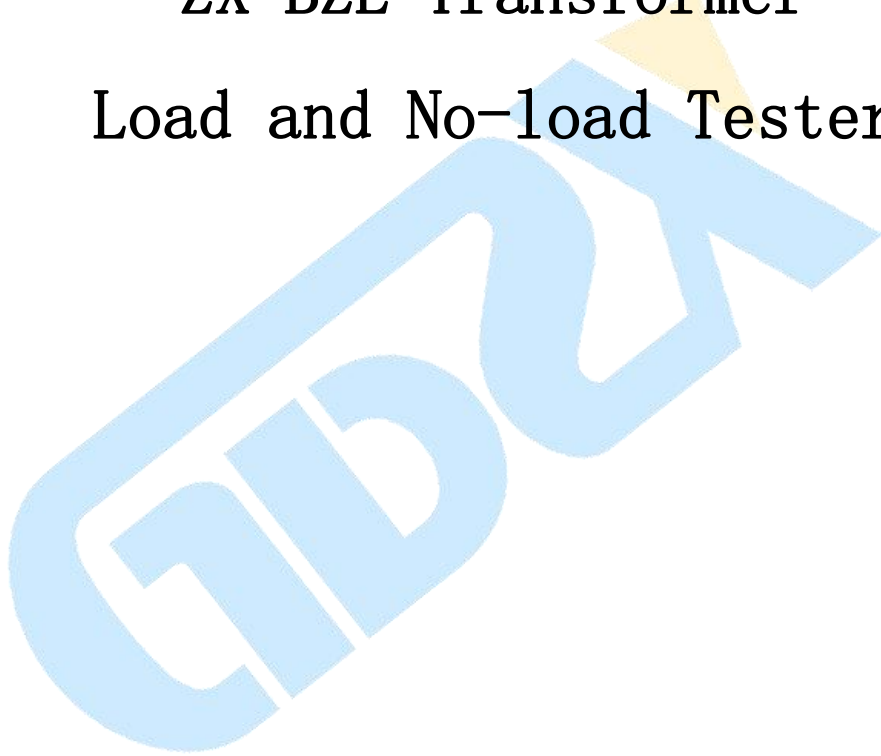


ZX-BZL Transformer  
Load and No-load Tester



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## I 、 Functional characteristics

---

- 1、 Measure the transformer load current, load loss, short-circuit voltage, short circuit (load) losses.
- 2、 Harmonic test can be analyzed to 31 harmonics.
- 3、 Support Three Methods, two table method, two experimental methods.
- 4、 Do three-phase transformer no-load, load test, the instrument can automatically determine the wiring is correct, and shows three-phase voltage and current vector map.
- 5、 Single machine can do the following 1000KVA distribution transformer full load current experiment; in one third of the rated current, complete 2500KVA distribution transformer load the following test (in one third of the rated current, the instrument can be converted to load loss under rated current parameters, the machine is mainly used in the test bed with integrated supporting the use of transformers, the load characteristics to achieve high-precision transformer no-load test).
- 6、 All the related test results are automatically corrected. Instrument can automatically such as: the waveform correction, temperature correction, non-rated voltage correction, calibration, and other non-rated current correction, so that more accurate test results.
- 7、 7.320x240 large screen, high brightness LCD display, full Chinese menu and operations to achieve prompt and friendly man-machine dialogue, touch buttons make the operation more convenient, wide LCD with brightness adjustment, can be adapted to the various summer and winter season.
- 8、 The instrument 40 can be preset by the user group is the test product parameters, and these parameters can be removed according to need and increase in use is very convenient.
- 9、 Comes with real-time clock, automatically recording test date, time, the preservation of favorable results, management.
- 10、 Panel-type thermal printer, the scene quickly print test results.
- 11、 Data (test sample set, the measurement results, the test of time, etc.) with power-down storage and browsing features, you can store 500 set of experimental results with computer on-line data transfer.
- 12、 Allows an external voltage transformer and current transformer for extended range of measurement, any measurable parameter is the test product.

## II 、 The main technical indicators

---

### 1、 Test Item

---

- ☆: RMS phase voltage:  $U_{ab}$ 、 $U_{bc}$ 、 $U_{ca}$ ;
- ☆: Average value of three-phase AC voltage:  $U_{ab}$ 、 $U_{bc}$ 、 $U_{ca}$ ;  
Three-phase current RMS:  $I_a$ 、 $I_b$ 、 $I_c$ ;  
Percentage of no-load loss and no-load current:  $P_0$ 、 $I_0\%$   
Load loss, impedance voltage, and the percentage of short-circuit impedance:  $P_t$ 、 $e_{kt}$ 、 $Z_t$ ;
- ☆: Any given temperature, load loss, the percentage impedance voltage and short circuit impedance;

Voltage waveform in the percentage of each harmonic component;  
 Current waveform in the percentage of each harmonic component;

## 2、Main technical parameters

☆: Current measurement range: 100mA ~ 60A, accuracy class 0.2;

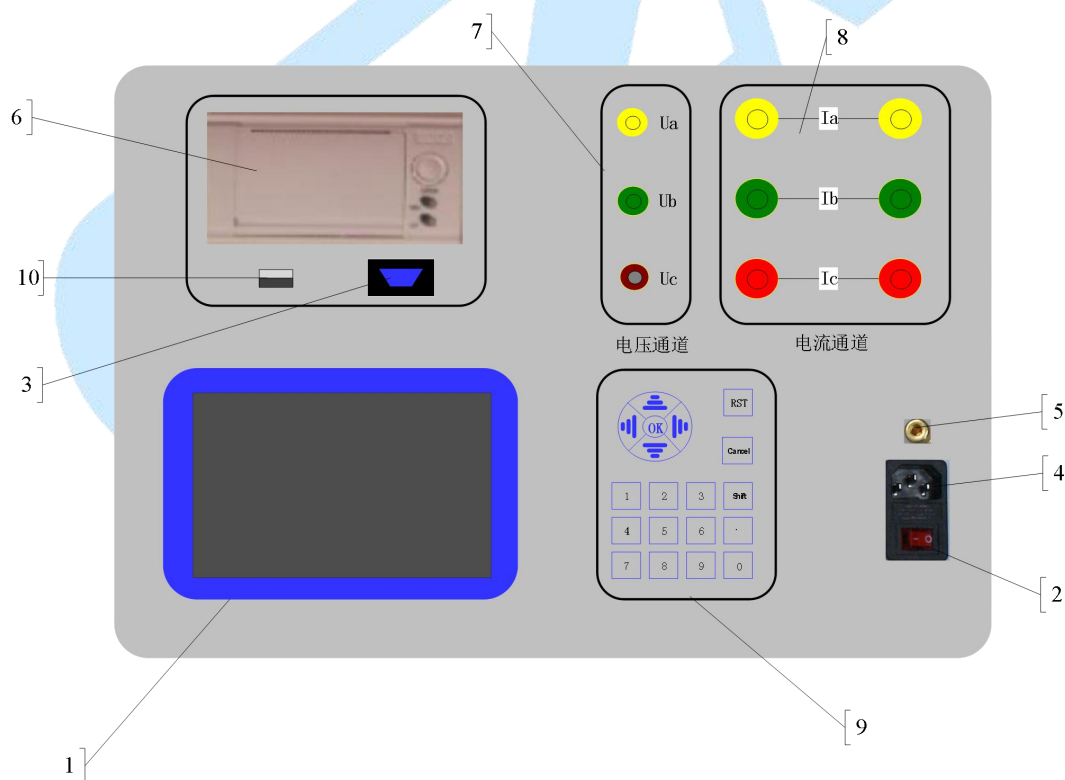
☆: Voltage Range: 10V ~ 650V, accuracy class 0.2;

External transformer can broaden the scope of measurement instruments;

☆: Frequency Range: 40 ~ 65Hz, accuracy class 0.2;

Power Input: AC220V ± 10%;

## III、Panels Description



**Figure 1 tester panel**

1.LCD screen

2.Power switch

3. RS 232 Communication port
4. Device Power Input
5. Earthing
6. Printer
7. Voltage channel
8. Current channel
9. Keyboard
10. USB

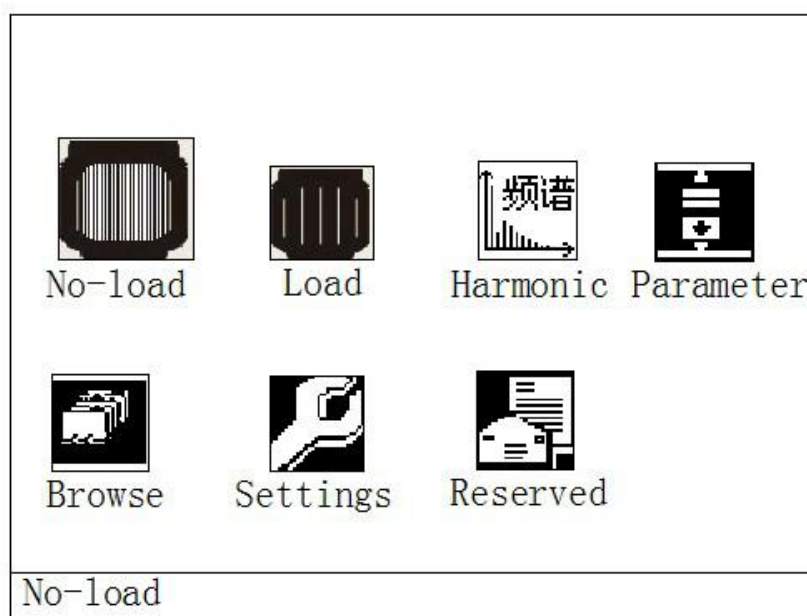
## IV、 Operating instructions

### 1、 Keyboard use

"OK" button to select the current input, "Cancel" the error can be eliminated just enter, "↑" "↓" "←" "→" can facilitate the realization of the cursor's movement. "Switch" button to spare key. The bottom of the keyboard data from 0 to 9 keys, the data input by the numeric keys can be easily input data.

