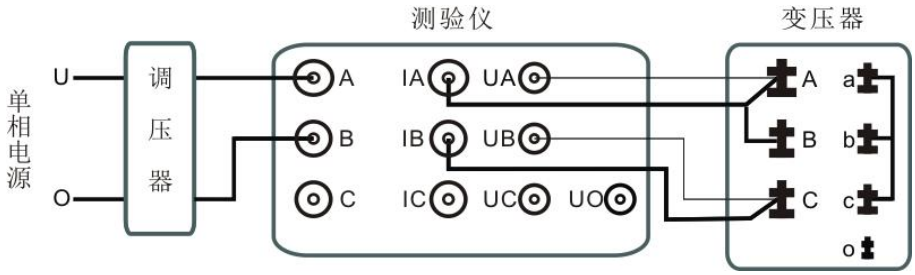


graph 38

After connecting the line, the voltage regulator pressurizes the BC phase, so that the test voltage slowly increases. After the data is stable, touch the "lock" or press the "confirm" key to end the BC phase measurement, appear in the interface as shown in Figure 39, and enter the CA phase measurement.

graph 39

In this state, do not exit the measurement state, zero the output voltage of the regulator, change the wiring to CA phase, AB short connection, the wiring as shown in Figure 40:



graph 40

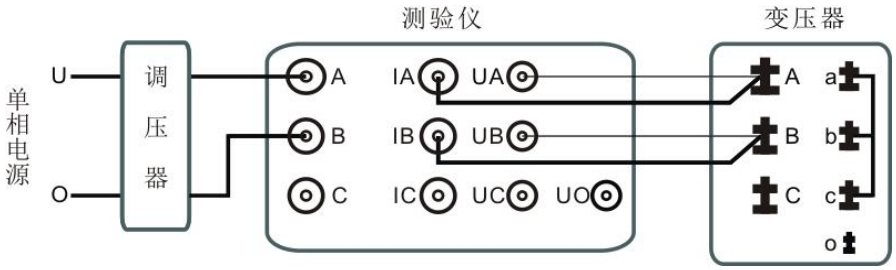
After connecting the line, the voltage regulator pressurized the test voltage to slowly increase. After the data is stable, touch "lock" or press "confirm" to finish the CA phase measurement, and the test result interface appears, as shown in Figure 41.

graph 41

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu.(Note: at the end of each test or in the middle of the test, always zero the output voltage of the regulator and disconnect the test power supply to prevent electric shock).

B. For the three-phase transformer with pressurized side winding Y and yn, y or d connection, when using the single-phase power supply, AB, BC, CA, and the other side winding three-phase short circuit, measure the relevant parameters of the transformer.

The wiring method is shown in Figure 42, connecting the "U" and "O" of "A" and "B" (100A or 5A range) to the "IA" and "UA" of the instrument to the transformer side to the high voltage side A end of the transformer, and "IB" and "UB" to the high voltage side B end of the transformer.



graph 42

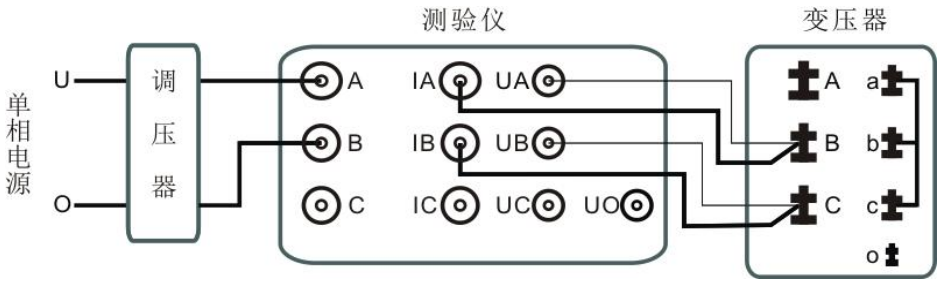
In the state of the main interface, select "short circuit test" and "single phase load loss" to enter the single phase load loss test interface, as shown in Figure 43.(Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)

graph 43

Turn on the test power supply and adjust the voltage regulator to then slowly raise the test voltage. After the data stabilizes, touch "lock" or press "confirm" to end the AB phase measurement, appear in Figure 44, and enter the BC phase measurement.

graph 44

In this state, do not exit the measurement state, zero the output voltage of the regulator and change the wiring to BC phase, the wiring is shown in Figure 45:



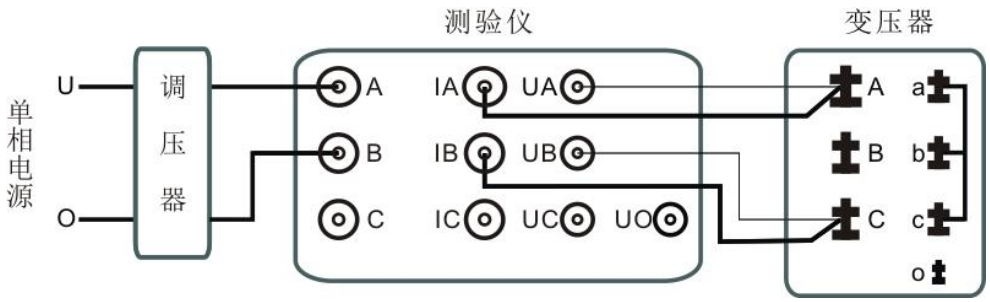
graph 45

After connecting the line, the regulator presses the BC phase to slowly raise the test voltage. After the data is stable, touch the "lock" or press the "confirm" key, and the BC phase measurement is over, and

the interface appears in Figure 46, and enter the CA phase measurement.

graph 46

In this state, do not exit the measurement state, zero the output voltage of the regulator and change the wiring to CA phase, the wiring is shown in Figure 47:



graph 47

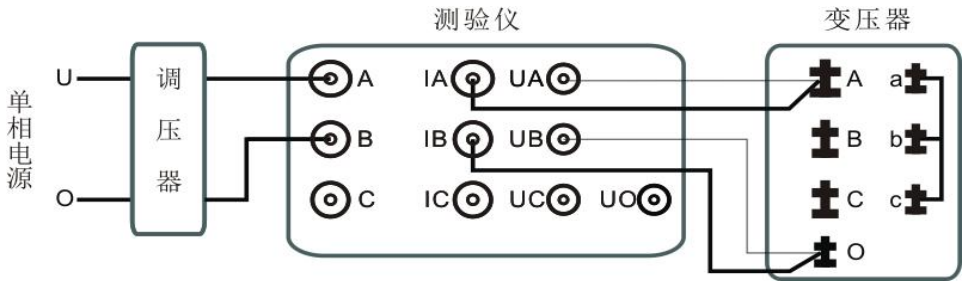
After connecting the line, the voltage regulator pressurized the test voltage to slowly increase. After the data is stable, touch "lock" or press "confirm" key to finish the CA phase measurement, and the test result interface appears, as shown in Figure 48.

graph 48

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu. (Note: at the end of each test or in the middle of the test, always zero the output voltage of the regulator and disconnect the test power supply to prevent electric shock).

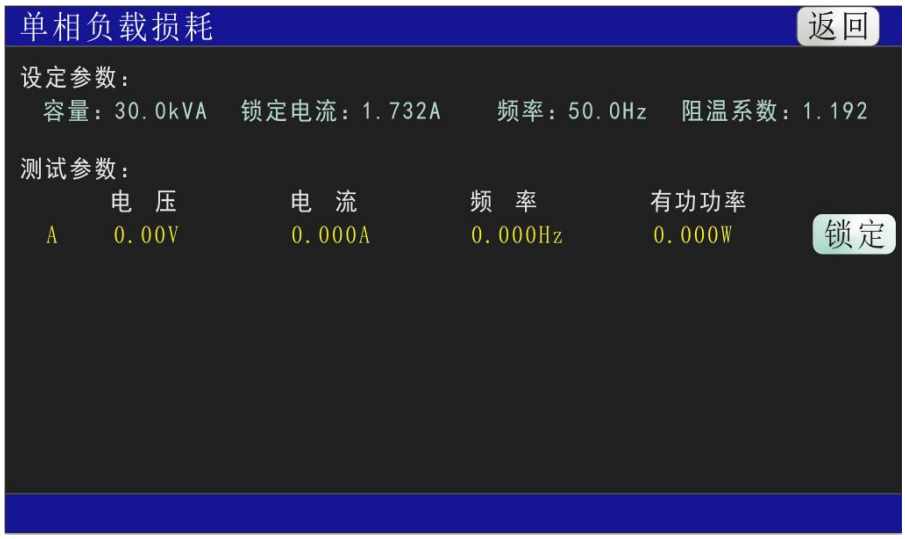
C. For the three-phase transformer with YN pressurized side winding and yn and d connection, when the single-phase power supply is used, pressure A0, B0 and C0 successively, while the other side winding has three-phase short circuit to measure the relevant parameters of the transformer.

The wiring method is shown in Figure 49, connecting the "U", "O" and "A" and "B" ("regulator" (100A or 5A range) to the "IA" and "UA" of the instrument to the transformer side to the low voltage side A end of the transformer, and "IB" and "UB" to the high voltage side O end of the transformer.



graph 49

In the state of the main interface, select "short circuit test" and "single phase load loss" to enter the single phase load loss test interface, as shown in Figure 50. (Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)

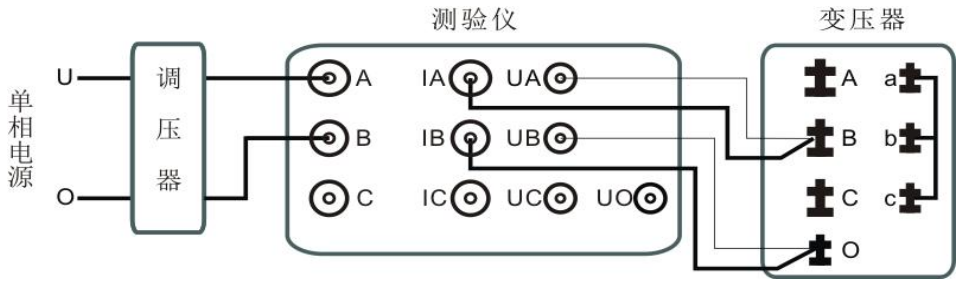


graph 50

Turn on the test power supply and adjust the voltage regulator to slowly increase the test voltage. After the data is stable, touch "lock" or press "confirm" key, the phase A measurement is over, and the interface shown in Figure 51, enter phase B measurement.

graph 51

In this state, do not exit the measurement state, zero the output voltage of the regulator and change the wiring to BO phase, the wiring is shown in Figure 52:



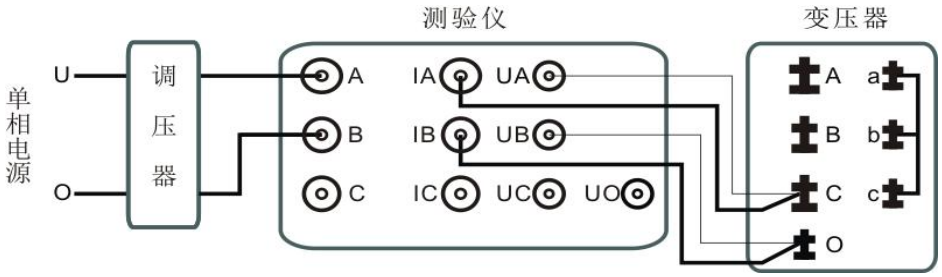
graph 52

After connecting the line, the voltage regulator presses the BO phase, so that the test voltage slowly increases. After the data is stable, touch the "lock" or press the "confirm" key, the BO phase measurement

is over, the interface appears in Figure 53, and enter the CO phase measurement.

graph 53

In this state, do not exit the measurement state, zero the output voltage of the voltage regulator, and change the wiring to the CO phase, as shown in Figure 54:



graph 54

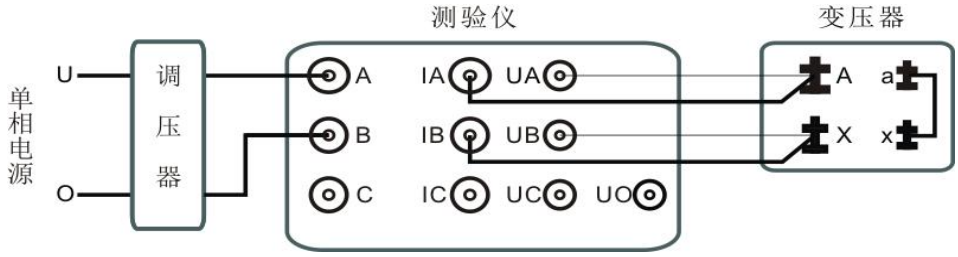
After connecting the line, the regulator presses the CO phase to make the test voltage slowly increase. After the data is stable, touch "lock" or press "confirm" key, the CO phase measurement is over, and the test result interface appears, as shown in Figure 55.

graph 55

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu.(Note: at the end of each test or in the middle of the test, always zero the output voltage of the regulator and disconnect the test power supply to prevent electric shock).

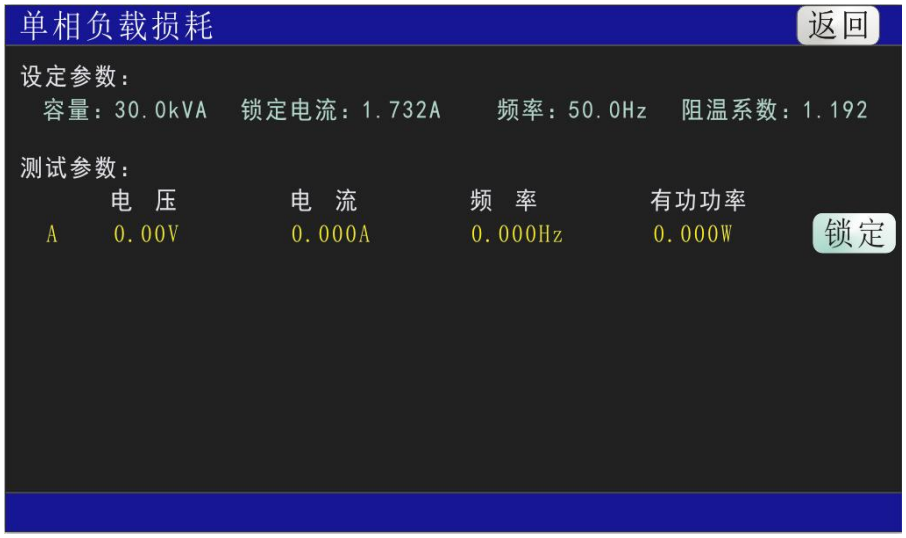
3. Single-phase transformer load loss test

Connect the "U", "O", "A", "B" (100A or 5A range) of the instrument to the "IA" and "UA" of the external side of the transformer to the high voltage side A of the transformer, and connect "IB" and "UB" to the X of the high voltage side end of the transformer. The wiring method is shown in Figure Figure 56:



graph 56

In the state of the main interface, select "short-circuit test" and "single-phase load loss" to enter the single-phase load loss test interface, as shown in Figure 57.(Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)



graph 57

In this state, switch on the single-phase test power supply, adjust the voltage regulator, and raise the test voltage slowly. After the data stabilizes, touch "lock" or press "confirm" key to lock the current test data, as shown in Figure 58

graph 58

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu.

9. Operation instructions of transformer short-circuit impedance test

Testing under the rated conditions

The test must be conducted under the rated frequency (sinusoidal waveform) and rated current, generally choose the transformer primary side winding for the test winding, secondary side (large current side) artificial short circuit, short circuit wire cross-section area should be not less than the cross-sectional area of the transformer wire, the length should be as short as possible, and ensure that the contact resistance can be ignored, so as not to affect the test results.

Testing in non-rated conditions

Due to the actual situation of the site, limited by the conditions, it is impossible to apply the rated voltage at the rated frequency to the tested transformer, especially for the large and medium-sized transformer test, which is more difficult to do in the field. It is suggested to use the small current for test and testing. According to the requirements of the national standard, the test current can reach 25~50% of the rated current to meet the test requirements.

Test requirements and attention

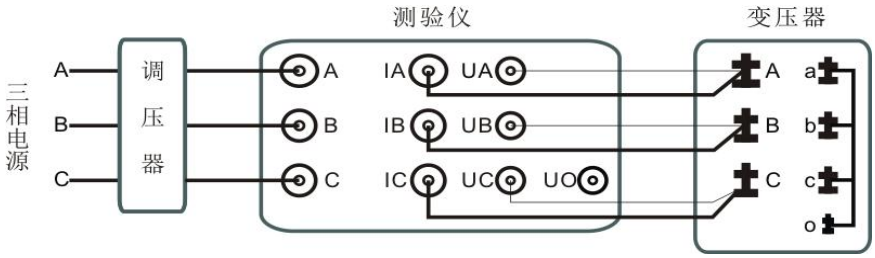
Before the test, the winding temperature of the tested transformer shall be measured accurately. The oil-immersed transformer shall take the oil surface temperature as the winding temperature, and the average temperature of different parts of the coil (not less than three points) as the winding temperature. For the power supply capacity requirements, see the appendix, for reference only.

