HZ-IV Transformer LV Short-circuit Impedance Tester

USER MANUAL

Huazheng Electric Manufacturing(Baoding) Co.,Ltd

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Transformer LV Short-circuit Impedance Tester applies to LV load impedance test during delivery, overhaul, trial test and handover test of power transformers (single phase or three-phase).

It tests the short-circuit impedance (%) of power voltage on site and compares it with the value indicated on the nameplate or the factory default to find out any defects including but not limited to winding displacement or deformation due to currents from major failure during transformation, installation or operation following the delivery test. **(The short circuit change shall be considered as significant if it exceeds ± 3% as specified in China International Conference on Electricity Distribution 2000 ("CICED 2000")).**

Transformer LV Short-circuit Impedance Tester is not provided with an external voltage regulator and adopts the primary connection mode. It begins the three-phase testing and calculates impedance error percentage automatically when the parameter is entered and provides intuitive results. This is a rapid tester which detects winding deformation of transformers on site.

I. Technical Parameters

Scope of voltage measurement: 5~400V	Accuracy of measurement: 0.2d
Scope of current measurement: 0.1~20A	Operating power: AC220V±10%
Power frequency: 50Hz	Operating temperature: -10℃~50℃
Ambient humidity: ≤85%RH	Net weight: 6kg

II. Characteristics

1. The tester is supplied with AC220V low voltage power to provide current for AB, BC and CA high voltage windings of the transformer automatically; collects data simultaneously and; calculates impedance error percentage automatically with intuitive testing results;
2. The tester completes the three-phase testing automatically in the primary connection mode other then inversed connection with the testing wire;
3. The tester allows either single phase testing or three-phase testing both manually and automatically;
4. The tester achieves output current limit applicable to test item with any impedance;
5. The test item can be measured without an external voltage regulator;
6. The tester functions in measuring zero sequence impedance;
7. The tester functions in measuring inductance;

8. The tester has a large LCD display with a menu in Chinese. Operation are facilitated based on the notes on the display; and

9. The tester enables printing and storage and is featured with high testing accuracy, high automation, small in size and light weight.

III. Wiring Diagram

- Fig. A depicts the wiring of a single phase transformer
- Fig. B depicts the wiring of a three-phase dual-winding transformer

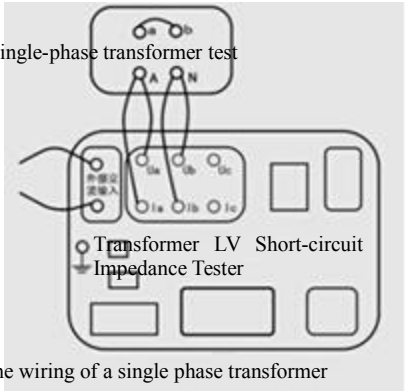

Fig. A

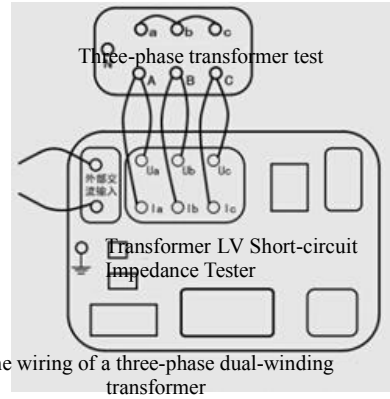

Fig. B

- Wiring of the three-phase dual-winding transformer is consistent with the selected position to be measured. If a High-Low position is selected for measurement, the testing wire should be connected to the HV side while the LV side is under short circuit; the remaining wires are under open circuit. If a High-Medium position is selected, the testing wire should be connected to the HV side while the medium voltage side is under short circuit; the remaining wires are under open circuit. If a Medium-Low position is selected, the testing wire should be connected to the medium voltage side while the LV side is under short circuit; the remaining wires are under open circuit.
- The section of short circuit wire should be no less than 10 mm^2 (bare copper wire is preferred). Such wire should be in good contact; otherwise it will affect the accuracy of testing data.