### 2、 Introduce the main interface

The main interface as shown below, consists of 7 modules.



**Figure 2 Test boot-load the main interface**

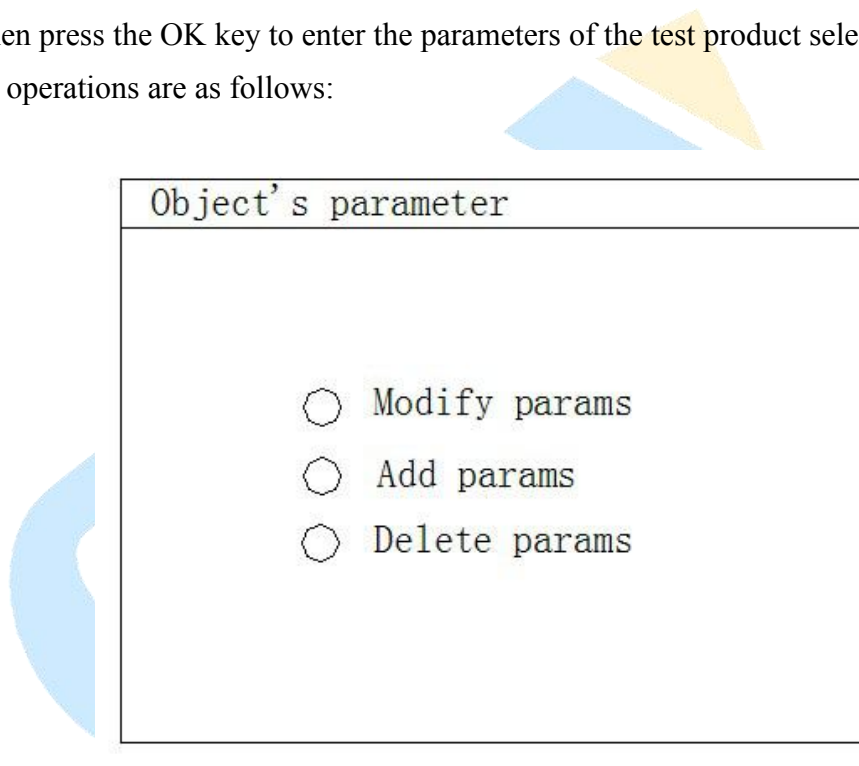
- 1) No-load test: the menu can be measured in the single-phase transformers, three-phase transformer no-load loss.

- 2) Load Test: In this menu, you can determine single-phase transformers, three-phase transformer load losses.
- 3) Harmonic test: single or three phase voltage and current harmonic analysis test.
- 4) Parameters: the default transformer parameters on modify, add, delete and other operations.
- 5) Browse: browse test record stored in the memory, delete and other management.
- 6) Settings: Set the current system time.
- 7) Reserved: This feature manufacturers for debugging.

### 3、Parameters of the test product management operations

---

i . On the main screen, the keyboard's arrow keys to move the cursor to the test product parameter menu, and then press the OK key to enter the parameters of the test product selection interface management operations are as follows:



**Figure 3 parameters of the test product management interface**

ii . Select the interface in the above parameters increase, the increase occurred following parameters of the test product page:

Add params		Type&Cap S0900315	
UN1	10.0KV	IN1	18.186A
UN2	400V	IN2	454.7A
PT1	1.000	CT1	1.000
PT2	1.000	CT2	1.000
T1	10°C	T2	75°C
R1	2.849 Ω	R2	4.178m Ω
T0	10°C		
<input type="button" value="OK"/>		<input type="button" value="Exit"/>	
Rated HV Voltage			

**Figure 4 parameters to increase the test product page**

Figure above, the number column number for the transformer, the length of number 7, behind the representative of the transformer type, five representatives, after the transformer capacity (maximum capacity is running input 63,000), in units of KVA, such as transformer type for the S9, capacity 315KVA, then the number column should be entered: 0900315.

Data input method as follows (in Un1 example, the input value is 35.00): Use the arrow keys to move the cursor to Un1 column after the data input through the numeric keypad to directly enter 35.00, input finished, press OK button. Note that the cursor after the Un1 input field, the bottom of the screen prompts "high side rated voltage" (the bottom of the screen cursor is always prompted to enter the field of parameter meaning).

- ① In Figure 3, choose to modify parameters, select the adapter number appeared the following pages:

Select number		
S0900050	S1100100	S0900315
S0700400		

**Figure 5 Select transformer numbers page**

Pre-modified by the arrow keys to select the number of its parameters, then press the OK button to enter the test sample parameters modify the page, change the page parameters the same as in Figure 4.

② In Figure 3 Select Delete parameter, the choice of the transformer in Figure 6, page number, selected number, press the OK button to delete the number of transformer parameters configuration.

#### 4、 No-load test process description

- i . According to the test method for dual-table method or three tables, reference back of the corresponding wiring diagram correctly, and then reconnect the power supply load tester.
- ii . On the main screen select the load test, load test setup interface is displayed as below:

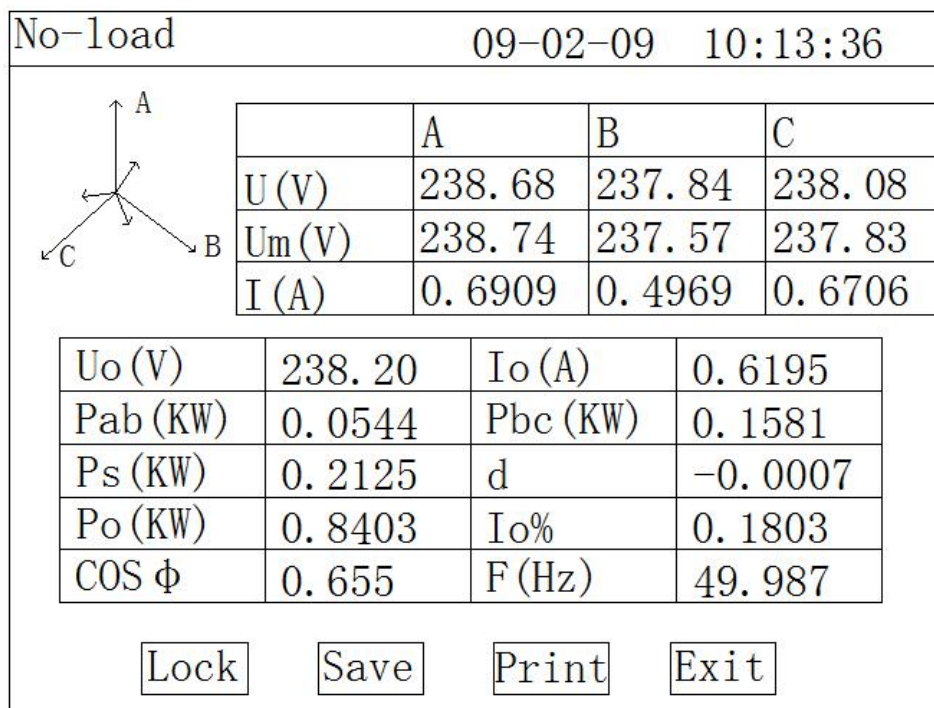
No-load		Type&Cap: <u>S 0900315</u>
Style	<input type="radio"/> Uniphase	<input checked="" type="radio"/> Triphase
Method	<input checked="" type="radio"/> Tri-watt	
Rated LV Voltage	<u>400.0V</u>	
Rated LV Current	<u>454.7A</u>	
PT when no-load test	<u>1.000</u>	
CT when no-load test	<u>1.000</u>	
<input type="button" value="Begin"/>		<input type="button" value="Exit"/>

**Figure 6 No Load Test Settings page**

Save the page when setting the last test, inspect, modify the settings page it consistent with the current testing transformer.

iii. In Figure 6, the cursor to select the "Start Test" and press OK key to enter the no-load test the following test data page:





**Figure 7 No Load Test test data page**

This page shows the full load test results of all tests:  $U_o$  (V) for the three-phase line voltage (dual-table method) or phase voltage (when the three-table method) of the average,  $P_m$  (KW) for the current voltage the measured power,  $d$  is the voltage waveform distortion factor,  $P_o$  (KW) for the corrected load loss,  $I_o\%$  for the no-load current percentage.