The load test of the double winding transformer supplies the rated current from one side of the transformer and the short circuit on the other side, and shall be conducted at the two limit separation positions. The measurement results shall be made between paired windings, and other windings are open. Measurement between high voltage winding and low voltage winding; measurement between high voltage winding and low voltage winding; measuring between medium voltage winding and low voltage winding; and open circuit of high voltage winding. Autotransformer can be regarded as double-winding transformer, for the autotransformer with independent third winding, can be regarded as three-winding transformer.

1. Three-phase short-circuit impedance test

Connect "Ua", "Ub" and "Uc" of the three-phase adjustable power output to the "A", "B", "C" (100A "and" C "of the instrument to the transformer" IA "," IB "," IC "," UA "," UB "and" UC " to the high voltage side

of the transformer, and ensure that the contact resistance can be ignored. Connect the zero-phase "Uo" of the three-phase power supply to the "UO" terminal of the instrument. The wiring method of tested transformer and instrument and three-phase power supply is shown in Figure 59. (Note: Three-phase transformers have the same test wiring mode during the three-phase test.)



graph 59

In the state of the main interface, select "short circuit test" and "three-phase short circuit impedance" to enter the three-phase short circuit impedance test interface, as shown in Figure 60. (Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)

graph 60

In this state, turn on the three-phase test power supply, adjust the voltage regulator, and make the test voltage rise slowly raised. After the data stabilizes, touch "lock" or press "confirm" to lock the current test data, and the interface as shown in Figure 61 appears:

graph 61

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu.(Note: at the end of each test or in the middle of the test, always zero the output voltage of the regulator and disconnect the test power supply to prevent electric shock).

The parameters are described as follows:

setup parameter:

(1) Capacity: the transformer rated capacity set in the parameter setting.

(2) Locking current: rated current on the high voltage side of the transformer, calculated from the transformer capacity and high voltage set in the parameter setting, $I_N=S_N/(U\sqrt{3}_N)$。

(3) Frequency: the transformer rated frequency set in the parameter setting.

(4) Temperature resistance coefficient (K): calculated from the current transformer temperature (t), correction temperature (T) and temperature coefficient set in the parameter setting, copper K=, aluminum K=. $\frac{235+T}{235+t}\frac{225+T}{225+t}$

test parameter:

(1) A, B, C: represent phases A, B and C, respectively.

(2) P: represents the three-phase average, and the power is the three-phase sum.

(3) Voltage: the effective value of the voltage after multiplying by the voltage variable ratio.

(4) Current: the effective value of the current.

(5) Frequency: Test frequency.

(6) Active power: the active power after multiplying the ratio of voltage and current change.

(7) Reactive power: reactive power after multiplying the voltage and current variable ratio.

test result:

(1) Impedance: the ratio of voltage to current of each phase.

(2) Resistance: the ratio of active power to current square of each phase.

(3) Reactance: the ratio of reactive power to current square in each phase.

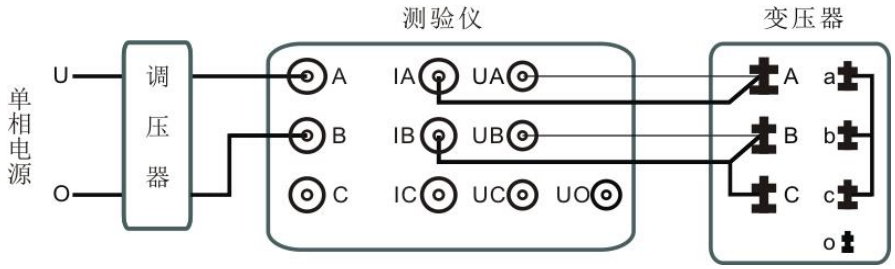
(4) Impedance voltage: average three-phase voltage (U_K) And the pressurized winding rated voltage (U_N) The percentage of the ratio is converted to the rated current, rated frequency, and reference temperature.

(5) National standard short circuit impedance: the corresponding short circuit impedance of this type of transformer in the national standard.

2. Single-phase short-circuit impedance test

A. For the three-phase transformer with the pressurized side winding D and the other side yn, y or d, when using single-phase power supply to measure the three-phase transformer, AB, BC and CA should be pressurized successively, and the non-pressurized winding should short circuit in turn, while the other side winding three-phase short circuit to measure the relevant parameters of the transformer.

The wiring method is shown in Figure 62, connecting the "U", "O", "A" and "B" (100A or 5A range) to the "IA" and "UA" of the transformer side to the high voltage side A end of the transformer, connecting the "IB" and "UB" to the high voltage side B end of the transformer, and the BC.



graph 62

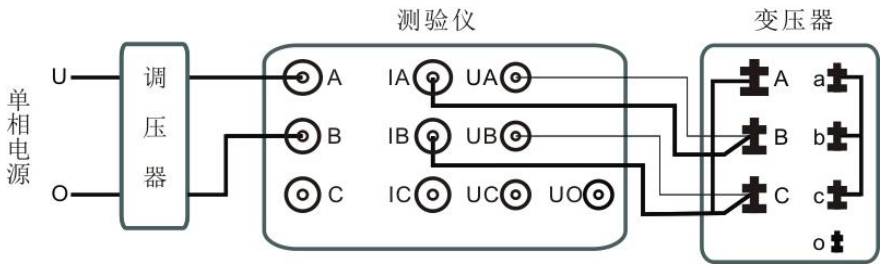
In the main interface, select "short-circuit test" and "single-phase short-circuit impedance" to enter the single-phase short-circuit impedance test interface, as shown in Figure 63.(Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)

graph 63

Turn on the test power supply, adjust the voltage regulator to raise the test voltage slowly. After the data is stable, touch "lock" or press "confirm" to end the AB phase measurement, appear in the interface as shown in Figure 64, and enter the BC phase measurement.

graph 64

In this state, do not exit the measurement state, zero the output voltage of the regulator, change the wiring to BC phase, CA short connection, the wiring is shown in Figure 65.



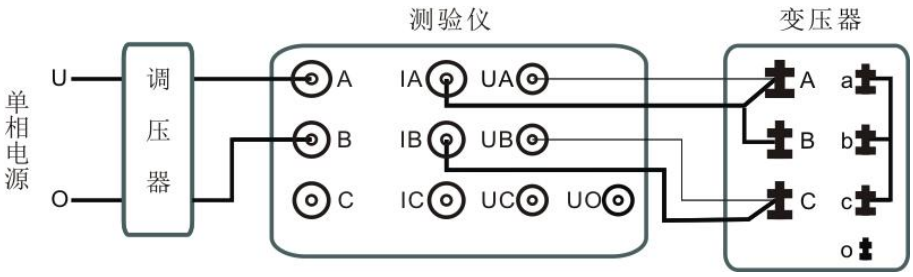
graph 65

After connecting the line, the voltage regulator pressurizes the BC phase, so that the test voltage slowly increases. After the data is stable, touch the "lock" or press the "confirm" key to end the BC phase measurement, appear in the interface as shown in Figure 66, and enter the CA phase measurement.

graph 66

In this state, do not exit the measurement state, zero the output voltage of the regulator, change the

wiring to CA phase, AB short connection, the wiring as shown in Figure 67:



graph 67

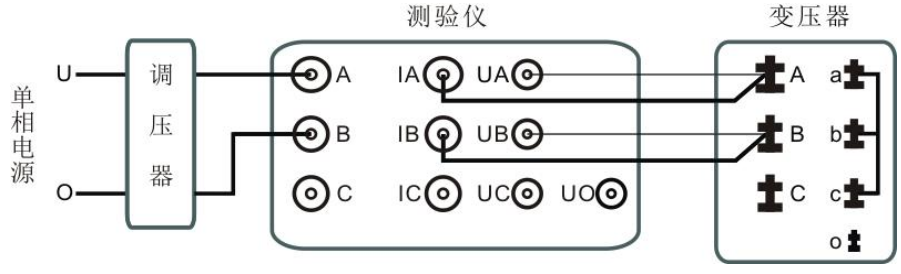
After connecting the line, the voltage regulator presses the test voltage to slowly increase. After the data is stable, touch "lock" or press "confirm" key, the CA phase measurement ends, and the test result interface appears, as shown in Figure 68.

graph 68

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu. (Note: at the end of each test or in the middle of the test, always zero the output voltage of the regulator and disconnect the test power supply to prevent electric shock).

B. For the three-phase transformer with pressurized side winding Y and yn, y or d connection, when using the single-phase power supply, AB, BC, CA, and the other side winding three-phase short circuit, measure the relevant parameters of the transformer.

The wiring method is shown in Figure 69, connecting the "U", "O", "A" and "B" (100A or 5A range) to the instrument, "IA" and "UA" of the instrument to the transformer side to the high voltage side A end of the transformer, and connecting "IB" and "UB" to the high voltage side B end of the transformer.



graph 69

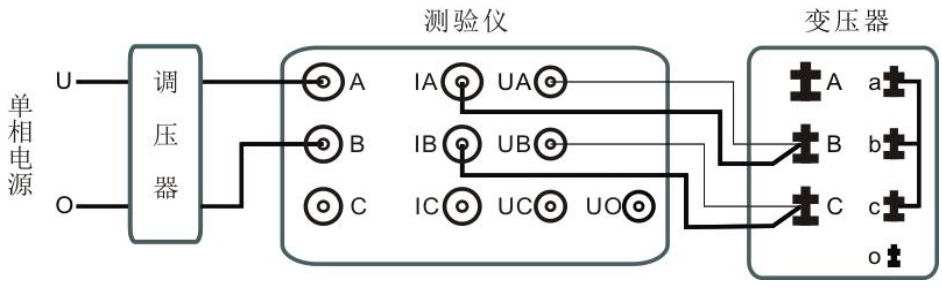
In the state of the main interface, select "short-circuit test" and "single-phase short-circuit impedance" to enter the single-phase short-circuit impedance test interface, as shown in Figure 70. (Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)

graph 70

Turn on the test power supply and adjust the voltage regulator to slowly increase the test voltage. After the data stabilizes, touch "lock" or press "confirm" key to end the AB phase measurement, and the interface appears in Figure 71, and enter the BC phase measurement.

graph 71

In this state, do not exit the measurement state, zero the output voltage of the regulator and change the wiring to BC phase, the wiring is shown in Figure 72:

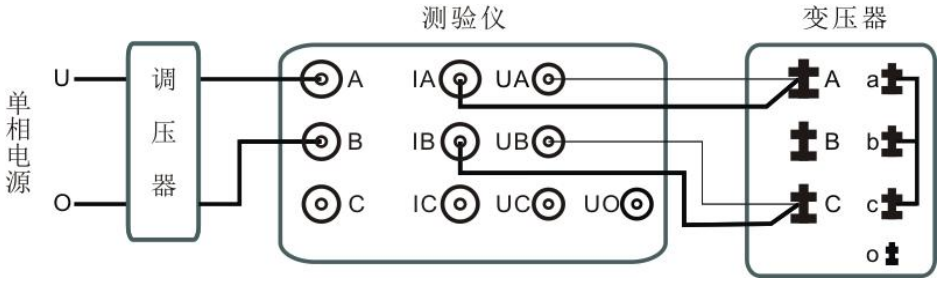


graph 72

After connecting the line, the regulator pressurizes the BC phase to slowly raise the test voltage. After the data is stable, touch the "lock" or press the "confirm" key to end the BC phase measurement, the interface appears in Figure 73, and enter the CA phase measurement.

graph 73

In this state, do not exit the measurement state, zero the output voltage of the regulator and change the wiring to CA phase, the wiring is shown in Figure 74:



graph 74

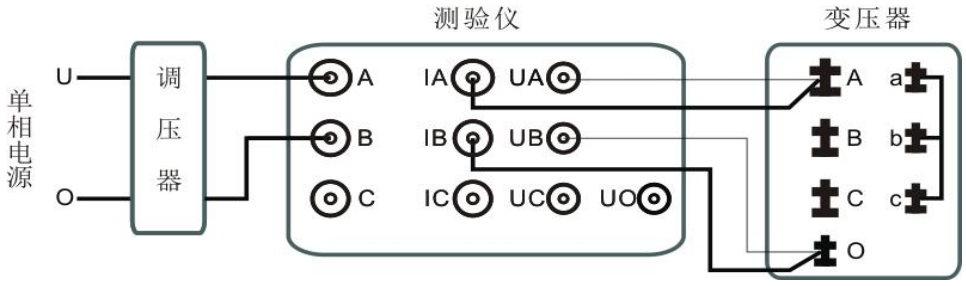
After connecting the line, the voltage regulator pressurizes the test voltage to slowly increase. After the data is stable, touch "lock" or press "confirm" key to finish the CA phase measurement, and the test result interface appears, as shown in Figure 75.

graph 75

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu. (Note: at the end of each test or in the middle of the test, always zero the output voltage of the regulator and disconnect the test power supply to prevent electric shock).

C. For the three-phase transformer with YN pressurized side winding and yn and d connection, when the single-phase power supply is used, pressure AO, BO and CO successively, while the other side winding has three-phase short circuit to measure the relevant parameters of the transformer.

The wiring method is shown in Figure 76, connecting the "U", "O" and "A", "B" (100A or 5A range) of the instrument to the "IA" and "UA" of the instrument to the transformer side "IA" to the high voltage side A end of the transformer, and "IB" and "UB" to the O end of the high voltage side of the transformer.



graph 76

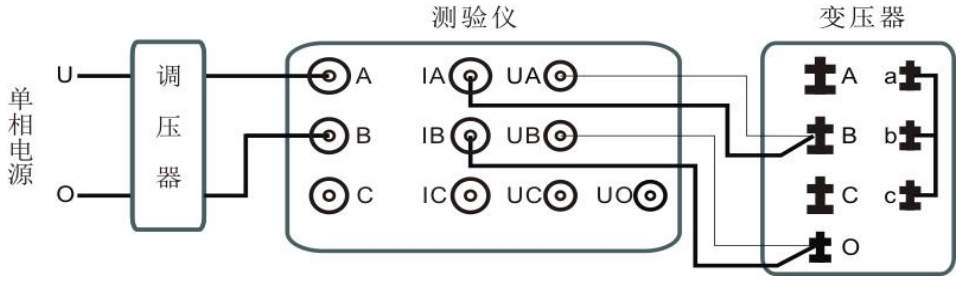
In the state of the main interface, select "short-circuit test" and "single-phase short-circuit impedance" to enter the single-phase short-circuit impedance test interface, as shown in Figure 77. (Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)

graph 77

Turn on the test power supply and adjust the regulator for voltage to slowly increase the test voltage. After the data stabilizes, touch "lock" or press "confirm" to end the AO phase measurement, and the interface appears in Figure 78, and enter the BO phase measurement.

graph 78

In this state, do not exit the measurement state, zero the output voltage of the voltage regulator, and change the wiring to the B0 phase, and the wiring is shown in Figure 79:

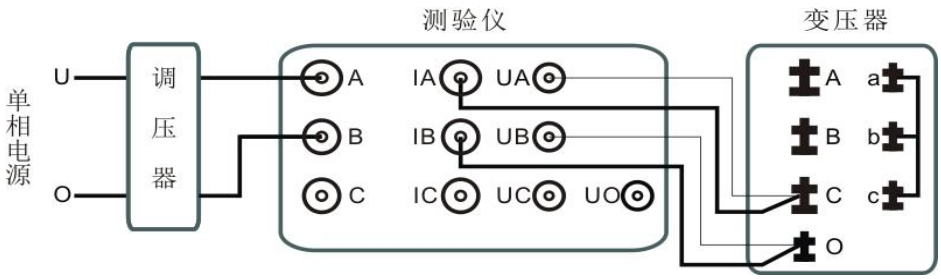


graph 79

After connecting the line, the voltage regulator pressurizes the B0 phase, so that the test voltage slowly increases. After the data is stable, touch the "lock" or press the "confirm" key, and the B0 phase measurement is over, and the interface appears in Figure 80, and enter the C0 phase measurement.

graph 80

In this state, do not exit the measurement state, zero the output voltage of the voltage regulator, and change the wiring to the C0 phase, as shown in Figure 81:



graph 81

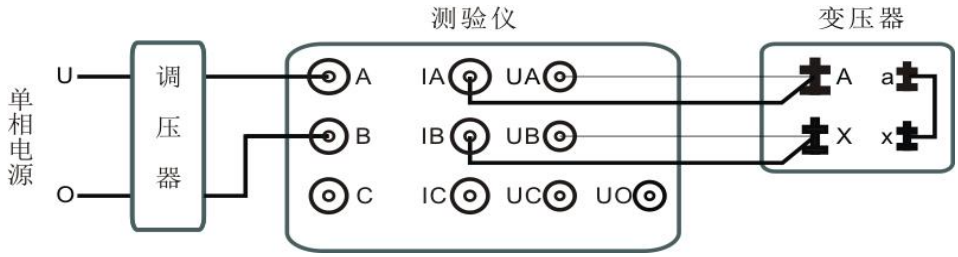
After connecting the line, the regulator presses the CO phase to make the test voltage slowly increase. After the data stabilizes, touch "lock" or press "confirm" key, the CO phase measurement is over, and the test result interface appears, as shown in Figure 82.

graph 82

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu. (Note: at the end of each test or in the middle of the test, always zero the output voltage of the regulator and disconnect the test power supply to prevent electric shock).