IV. Operating Instructions:

1. The interface shows when the tester is powered on: (Interface 1)

Welcome

Interface 1

2. Push down ENT to enter into the parameter setting interface: (Interface 2)

Rated capacity:	50,000 KVA
Rated voltage:	110.00 KV
Nameplate impedance:	17.98 %
Tapping position:	09
Measurement position:	High-Low
Item No.:	10
Testing temperature:	+20℃
Note: ▼▲ : Select, Ent: Test, Esc: Exit	

Interface 2

3. Enter the data on the transformer nameplate according to notes on the display. Push down ↑↓ to select a line. Push down ← to delete a digit towards the left. Push down the numeric keys to enter a digit. If negative testing temperature is needed, first push down ← to delete the digit, then push down ↓ to adjust a positive/negative sign; enter the temperature data and push down ENT to go to the interface below: (Interface 3)

Note:

- **The input of rated voltage should be consistent with the tapping position.**
- **If the single-phase process is used for a three-phase transformer, the data to be entered should be 1/3 of the rated capacity.**

Test
Single Phase Three-phase Zero Sequence Impedance
Note: ← →: Select, Ent: OK, Esc: Exit

Interface 3

4. Select a single phase transformer or a three-phase transformer to be measured.

- **Measurement of a single phase transformer:**

① Connect the testing wire between the tester and the transformer as shown in Fig. A of the wiring diagram. Enter the parameter. Select Single Phase in Interface 3. Push down ENT and it will show as follows: (Interface 4)

Single Phase Test	
UAN: V	IAN: A
ZK%: %	△ZK%: %
Frq: Hz	LAN: mH
Note: Ent: Start,	Esc: Exit

Interface 4

② Push down ENT to start measurement. The testing results will be shown on the display. The interface will show as follows: (Interface 5)

Single Phase Test			
UAN: x.xxx	V	IAN: x.xxx	A
ZK%: xxx.x	%	△ZK%: - x.xxx	%
Frq: 50.00	Hz	LAN: x.xxx	mH
Note: Ent: Lock, Esc: Exit			

Interface 5

③ Push down ENT to stop when the desired value of testing data is achieved. The testing data will be locked.

④ After locking the data, push down Print to directly print the test report.

Item No.: 10
Tester by:
Test date:
Rated capacity Sn: 50,000 KVA
Rated voltage Un: 110.00 KV
Nameplate impedance ZK%: 17.89%
Tapping position: 09
Testing position: High-Low
Measurement connection: Single phase
Voltage applied UAN: x.xxx V
Current applied IAN: x.xxx A
Measured impedance ZK%: x.xxx %
Impedance error △ZK%:- x.xxx %
Test frequency Frq: 50.00Hz
Measured inductance LAN: x.xxx mH

⑤ Push down SAVE. An "ALL DONE" notice will show at the lower right corner. If it is stored in the U-disk, please return to the "Welcome" interface when the tester is powered on. Press SAVE and the display will show all records saved. Select a record, insert the U-disk and press SAVE to save it in the U-disk. An "ALL DONE" notice will show at the lower right corner of the display.

- **Measurement of a three-phase transformer – manual measurement:**

① Connect the testing wire between the tester and the transformer as shown in Fig. B of the wiring diagram. Enter the parameter. Select Three-phase in Interface 3. Push down ENT and it will show as follows: (Interface 6)

Test		
Single Phase	Three-phase	Zero Sequence Impedance
Manual	Auto	
Note: ← →: Select, Ent: OK, Esc: Exit		

Interface 6

② Push down ← → to select the Manual or Auto mode. If Manual is selected, push down ENT to show three connection modes of the transformer: Y/△, Y/Y, △/Y, as shown below: (Interface 7)

Test		
Single Phase	Three-phase	Zero Sequence Impedance
Manual	Auto	
Note: ← →: Select, Ent: OK, Esc: Exit		

Interface 7

Notes:

a. The connection mode in Interface 7 should be selected based on the connection group of the transformer terminal.

b. Note: For the Medium-Low position of the three-phase three-winding transformer, Y denotes medium voltage and the low voltage side is under short circuit. Y/△ or Y/Y may be selected without allowing the connection mode of low voltage.

c. Push down ← → to select the connection mode of the transformer. If △/Y is selected, two different connection modes of △ mode will show: AZ-BX-CY or AY-BZ-CX to be determined by user according to conditions of the test item.