Left side of the test voltage and current vector, if the connection is wrong, the page says "connection error, check off"; by slowly increasing the test voltage booster, when  $U_o$  (V) is equal to the rated voltage no-load test ( low-pressure side of the transformer for the 400V, no-load test, two-table method, the test voltage  $U_o$  was 400V, three-table method load test, the test voltage  $U_o$  was 230V), to stop boost. Move the cursor to "lock" button, press OK button to lock the current test results, then "lock" button to "re-test" button.

In the page's "Save" to save the results to the current random storage; "Print" to print through the printer, the current test results.

**★Note:** The step-up the process, we should always pay attention to  $U_o$  and  $I_o$ , in addition to avoid over-voltage, but also to guard against abnormal test test sample over current damage to equipment or the test product.

iv. In Figure 7 by "re-test" will be re-tested on the current transformer, press the "exit" is back to Figure 3, the main interface of system functions.

## 5、 Load test process description

- i. According to the test method for dual-table method or three tables, reference back of the corresponding wiring diagram correctly, and then reconnect the power supply load tester.
- ii. On the main screen select the load test, load test setup interface is displayed as below:

Load	Type&Cap: $\Sigma$ 0900400	
Style	<input type="radio"/> Uniphase	<input checked="" type="radio"/> Triphase
Method	<input checked="" type="radio"/> Tri-watt	
Rated LV Voltage	<u>400.0V</u>	
Rated LV Current	<u>454.7A</u>	
Rated HV Voltage	<u>10.0KV</u>	
Rated HV Current	<u>18.19A</u>	
PT when no-load test	<u>1.000</u>	
CT when no-load test	<u>1.000</u>	
<input type="button" value="Begin"/>		<input type="button" value="Exit"/>

**Figure 8 Load Test Settings Page**

Save the page when setting the last test, inspect, modify the settings page it consistent with the current test transformers, with particular attention to check the number after the 5 values  $\hat{\epsilon}$  represent the capacity of the high pressure side of the rated current, current transformer Variable ratio, to avoid setting is incorrect or test current over range.

iii. In Figure 8, select the "Start Test", enter the load test the test data interface:

Load	09-02-09 10:13:36			
		A	B	C
	U (V)	238.68	237.84	238.08
	Um (V)	238.74	237.57	237.83
	I (A)	0.6909	0.4969	0.6706
Uo (V)	238.20	Io (A)	0.6195	
Pab (KW)	0.0544	Pbc (KW)	0.1581	
Ps (KW)	0.2125	Zt ( $\Omega$ )	7.000	
Pt (KW)	0.8403	UK (%)	4.16	
COS $\phi$	0.655	F (Hz)	49.987	
<input type="button" value="Lock"/>		<input type="button" value="T-Correction"/>		<input type="button" value="Exit"/>

**Figure 9 test data load test page**

This page displays the current temperature load test all the test data: Io (A) the average for the three-phase current, Pm (KW) for the current measured under voltage power, Pt (KW) for the

current temperature correction to the rated current reproduced when the loss,  $Z_t (\hat{I}^2)$  for the current temperature of the short circuit impedance,  $U_k\%$  for the current temperature, the percentage of short-circuit voltage.

Left side of the test voltage and current vector, if the connection is wrong, the page says "connection error, check off"; by slowly increasing the test voltage booster, when  $I_o$  (A) test current equal to the load test, stop boost. Move the cursor to "lock" button, press OK button to lock the current test results, then "lock" button to "re-test" button.

★Note: The step-up the process, we should always pay attention to  $U_o$  and  $I_o$ , in addition to avoid over-voltage, but also to guard against abnormal test test sample over current damage to equipment or the test product.

iv. In Figure 10 Select the "temperature correction" to show the temperature correction interface:

T-Correction

HV Resistance 2.849  $\Omega$

LV Resistance 4.178 m $\Omega$

T when measure resistance 10  $^{\circ}\text{C}$

T-object 10  $^{\circ}\text{C}$       T-aimed 75  $^{\circ}\text{C}$

	$U_k$ (%)	$Z_t$ ( $\Omega$ )	$P_t$ (W)
T-aimed	73.581	233.59	191.71
Equation	73.581	233.59	121.03

**Figure 10 the results of temperature calibration load page**

The page parameters is the last trial setting, inspection, modification to the test items are consistent with the current, the instrument provides two temperature correction algorithm: temperature coefficient method and the national standard formula, the formula see these two algorithms behind the appendix.

In the page's "Save" to save the results to the current random storage; "Print" to print through the printer, the current test results.

## 6、Harmonic test procedure describes

No-load test, the transformer magnetic core of the Li curve is nonlinear curve, the load current through the transformer will have a certain harmonic component, the number of harmonics and test the power of volume. Harmonic test that is done no-load test or load test, the situation does not change the test connection, the measurement of time through the transformer voltage and current harmonic components of the situation.

i . Press the aforementioned process or load test load test, test is complete, do not change the wiring and the regulator output voltage in the system's main interface, select the harmonic test, the harmonic components will appear below the list of pages:

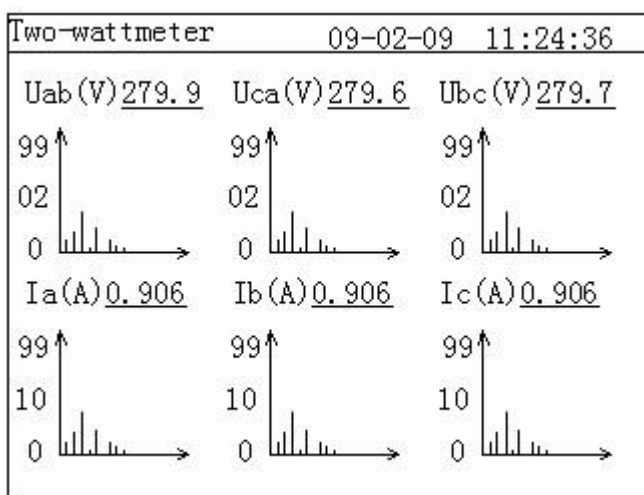
Harmonic component 09-02-09 11:23:33						
	AB%	CB%	CA%	Ia%	Ib%	Ic%
01	100.	100.	100.	100.	100.	100.
02	0.02	0.02	0.02	0.31	0.31	0.31
03	0.20	0.20	0.20	5.11	5.11	5.11
04	0.01	0.01	0.01	0.17	0.17	0.17
05	0.64	0.64	0.64	7.20	7.20	7.20
06	0.02	0.02	0.02	0.05	0.05	0.05
07	1.44	1.44	1.44	1.59	1.59	1.59
08	0.02	0.02	0.02	0.02	0.02	0.02
09	0.09	0.09	0.09	0.33	0.33	0.33
Σ%	1.77	1.77	1.77	9.02	9.02	9.02

**Figure 11 harmonic component list page**

The list is the fundamental harmonic component relative to the percentage of the system to a total of 31 harmonics, the first page shows 1 to 9 harmonics relative value, press "↑" "↓" key to page up and down to show the value of other harmonic components.