3, single-phase transformer short-circuit impedance test

Connect "U", "O", "A", "B" (100A or 5A range) of the instrument, connect "IA" and "UA" of the instrument to the high voltage side A end of the transformer, and connect "IB" and "UB" to the high voltage side X end of the transformer. The wiring method is shown in Figure Figure 83:



graph 83

In the state of the main interface, select "Short-circuit test" and "Single-phase load test" to enter the single-phase load test interface, as shown in Figure 84. (Note: Before the test, you should enter the parameter setting interface to set the relevant parameters of the tested transformer.)

graph 84

In this state, switch on the single-phase test power supply, adjust the voltage regulator, and raise the test voltage slowly. After the data stabilizes, touch "lock" or press "confirm" to lock the current test data, shown in Figure 85:

graph 85

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu.

X, the measurement of the zero-order impedance

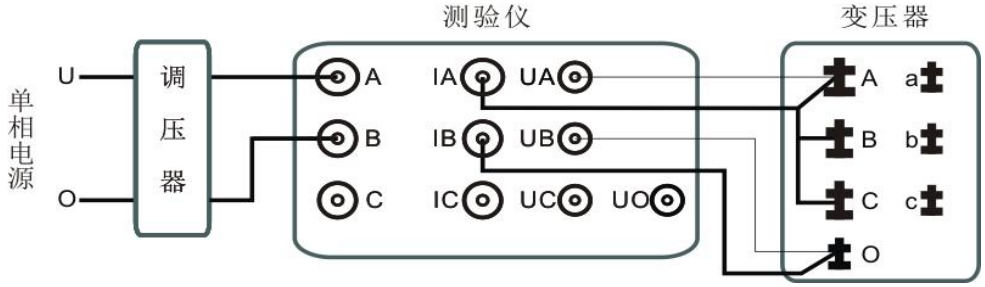
Test requirements and attention

The zero sequence impedance shall be measured at the rated frequency between the three short line terminals (line terminals of the star or zigzag winding) and the neutral terminals. During the test, pay attention to the heating caused by the neutral point lead and the neutral point casing of the test current.

1, zero sequence impedance measurement with equilibrium Ann turn

In the winding of a closed triangle connected winding belong to the equilibrium safety turn, its zero sequence impedance is linear, generally only measured a point, the test current should be as far as possible, limited by the capacity of the equipment, should not be less than 25% of the rated current.

a、For the transformer of Ynd 11, only the high voltage winding is measured, ABC-O power supply, low voltage open circuit during the test, and the wiring mode is shown in Figure 86.(Note: When the test voltage and current exceed the test range of the instrument, the voltage transformer and current transformer shall be connected.)



graph 86

In the state of the main interface, select "zero sequence impedance" and enter the zero sequence impedance test interface, as shown in Figure 87.

graph 87

In this state, turn on the test power supply and adjust the voltage regulator to raise the test current slowly to the rated current. After the data is stable, press the "print" key to print the current test data; press the "Save" key to store the current test data (power loss). Measure the output voltage of the regulator and disconnect the test power supply.

B. For the YNyn0d11 transformer, the measurement wiring shall be conducted according to Table 2, with high voltage winding ABC- -O and medium voltage winding $A_mB_mC_m$—O_m, Low pressure winding is open. (Note: When the test voltage and current exceed the test range of the instrument, the voltage transformer and current transformer shall be connected.)

Table 2

order number	Power supply terminal	Open road terminal	Short circuit terminal
1	ABC—O	$A_mB_mC_m$—O_m	
2	ABC—O		$A_mB_mC_m$—O_m
3	$A_mB_mC_m$—O_m	ABC—O	
4	$A_mB_mC_m$—O_m		ABC—O

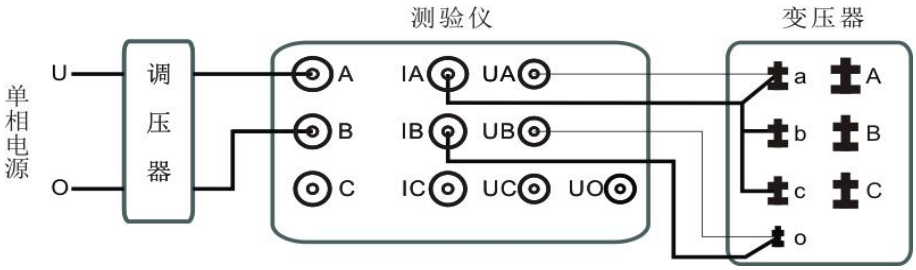
C. For other transformers with balanced safety turn, the measurements can be made according to the measurement combination in Table 1.

2. Zero-sequence impedance measurement without equilibrium turn

For the three-winding transformer with YNyn0yn0 and the double-winding transformer with Yyn 0 and the transformer without closed triangle in all connection combinations, they are unbalanced safety turns.

The zero sequence impedance of the transformer without equilibrium safety turn is nonlinear, which decreases with the increase of the applied current, so it needs to measure a series of impedance values, generally not less than 5 points, such as measuring the zero sequence impedance of 20%, 40%, 60%, 80%, 100% test current. The test current generally does not exceed the rated current, if the zero-order impedance is too large, and control the test current, so that the test voltage does not exceed the rated phase voltage.

a、For Yyn 0 transformer, only the low voltage winding is measured. During the test, the abc-o power supply and the high voltage winding is open. The wiring mode is shown in Figure 88. (Note: When the test voltage and current exceed the test range of the instrument, the voltage transformer and current transformer shall be connected.)



graph 88

In the state of the main interface, select "zero sequence impedance" and enter the zero sequence impedance test interface, as shown in Figure 89.

graph 89

In this state, switch on the test power supply and adjust the voltage regulator to slowly raise the test current to 20% of the rated current. After the data stabilizes, touch "lock" or press "confirm" key to lock the current test data and enter the next set of zero-sequence impedance measurements, as shown in Figure 90.

graph 90

Adjust the regulator, raise the output current successively, and measure the zero-order impedance under

other four different currents. After measuring one set of data, touch "lock" or press "confirm" to lock the current test data, and enter the next set of zero-order impedance measurement.

Complete the measurement to print the data of the current test; press Save to store the current test data (no power loss). Measure the output voltage of the regulator and disconnect the test power supply.

B. For the YNyn0yn0 transformer, the measurement wiring shall be conducted according to Table 3, with high voltage winding ABC- -O and medium voltage winding $A_mB_mC_m$—O_m, Low-pressure winding, abc-o.

Table 3

order number	Power supply terminal	Open road terminal	Short circuit terminal
1	ABC—O	$A_mB_mC_m$—O_m abc-o	
2	ABC—O	abc-o	$A_mB_mC_m$—O_m
3	ABC—O	$A_mB_mC_m$—O_m	abc-o
4	ABC—O		$A_mB_mC_m$—O_m abc-o
5	$A_mB_mC_m$—O_m	ABC—O	abc-o
6	$A_mB_mC_m$—O_m	ABC—O abc-o	
7	$A_mB_mC_m$—O_m	abc-o	ABC—O
8	$A_mB_mC_m$—O_m		ABC—O abc-o
9	abc-o	$A_mB_mC_m$—O_m	ABC—O
10	abc-o	ABC—O $A_mB_mC_m$—O_m	
11	abc-o		ABC—O $A_mB_mC_m$—O_m
12	abc-o	ABC—O	$A_mB_mC_m$—O_m

C. For other transformers without balanced safety turns, the measurements can be made by referring to the measurement combination in Table 2.

XI. Transformer passive capacity test and operation instructions

test requirements document

The passive capacity test of this instrument uses external three-phase power supply. Before the test, the winding temperature of the tested transformer should be accurately measured, the oil immersed transformer as the winding temperature, and the average temperature of the coil (not less than three points) shall be taken as the winding temperature. Generally, the primary side winding of the transformer is selected as the test winding, the secondary side (high current side) is artificial short-circuit, the cross-sectional area of the short-circuit wire should not be less than the cross-sectional area of the transformer wire, its length should be as short as possible, and ensure that the contact resistance can be ignored, so as not to affect the test results. The instrument can use the small current method, the test current is selected from 1%~20% of the rated current to calculate the result. For the power supply capacity requirements, see the appendix, for reference only.

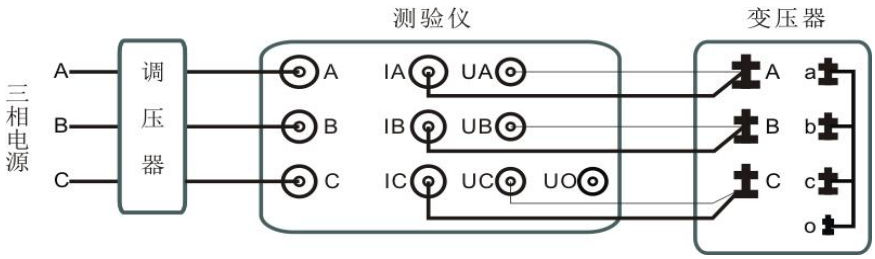
1. Parameter setting

Before testing the transformer, it should enter the parameter setting interface to set the relevant parameters

of the transformer according to the parameters of the tested transformer.

2. Passive capacity test of the three-phase transformer

A. Connect the "Ua", "Ub" and "Uc" of the three-phase adjustable power supply to "A", "B", "C" range "(100A" from the external side of the instrument to the transformer "IA", "IB", "IC", "UA", "" UB "and" UC " to the transformer to the high voltage side of the low voltage side and ensure that the contact resistance can be ignored. Connect the zero-phase "Uo" of the three-phase power supply to the "UO" terminal of the instrument. The wiring method of the tested transformer and the instrument is shown in Figure Figure 91. (Note: Three-phase transformers have the same test wiring mode during the three-phase test.)



graph 91

Under the main interface, select "Capacity determination" and enter the passive capacity determination load test interface, as shown in Figure 92. (Note: Relevant parameters of the transformer shall be set before testing.)

graph 92

In this state, turn on the three-phase test power supply, adjust the voltage regulator to raise the test voltage slowly. After the data stabilizes, touch "lock" or press "confirm" key to lock the current test data, appearing the interface as shown in Figure 93.

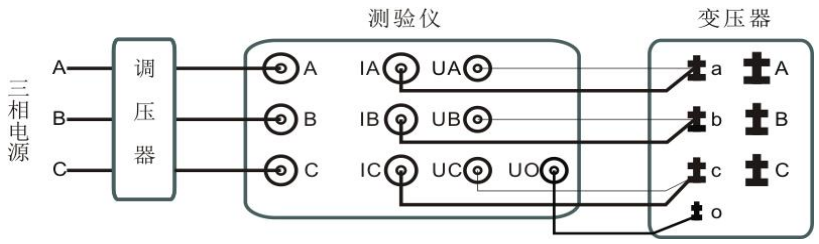
graph 93

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu.

B. If you need to determine the transformer loss level (core form), press the "left" or "right" button to enter the passive capacity determination empty load test interface, as shown in Figure 94.

graph 94

The "Ua", "Ub" and "Uc" of the three-phase adjustable power supply are connected to "A", "B", "C" (100A or 5A range) terminals on the external side of the instrument, and "IA", "IB", "IC" and "UA", "UB" and "UC" are connected to the low voltage side of the transformer. If the transformer has a neutral point, connect the neutral point to the "UO" terminal of the instrument, and the high voltage side of the transformer is open. The wiring method is shown in Figure 95:



graph 95

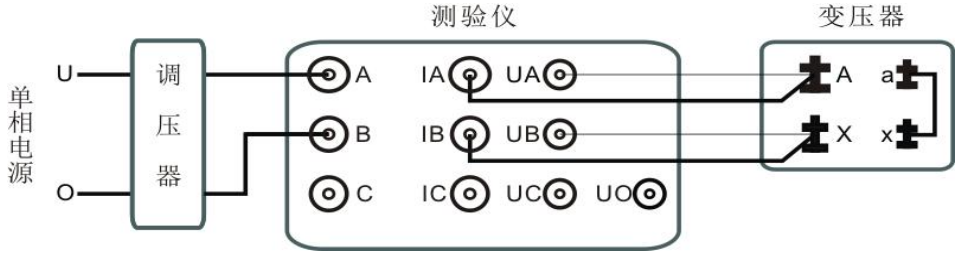
Turn on the three-phase test power supply and adjust the voltage regulator so that the test voltage slowly rises to the lock voltage. After the data is stable, touch the "lock" or press the "confirm" key to lock the current test data. The interface shown in Figure 96 calculates the no-load current and no-load loss and loss level of the transformer based on the three-phase measurement data.

graph 96

Zero the output voltage of the voltage regulator and disconnect the test power supply. Press Print to print the current test data; press Save to store the current test data (no power loss); press Back to exit the test and return to the previous menu.

3, single-phase transformer passive capacity test

A. Connect the "U", "A" ("B A" or "5A", "A" of the external regulator; connect "IA" and "UA" of the external transformer side to the high voltage side A end of the transformer, and connect "IB" and "UB" to the X of the high voltage side end of the transformer. The wiring method is shown in Figure Figure 97:

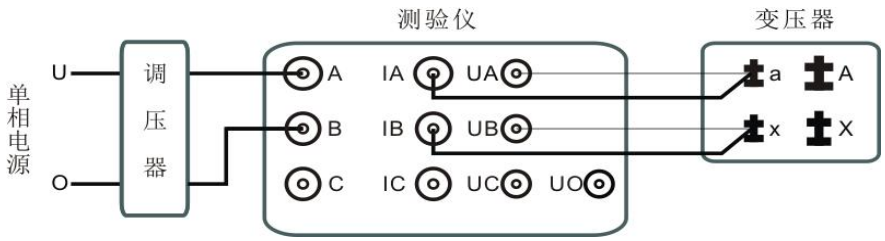


graph 97

After setting the relevant parameters, the test method is consistent with the passive capacity test of the three-phase transformer.

b、For the transformer loss level (iron core form), connect "U", "O" to the "A" to the voltage regulator

"A", "B" (100A or 5A range); connect the external side "IA" and "UA" to the transformer, and connect "IB" and "UB" to the low voltage side x end of the transformer, open the high voltage side of the transformer as shown in Figure 98, the test method is consistent with the passive capacity test of the three-phase transformer.



graph 98

Xii. Measurement of electrical parameters

Measure the "Ua", "Ub" and "Uc" terminal terminals with the external voltage of the instrument from the "A", "B", "C" (100A or 5A range), and the "IA", "IB" and "IC" terminals from the external transformer. If the neutral device connects the neutral point to the external transformer to measure the "UO" terminal. If the transformer is not neutral point, then the "UO" wiring terminal will be ground.

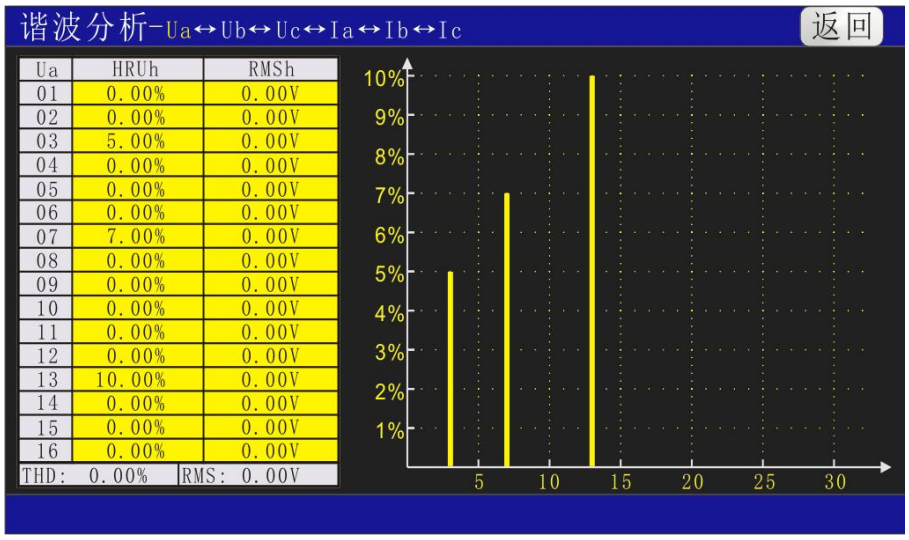
Measure the electrical parameters of the three-phase or single-phase transformer, and the electrical parameter measurement interface is shown in Figure 99.

graph 99

Open or close the corresponding waveform curve: it can be realized by touching the LCD screen or "", "", "confirm" key to select each phase voltage and current channel.