③ After selecting, push down ENT to go to the interface below: (Interface 8)

AB BC CA	Manual Three-phase	
UAB:	V	IAB: A
UBC:	V	IBC: A
UCA:	V	ICA: A
Note: Ent: Start, Esc: Exit		

Interface 8

④ Push down ← → to select the current applied AB, BC or CA phase. If AB phase is selected, push down ENT to measure the voltage and current of AB phase, as shown below (Interface 9):

AB BC CA	Manual Three-phase	
UAB: x.xxx V	IAB: x.xxx A	
UBC:	V	IBC: A
UCA:	V	ICA: A
Note: Ent: Lock, Esc: Exit		Testing

Interface 9

⑤ Push down Ent to lock the data. Push down Ent again to select the status of BC phase. Push down ← → to select BC phase, as shown below (Interface 10):

AB BC CA Manual Three-phase	
UAB: x.xxx V	IAB: x.xxx A
UBC: V	IBC: A
UCA: V	ICA: A
Note: Ent: Start, Esc: Exit	Testing

Interface 10

⑥ Push down ENT to measure the voltage and current of BC phase, as shown below: (Interface 11)

AB BC CA Manual Three-phase	
UAB: x.xxx V	IAB: x.xxx A
UBC: x.xxx V	IBC: x.xxx A
UCA: V	ICA: A
Note: Ent: Lock, Esc: Exit	Testing

Interface 11

⑦ The testing procedure of CA phase is the same as above. When the data of CA phase is locked, the tester will give an integrated calculation for the testing data of manual single phase for three times automatically. The display will show the impedance testing results and provide a printed report after two seconds.

An interface will show as follows: (Interface 12)

AB BC CA Manual Three-phase	
ZK%a: x.xxx %	ZK%b: x.xxx %
ZK%c: x.xxx %	
ZK%: x.xxx %75°	△ZK%:- x.xxx %
LAN: x.xxx mH	LBN: x.xxx mH
LCN: x.xxx mH	
Note: Esc: Exit	

Interface 12

⑧ Push down Print to directly print the test data report (the same with subsequent three-phase auto report).

⑨ Push down SAVE to save it in the tester. An "ALL DONE" notice will show at the lower right corner. If it is stored in the U-disk, please return to the "Welcome" interface when the tester is powered on. Press SAVE and the display will show all records saved. Select a record, plug in the U-disk and press SAVE to save it in the U-disk. An "ALL DONE" notice will show at the lower right corner of the display.

⑩ Push down ESC to return to the parameter setting interface from the testing interface. The manual single phase measurement of a three-phase transformer ends.

- **Measurement of a three-phase transformer – three-phase auto measurement:**

① Push down Ent after entering the data. Select the three-phase transformer, as shown below: (Interface 13)

Test
Single Phase Three-phase Zero Sequence Impedance
Note: ← →: Select, Ent: OK, Esc: Exit

Interface 14

② Push down Ent. Press ← → to select Auto mode, as shown below: (Interface 14)

Test
Single Phase Three-phase Zero Sequence Impedance
Manual Auto
Note: ← →: Select, Ent: OK, Esc: Exit

Interface 14

③ Push down ENT. Press ← → to select the connection mode, as shown below: (Interface 15):

Test
Single Phase Three-phase Zero Sequence Impedance
Manual Auto
Y/△ Y/Y △/Y
Note: ← →: Select Ent: OK, Esc: Exit