Bottom of the page shows all the column relative to the fundamental harmonic and the percentage.

ii . In Figure 11, page press OK button, the page appears the following spectrum:

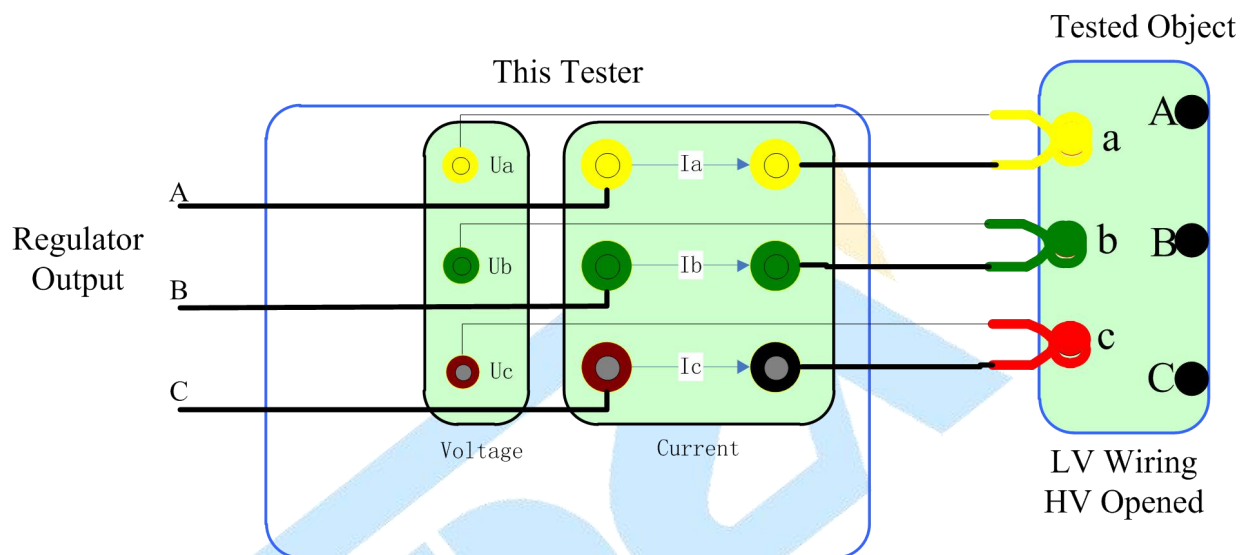


**Figure 12 pages harmonic spectrum**

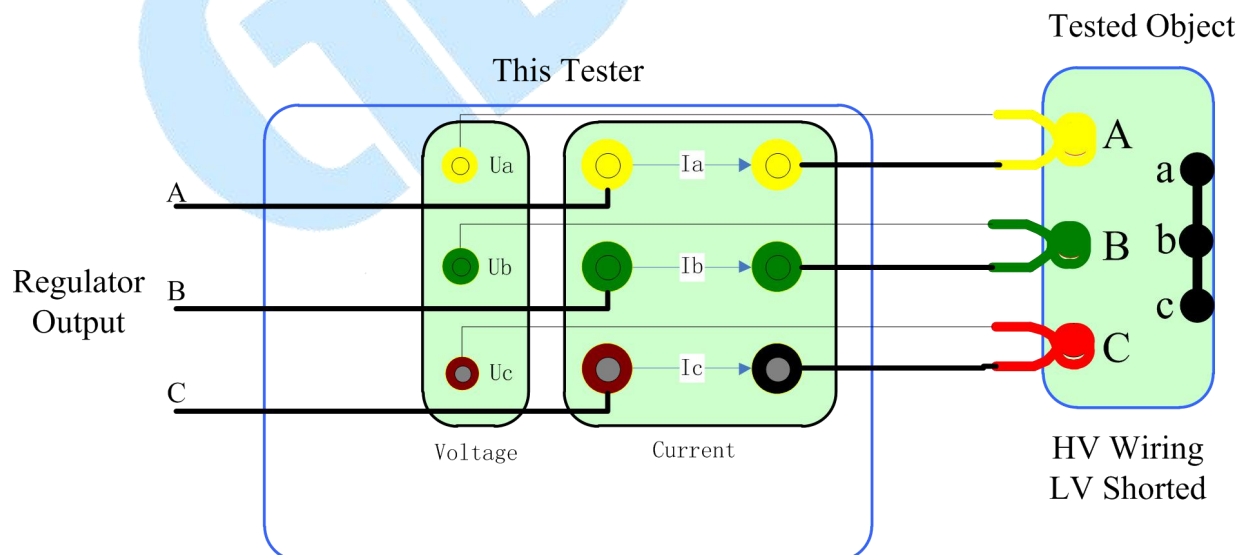
## Appendix

### 1. Test wiring diagram

i . No-load test wiring diagram for three phase transformer:

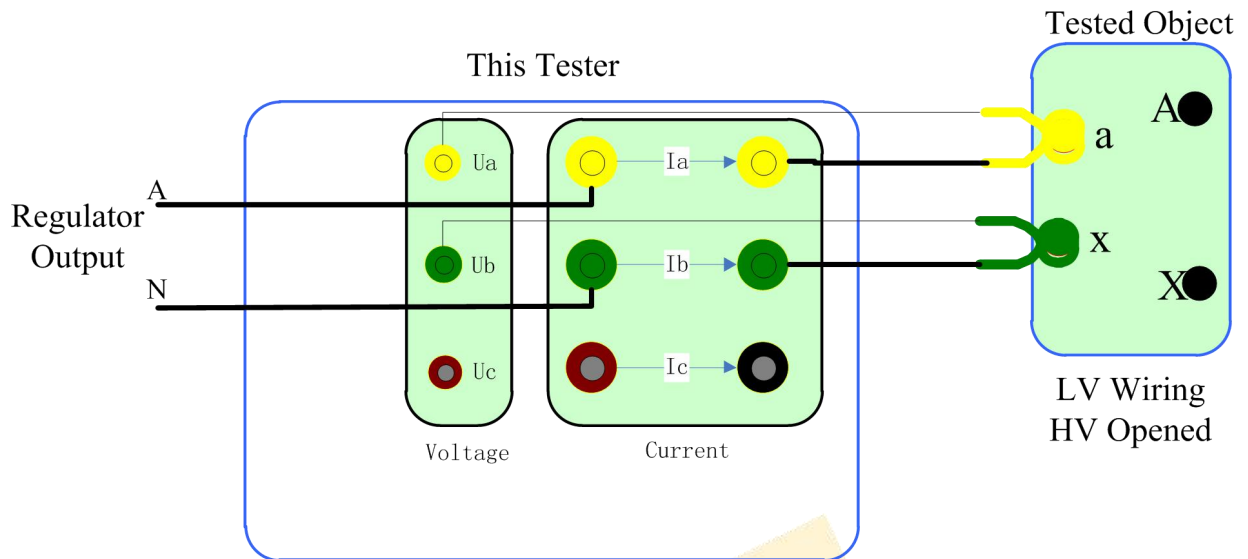


ii . Load test wiring diagram for three phase transformer:

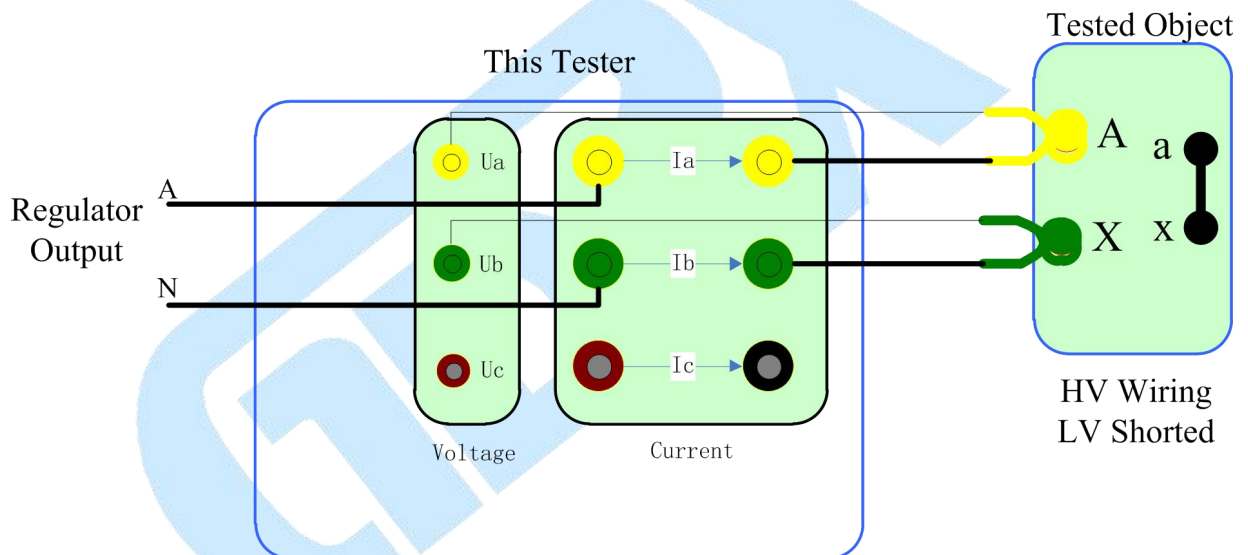


iii. No-load test wiring diagram for single phase transformer:

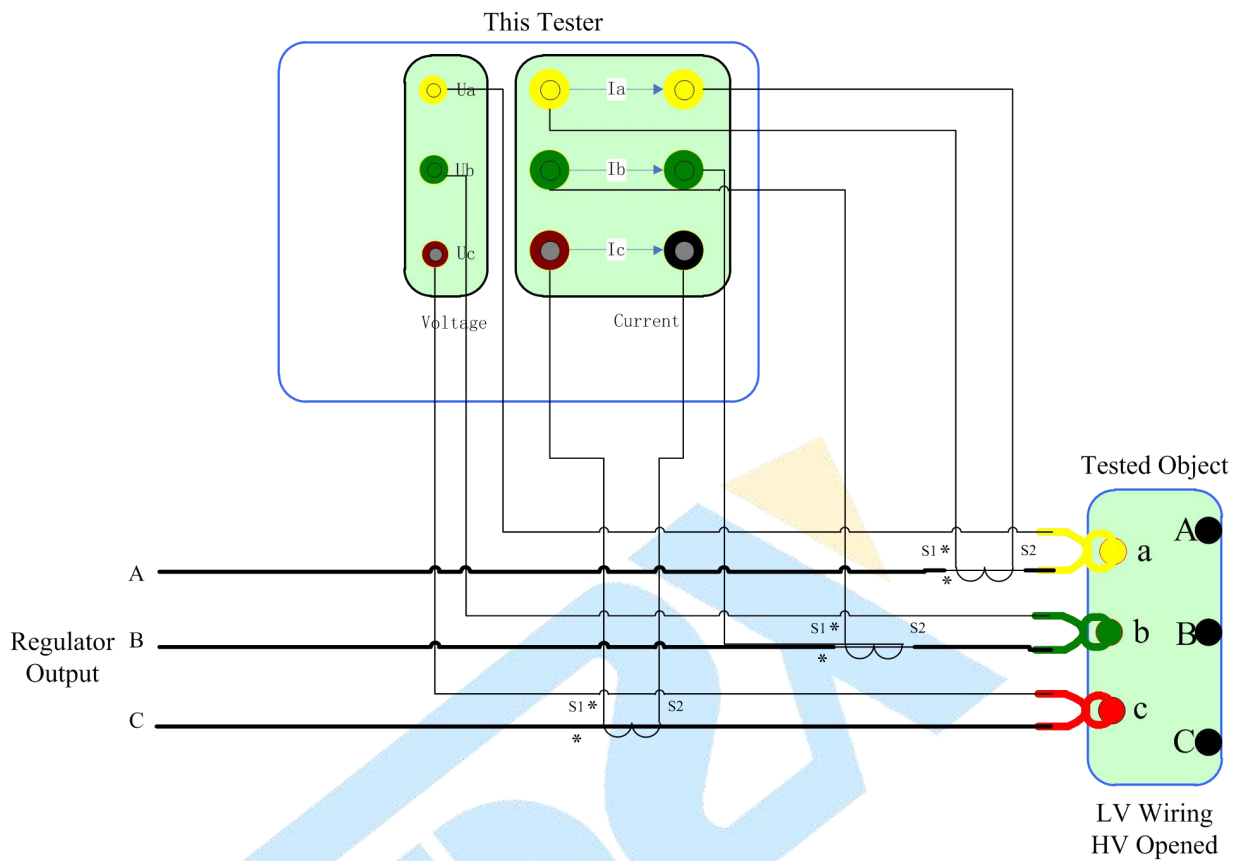




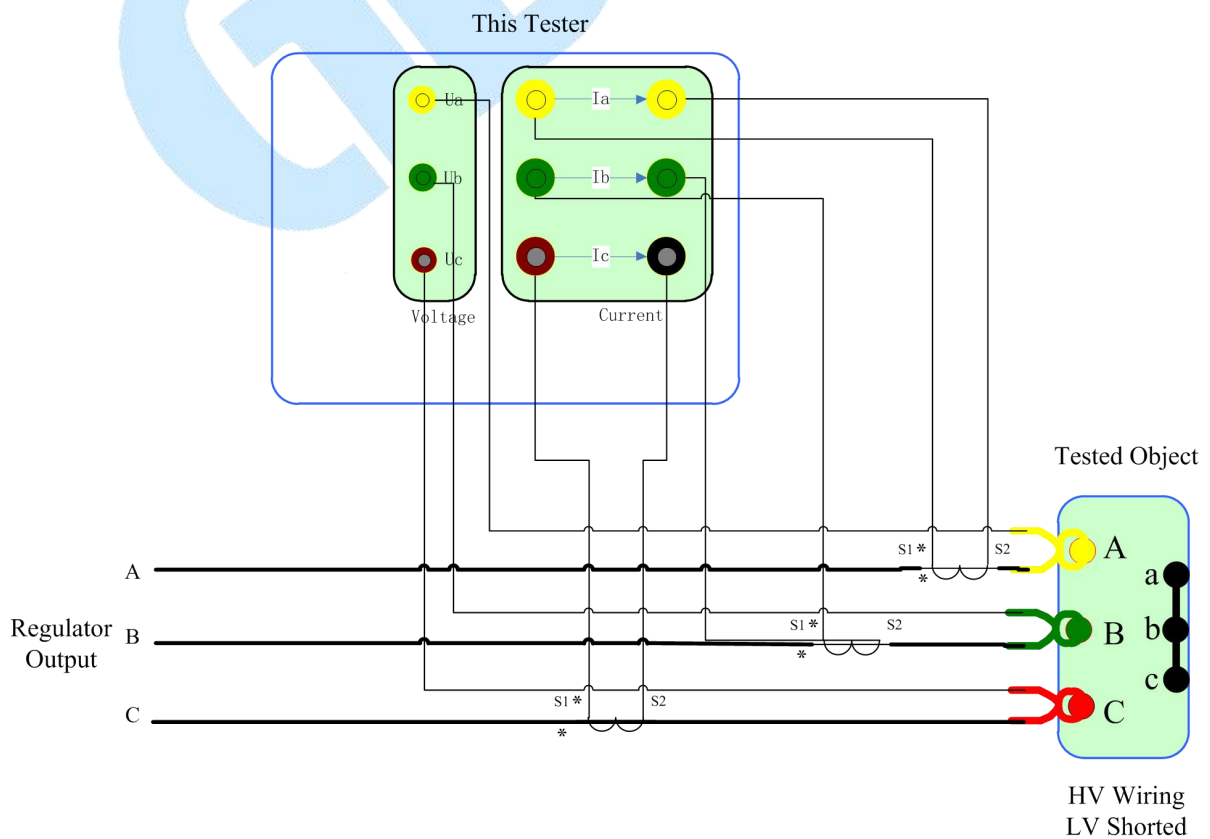
iv . Load test wiring diagram for single phase transformer:



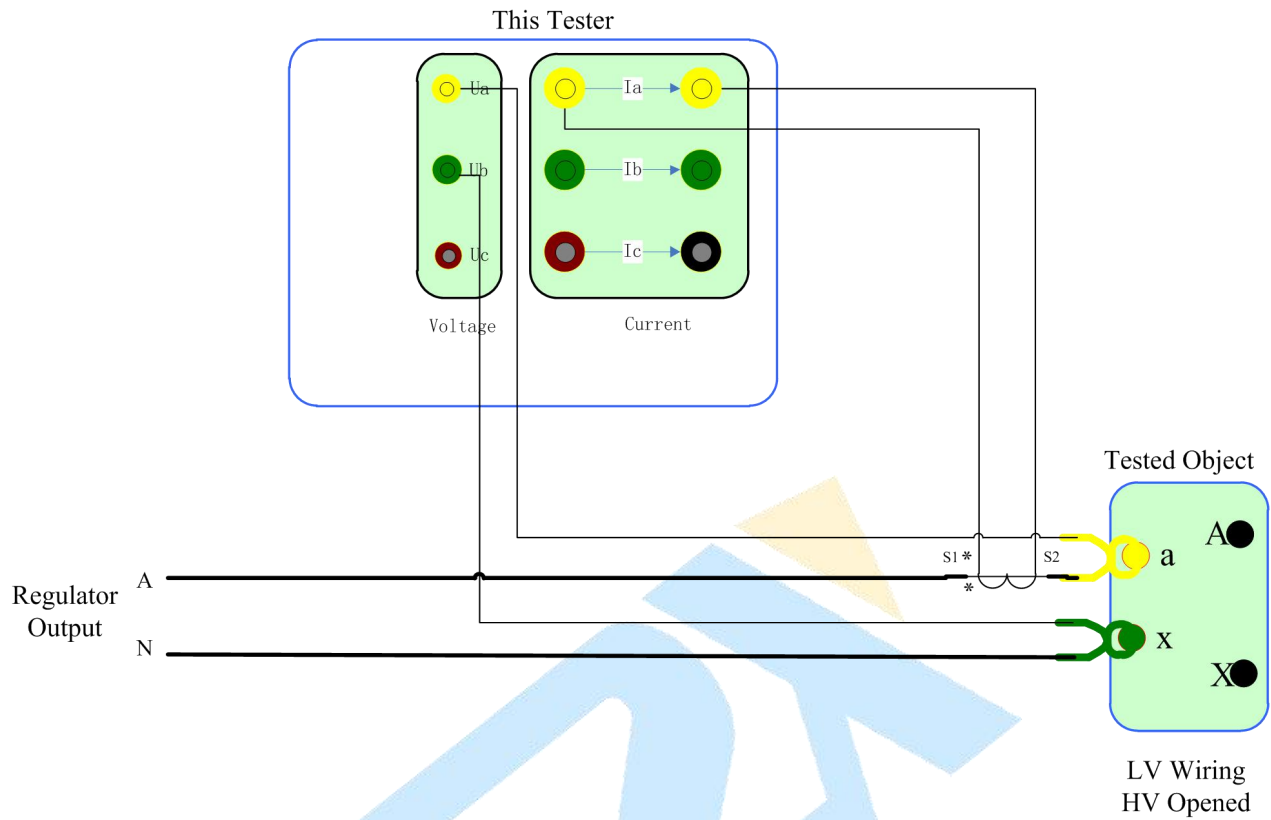
v . No-load test wiring diagram for three phase transformer with CT:



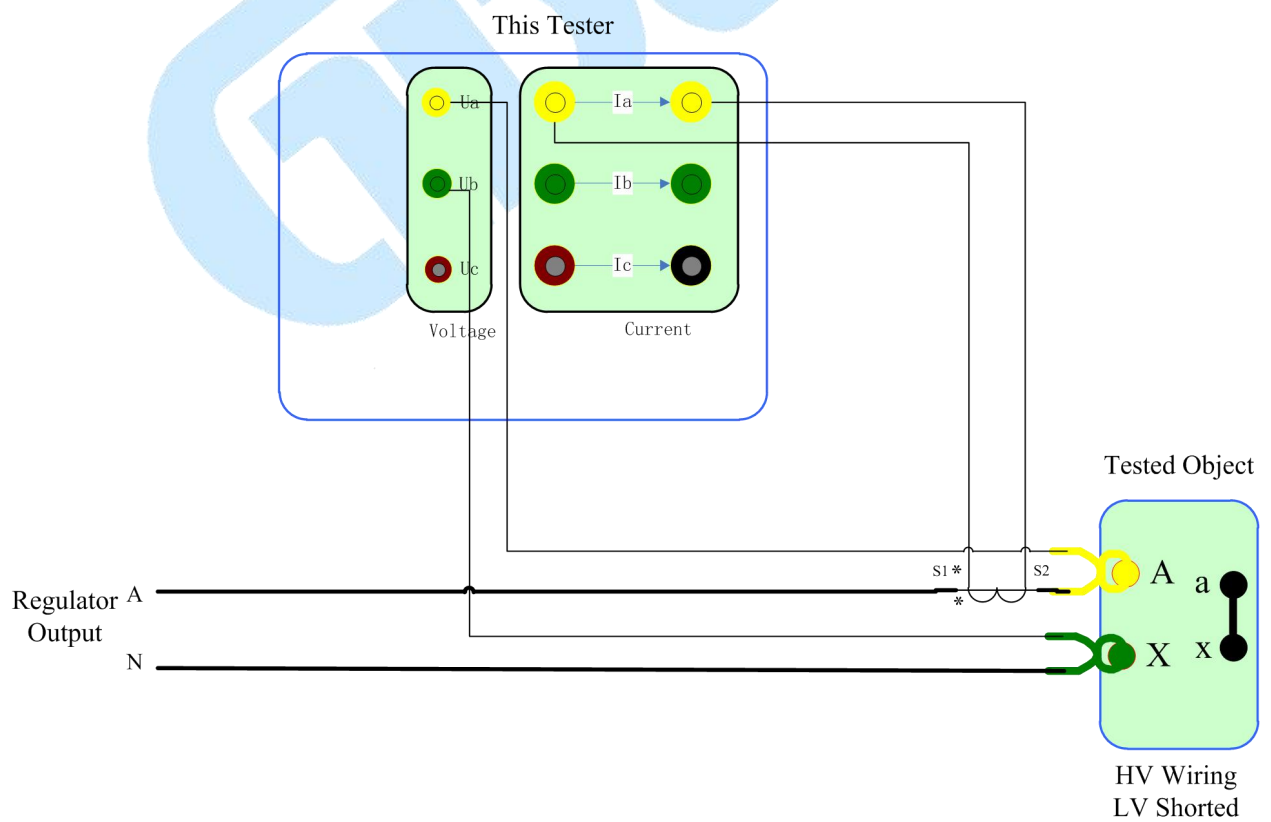
vi . Load test wiring diagram for three phase transformer with CT:



Vii. No-load test wiring diagram for single phase transformer with CT:

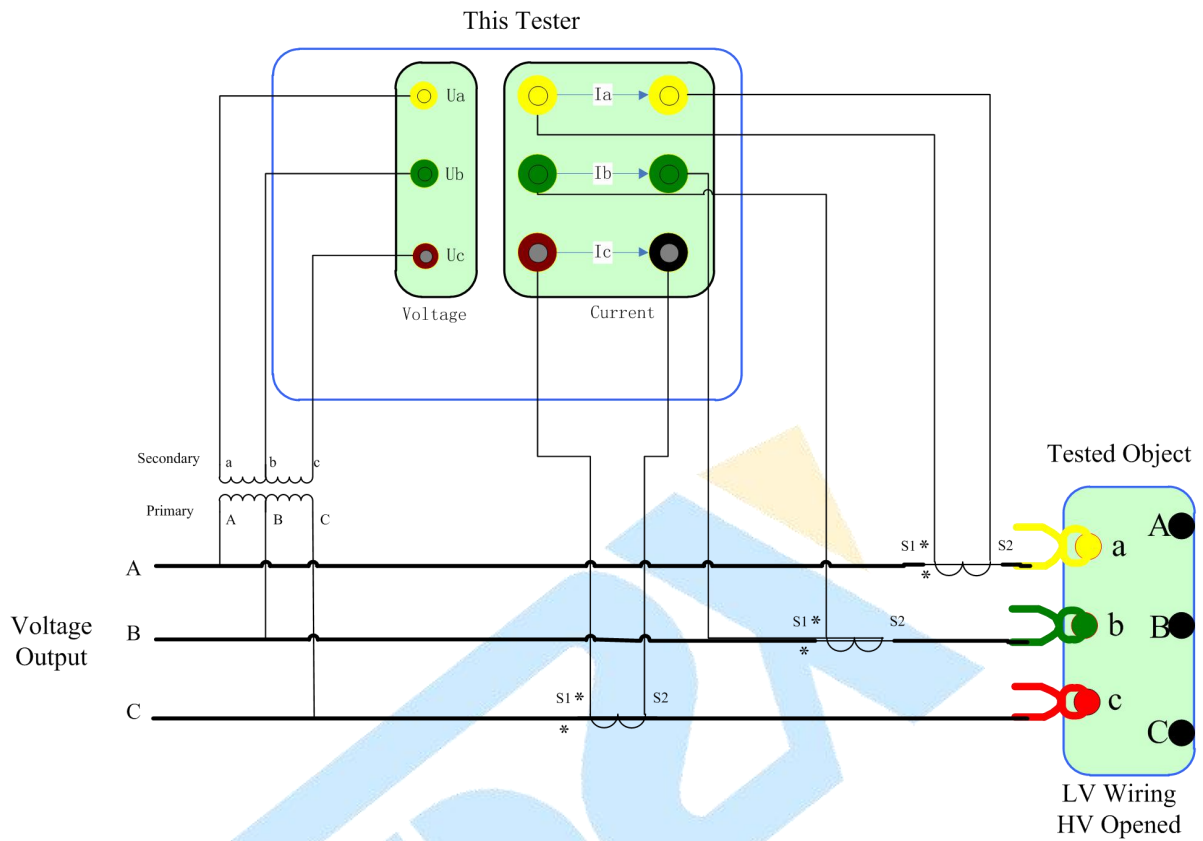


Viii. Load test wiring diagram for single phase transformer with CT:

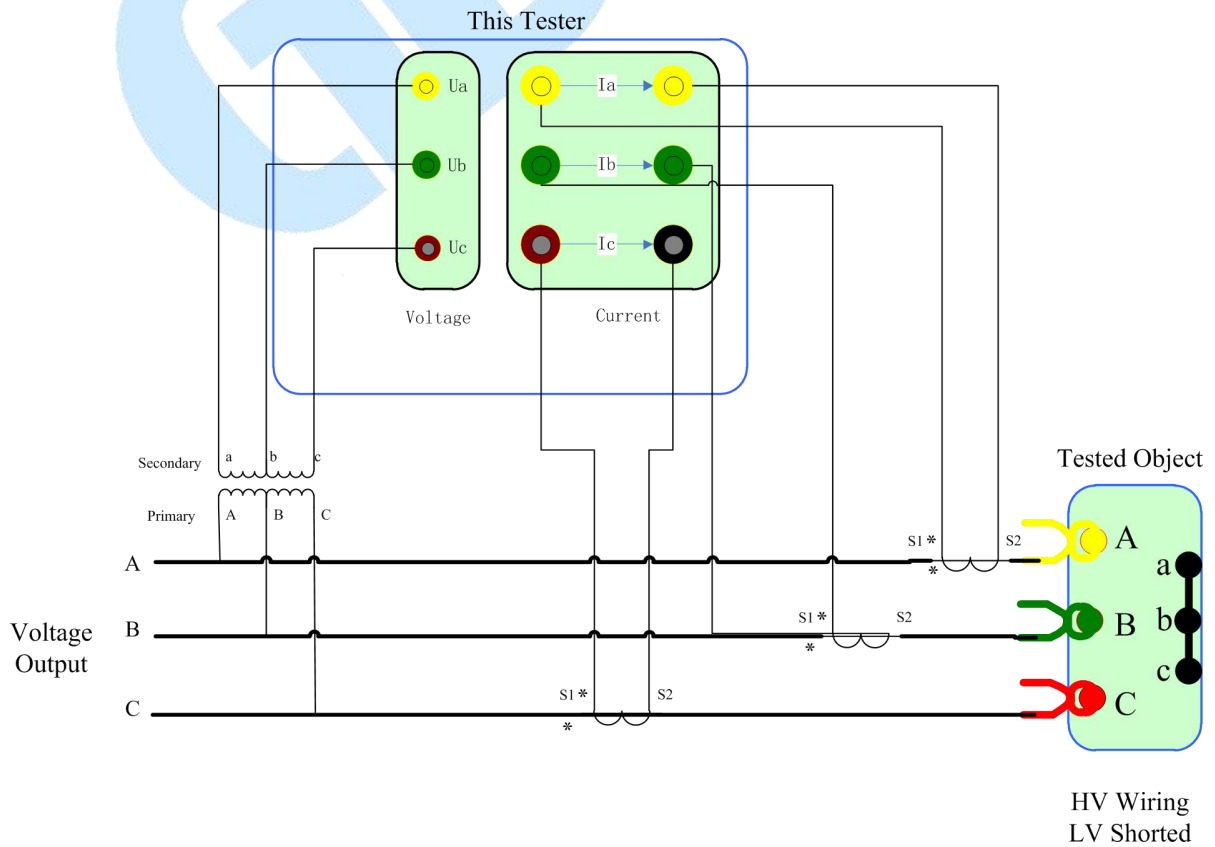




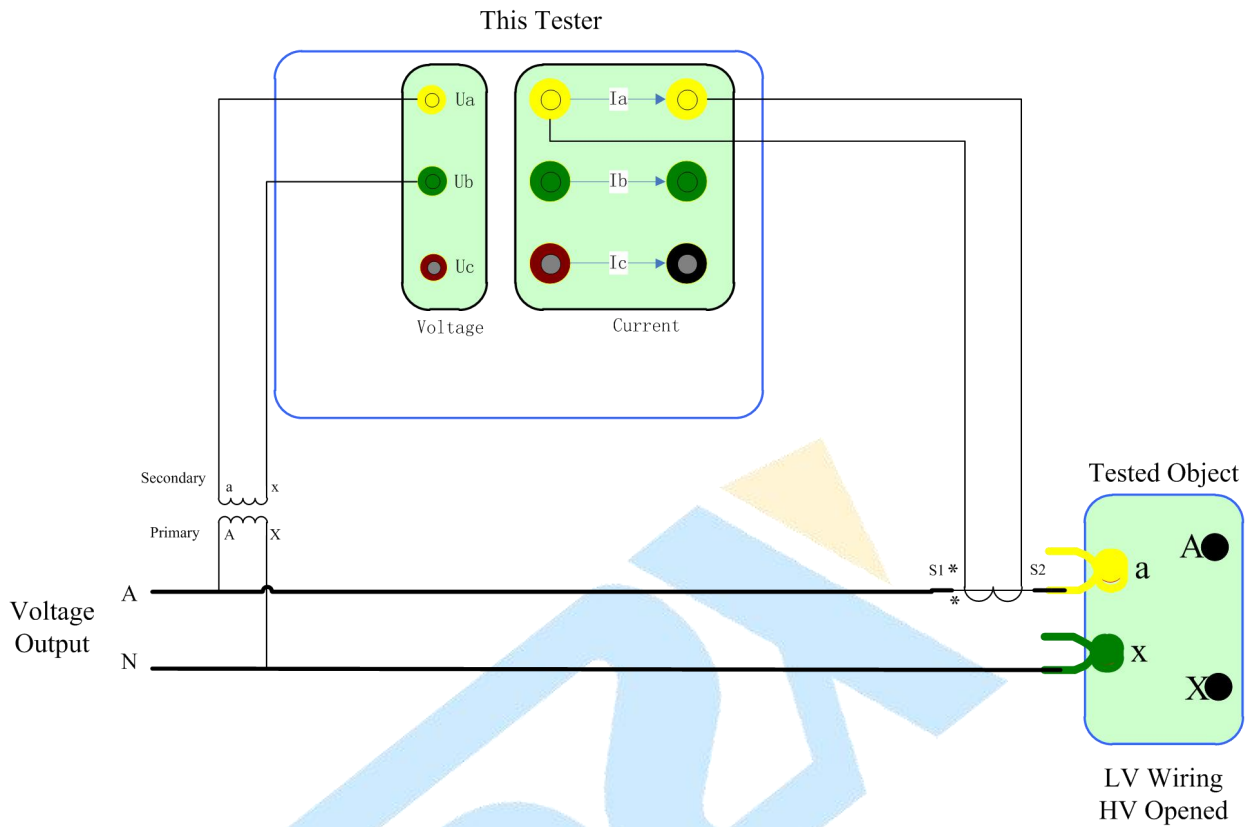
IX. No-load test wiring diagram for three phase transformer with CT and PT:



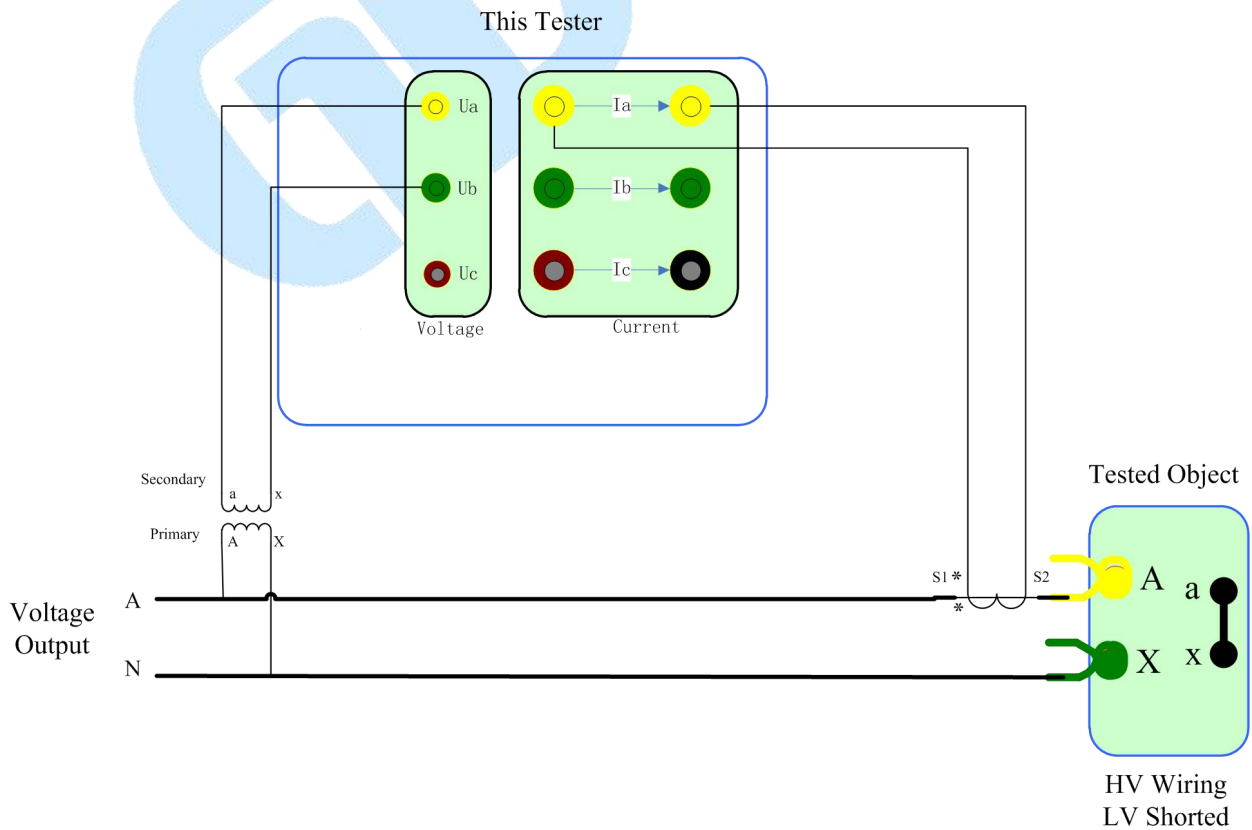
X. Load test wiring diagram for three phase transformer with CT and PT:



**Xi. No-load test wiring diagram for single phase transformer:**

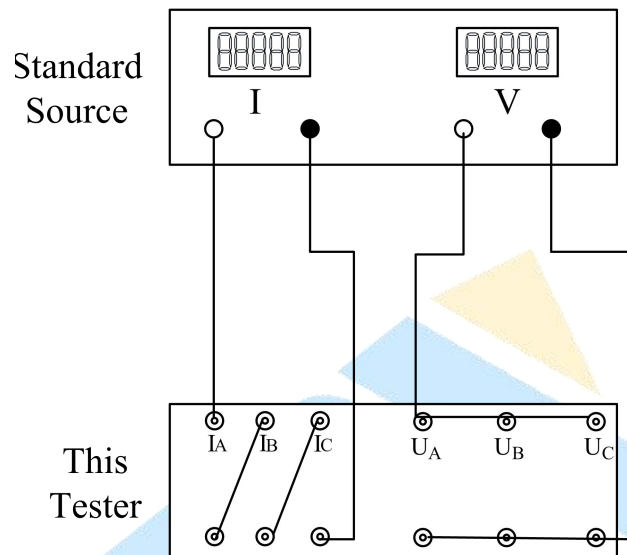


**Xii. Load test wiring diagram for single phase transformer:**



## 2. Instrument testing methods

- i . Necessary equipment: error less than 0.1% of the standard source, the standard source can provide at least one voltage and one current;
- ii . Wiring diagram: load testing instrument air source with standard wiring diagram is as follows:



- iii. Reconnect the power supply load tester, load test data into the page in Figure 8, measured under the test of the page voltage, current, and the measured power Pm (KW) and the standard source of the error between the input value.

## 3. Results and theoretical calculations show that formula

☆ "Double-table method" means the two-Wattmeter Test Method for transformer losses by three-phase three-wire connection, "Three Methods" means three wattmeter method for measuring transformer loss test, according to three-phase four-wire connection.

☆ Load test the temperature conversion formula

$$\text{Percentage impedance voltage: } u_{kt} \% = \sqrt{u_k^2 + \left(\frac{P_k}{10S_n}\right)^2 \times (k_t^2 - 1)} \times 100\%$$

$$\text{Short circuit impedance: } z_t = u_{kt} \times \frac{u_n^2}{S_n}$$

$$\text{Temperature coefficient conversion formula is: } P_{kt} = K_t P_k$$

$$\text{GB formula conversion formula is: } P_{kt} = \frac{P_k + \sum I_n^2 R_T (K_t^2 - 1)}{K_t}$$

Symbolic meaning of the formula:

T-correction of the target temperature, is 75 or 120

T- Current temperature

$t_R$  - The temperature when measuring resistance

$K_t$  - The current ambient temperature conversion to t (75 or 120) degrees temperature

coefficient,  $K_t = \frac{235 + t}{235 + T}$

$K_R$  - The measuring resistance to temperature conversion when the temperature coefficient

of the current ambient temperature,  $K_R = \frac{235 + T}{235 + t_R}$

$U_o$  - The average of the measured rms phase voltage,  $U_o = (U_{ab} + U_{bc} + U_{ca}) / 3$

$I_o$  - The average of the measured RMS phase current,  $I_o = (I_a + I_b + I_c) / 3$

$P'_k$  - The total loss measured power transformer, two-table method  $P'_k = P_{ab} + P_{bc}$ ,

three-table method  $P'_k = P_a + P_b + P_c$

$u_k$  - The impedance voltage percentage of the current temperature,  $u_k = (U_o / U_n) * (I_n / I_o)$

$P_k$  - The current temperature, the conversion to the rated current of the total loss power,

$P_k = P'_k * (I_n / I_o)$

$U_n$  - Rated voltage of the applied voltage test, if the voltage was applied from the high side is

$U_{n1}$ , if the voltage was applied from the low side is  $U_{n2}$ .

$I_n$  - Applied voltage side of the rated current, if the voltage was applied from the high side

is  $I_{n1}$ , if the voltage was applied from the low side is  $I_{n2}$ .

$S_n$  - Rated transformer capacity measured (in KVA).

$U_{n1} / U_{n2}$  - Respectively, the measured high side and low-voltage test transformer rated voltage.

$I_{n1} / I_{n2}$  - Respectively, the measured high side and low-voltage test transformer rated current.

$\Sigma I_n^2 R$  - The transformer being tested high and low pressure side of the three-phase winding resistance loss (unit: W); "Y" and "D" connection type of resistance loss =  $1.5 I_n^2 R_x$ . "Yn"

connection type of resistance loss =  $3I_n^2 R_{xn}$ , in which  $R_x$  - human type high / low pressure side of the line resistance,  $R_{xn}$  - manual type high / low voltage side of the phase resistance (X=1 or 2).

$\Sigma I_n^2 R_T$  - Converted to the current temperature of the transformer winding resistance loss,

$$\Sigma I_n^2 R_T = K_R * \Sigma I_n^2 R$$

#### 4. Appendix Table:

**10KV level distribution transformer Main technical data (for reference)**

Capacity (KVA)	Rated Current (A)		Io(%)				Loss(W)								Uk (%)
	HV Side	LV Side	S7	S9	S11	SH   M	S7		S9		S11		SH-M		
							No-load	Load	No-load	Load	No-load	Load	No-load	Load	
30	1.73	43.3	2.8	2.1			150	800	130	600					
50	2.88	72.2	2.6	2.0	0.6	1.5	190	1150	170	870	130	870	34	870	
63	3.64	90.93	2.5	1.9	0.55		220	1400	200	1040	150	1040			
80	4.62	115.5	2.4	1.8	0.55	1.2	270	1650	240	1250	180	1250	50	1250	
100	5.77	144.3	2.3	1.6	0.5	1.1	320	2000	290	1500	200	1500	60	1500	
125	7.2	180.4	2.2	1.5	0.5		370	2450	340	1800	240	1800			4
160	9.23	230.9	2.1	1.4	0.45	0.9	460	2850	400	2200	270	2200	80	2200	
200	11.55	288.7	2.1	1.3	0.4	0.9	540	3400	480	2600	340	2600	100	2600	
250	14.4	360.9	2.0	1.2	0.4	0.8	640	4000	560	3050	400	3050	120	3050	
315	18.19	454.7	2.0	1.1	0.35	0.8	760	4800	670	3650	480	3650	140	3650	
400	23.1	577.4	1.9	1.0	0.3	0.7	920	5800	800	4300	570	4300	170	4300	
500	28.8	721.7	1.9	1.0	0.3	0.6	1080	6900	960	5100	680	5100	200	5100	
630	36.4	909.3	1.8	0.9	0.3	0.6	1300	8100	1200	6200	810	6200	240	6200	
800	46.2	1154.7	1.5	0.8	0.25	0.5	1540	9900	1400	7500	980	7500	300	7600	
1000	57.7	1443.38	1.2	0.7	0.25	0.5	1800	11600	1700	10300	1150	10300	340	10300	
1250	72.1	1804.22	1.2	0.6	0.25	0.5	2200	13800	1950	12000	1360	12000	400	12000	
1600	92.3	2309.38	1.1	0.6	0.2	0.5	2650	16500	2400	14500	1640	14500	500	14500	
2000	115.5	2886.75	1.1	0.6	0.2	0.5			2830	17500	1940	17500	600	18000	
2500	144.34	3608.44	1.0	0.5	0.2	0.5			3350	20500	2300	20500	700	21500	4.5

**Note: SH-M-type amorphous alloy core power transformer**

## 5 .Common Troubleshooting

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- ☆ Boot no display: first off, open the socket on the back panel AC 220V fuse box, check the fuse box, you can replace insurance.
- ☆ The screen suddenly black screen: press the reset button, to start measurement.
- ☆ Measurement and computation results are not correct: Check the external wiring, whether by manual operation, whether bad or take the wrong line; relevant parameter is incorrect.  
Measuring voltage and current display to zero the normal, check whether the current file fuse blown

## 6. Quality assurance

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### ● Service commitment

The company sold the product warranty for one year, responsible for the maintenance (warranty period of the instrument users to the date of purchase), free maintenance during the warranty period, maintenance fees collected only during the period. Hotline 027-65526006

### ● Maintenance Responsibility

- ▼ The failure or damage caused by user's drop during use or handling.
- ▼ The failure or damage caused by user's maintenance with other units.
- ▼ The failure or damage caused by the abnormal voltage.
- ▼ The failure or damage caused by the force majeure (such as fire, flood, natural disasters, etc.) .
- ▼ The failure or damage caused by the do not follow the requirements of this manual, free to connect to other devices.
- ▼ No warranty card, and because the equipment could not confirm the defective product under warranty.