Thirteen, harmonic analysis

When there is a waveform distortion, select "Harmonic Analysis" under the main interface and enter the harmonic analysis page, as shown in Figure 100.



graph 100

You can swipe on the LCD screen or press the "left" and "right" keys on the keyboard to switch the display page.

The parameters are described as follows:

(1) Ua indicates that the page is a harmonic analysis of A phase voltage; Ia means that the page is a harmonic analysis of A phase current.

(2) HRUh represents the percentage of each harmonic of the voltage and HRIh represents the percentage of the base wave.

(3) RMSh represents the effective value of each subharmonic of the voltage or current.

(4) The serial number represents each harmonic of the voltage or current of the phase.

(5) The THD represents the harmonic distortion rate of the total voltage or current of the phase.

(6) The RMS represents the effective value of the total voltage or current of the phase.

XIV. Data records

When required to view the test record, select "Data Record" under the main interface and enter the data record page as shown in Figure 101:

graph 101

operation declaration:

(1) If there are more than 10 data records, press the "left" and "right" keys on the LCD screen or keyboard to switch the data page.

(2) You can select the data record of the key to be viewed by clicking on the keyboard "up", "down"

and "confirm", and enter the detailed record of the data. Each data record includes two pages: set parameters and test data, switch through the "left" and "right" keys, and press the "Back" key to exit the detailed data record.

(3) Press the search key to search for the required data by device number or test time.

(4) Delete, there are three ways to delete: a single data deletion, this page data deletion, all data deletion.

Note: A single data deletion shall first select the data to be deleted; all data deletion takes a long time and wait patiently.

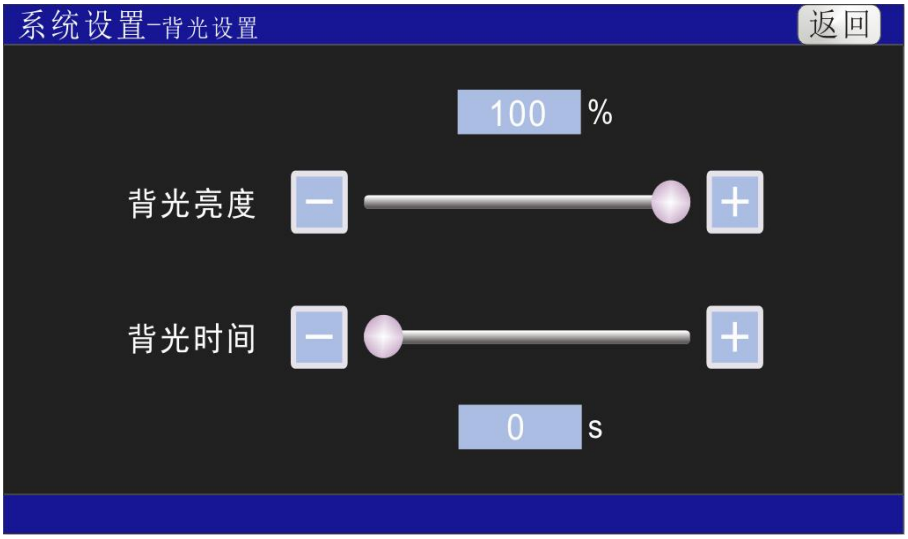
(5) U disk export, insert U disk, select U disk export, each piece of data will be exported to the CT3200 folder in a word document.

XV. System setting

The system setting includes four parts: parameter correction, backlight setting, time setting, and software version.

(1) Parameter correction: set at the factory, the user does not need to operate, if the change will affect the measurement of each parameter.

(2) Backlighting setting: As shown in FIG. 102, the user may set the backlight brightness and the backlight time as required. If the backlight brightness is set to 30% and the backlight time is set to 30S, the LCD screen will be reduced from 100% to 30% brightness after 30S without any operation of the instrument, and the touch LCD screen will be restored to 100% brightness.



graph 102

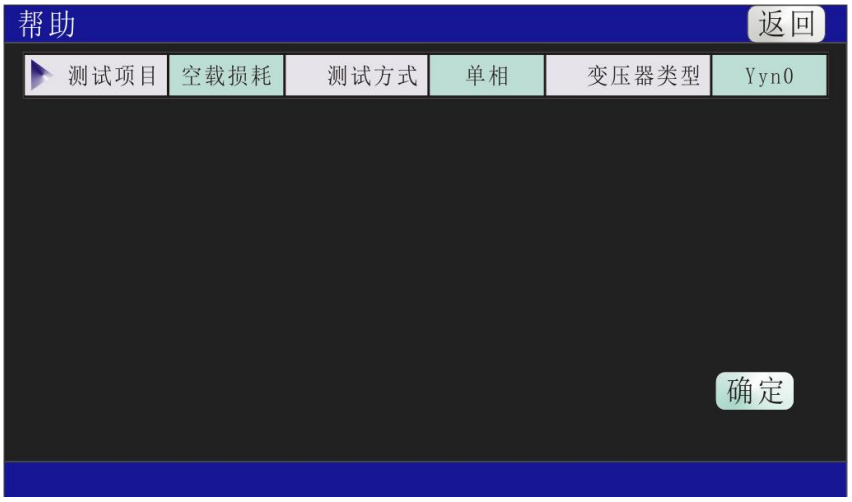
(3) Time setting: As shown in Figure 103, after setting the time, press the change key to display the time will complete the setting,

graph 103

(4) Software version: Display the software version of this tester.

16. Help

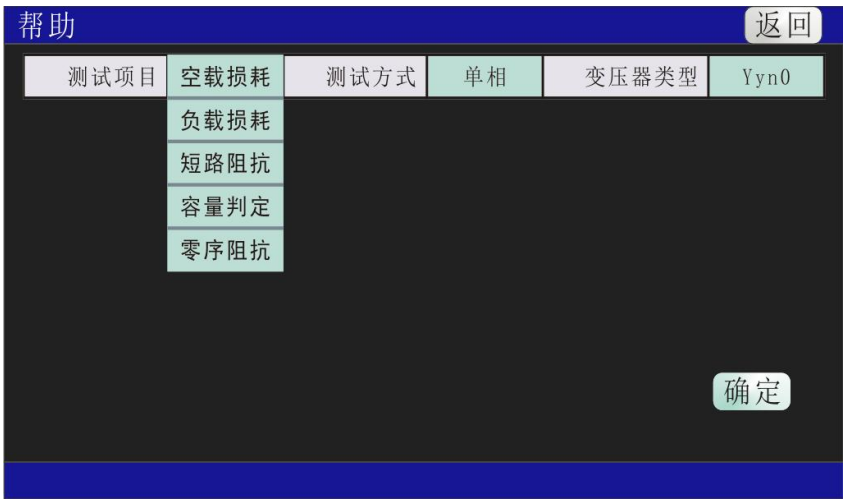
When you need to check the wiring mode and calculation formula of each test item, select "Help" under the main interface and enter the help page, as shown in Figure 104:



graph 104

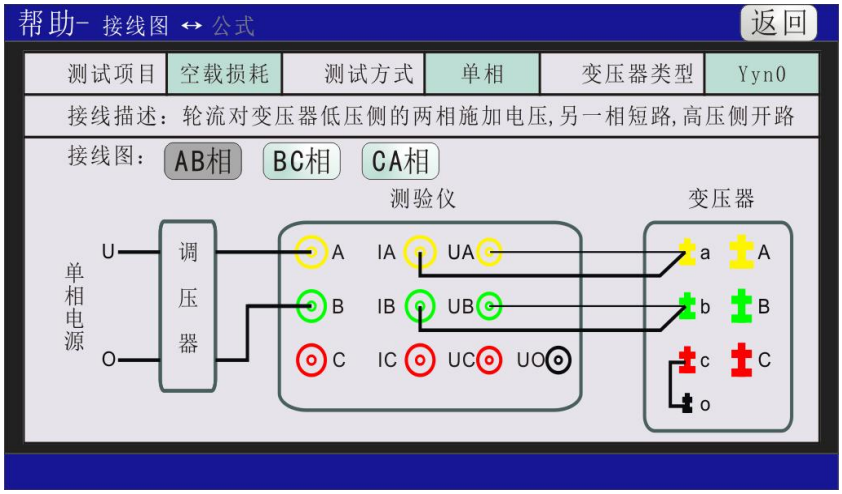
operation declaration:

(1) Click the corresponding dialog box in the content part of each selected item (or press the left and right keys on the keyboard, and press the confirmation key to pop up the corresponding dialog box), as shown in Figure 105.



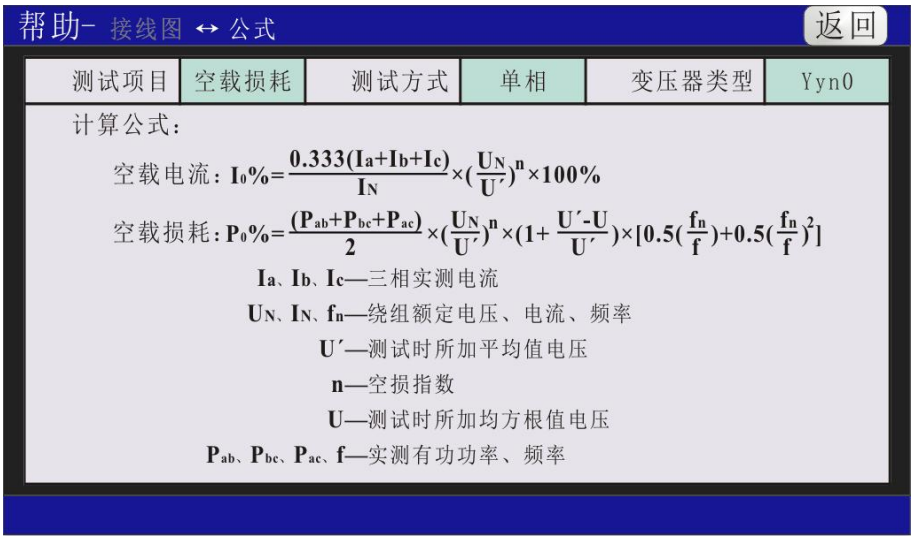
graph 105

(2) Select the content to be checked, click "OK" or press the confirmation key on the keyboard to enter the wiring diagram of the corresponding transformer test items, as shown in Figure 106.



graph 106

(3) Stroke the screen or press the left and right keys on the keyboard to switch between the wiring diagram and the formula of the corresponding transformer test items, as shown in Figure 107.



graph 107

XVII. Matters needing attention

1. Use this instrument, please wire and operate according to this manual.

2. The grounding terminal should be reliably grounded nearby, and start the test line is connected. During the test line, never dismantle the test line to avoid accidents, lock the test power supply, and then view or print the locked data or move to remove the test line.

3. Please enter the correct auxiliary parameters before the test starts. The measurement results of the instrument all depend on the input auxiliary parameters.

4. Pay attention to the position of the transformer tap switch during the test, and the measurement results at different positions are also different. If the impedance voltage is to be measured, the transformer must be at the rated tap position.

5. When measuring the no-load loss, the voltage correction is an approximate correction under the non-rated voltage condition, so please try to measure under the rated voltage condition.

6. When measuring the load loss, the test should be carried out as quickly as possible to reduce the error caused by the

winding temperature rise.

7. When measuring load loss, the short route of the low voltage side should be thick enough to withstand the rated current of the low voltage side, and the connection is reliable to ensure that the contact resistance can be ignored.

8. The selection of test menu items should be consistent with the actual test items and wiring.

9. The current circuit is connected by thick lines, and the voltage circuit is connected with thin lines.

10. Please do not work under the voltage or current input overload conditions.

11. Memory can store up to 9999 measurements, and the oldest records will be covered over 9999. Please note to copy or upload to the computer to save or transfer to the mobile U disk.

18. Accessories (packing list)

1. 1 host unit
2. 1 power adapter
3. One set of test line
4. Manual: 1 book
5. Print 2 volumes of paper
6. High current short circuit, 1 flat copper wire
7. Short wiring (2 meters), 1 root
8. 1 grounding wire
9. Three alligator clips

19. After-sales service

This product from the sale date of three years, if there are quality problems to be free warranty, lifelong maintenance.

The consequences of dismantling the instrument, the company is no longer responsible for maintenance!

Appendix 1 Common failures and analysis of the instrument

Common fault	failure cause
LCD no display	1) Main board failure; 2) power supply failure
Can't test	1) The clamp is not clamped. 2) the power supply is not connected. 3) The internal wiring of the instrument is loose
The printer is not printed	1) printer failure 2) instrument motherboard failure 3) printing paper is well installed (thermal paper can only be printed on one side) 4) the printer power supply is not well connected

Appendix II Determination of test power supply capacity during no-load loss test

In order to select the suitable test power supply, the capacity must be determined before the test. According to the nameplate capacity of the tested transformer and the percentage of no-load current contained in the nameplate (if there is no nameplate or the nameplate, the rated data of the same type transformer can be checked), when the test is conducted at the rated voltage, the following calculation:

$$S' \geqslant (S_N \times I0\% \times K)/100$$

The three-phase power supply capacity required by the S ′ --test;

S_N- -Rated capacity of the transformer;

I0% - -% of empty-load current.

K- -coefficient power supply is the regulator K=2.5 power supply is the generator K=5;

Empically, the formula is also practical

$$S' \geqslant S_N \times K$$

The three-phase power supply capacity required by the formula S ′ --test;

S_N- -Rated capacity of the transformer;

K-experience coefficient can be selected between 0.05 and 0.10

If a single-phase power supply is used, the power supply capacity = three-phase power supply capacity / 1.5

Appendix 3 Load loss, short circuit impedance, capacity analysis, and determination of test power supply capacity during test

The required three-phase power supply capacity S can be calculated in the following equation:

$$S \geqslant S_N \times (Uk\%/100) \times (Ik/I_N)2$$

The required test three-phase voltage Uk is:

$$Uk > U_N \times (Uk\%/100) \times (Ik/I_N)$$

In formula S_N、U_N- -Rated voltage of the rated capacity, respectively;

I_N, Ik- -is the rated current and the short-circuit test current respectively;

S, Uk- -are the required apparent power and short-circuit test voltage respectively;

Uk% - -Short-circuit voltage percentage (%) of the tested transformer (i. e., impedance voltage).