Interface 15

Notes:

a. The connection mode in Interface 15 should be selected based on the connection group of the transformer terminal.

b. Note: For the Medium-Low position of the three-phase three-winding transformer, Y denotes medium voltage and the low voltage side is under short circuit. Y/△ or Y/Y may be selected without allowing the connection mode of low voltage.

c. Push down ← → to select the connection mode of the transformer. If △/Y is selected, two different connection modes of △ mode will show: AZ-BX-CY or AY-BZ-CX to be determined by user according to conditions of the test item.

④ Push down ENT to go to the interface below: (Interface 16)

AB BC CA	Auto Three-phase
UAB: V	IAB: A
UBC: V	IBC: A
UCA: V	ICA: A
Note: Ent: Start, Esc: Exit	

Interface 16

⑤ Push down Ent to measure. The tester applies current to the windings of AB, BC and CA phases, collects data automatically and locks the measurements of three phases in turn. After measuring, the tester calculates

impedance error automatically.

The display will show the measurements: (Interface 17)

AB BC CA Auto Three-phase	
ZK%a: x.xxx %	ZK%b: x.xxx %
ZK%c: x.xxx %	
ZK%: x.xxx %75°	△ZK%:-x.xxx %
LAN: x.xxx mH	LBN: x.xxx mH
LCN: x.xxx mH	
Note: Esc: Exit	

Interface 17

⑥ Push down Print to directly print the test report below:

Item No.: 10

Tested by:

Test date:

Rated capacity Sn: 50,000 KVA

Rated voltage Un: 110.0 KV

Nameplate impedance: ZK%: 17.89 %

Tapping position: 09

Testing position: High-Low

Measurement connection: Three-phase Y/△

Voltage applied UAB: x.xxx V

Voltage applied UBC: x.xxx V
Voltage applied UCA: x.xxx V

Current applied IAB: x.xxx A

Current applied IBC: x.xxx A

Current applied ICA: x.xxx A
Measured impedance ZKab%: x.xxx %

Impedance error △ZKab%: - x.xxx %

Measured impedance ZKbc%: x.xxx %

Impedance error △ZKbc%: - x.xxx%

Measured impedance ZKca%: x.xxx %

Impedance error △ZKca%: - x.xxx%

Measured impedance ZK%: x.xxx %

Impedance error △ZK%: - x.xxx %

Measured inductance LAN: x.xxx mH

Measured inductance LBN: x.xxx mH
Measured inductance LCN: x.xxx mH

⑦ Push down SAVE to save it in the tester. An "ALL DONE" notice will show at the lower right corner. If it is stored in the U-disk, please return to the "Welcome" interface when the tester is powered on. Press SAVE and the display will show all records saved. Select a record, plug in the U-disk and press SAVE to save it in the U-disk. An "ALL DONE" notice will show at the lower right corner of the display.

- **Measurement of a three-phase transformer – single phase measurement:**

If the single-phase process is used for a three-phase transformer, the data to be entered should be 1/3 of the rated capacity.

The connection and operating mode should be the same with that of a single-phase transformer.

- **Measurement of zero sequence impedance:** When the zero sequence impedance is measured, the connection mode should be in such a manner that the HV three phases should be in parallel while the low voltage is under short circuit. Operations are provided as follows:

① Select Zero Sequence Impedance in Interface 3 as follows: (Interface 18)

Test
Single Phase Three-phase Zero Sequence Impedance
Note: ← →: Select, Ent: OK, Esc: Exit

Interface 18

② Push down Ent to measure. The measurement results are shown below: (Interface 19)

Zero Sequence Impedance
UAN:x.xxx V IAN: x.xxx A ZK: x.xxx Ω
Note: Ent: Lock, Esc: Exit

Interface 19

③ Push down Ent to lock. Push down Print to directly print the test report below:

Item No.: 10
Tested by:
Test date:
Rated capacity Sn :50000 KVA
Rated voltage Un :110.0 KV
Voltage applied UAB: x.xxx V
Current applied IAB: x.xxx A
Zero sequence impedance: x.xxx %

④ Data storage and storage in the U-disk are the same with that of impedance testing.