If a single-phase power supply is used, the power supply capacity = three-phase power supply capacity / 1.5

Example: The rated capacity of the tested transformer is 50 kVA, and the impedance voltage is 4%,

If tested with a rated current, Ik / I_N=1, the power supply capacity shall be greater than (504) / 100=2kW

If tested with 50% rated current, Ik / I_N=0.5, the power supply capacity shall be greater than 2KW×0.5×0.5=0.5kW

Appendix IV

6-10K V voltage grade 30 kVA-2500 kVA oil-immersed dual-winding non-excitation adjustable voltage distribution transformer

rated capacity k VA	open circuit losses W					load losses W		no-load current%			short-circuit impedance %
	S9	S10	S11	S12	S13 S13-RL	S9～S13/S13-RL		S10～S13	S9	S13-RL	
						Dyn11 Yzn11	Yyn0				
30	130	110	100	90	80	630	600	1.5	2.3	0.3	4.0
50	170	150	130	120	100	910	870	1.3	2.0	0.24	
63	200	180	150	130	110	1090	1040	1.2	1.9	0.23	
80	250	200	180	150	130	1310	1250	1.2	1.8	0.22	
100	290	230	200	170	150	1580	1500	1.1	1.8	0.21	
125	340	270	240	200	170	1890	1800	1.1	1.7	0.2	
160	400	310	280	240	200	2310	2200	1.0	1.6	0.19	
200	480	380	340	280	240	2730	2600	1.0	1.5	0.18	
250	560	460	400	340	290	3200	3050	0.9	1.4	0.17	
315	670	540	480	410	340	3830	3650	0.9	1.4	0.16	
400	800	650	570	490	410	4520	4300	0.8	1.3	0.16	
500	960	780	680	580	480	5410	5150	0.8	1.2	0.16	
630	1200	920	810	690	570	6200	6200	0.6	1.1	0.15	4.5
800	1400	1120	980	840	700	7500	7500	0.6	1.0	0.15	
1000	1700	1320	1150	990	830	10300	10300	0.6	1.0	0.14	
1250	1950	1560	1360	1170	970	12000	12000	0.5	0.9	0.13	
1600	2400	1880	1640	1410	1170	14500	14500	0.5	0.8	0.12	
2000	—	2220	1940	1750	1360	18300	18300	0.4	—		5.0
2500	—	2620	2290	2060	1600	21200	21200	0.4	—		

6-10K V voltage grade 30 kVA-2500 kVA oil-immersed dual-winding non-excitation adjustable voltage distribution transformer

rated capacity k VA	open circuit losses W			load losses W						no-load current %	short-circuit impedance %
				S14		S20		S22			
	S14	S20	S22	Dyn11 Yzn11	Yyn0	Dyn11 Yzn11	Yyn0	Dyn11 Yzn11	Yyn0		
30	80	70	65	505	480	505	480	455	430	1.5	4.0
50	100	90	80	730	695	730	695	655	625	1.3	
63	110	100	90	870	830	870	830	785	745	1.2	
80	130	115	105	1050	1000	1050	1000	945	900	1.2	
100	150	135	120	1265	1200	1265	1200	1140	1080	1.1	
125	170	150	135	1510	1440	1510	1440	1360	1295	1.1	
160	200	180	160	1850	1760	1850	1760	1665	1585	1.0	
200	240	215	190	2185	2080	2185	2080	1970	1870	1.0	
250	290	260	230	2560	2440	2560	2440	2300	2195	0.9	
315	340	305	270	3065	2920	3065	2920	2760	2630	0.9	
400	410	370	330	3615	3440	3615	3440	3250	3095	0.8	
500	480	430	385	4330	4120	4330	4120	3900	3710	0.8	
630	570	510	460	4960	4960	4960	4960	4460	4460	0.6	4.5
800	700	630	560	6000	6000	6000	6000	5400	5400	0.6	
1000	830	745	665	8240	8240	8240	8240	7415	7415	0.6	
1250	970	870	780	9600	9600	9600	9600	8640	8640	0.5	
1600	1170	1050	940	11600	11600	11600	11600	10440	10440	0.5	
2000	1550	1225	1085	14640	14640	14640	14640	13180	13180	0.4	5.0
2500	1830	1440	1280	16960	16960	14840	14840	13360	13360	0.4	

6-10K V voltage grade 30 kVA-2500 kVA oil-immersed dual-winding non-excitation adjustable voltage distribution transformer

rated capacity k VA	open circuit losses kW				load losses kW				no-load current %	short impedance %
	SH15	SH16	SH21	SH25	SH15	SH16	SH21	SH25	SH15/ SH16 SH21/ SH25	
30	0.033	0.033	0.033	0.025	0.63/0.6	0.565/0.54	0.535/0.51	0.51/0.48	1.5	4.0
50	0.043	0.043	0.043	0.035	0.91/0.87	0.82/0.785	0.780.745	0.735/0.7	1.2	
63	0.050	0.050	0.050	0.040	1.09/1.04	0.98/0.935	0.93/0.89	0.88/0.84	1.1	
80	0.060	0.060	0.060	0.050	1.31/1.25	1.18/1.12	1.12/1.07	1.06/1.01	1.0	
100	0.075	0.075	0.075	0.060	1.58/1.5	1.42/1.35	1.35/1.285	1.27/1.215	0.9	
125	0.085	0.085	0.085	0.070	1.89/1.8	1.7/1.62	1.615/1.54	1.53/1.45	0.8	
160	0.100	0.100	0.100	0.080	2.31/2.2	2.08/1.98	1.975/1.88	1.87/1.78	0.6	
200	0.120	0.120	0.120	0.095	2.73/2.6	2.45/2.34	2.33/2.25	2.21/2.1	0.6	
250	0.140	0.140	0.140	0.110	3.2/3.05	2.88/2.74	2.735/2.61	2.59/2.47	0.6	
315	0.170	0.170	0.170	0.135	3.83/3.65	3.44/3.28	3.275/3.12	3.1/2.95	0.5	
400	0.200	0.200	0.200	0.160	4.52/4.3	4.07/3.87	3.865/3.675	3.66/3.48	0.5	
500	0.240	0.240	0.240	0.190	5.41/5.15	4.87/4.63	4.625/4.4	4.38/4.17	0.5	
630	0.320	0.320	0.320	0.250	6.2	5.58	5.3	5.02	0.3	4.5
800	0.380	0.380	0.380	0.300	7.5	6.75	6.415	6.075	0.3	
1000	0.450	0.450	0.450	0.360	10.3	9.27	8.8	8.34	0.3	
1250	0.530	0.530	0.530	0.425	12	10.8	10.26	9.72	0.2	
1600	0.630	0.630	0.630	0.500	14.5	13	12.4	11.745	0.2	
2000	0.720	0.750	0.710	0.550	18.3	16.4	14.8	14	0.2	5.0
2500	0.865	0.900	0.860	0.670	21.2	19	16.3	15.45	0.2	

Note: The load loss value above the diagonal line applies to the Dyn 11 coupling group, and the load loss value below the

diagonal line applies to the Yyn 0 coupling group.

6-10K V voltage grade oil-immersed three-phase double-winding transformer

rated capacity	open circuit losses kW					load losses kW			no-load current%		short-circuit impedance%	
	S9	S10	S11	S12	S13	S9	S10	S11～S13	S9 S10	S11～S13	S9 S10	S11～S13
630 kVA-6300 kVA unexciting voltage power transformer (6k V or 3k V for LV)												
630	1.03	0.927	0.82	0.738	0.656	7.29	6.925	6.92	1.1	0.6	4.5	5.5
800	1.26	1.134	1.0	0.9	0.8	8.91	8.464	8.46	1.0	0.6	5.5	
1000	1.48	1.332	1.18	1.062	0.944	10.44	9.918	9.91	1.0	0.6		
1250	1.75	1.575	1.4	1.26	1120	12.42	11.799	11.7	0.9	0.5		
1600	2.11	1.899	1.68	1.512	1.344	14.85	14.107	14.1	0.8	0.4		
2000	2.52	2.268	2.01	1.809	1.608	17.82	16.929	16.9	0.8	0.4		
2500	2.97	2.673	2.37	2.133	1.896	20.7	19.665	19.6	0.8	0.4		
3150	3.51	3.159	2.8	2.52	2.24	24.3	23.085	23.0	0.7	0.4		
4000	4.32	3.888	3.45	3.105	2.76	28.8	27.36	27.3	0.7	0.4		
5000	5.13	4.617	4.1	3.69	3.28	33.03	31.378	31.3	0.7	0.4		
6300	6.12	5.508	4.89	4.401	3.912	36.9	35.055	35.0	0.6	0.4		
			200 kVA-2500k V on-load voltage distribution transformer (0.4k V)									
200	0.47	0.423	0.38	0.342	0.304	3.06	2.907	2.9	1.7	1.0	4.0	4.0
250	0.56	0.504	0.44	0.396	0.352	3.6	3.42	3.42	1.5	0.9		
315	0.67	0.603	0.53	0.477	0.424	4.32	4.104	4.1	1.4	0.9		
400	0.8	0.72	0.64	0.576	0.512	5.22	4.959	4.95	1.3	0.8		
500	0.96	0.864	0.76	0.684	0.608	6.21	5.9	5.89	1.2	0.8		
630	1.15	1.035	0.96	0.864	0.778	7.65	7.267	7.26	1.1	0.6	4.5	4.5
800	1.4	1.26	1.12	1.008	0.896	9.36	8.892	8.89	1.0	0.6		
1000	1.65	1.485	1.36	1.224	1.088	10.98	10.431	10.4	1.0	0.6		
1250	1.95	1.755	1.56	1.404	1.248	13.05	12.397	12.3	0.9	0.5		
1600	2.4	2.16	1.92	1.728	1.536	15.57	14.791	14.7	0.8	0.5		
2000	—	—	2.27	2.043	1.816	—	—	18.6		0.4	5.0	5.0
2500	—	—	2.68	2.412	2.144	—	—	21.6		0.4		

Note: Table 630 kVA-6300 kVA double-winding power transformer data for coupling transformers Yd 11 and Dy 11; 200 kVA-2500 kVA on-load distribution transformer data for coupling transformers Dyn 11 and Yyn 0.

20K V voltage grade 30 kVA-2500 kVA oil-immersed dual winding non-excitation adjustable voltage and distribution transformer

rated capacity k VA	open circuit losses W				load losses W		no-load current%	short-circuit impedance%
	S11	S12	S13	SH15	S11～S13/SH15		S11～S13 SH15	S11～S13 SH15
					Dyn11 Yzn11	Yyn0		
30	100	90	80	40	690	660	2.1	5.5
50	130	117	104	55	1010	960	2.0	
63	150	135	120	65	1200	1150	1.9	
80	180	162	144	75	1440	1370	1.8	
100	200	180	160	90	1730	1650	1.6	
125	240	216	192	100	2080	1980	1.5	
160	290	261	232	120	2540	2420	1.4	
200	340	306	272	145	3000	2860	1.3	
250	400	360	320	165	3520	3350	1.2	
315	480	432	384	200	4210	4010	1.1	
400	570	513	456	240	4970	4730	1.0	
500	680	612	544	290	5940	5660	1.0	
630	810	729	648	370	6820	6820	0.9	6.0
800	980	882	784	450	8250	8250	0.8	
1000	1150	1035	920	530	11330	11330	0.7	
1250	1380	1242	1104	620	13200	13200	0.7	
1600	1660	1494	1328	750	15950	15950	0.6	
2000	1950	1755	1560	900	19140	19140	0.6	
2500	2340	2106	1872	1080	22220	22220	0.5	

35K V voltage grade 50 kVA-1600 kVA oil-immersed three-phase double winding without excitation voltage regulating distribution transformer

rated capacity	open circuit losses kW		load losses kW		no-load current%	short-circuit impedance%
	S9	S10	S9	S10	S9/S10	S9/S10
50	0.21	0.189	1.27/1.21	1.206/1.15	2.0	6.5
100	0.29	0.261	2.12/2.02	2.014/1.919	1.8	
125	0.34	0.306	2.5/2.38	2.375/2.261	1.7	
160	0.36	0.324	2.97/2.83	2.821/2.688	1.6	
200	0.43	0.387	3.5/3.33	3.325/3.163	1.5	
250	0.51	0.459	4.16/3.96	3.952/3.762	1.4	
315	0.61	0.549	5.01/4.77	4.76/4.531	1.4	
400	0.73	0.657	6.05/5.76	5.747/5.472	1.3	
500	0.86	0.774	7.28/6.93	6.916/6.583	1.2	
630	1.04	0.936	8.28	7.866	1.1	
800	1.23	1.107	9.9	9.405	1.0	
1000	1.44	1.296	12.15	11.542	1.0	
1250	1.76	1.584	14.67	13.936	0.9	
1600	2.12	1.908	17.55	16.672	0.8	

Note: For transformers with rated capacity of 500 kVA and below, the load loss value above the diagonal in the table applies to the Dyn 11 coupling group, and the load loss value below the diagonal applies to the Yyn 0 coupling group.

35K V voltage grade 50 kVA-2500 kVA oil-immersed three-phase double winding without excitation magnetic regulation voltage distribution transformer

rated capacity	open circuit losses kW				load losses kW		no-load current%		short-circuit impedance %
	S11	S12	S13	SH15	S11～S13	SH15	S11～S13	SH15	S9/S10
50	0.16	0.144	0.128	0.085	1.2/1.14	1.21/1.14	1.3	1.5	6.5
100	0.23	0.207	0.184	0.12	2.01/1.91	2.01/1.91	1.1	1.2	
125	0.27	0.243	0.216	0.135	2.37/2.26	2.37/2.26	1.1	1.1	
160	0.28	0.252	0.224	0.15	2.82/2.68	2.82/2.68	1.0	0.9	
200	0.34	0.306	0.272	0.175	3.32/3.16	3.32/3.16	1.0	0.9	
250	0.4	0.36	0.32	0.205	3.95/3.76	3.95/3.76	0.95	0.9	
315	0.48	0.432	0.384	0.245	4.75/4.53	4.76/4.53	0.95	0.7	
400	0.58	0.522	0.464	0.295	5.74/5.47	5.75/5.47	0.85	0.7	
500	0.68	0.612	0.544	0.345	6.91/6.58	6.92/6.58	0.85	0.7	
630	0.83	0.747	0.664	0.42	7.86	7.87	0.65	0.5	

800	0.98	0.882	0.784	0.5	9.4	9.4	0.65	0.5	
1000	1.15	1.035	0.92	0.59	11.5	11.54	0.65	0.5	
1250	1.4	1.26	1.12	0.71	13.9	13.94	0.6	0.4	
1600	1.69	1.521	1.352	0.85	16.6	16.67	0.6	0.4	
2000	1.99	1.791	1.592	1.09	19.7	19.71	0.55	0.4	
2500	2.36	2.124	1.888	1.28	23.2	23.3	0.55	0.4	

Note: For transformers with rated capacity of 500 kVA and below, the load loss value above the diagonal in the table applies to the Dyn 11 coupling group, and the load loss value below the diagonal applies to the Yyn 0 coupling group.

35K V voltage grade 630 kVA-31500 kVA oil-immersed three-phase double-winding transformer

rated capacity k VA	open circuit losses kW					load losses kW				no-load current%		short-circuit impedance%	
	S9	S10	S11	S12	S13	S9	S10	S11 S12	S13	S9 S10	S11～S13	S9 S10	S11～S13
630 kVA-31500 kVA unexciting voltage regulating power transformer (Grade 3-10k V).5													
630	1.04	0.936	0.83	0.747	0.664	8.28	7.866	7.86	7.86	1.1	0.65	6.5	6.5
800	1.23	1.107	0.98	0.882	0.784	9.90	9.405	9.40	9.4	1.0	0.65		
1000	1.44	1.296	1.15	1.035	0.92	12.15	11.542	11.50	11.5	1.0	0.65		
1250	1.76	1.584	1.4	1.26	1.12	14.67	13.936	13.90	13.9	0.9	0.55		
1600	2.12	1.908	1.69	1.521	1.352	17.55	16.672	16.60	16.6	0.8	0.45		
2000	2.72	2.448	2.17	1.953	1.562	19.35	18.382	18.30	18.3	0.7	0.45		
2500	3.20	2.88	2.56	2.304	2.048	20.70	19.665	19.60	19.6	0.6	0.45		
3150	3.80	3.42	3.04	2.736	2.432	24.30	23.085	23.00	21.9	0.56	0.45	7.0	7.0
4000	4.52	4.068	3.61	3.249	2.888	28.80	27.36	27.30	25.9	0.56	0.45		
5000	5.40	4.86	4.32	3.888	3.456	33.03	31.378	31.30	29.7	0.48	0.45		
6300	6.56	5.904	5.24	4.716	4.192	36.90	35.055	35.00	33.3	0.48	0.45	7.5	8.0
8000	9.00	8.1	7.2	6.48	5.76	40.50	38.475	38.40	36.5	0.42	0.35		
10000	10.88	9.792	8.7	7.83	6.96	47.70	45.315	45.30	45.0	0.42	0.35		
12500	12.60	11.34	10.0	9.0	8.0	56.70	53.865	53.80	51.1	0.40	0.30	8.0	
16000	15.20	13.68	12.1	10.89	9.68	69.30	65.835	65.80	62.5	0.40	0.30		
20000	18.00	16.2	14.4	12.96	11.52	83.70	79.515	79.50	75.5	0.40	0.30		
25000	21.28	19.152	17.0	15.3	13.6	99.00	94.05	94.00	89.3	0.32	0.25		10.0
31500	25.28	22.752	20.2	18.18	16.16	118.8	112.86	112.0	106.4	0.32	0.25		
2000 kVA-31500 kVA on-load voltage regulating power transformer (low voltage is class 6.3-10.5k V)													
rated capacity k VA	open circuit losses kW					load losses kW				no-load current%		short-circuit impedance%	
	S9	S10	S11	S12	S13	S9	S10	S11 S12	S13	S9 S10	S11～S13	S9 S10 S 13	S11 S12
2000	2.88	2.592	2.30	2.07	1.84	20.25	19.237	19.2	19.2	0.80	0.50	6.5	6.5
2500	3.40	3.06	2.72	2.448	2.176	21.73	20.643	20.6	20.6	0.80	0.50		
3150	4.04	3.636	3.23	2.907	2.60	26.01	24.71	24.7	23.5	0.72	0.50	7.0	7.0
4000	4.84	4.356	3.87	3.483	3.10	30.69	29.155	29.1	27.6	0.72	0.50		
5000	5.80	5.22	4.64	4.176	3.70	36.00	34.2	34.2	32.5	0.68	0.50		
6300	7.04	6.336	5.63	5.067	4.50	38.70	36.765	36.7	34.9	0.68	0.50	7.5	8.0
8000	9.84	8.856	7.87	7.083	6.30	42.75	40.612	40.6	38.6	0.60	0.40		
10000	11.6	10.44	9.28	8.352	7.40	50.58	48.051	48.0	45.6	0.60	0.40		
12500	13.68	12.312	10.9	9.81	8.70	59.85	56.857	56.8	54.6	0.56	0.35	8.0	

16000	16.46	14.814	13.1	11.79	10.5	74.02	70.319	70.3	66.8	0.54	0.35	
20000	19.46	17.514	15.5	13.95	12.4	87.14	82.783	82.7	78.6	0.54	0.35	
25000	—	—	18.3	16.47	14.6	—	—	97.8	92.9	—	0.30	10.0	10.0
31500	—	—	21.8	19.44	17.4	—	—	116.0	110.2	—	0.30	

35K V voltage grade 630 kVA-31500 kVA oil-immersed three-phase double-winding transformer

rated capacity k VA	open circuit losses kW		load losses kW	no-load current%	short-circuit impedance %
	S20	S22	S20/S22	S20/S22	S20/S22
3150 kVA-31500 kVA unexciting voltage regulating power transformer (Grade 3-10k V).5					
3150	2.0	1.7	20.7	0.45	7.0
4000	2.3	2.0	24.6	0.45	
5000	2.8	2.4	28.2	0.45	
6300	3.4	2.9	31.5	0.45	8.0
8000	4.7	4.0	34.6	0.35	
10000	5.7	4.8	40.8	0.35	
12500	6.5	5.5	48.4	0.30	
16000	7.9	6.7	59.2	0.30	
20000	9.4	7.9	71.6	0.30	
25000	11.1	9.4	84.6	0.25	10.0
31500	13.1	11.1	100.8	0.25	
3150 kVA-31500 kVA on-load voltage regulating power transformer (low voltage is class 6.3-10.5k V)					
3150	2.1	1.8	22.2	0.5	7.0
4000	2.5	2.1	26.2	0.5	
5000	3.0	2.6	30.8	0.5	
6300	3.7	3.1	33.0	0.5	7.5
8000	5.1	4.3	36.5	0.4	
10000	6.0	5.1	43.2	0.4	
12500	7.1	6.0	51.1	0.35	8.0
16000	8.5	7.2	63.3	0.35	
20000	10.1	8.5	74.4	0.35	
25000	11.9	10.1	88.0	0.3	10.0
31500	14.2	12.0	104.4	0.3	

66K V voltage grade oil-immersed three-phase double-winding transformer

rated capacity k VA	open circuit losses kW					load losses kW				no-load current%		short-circuit impedance%
	S9	S10	S11	S12	S13	S9	S10	S11 S12	S13	S9 S10	S11～S13	S9～S13
630 kVA-63000 kVA unexciting regulating power transformer (low voltage class 6.3-10k V).5												
630	1.6	1.44	1.2	1.08	0.96	7.5	7.125	7.1	7.1	1.40	1.1	8.0
800	1.9	1.71	1.5	1.35	1.2	9.0	8.55	8.5	8.5	1.35	1.0	
1000	2.2	1.98	1.7	1.53	1.36	10.4	9.88	9.8	9.8	1.30	1.0	
1250	2.6	2.34	2.0	1.8	1.6	12.6	11.97	11.9	11.9	1.30	1.0	
1600	3.1	2.79	2.4	2.16	1.92	14.8	14.06	14.0	14.0	1.25	1.0	
2000	3.6	3.24	2.8	2.52	2.24	17.5	16.625	16.6	16.6	1.20	0.96	
2500	4.3	3.87	3.4	3.06	2.72	20.7	19.665	19.6	19.6	1.10	0.88	
3150	5.1	4.59	4.0	3.6	3.2	24.3	23.085	23.0	21.9	1.05	0.84	
4000	6.0	5.4	4.8	4.32	3.8	28.8	27.36	27.3	25.9	1.00	0.8	
5000	7.2	6.48	5.7	5.13	4.6	32.4	30.78	30.7	29.2	0.85	0.68	
6300	9.2	8.28	7.3	6.57	5.8	36.0	34.2	34.2	32.5	0.75	0.6	9.0
8000	11.2	10.08	8.9	8.01	7.1	42.7	40.565	40.5	38.5	0.75	0.6	
10000	13.2	11.88	10.5	9.45	8.4	50.4	47.88	47.8	45.4	0.70	0.56	
12500	15.6	14.04	12.4	11.16	9.9	59.8	56.81	56.8	54.0	0.70	0.56	
16000	18.8	16.92	15.0	13.5	12.0	73.5	69.825	69.8	66.3	0.65	0.52	
20000	22.0	19.8	17.6	15.84	14.1	89.1	84.645	84.6	80.4	0.65	0.52	
25000	26.0	23.4	20.8	18.72	16.6	105.3	100.035	100.0	95.0	0.60	0.48	
31500	30.8	27.72	24.6	22.14	19.7	126.9	120.555	120.0	114.0	0.55	0.44	
40000	36.8	33.12	29.4	26.46	23.5	148.9	141.455	141.0	134.0	0.55	0.44	
50000	44.0	39.6	35.2	31.68	28.2	184.5	175.275	167.0	158.7	0.50	0.4	
63000	52.0	46.8	41.6	37.44	33.3	222.3	211.185	198.0	188.1	0.45	0.36	
6300 kVA-63000 kVA on-load voltage regulating power transformer (Grade 6.3-10k V).5												
rated capacity k VA	open circuit losses kW					load losses kW				no-load current%		short-circuit impedance%	
	S9	S10	S11	S12	S13	S9	S10	S11 S12	S13	S9 S10	S11～S13	S9 S10 S13	S11 S12
6300	10.0	9.0	8.0	7.2	6.4	36.0	34.2	34.2	32.5	0.75	0.60	9.0	9～11
8000	12.0	10.8	9.6	8.64	7.7	42.7	40.565	40.5	38.5	0.75	0.60		
10000	14.2	12.78	11.3	10.17	9.0	50.4	47.88	47.8	45.4	0.70	0.56		
12500	16.8	15.12	13.4	12.06	10.7	59.8	56.81	56.8	54.0	0.70	0.56		

16000	20.2	18.18	16.1	14.49	12.9	73.5	69.825	69.8	66.3	0.65	0.52		
20000	24.0	21.6	19.2	17.28	15.4	89.1	84.645	84.6	80.4	0.65	0.52		
25000	28.4	25.56	22.7	20.43	18.2	105.3	100.035	100.0	95.0	0.60	0.48		
31500	33.7	30.33	26.9	24.21	21.5	126.9	120.555	120.0	114.0	0.55	0.44		
40000	40.3	36.27	32.2	28.98	25.8	148.9	141.455	141.0	134.0	0.55	0.44		
50000	47.6	42.84	38.0	34.2	30.4	184.5	175.275	167.0	158.7	0.50	0.40		10～12
63000	56.2	50.58	44.9	40.41	35.9	222.3	211.185	198.0	188.1	0.45	0.36		

66K V voltage grade oil-immersed three-phase double-winding transformer

rated capacity k VA	open circuit losses kW		load losses kW	no-load current%	short-circuit impedance %
	S20	S22	S20/S22	S20/S22	S20/S22
3150 kVA-63000 kVA Unexciting voltage regulating power transformer (low voltage: 6.3-10k V class).5					
3150	2.6	2.2	20.7	0.84	8.0
4000	3.1	2.6	24.6	0.80	
5000	3.7	3.1	27.6	0.68	
6300	4.7	4.0	30.8	0.60	9.0
8000	5.8	4.9	36.5	0.60	
10000	6.8	5.8	43.0	0.56	
12500	8.1	6.8	51.1	0.56	
16000	9.8	8.3	62.8	0.52	
20000	11.4	9.7	76.1	0.52	
25000	13.5	11.4	90.0	0.48	
31500	16.0	13.5	108.0	0.44	
40000	19.1	16.2	126.9	0.44	
50000	22.9	19.4	150.3	0.40	
63000	27.0	22.9	178.2	0.36	
6300 kVA-63000 kVA on-load voltage regulating power transformer (low voltage is class 6.3-10.5k V)					
3150	5.2	4.4	30.8	0.60	9.0
4000	6.2	5.3	36.5	0.60	
5000	7.3	6.2	43.0	0.56	
6300	8.7	7.4	51.1	0.56	
8000	10.5	8.9	62.8	0.52	
10000	12.5	10.6	76.1	0.52	
12500	14.8	12.5	90.0	0.48	
16000	17.5	14.8	108.0	0.44	

20000	20.9	17.7	126.9	0.44	
25000	24.7	20.9	150.3	0.40	
31500	29.2	24.7	178.2	0.36	

110K V voltage grade oil-immersed three-phase double-winding transformer

rated capacity k VA	open circuit losses kW					load losses kW				no-load current%		short-circuit impedance%
	S9	S10	S11	S12	S13	S9	S10	S11 S12	S13	S9 S10	S11～S13	S9～S13
6300 kVA-180000 kVA power transformer (6.3-21k V)												
6300	9.3	8.37	7.4	6.66	5.9	36.0	34.2	35.0	33.0	0.77	0.62	10.5
8000	11.2	10.08	8.9	8.01	7.1	45.0	42.75	42.0	40.0	0.77	0.62	
10000	13.2	11.88	10.5	9.45	8.4	53.0	50.35	50.0	48.0	0.72	0.58	
12500	15.6	14.04	12.4	11.16	9.9	63.0	59.85	59.0	56.0	0.72	0.58	
16000	18.8	16.92	15.0	13.5	12.0	77.0	73.15	73.0	69.0	0.67	0.54	
20000	22.0	19.8	17.6	15.84	14.1	93.0	88.35	88.0	84.0	0.67	0.54	
25000	26.0	23.4	20.8	18.72	16.6	110.0	104.5	104.0	99.0	0.62	0.50	
31500	30.8	27.72	24.6	22.14	19.7	133.0	126.35	123.0	117.0	0.60	0.48	
40000	36.8	33.12	29.4	26.46	23.5	156.0	148.2	148.0	141.0	0.56	0.45	
50000	44.0	39.6	35.2	31.68	28.2	194.0	184.3	175.0	166.0	0.52	0.42	
63000	52.0	46.8	41.6	37.44	33.3	234.0	222.3	208.0	198.0	0.48	0.38	
75000	59.0	53.1	47.2	42.48	37.8	278.0	264.1	236.0	224.0	0.42	0.33	12～14
90000	68.0	61.2	54.4	48.96	43.5	320.0	304.0	272.0	258.0	0.38	0.30	
120000	84.8	76.32	67.8	61.02	54.2	397.0	377.15	337.0	320.0	0.34	0.27	
150000	100.2	90.18	80.1	72.09	64.1	472.0	448.4	399.0	379.0	0.30	0.24	
180000	112.5	101.25	90.0	81	72.0	532.0	505.4	457.0	434.0	0.25	0.20	
6300 kVA-63000 kVA on-load voltage regulating power transformer (LV class 6.3-21k V)												
specified capacity k VA	open circuit losses kW					load losses kW				no-load current%		short-circuit impedance%	
	S9	S10	S11	S12	S13	S9	S10	S11 S12	S13	S9 S10	S11～S13	S9 S10 S13	S11 S12
6300	10.0	9.0	8.0	7.2	6.4	36.0	34.2	35.0	33.0	0.8	0.64	10.5	10.5
8000	12.0	10.8	9.6	8.64	7.7	45.0	42.75	42.0	44.0	0.8	0.64		
10000	14.2	12.78	11.3	10.17	9.0	53.0	50.35	50.0	48.0	0.74	0.59		

12500	16.8	15.12	13.4	12.06	10.7	63.0	59.85	59.0	56.0	0.74	0.59		
16000	20.2	18.18	16.1	14.49	12.9	77.0	73.15	73.0	69.0	0.69	0.55		
20000	24.0	21.6	19.2	17.28	15.4	93.0	88.35	88.0	84.0	0.69	0.55		
25000	28.4	25.56	22.7	20.43	18.2	110.0	104.5	104.0	99.0	0.64	0.51		
31500	33.8	30.42	27.0	24.3	21.6	133.0	126.35	123.0	117.0	0.64	0.51		
40000	40.4	36.36	32.3	29.07	25.8	156.0	148.2	156.0	148.0	0.58	0.46		
50000	47.8	43.02	38.2	34.38	30.6	194.0	184.3	194.0	184.0	0.58	0.46		12～18
63000	56.8	51.12	45.4	40.86	36.3	234.0	222.3	232.0	220.0	0.52	0.42		

110K V voltage grade oil-immersed three-phase double-winding transformer

specified capacity k VA	open circuit losses kW		load losses kW	no-load current%	short-circuit impedance%
	S20	S22	S20/S22	S20/S22	S20/S22
6300 kVA-180000 kVA power transformer (6.3-21k V)					
6300	4.8	4.1	32.0	0.62	
8000	5.8	4.9	38.0	0.62	
10000	6.8	5.8	45.0	0.58	
12500	8.1	6.8	53.0	0.58	
16000	9.8	8.3	65.7	0.54	
20000	11.4	9.7	79.0	0.54	10.5
25000	13.5	11.4	94.0	0.50	
31500	16.0	13.5	111.0	0.48	
40000	19.1	16.2	133.0	0.45	
50000	22.9	19.4	158.0	0.42	
63000	27.0	22.9	187.0	0.38	
75000	30.7	26.0	212.0	0.33	
90000	35.4	29.9	245.0	0.30	
120000	44.1	37.3	303.0	0.27	12～14
150000	52.1	44.1	359.0	0.24	
180000	58.5	49.5	411.0	0.20	
6300 kVA-63000 kVA on-load voltage regulating power transformer (LV class 6.3-21k V)					
6300	5.2	4.4	32.0	0.64	
8000	6.2	5.3	38.0	0.64	
10000	7.3	6.2	45.0	0.59	10.5
12500	8.7	7.4	53.0	0.59	

16000	10.5	8.9	66.0	0.55	
20000	12.5	10.6	79.0	0.55	
25000	14.8	12.5	94.0	0.51	
31500	17.6	14.9	111.0	0.51	
40000	21.0	17.2	140.0	0.46	
50000	24.8	21.0	175.0	0.46	
63000	29.5	25.0	209.0	0.42	

110K V voltage grade 6300 kVA-63000 kVA oil-immersed three-phase double winding low voltage is 35k V no-excitation voltage regulating power transformer

rated capacity k VA	open circuit losses kW					load losses kW				no-load current%		short-circuit impedance%
	S9	S10	S11	S12	S13	S9	S10	S11 S12	S13	S9 S10	S11～S13	S9～S13
6300	10.0	9.0	8.0	7.2	6.4	39.0	37.05	37.0	35.0	0.84	0.67	10.5
8000	12.0	10.8	9.6	8.64	7.7	47.0	44.65	44.0	42.0	0.84	0.67	
10000	14.0	12.6	11.2	10.08	9.0	55.0	52.25	52.0	49.0	0.78	0.62	
12500	16.4	14.76	13.1	11.79	10.5	66.0	62.7	62.0	59.0	0.78	0.62	
16000	19.6	17.64	15.6	14.04	12.5	81.0	76.95	76.0	72.0	0.72	0.57	
20000	23.2	20.88	18.5	16.65	14.8	99.0	94.05	94.0	89.0	0.72	0.57	
25000	27.4	24.66	21.9	19.71	17.5	116.0	110.2	110.0	105.0	0.67	0.53	
31500	32.4	29.16	25.9	23.31	20.7	140.0	133	133.0	126.0	0.67	0.53	
40000	38.6	34.74	30.8	27.72	24.6	164.0	155.8	155.0	147.0	0.61	0.49	
50000	46.2	41.58	36.9	33.21	29.5	204.0	193.8	193.0	183.0	0.61	0.49	
63000	54.6	49.14	43.6	39.24	34.9	245.0	232.75	232.0	220.0	0.56	0.45	

rated capacity k VA	open circuit losses kW		load losses kW	no-load current%	short-circuit impedance%
	S20	S22	S20/S22	S20/S22	S20/S22
6300	5.2	4.4	33.0	0.67	10.5
8000	6.2	5.3	40.0	0.67	

10000	7.3	6.2	47.0	0.62	
12500	8.5	7.2	56.0	0.62	
16000	10.1	8.6	68.0	0.57	
20000	12.0	10.2	85.0	0.57	
25000	14.2	12.1	99.0	0.53	
31500	16.8	14.3	120.0	0.53	
40000	20.0	16.9	140.0	0.49	
50000	24.0	20.3	174.0	0.49	
63000	28.3	24.0	209.0	0.45	