V. Impedance Formula

(1) For single phase transformer: Calculations should be based on the rated capacity for the level to be measured

Y/△ connection: $Z_K\% = \frac{3}{1000} \times \frac{U_K}{I_K} \times \frac{S_N}{U_N^2} \times 100\%$

Impedance error: $\triangle Z_K\% = (Z_{K'}\% — Z_K\%) \div Z_{K'}\%$

Wherein: I_K -Short-circuit current during testing (A)

U_K -Short-circuit voltage during testing (V)

U_N - Rated voltage (the rated voltage for the line during testing) (KV)

Z_K %-LV short-circuit impedance percentage

$Z_{K'}$ %-Short-circuit impedance percentage indicated on the nameplate or in the delivery test report

(2) Three-phase transformer:

1. Y/△ or Y/Y connection: Calculations should be based on the rated capacity

$$Z_A\% = \frac{1}{2000} \times \frac{U_{AB}I_{AC}I_{BC} + U_{AC}I_{AB}I_{BC} - U_{BC}I_{AB}I_{AC}}{I_{AB}I_{AC}I_{BC}} \times \frac{S_N}{U_N^2} \times 100\%$$

$$Z_B\% = \frac{1}{2000} \times \frac{U_{AB}I_{AC}I_{BC} + U_{BC}I_{AB}I_{AC} - U_{AC}I_{AB}I_{BC}}{I_{AB}I_{AC}I_{BC}} \times \frac{S_N}{U_N^2} \times 100\%$$

$$Z_C\% = \frac{1}{2000} \times \frac{U_{BC}I_{AC}I_{AB} + U_{AC}I_{AB}I_{BC} - U_{AB}I_{BC}I_{AC}}{I_{AB}I_{AC}I_{BC}} \times \frac{S_N}{U_N^2} \times 100\%$$

$$Z_K\% = (Z_A\% + Z_B\% + Z_C\%)/3$$

Impedance error: $\triangle Z_K\% = (Z_{K'}\% — Z_K\%) \div Z_{K'}\%$

Wherein: $I_{AB} + I_{BC} + I_{CA}$ -Short-circuit current during testing (A);

U_{AB}, U_{BC}, U_{CA} -Short-circuit voltage during testing (V)

U_N -Rated voltage (rated voltage for the line during testing) (KV)

S_N -Rated capacity (KVA)

Z_K %-LV short-circuit impedance percentage

$Z_{K'}$ %-Short-circuit impedance percentage indicated on the nameplate or in the delivery test report

2. △/Y connection: (a, b and c at the secondary side should be short circuited)

(1) For AZ-BX-CY connection: Calculations should be based on the rated capacity

$$Z_{AZ}\% = \frac{1}{60} \times \left[\frac{(U_{AC}I_{AB}I_{BC} - U_{AB}I_{BC}I_{AC} - U_{BC}I_{AB}I_{AC})^2 - 4U_{AB}U_{BC}I_{AC}^2 I_{AB}I_{BC}}{I_{AB}I_{BC}I_{AC}(U_{AC}I_{AB}I_{BC} - U_{AB}I_{AC}I_{BC} - U_{BC}I_{AB}I_{AC})} \right] \times \frac{S_N}{U_N^2}$$

$$Z_{BX}\% = \frac{1}{60} \times \left[\frac{(U_{AB}I_{AC}I_{BC} - U_{BC}I_{AB}I_{AC} - U_{AC}I_{AB}I_{BC})^2 - 4U_{AC}U_{BC}I_{AB}^2 I_{AC}I_{BC}}{I_{AB}I_{BC}I_{AC}(U_{AB}I_{AC}I_{BC} - U_{BC}I_{AC}I_{AB} - U_{AC}I_{AB}I_{BC})} \right] \times \frac{S_N}{U_N^2}$$