220K V voltage grade oil-immersed three-phase double-winding transformer

specified capacity k VA	open circuit losses kW					load losses kW				no-load current%		short-circuit impedance %
	S9	S10	S11	S12	S13	S9	S10	S11 S12	S13	S9 S10	S11～S13	S9～S13
3150 kVA-420000 kVA power transformer (6.3-20k V)												
31500	35.0	31.5	28.0	25.2	22.0	135.0	128.25	128	122	0.7	0.56	12～14
40000	41.0	36.9	32.0	28.8	26.0	157.0	149.15	149	142	0.7	0.56	
50000	49.0	44.1	39.0	35.1	31.0	189.0	179.55	179	170	0.65	0.52	
63000	58.0	52.2	46.0	41.4	37.0	220.0	209.0	209	199	0.65	0.52	
75000	67.0	60.3	53.0	47.7	42.0	250.0	237.5	237	225	0.6	0.48	
90000	77.0	69.3	61.0	54.9	49.0	288.0	273.6	273	259	0.55	0.44	
120000	94.0	84.6	75.0	67.5	60.0	345.0	327.75	338	321	0.55	0.44	
150000	112.0	100.8	89.0	80.1	71.0	405.0	384.75	400	380	0.50	0.40	
160000	117.0	105.3	93.0	83.7	74.0	425.0	403.75	420	399	0.49	0.39	
180000	128.0	115.2	102.0	91.8	82.0	459.0	436.05	459	436	0.46	0.36	
240000	160.0	144.0	128.0	115.2	102.0	567.0	538.65	538	511	0.42	0.33	
300000	189.0	170.1	151.0	135.9	121.0	675.0	641.25	641	609	0.38	0.30	
360000	217.0	195.3	173.0	155.7	138.0	774.0	735.3	735	698	0.38	0.30	
370000	221.0	198.9	176.0	158.4	141.0	790.0	750.5	750	713	0.38	0.30	

400000	234.0	210.6	187.0	168.3	150.0	837.0	795.15	795	755	0.35	0.28	
420000	242.0	217.8	193.0	173.7	154.0	868.0	824.6	824	783	0.35	0.28	
31500 kVA-240000 kVA on-load voltage regulating power transformer												
specified capacity k VA	open circuit losses kW					load losses kW				no-load current%		short-circuit impedance %
	S9	S10	S11	S12	S13	S9	S10	S11 S12	S13	S9 S10	S11～S13	S9～S13
31500	38	34.2	30	27	24	135	128.25	128	122	0.70	0.57	12～14
40000	45	40.5	36	32.4	29	157	149.15	149	142	0.63	0.57	
50000	54	48.6	43	38.7	34	189	179.55	179	170	0.56	0.53	
63000	63	56.7	50	45.0	40	220	209	209	199	0.56	0.53	
90000	80	72.0	64	57.6	51	288	273.6	273	259	0.49	0.45	
120000	99	89.1	79	71.1	63	346	328.7	338	321	0.49	0.45	
150000	116	104.4	92	82.8	74	405	384.75	400	380	0.42	0.41	
180000	135	121.5	108	97.2	86	468	444.6	459	436	0.42	0.38	
120000	102	91.8	81	72.9	65	355	337.25	337	320	0.49	0.45	
150000	120	108	96	86.4	77	415	394.25	394	374	0.42	0.41	
180000	140	126	112	100.8	90	475	451.25	451	428	0.42	0.38	
240000	—	—	140	126	112	—	—	560	532	—	0.30	

220K V voltage grade oil-immersed three-phase double-winding transformer

specified capacity k VA	open circuit losses kW		load losses kW	no-load current%	short-circuit impedance%
	S20	S22	S20/S22	S20/S22	S20/S22
3150 kVA-420000 kVA power transformer (6.3-20k V)					
31500	18	15	115	0.56	12～14
40000	21	18	134	0.56	
50000	25	21	161	0.52	
63000	30	25	188	0.52	
75000	34	29	213	0.48	
90000	40	34	246	0.44	
120000	49	41	304	0.44	
150000	58	49	360	0.40	
160000	60	51	378	0.39	
180000	66	56	413	0.36	

240000	83	70	484	0.33	
300000	98	83	577	0.30	
360000	112	95	662	0.30	
370000	114	97	675	0.30	
400000	122	103	716	0.28	
420000	125	106	742	0.28	
31500 kVA-240000 kVA on-load voltage regulating power transformer					
31500	20	17	115	0.57	12～14
40000	23	20	134	0.57	
50000	28	24	161	0.53	
63000	33	28	188	0.53	
90000	42	35	246	0.45	
120000	51	43	304	0.45	
150000	60	51	360	0.41	
180000	70	59	413	0.38	
120000	53	45	303	0.45	
150000	62	53	355	0.41	
180000	73	62	406	0.38	
240000	91	77	504	0.30	

220K V voltage class 31500 kVA-240000 kVA low voltage is 66k V class oil immersed three-phase double winding without excitation voltage regulating power transformer

specified capacity k VA	open circuit losses kW					load losses kW				no-load current%		short-circuit impedance%
	S9	S10	S11	S12	S13	S9	S10	S11 S12	S13	S9 S10	S11～S13	S9～S13
31500	38	34.2	30	27	24	151	143.45	143	136	0.89	0.71	12～14
40000	45	40.5	36	32.4	29	176	167.2	167	159	0.89	0.71	
50000	53	47.7	42	37.8	34	211	200.45	200	190	0.82	0.65	
63000	63	56.7	50	45	40	247	234.65	234	222	0.82	0.65	
90000	83	74.7	66	59.4	53	323	306.85	306	291	0.75	0.60	
120000	102	91.8	81	72.9	65	387	367.65	367	349	0.75	0.60	
150000	122	109.8	97	87.3	78	453	430.35	430	409	0.68	0.54	

180000	138	124.2	110	99	88	513	487.35	487	463	0.68	0.54	
240000	171	153.9	136	122.4	109	635	603.25	603	573	0.61	0.42	

specified capacity k VA	open circuit losses kW		load losses kW	no-load current%	short-circuit impedance%
	S20	S22	S20/S22	S20/S22	S20/S22
31500	20	17	129	0.71	12～14
40000	23	20	150	0.71	
50000	27	23	180	0.65	
63000	33	28	211	0.65	
90000	43	36	275	0.60	
120000	53	45	330	0.60	
150000	63	53	387	0.54	
180000	72	61	438	0.54	
240000	88	75	543	0.42	

6-10K V Voltage Class 5 kVA-160 kVA Single-phase oil-immersed voltage distribution transformer

rated capacity k VA	open circuit losses W						load losses W			no-load current%			short-circuit impedance%	
	S9	S10	S11	S12	S13	SH15	S9	S10	S11～S13 SH15	S9 S10	S11～S13	SH15	S9/S10 SH15	S11～S13
5	35	31.5	30	27	24	15	145	130.5	130	4.0	1.2	2.0	3.5	3.0
10	55	49.5	45	40.5	36	18	260	234	235	3.5	1.1	2.0		
16	65	58.5	55	49.5	44	22	365	328.5	330	3.2	1.0	1.8		

20	80	72	65	58.5	52	25	430	387	385	3.0	0.9	1.8	
30	100	90	80	72	64	30	625	562.5	560	2.8	0.8	1.4	
40	125	112.5	100	90	80	35	775	697.5	700	2.5	0.8	1.4	
50	150	135	120	108	96	40	950	855	855	2.3	0.7	1.0	
63	180	162	145	130.5	116	50	1135	1021.5	1020	2.1	0.6	1.0	
80	200	180	160	144	128	60	1400	1260	1260	2.0	0.6	0.8	3.5
100	240	216	190	171	152	70	1650	1485	1485	1.9	0.6	0.8	
125	285	256.5	230	207	184	85	1950	1755	1755	1.8	0.5	0.6	
160	365	328.5	290	261	232	100	2365	2128.5	2130	1.7	0.5	0.6	

20K V voltage class 5 kVA-160 kVA Single-phase oil-immersed voltage distribution transformer

rated capacity k VA	open circuit losses W			load losses W	no-load current%	short-circuit impedance%
	S11	S12	S13	S11～S13		
5	30	27	24	135	2.2	3.5
10	45	40.5	36	245	2.0	
16	55	49.5	44	345	1.9	
20	65	58.5	52	405	1.8	
30	80	72	64	585	1.7	
40	100	90	80	735	1.6	
50	120	108	96	900	1.5	
63	145	130.5	116	1070	1.4	
80	160	144	128	1325	1.4	
100	190	171	152	1560	1.3	
125	230	207	184	1840	1.2	
160	290	261	232	2235	1.2	

6-10K V voltage grade 30 kVA-2500 kVA dry three-phase unexcitation voltage distribution transformer

rated capacity	open circuit losses kW			load losses kW		no-load current%		short-circuit
	SCB9	SCB10	SCB11	SCB9	SCB10/SCB11	SCB9	SCB10	

k VA				100℃	120℃	145℃	100℃	120℃	145℃		SCB11	imped ance %
30	0.22	0.19	0.17	0.71	0.75	0.8	0.67	0.71	0.76	2.4	2.0	
50	0.31	0.27	0.24	0.99	1.06	1.13	0.94	1.0	1.07	2.4	2.0	
80	0.42	0.37	0.33	1.37	1.46	1.56	1.29	1.38	1.48	1.8	1.5	
100	0.45	0.4	0.36	1.57	1.67	1.78	1.48	1.57	1.69	1.8	1.5	
125	0.53	0.47	0.42	1.84	1.96	2.1	1.74	1.85	1.98	1.6	1.3	
160	0.61	0.54	0.48	2.12	2.25	2.41	2.0	2.13	2.28	1.6	1.3	
200	0.7	0.62	0.55	2.51	2.68	2.87	2.37	2.53	2.71	1.4	1.1	4.0
250	0.81	0.72	0.64	2.75	2.92	3.12	2.59	2.76	2.96	1.4	1.1	
315	0.99	0.88	0.79	3.46	3.67	3.93	3.27	3.47	3.73	1.2	1.0	
400	1.1	0.98	0.88	3.97	4.22	4.52	3.75	3.99	4.28	1.2	1.0	
500	1.31	1.16	1.04	4.86	5.17	5.53	4.59	4.88	5.23	1.2	1.0	
630	1.51	1.34	1.2	5.85	6.22	6.66	5.53	5.88	6.29	1.0	0.85	
630	1.46	1.3	1.17	5.94	6.31	6.75	5.61	5.96	6.4	1.0	0.85	
800	1.71	1.52	1.36	6.93	7.36	7.88	6.55	6.96	7.46	1.0	0.85	
1000	1.99	1.77	1.59	8.1	8.61	9.21	7.65	8.13	8.76	1.0	0.85	
1250	2.35	2.09	1.88	9.63	10.26	10.98	9.1	9.69	10.3	1.0	0.85	6.0
1600	2.76	2.45	2.2	11.7	12.4	13.27	11.0	11.7	12.5	1.0	0.85	
2000	3.4	3.05	2.74	14.4	15.3	16.37	13.6	14.4	15.5	0.8	0.7	
2500	4.0	3.6	3.24	17.1	18.18	19.46	16.1	17.1	18.4	0.8	0.7	
1600	2.76	2.45	2.2	13.0	13.7	14.66	12.2	12.9	13.9	1.0	0.85	
2000	3.4	3.05	2.74	15.9	16.9	18.0	15.0	15.9	17.1	0.8	0.7	8.0
2500	4.0	3.6	3.24	18.8	20.0	21.4	17.7	18.8	20.2	0.8	0.7	

6-10K V voltage grade 30 kVA-2500 kVA dry three-phase unexcitation voltage distribution

transformer

rated capacity k VA	open circuit losses kW			load losses kW						no-load current%	short-circuit impedance %
	SCB12	SCB14	SCB18	SCB12			SCB14/SCB18			SCB12 SCB14 SCB18	
				100℃	120℃	145℃	100℃	120℃	145℃		
30	0.15	0.13	0.105	0.67	0.71	0.76	0.605	0.64	0.685	2.0	4.0
50	0.215	0.185	0.155	0.94	1.0	1.07	0.845	0.9	0.965	2.0	
80	0.295	0.25	0.21	1.29	1.38	1.48	1.16	1.24	1.33	1.5	
100	0.32	0.27	0.23	1.48	1.57	1.69	1.33	1.415	1.52	1.5	
125	0.375	0.32	0.27	1.74	1.85	1.98	1.565	1.665	1.78	1.3	
160	0.43	0.365	0.31	2.0	2.13	2.28	1.8	1.915	2.05	1.3	
200	0.495	0.42	0.36	2.37	2.53	2.71	2.135	2.275	2.44	1.1	
250	0.575	0.49	0.415	2.59	2.76	2.96	2.33	2.485	2.665	1.1	
315	0.705	0.6	0.51	3.27	3.47	3.73	2.945	3.125	3.355	1.0	
400	0.785	0.665	0.57	3.75	3.99	4.28	3.375	3.59	3.85	1.0	
500	0.93	0.79	0.67	4.59	4.88	5.23	4.13	4.39	4.705	1.0	
630	1.07	0.91	0.775	5.53	5.88	6.29	4.975	5.29	5.66	0.85	
630	1.04	0.885	0.75	5.61	5.96	6.4	5.05	5.365	5.76	0.85	6.0
800	1.215	1.035	0.875	6.55	6.96	7.46	5.895	6.265	6.715	0.85	
1000	1.415	1.205	1.02	7.65	8.13	8.76	6.885	7.315	7.885	0.85	
1250	1.67	1.42	1.205	9.1	9.69	10.37	8.19	8.72	9.335	0.85	
1600	1.96	1.665	1.415	11.05	11.73	12.58	9.945	10.555	11.32	0.85	
2000	2.44	2.075	1.76	13.6	14.45	15.56	12.24	13.005	14.005	0.7	
2500	2.88	2.45	2.08	16.15	17.17	18.45	14.535	15.445	16.605	0.7	

6-10K V voltage grade 30 kVA-2500 kVA dry three-phase unexcitation voltage distribution transformer

rated capacity k VA	open circuit losses kW		load losses kW						no-load current%	short-circuit impedance %
			SCB13			SCBH16				
	SCB13	SCBH16	100℃	120℃	145℃	100℃	120℃	145℃	SCB13 SCBH16	
30	0.135	0.07	0.605	0.64	0.685	0.635	0.675	0.72	2.0	4.0
50	0.195	0.09	0.845	0.9	0.965	0.895	0.95	1.01	2.0	
80	0.265	0.12	1.16	1.24	1.33	1.22	1.31	1.4	1.5	
100	0.29	0.13	1.33	1.41	1.52	1.4	1.49	1.6	1.5	
125	0.34	0.15	1.56	1.66	1.78	1.65	1.76	1.88	1.3	
160	0.385	0.17	1.8	1.91	2.05	1.9	2.02	2.16	1.3	
200	0.445	0.2	2.13	2.27	2.44	2.25	2.4	2.57	1.1	
250	0.515	0.23	2.33	2.48	2.66	2.46	2.62	2.81	1.1	
315	0.635	0.28	2.94	3.12	3.35	3.1	3.29	3.54	1.0	
400	0.705	0.31	3.37	3.59	3.85	3.56	3.79	4.06	1.0	
500	0.835	0.36	4.13	4.39	4.7	4.36	4.63	4.97	1.0	
630	0.965	0.42	4.97	5.29	5.66	5.25	5.58	5.97	0.85	
630	0.935	0.41	5.05	5.36	5.76	5.33	5.66	6.08	0.85	6.0
800	1.09	0.48	5.89	6.26	6.71	6.22	6.61	7.08	0.85	
1000	1.27	0.55	6.88	7.31	7.88	7.26	7.72	8.32	0.85	
1250	1.5	0.65	8.19	8.72	9.33	8.64	9.2	9.85	0.85	
1600	1.76	0.76	9.94	10.5	11.3	10.4	11.1	11.9	0.85	
2000	2.19	1.0	12.2	13.0	14.0	12.9	13.7	14.7	0.7	
2500	2.59	1.2	14.5	15.4	16.6	15.3	16.3	17.5	0.7	
1600	1.76	0.76	11.0	11.5	12.5	11.6	12.3	13.2	0.85	8.0
2000	2.19	1.0	13.5	14.3	15.4	14.2	15.1	16.2	0.7	
2500	2.59	1.2	15.9	17.0	18.2	16.8	17.9	19.2	0.7	

6-10K V voltage grade 30 kVA-2500 kVA dry three-phase unexcitation voltage distribution transformer

rated capacity k VA	open circuit losses kW			load losses kW						no-load current%	short-circuit impedance %
	SCBH15	SCBH17	SCBH19	SCBH15			SCBH17/SCBH19			SCBH15 SCBH17 SCBH19	
				100℃	120℃	145℃	100℃	120℃	145℃		
30	0.07	0.06	0.05	0.67	0.71	0.76	0.605	0.64	0.685	2.0	4.0
50	0.09	0.075	0.06	0.94	1.0	1.07	0.845	0.9	0.965	2.0	
80	0.12	0.1	0.085	1.29	1.38	1.48	1.16	1.24	1.33	1.5	
100	0.13	0.11	0.09	1.48	1.57	1.69	1.33	1.415	1.52	1.5	
125	0.15	0.13	0.105	1.74	1.85	1.98	1.565	1.665	1.78	1.3	
160	0.17	0.145	0.12	2.0	2.13	2.28	1.8	1.915	2.05	1.3	
200	0.2	0.17	0.14	2.37	2.53	2.71	2.135	2.275	2.44	1.1	
250	0.23	0.195	0.16	2.59	2.76	2.96	2.33	2.485	2.665	1.1	
315	0.28	0.235	0.195	3.27	3.47	3.73	2.945	3.125	3.355	1.0	
400	0.31	0.265	0.215	3.75	3.99	4.28	3.375	3.59	3.85	1.0	
500	0.36	0.305	0.25	4.59	4.88	5.23	4.13	4.39	4.705	1.0	
630	0.42	0.36	0.295	5.53	5.88	6.29	4.975	5.29	5.66	0.85	
630	0.41	0.35	0.29	5.61	5.96	6.4	5.05	5.365	5.76	0.85	6.0
800	0.48	0.41	0.335	6.55	6.96	7.46	5.895	6.265	6.715	0.85	
1000	0.55	0.47	0.385	7.65	8.13	8.76	6.885	7.315	7.885	0.85	
1250	0.65	0.55	0.455	9.1	9.69	10.37	8.19	8.72	9.335	0.85	
1600	0.76	0.645	0.530	11.05	11.73	12.58	9.945	10.555	11.32	0.85	
2000	1.0	0.85	0.7	13.6	14.45	15.56	12.24	13.005	14.005	0.7	
2500	1.2	1.02	0.84	16.15	17.17	18.45	14.535	15.445	16.605	0.7	