$$Z_{CY}\% = \frac{1}{60} \times \left[\frac{(U_{BC}I_{AB}I_{AC} - U_{AB}I_{BC}I_{AC} - U_{AC}I_{AB}I_{BC})^2 - 4U_{AB}U_{AC}I_{BC}^2 I_{AB}I_{AC}}{I_{AB}I_{BC}I_{AC}(U_{BC}I_{AB}I_{AC} - U_{AB}I_{AC}I_{BC} - U_{AC}I_{AB}I_{BC})} \right] \times \frac{S_N}{U_N^2}$$

(2) For AY-BZ-CX connection: Calculations should be based on the rated capacity

$$Z_{AY}\% = \frac{1}{60} \times \left[\frac{(U_{BC}I_{AB}I_{AC} - U_{AB}I_{BC}I_{AC} - U_{AC}I_{AB}I_{BC})^2 - 4U_{AB}U_{AC}I_{BC}^2 I_{AB}I_{AC}}{I_{AB}I_{BC}I_{AC}(U_{BC}I_{AB}I_{AC} - U_{AB}I_{AC}I_{BC} - U_{AC}I_{AB}I_{BC})} \right] \times \frac{S_N}{U_N^2}$$

$$Z_{BZ}\% = \frac{1}{60} \times \left[\frac{(U_{AC}I_{AB}I_{BC} - U_{AB}I_{BC}I_{AC} - U_{BC}I_{AB}I_{AC})^2 - 4U_{AB}U_{BC}I_{AC}^2 I_{AB}I_{BC}}{I_{AB}I_{BC}I_{AC}(U_{AC}I_{AB}I_{BC} - U_{AB}I_{AC}I_{BC} - U_{BC}I_{AB}I_{AC})} \right] \times \frac{S_N}{U_N^2}$$

$$Z_{CX}\% = \frac{1}{60} \times \left[\frac{(U_{AB}I_{AC}I_{BC} - U_{BC}I_{AB}I_{AC} - U_{AC}I_{AB}I_{BC})^2 - 4U_{AC}U_{BC}I_{AB}^2 I_{AC}I_{BC}}{I_{AB}I_{BC}I_{AC}(U_{AB}I_{AC}I_{BC} - U_{BC}I_{AC}I_{AB} - U_{AC}I_{AB}I_{BC})} \right] \times \frac{S_N}{U_N^2}$$

$$Z_K\% = (Z_A\% + Z_B\% + Z_C\%)/3$$

Impedance error: $\triangle Z_K\% = (Z_{K'}\% — Z_K\%) \div Z_K\%$

Wherein: $I_{AB} + I_{BC} + I_{CA}$ -Short-circuit current during testing (A);

U_{AB}, U_{BC}, U_{CA} -Short-circuit voltage during testing (V)

U_N -Rated voltage (rated voltage for the line during testing) (KV)

S_N -Rated capacity (KVA)

Z_K %-LV short-circuit impedance percentage

$Z_{K'}$ %-Short-circuit impedance percentage indicated on the nameplate or in the delivery test report

VI. Packing List

TESTER	1 SET
Private wire	1 SET
Power wire	1 piece
Ground wire	1 piece
Line box	1 NO.
FUSE	1 NOS.
PRODUCT MANUAL	1 NO.
Test report	1 NO.
Product certificate	1 NO.
Typing paper	1 roll

VII. Order and Service

1. A one-year free warranty is given to products subject to quality problems since the date of manufacture; materials costs will be charged for any damage due to other causes. Costs of repair and maintenance will be only charged if it is out of the free warranty.
2. We provide lifetime maintenance and technical services for the products.
3. Please contact us immediately upon discovery of any abnormality in the tester . We will provide the most convenient solution for you. DO NOT disassemble the tester!