6-10K V voltage grade 30 kVA-2500 kVA dry three-phase unexcitation voltage distribution transformer

rated capacity k VA	open circuit losses kW			load losses kW						no-load current%	short-circuit impedance %
	SCB11-RL	SCB12-RL	SCB13-RL	SCB11-RL SCB12-RL			SCB13-RL			SCB11-RL SCB12-RL SCB13-RL	
				100℃	120℃	145℃	100℃	120℃	145℃		
30	0.17	0.15	0.135	0.67	0.71	0.76	0.605	0.64	0.685	0.6	4.0
50	0.24	0.215	0.195	0.94	1.0	1.07	0.845	0.9	0.965	0.6	
80	0.33	0.295	0.265	1.29	1.38	1.48	1.16	1.24	1.33	0.6	
100	0.36	0.32	0.29	1.48	1.57	1.69	1.33	1.41	1.52	0.6	
125	0.42	0.375	0.34	1.74	1.85	1.98	1.56	1.66	1.78	0.6	
160	0.48	0.43	0.385	2.0	2.13	2.28	1.8	1.91	2.05	0.6	
200	0.55	0.495	0.445	2.37	2.53	2.71	2.13	2.27	2.44	0.5	
250	0.64	0.575	0.515	2.59	2.76	2.96	2.33	2.48	2.66	0.5	
315	0.79	0.705	0.635	3.27	3.47	3.73	2.94	3.12	3.35	0.5	
400	0.88	0.785	0.705	3.75	3.99	4.28	3.37	3.59	3.85	0.4	
500	1.04	0.93	0.835	4.59	4.88	5.23	4.13	4.39	4.7	0.4	
630	1.2	1.07	0.965	5.53	5.88	6.29	4.97	5.29	5.66	0.4	
630	1.17	1.04	0.935	5.61	5.96	6.4	5.05	5.36	5.76	0.3	6.0
800	1.36	1.21	1.09	6.55	6.96	7.46	5.89	6.26	6.71	0.3	
1000	1.59	1.41	1.27	7.65	8.13	8.76	6.88	7.31	7.88	0.3	
1250	1.88	1.67	1.5	9.1	9.69	10.3	8.19	8.72	9.33	0.25	
1600	2.2	1.96	1.76	11.0	11.7	12.5	9.94	10.5	11.3	0.25	
2000	2.74	2.44	2.19	13.6	14.4	15.5	12.2	13.0	14.0	0.2	
2500	3.24	2.88	2.59	16.1	17.1	18.4	14.5	15.4	16.6	0.2	
1600	2.2	1.96	1.76	12.2	12.9	13.9	11.0	11.5	12.5	0.25	8.0
2000	2.74	2.44	2.19	15.0	15.9	17.1	13.5	14.3	15.4	0.2	
2500	3.24	2.88	2.59	17.7	18.8	20.2	15.9	17.0	18.2	0.2	

6-10K V voltage grade 630 kVA-6300 kVA, dry three-phase unexcitation voltage regulating power transformer

rated capacity k VA	open circuit losses kW				load losses kW						no-load current%		short-circuit impedance %
					SCB9			SCB10/SCB11/SCB12					
	SCB9	SCB10	SCB11	SCB12	100℃	120℃	145℃	100℃	120℃	145℃	SCB9	SCB10 SCB11 SCB12	
630	1.6	1.44	1.296	1.152	6.3	6.7	7.15	6.0	63.6	6.8	1.2	1.0	6.0
800	1.8	1.62	1.458	1.296	7.4	8.0	8.4	7.17	7.6	8.13	1.2	1.0	
1000	2.16	1.94	1.746	1.552	8.73	9.25	9.9	8.28	8.78	9.39	1.0	0.85	
1250	2.6	2.34	2.106	1.872	10.4	11.0	11.7	9.86	10.4	11.1	1.0	0.85	
1600	3.1	2.79	2.511	2.232	12.6	13.4	14.3	12.0	12.7	13.6	1.0	0.85	
2000	4.0	3.6	3.24	2.88	15.1	16.0	17.05	14.3	15.2	16.2	0.8	0.7	
2500	4.7	4.23	3.807	3.384	17.7	18.8	20.1	16.8	17.8	19.1	0.8	0.7	
3150	5.6	5.04	4.536	4.032	20.8	22.0	23.5	19.7	20.9	22.3	0.7	0.6	7.0
4000	6.7	6.03	5.427	4.824	25.0	26.5	28.3	23.7	25.1	26.9	0.7	0.6	
5000	8.0	7.2	6.48	5.76	29.5	31.3	33.5	28.0	29.7	31.8	0.6	0.5	
6300	9.45	8.5	7.65	6.8	35.1	37.2	39.8	33.3	35.3	37.8	0.6	0.5	

6-10K V voltage grade 315 kVA-2500 kVA dry-type three-phase on-load voltage regulating distribution transformer

rated capacity k VA	open circuit losses kW				load losses kW						no-load current%		short-circuit impedance %
					SCB9			SCB10/SCB11/SCB12					
	SCB9	SCB10	SCB11	SCB12	100℃	120℃	145℃	100℃	120℃	145℃	SCB9	SCB10 SCB11 SCB12	
315	1.1	0.99	0.891	0.792	3.6	3.8	4.1	3.4	3.61	3.86	1.4	1.1	4.0

400	1.25	1.12	1.008	0.896	4.25	4.5	4.8	4.02	4.27	4.57	1.4	1.1	
500	1.44	1.29	1.161	1.032	5.15	5.5	5.85	4.92	5.22	5.58	1.4	1.1	
630	1.66	1.49	1.341	1.192	6.1	6.5	6.95	5.82	6.17	6.6	1.2	1.0	
630	1.6	1.44	1.296	1.152	6.25	6.7	7.1	6.0	6.36	6.8	1.2	1.0	
800	1.9	1.71	1.539	1.368	7.4	7.9	8.4	7.07	7.5	8.02	1.2	1.0	
1000	2.2	1.98	1.782	1.584	8.7	9.25	9.9	8.28	8.78	9.39	1.0	0.85	
1250	2.6	2.34	2.106	1.872	10.4	11.0	11.8	9.86	10.4	11.1	1.0	0.85	6.0
1600	3.03	2.72	2.448	2.176	12.3	13.1	14.0	11.7	12.4	13.3	1.0	0.85	
2000	3.8	3.42	3.078	2.736	15.1	16.0	17.1	14.3	15.2	16.2	0.8	0.7	
2500	4.4	3.96	3.564	3.168	18.0	19.1	20.4	17.1	18.1	19.4	0.8	0.7	

20K V voltage grade 50 kVA-2500 kVA dry three-phase non-free voltage distribution transformer

rated capacity k VA	open circuit losses kW				load losses kW						no-load current%		short-circuit impedance %
	SCB9	SCB10	SCB11	SCB12	SCB9			SCB10/SCB11/SCB12			SCB9	SCB10 SCB11 SCB12	
					100℃	120℃	145℃	100℃	120℃	145℃			
50	0.38	0.34	0.306	0.272	1.23	1.3	1.39	1.16	1.23	1.31	2.4	2.0	
100	0.6	0.54	0.486	0.432	1.98	2.1	2.25	1.87	1.99	2.13	2.2	1.8	
160	0.75	0.67	0.603	0.536	2.47	2.6	2.8	2.33	2.47	2.64	1.8	1.5	
200	0.82	0.73	0.657	0.584	2.95	3.1	3.31	2.77	2.94	3.14	1.8	1.5	
250	0.94	0.84	0.756	0.672	3.44	3.6	3.91	3.22	3.42	3.66	1.6	1.3	
315	1.08	0.97	0.873	0.776	4.1	4.3	4.6	3.85	4.08	4.36	1.6	1.3	
400	1.28	1.15	1.035	0.92	4.9	5.1	5.46	4.65	4.84	5.18	1.4	1.1	
500	1.5	1.35	1.215	1.08	5.8	6.1	6.5	5.46	5.79	6.19	1.4	1.1	6.0
630	1.7	1.53	1.377	1.224	6.88	7.2	7.75	6.45	6.84	7.32	1.2	1.0	
800	1.95	1.75	1.575	1.4	8.23	8.7	9.3	7.79	8.26	8.84	1.2	1.0	
1000	2.3	2.07	1.863	1.656	9.72	10.3	11.0	9.22	9.78	10.4	1.0	0.85	
1250	2.65	2.38	2.142	1.904	11.5	12.15	13.0	10.8	11.5	12.3	1.0	0.85	
1600	3.1	2.79	2.511	2.232	13.78	14.6	15.65	13.0	13.8	14.8	1.0	0.85	
2000	3.6	3.24	2.916	2.592	16.3	17.25	18.5	15.4	16.3	17.5	0.8	0.7	
2500	4.3	3.87	3.483	3.096	19.35	20.4	21.8	18.2	19.3	20.7	0.8	0.7	
2000	3.6	3.24	2.916	2.592	17.8	18.8	20.0	16.8	17.8	19.1	0.8	0.7	8.0
2500	4.3	3.87	3.483	3.096	21.3	22.4	23.9	20.0	21.2	22.7	0.8	0.7	

35K V voltage grade 50 kVA-2500 kVA dry three-phase non-free voltage distribution transformer

rated capacity k VA	open circuit losses kW				load losses kW						no-load current%		short-circuit impedance %
					SCB9			SCB10/SCB11/SCB12					
	SCB9	SCB10	SCB11	SCB12	100℃	120℃	145℃	100℃	120℃	145℃	SCB9	SCB10 SCB11 SCB12	
50	0.5	0.45	0.405	0.36	1.42	1.5	1.6	1.34	1.42	1.52	2.8	2.3	6.0
100	0.7	0.63	0.567	0.504	2.08	2.2	2.35	1.97	2.09	2.23	2.4	2.0	
160	0.88	0.79	0.711	0.632	2.79	2.96	3.17	2.65	2.81	3.0	1.8	1.5	
200	0.98	0.88	0.792	0.704	3.3	3.5	3.75	3.13	3.32	3.55	1.8	1.5	
250	1.1	0.99	0.891	0.792	3.75	4.0	4.28	3.58	3.8	4.06	1.6	1.3	
315	1.31	1.17	1.053	0.936	4.48	4.75	5.08	4.25	4.51	4.82	1.6	1.3	
400	1.53	1.37	1.233	1.096	5.36	5.7	6.08	5.1	5.41	5.79	1.4	1.1	
500	1.8	1.62	1.458	1.296	6.57	7.0	7.45	6.27	6.65	7.11	1.4	1.1	
630	2.07	1.86	1.674	1.488	7.65	8.1	8.7	7.25	7.69	8.23	1.2	1.0	
800	2.4	2.16	1.944	1.728	9.0	9.6	10.25	8.6	9.12	9.76	1.2	1.0	
1000	2.7	2.43	2.187	1.944	10.4	11.0	11.8	9.86	10.4	11.1	1.0	0.75	
1250	3.15	2.83	2.547	2.264	12.7	13.4	14.3	12.0	12.7	13.6	0.9	0.75	
1600	3.6	3.24	2.916	2.592	15.4	16.3	17.4	14.6	15.4	16.5	0.9	0.75	
2000	4.25	3.82	3.438	3.056	18.1	19.2	20.5	17.2	18.2	19.5	0.9	0.75	
2500	4.95	4.45	4.005	0.356	21.7	23.0	24.6	20.6	21.8	23.3	0.9	0.75	

35K V voltage grade 800 kVA-25000 kVA dry-type three-phase unexcitation voltage regulating power transformer

rated capacity k VA	open circuit losses kW				load losses kW						no-load current%		short-circuit impedance %
					SCB9			SCB10/SCB11/SCB12					
	SCB9	SCB10	SCB11	SCB12	100℃	120℃	145℃	100℃	120℃	145℃	SCB9	SCB10 SCB11 SCB12	
800	2.5	2.25	2.025	1.8	9.4	9.9	10.6	8.87	9.4	10.0	1.1	0.95	6.0
1000	2.97	2.67	2.403	2.136	10.8	11.5	12.3	10.3	10.9	11.6	1.1	0.95	
1250	3.48	3.13	2.817	2.504	12.8	13.6	14.5	12.1	12.9	13.8	1.0	0.85	
1600	4.1	3.69	3.321	2.952	15.4	16.3	17.4	14.6	15.4	16.5	1.0	0.85	
2000	4.7	4.23	3.807	3.384	18.1	19.2	20.6	17.2	18.2	19.5	0.9	0.75	7.0
2500	5.4	4.86	4.374	3.888	21.7	23.0	24.6	20.6	21.8	23.3	0.9	0.75	
3150	6.7	6.03	5.427	4.824	24.3	25.8	27.5	23.1	24.5	26.2	0.8	0.7	8.0
4000	7.8	7.02	6.318	5.616	29.4	31.0	33.0	27.7	29.4	31.5	0.8	0.7	
5000	9.3	8.37	7.533	6.696	34.7	36.8	39.3	32.9	34.9	37.4	0.7	0.6	
6300	11.0	9.9	9.801	7.92	40.5	43.0	45.9	38.5	40.8	43.7	0.7	0.6	
8000	12.6	11.3	10.17	9.04	45.7	48.5	51.9	43.4	46.0	49.3	0.6	0.5	9.0
10000	14.4	12.9	11.61	10.32	55.5	58.5	62.6	52.4	55.5	59.4	0.6	0.5	
12500	17.5	15.7	14.13	12.56	64.0	68.0	72.7	60.9	64.6	69.1	0.5	0.4	

16000	21.5	19.3	17.37	15.44	75.5	80.0	84.8	71.7	76.0	81.3	0.5	0.4	
20000	25.5	22.9	20.61	18.32	85.0	90.0	96.3	80.6	85.5	91.5	0.4	0.35	10.0
25000		27.1	24.39	21.68				95.3	101.0	108.0		0.35	

35K V voltage grade 2000 kVA-25000 kVA dry-type three-phase on-load voltage regulating power transformer

rated capacity k VA	open circuit losses kW				load losses kW						no-load current%		short-circuit impedance %
	SCB9	SCB10	SCB11	SCB12	SCB9			SCB10/SCB11/SCB12			SCB9	SCB10 SCB11 SCB12	
					100℃	120℃	145℃	100℃	120℃	145℃			
2000	5.0	4.5	4.05	3.6	18.9	20.0	21.4	17.9	19.0	20.3	0.9	0.75	7.0
2500	5.8	5.22	4.698	4.176	22.5	23.8	25.5	21.3	22.6	24.2	0.9	0.75	
3150	7.0	6.3	5.67	5.04	25.3	26.8	28.7	24.0	25.4	27.2	0.8	0.7	
4000	8.2	7.38	6.642	5.904	30.3	32.1	34.4	28.7	30.4	32.6	0.8	0.7	
5000	9.7	8.73	7.857	6.984	35.8	38.0	40.6	34.0	36.1	38.6	0.7	0.6	8.0
6300	11.5	10.3	9.27	8.24	41.5	44.0	47.0	39.4	41.8	44.7	0.7	0.6	
8000	13.2	11.8	10.62	9.44	47.2	50.0	53.5	44.8	47.5	50.8	0.6	0.5	9.0
10000	15.1	13.5	12.15	10.8	56.8	60.2	64.5	53.9	57.1	61.2	0.6	0.5	
12500	18.3	16.4	14.76	13.12	67.0	70.0	76.0	62.7	66.5	71.1	0.5	0.4	
16000	22.5	20.2	18.18	16.16	77.6	82.4	88.1	73.8	78.2	83.7	0.5	0.4	
20000	26.5	23.8	21.42	19.04	87.5	92.7	99.2	83.0	88.0	94.2	0.4	0.35	10.0
25000		28.1	25.29	22.48				98.2	104.0	111.0		0.35	