

# **HZ-20AS**

## **Portable Lighting Arrester Tester**



**Huazheng Electric Manufacturing (Baoding) Co., Ltd**

Dear user:

Thank you for choosing HZ-20AS Portable Lighting Arrester Tester.

We hope that this instrument can make your work easier and more enjoyable, so that you can get the feeling of office automation in the test and analysis work.

Before using the instrument, please read this manual, and operate and maintain the instrument according to the manual to prolong its service life. "Just a light press, the test will be completed automatically" is the operating characteristics of this instrument.

If you are satisfied with this instrument, please tell your colleagues; if you are not satisfied with this instrument, please call (0312) 6775656 to tell you to serve you at all times-Baoding Huazheng Electric Manufacturing Co., Ltd., our company will definitely make you satisfied !

## Contents

I.Important.....	1
II.Overview.....	2
III.Functions And Fearutres.....	2
IV.Technical Index.....	4
V.Measurement And Compensation Principle.....	5
VI.Functions Of Panel Aand Components.....	7
VII.Operating Instructions.....	10
VIII. Test Wiring.....	22
IX.After-sales Service.....	25
X.Packing List.....	25

## **I.Important**

1. If the instrument is not in use, please turn off the power in time!
2. The rechargeable battery, as consumable part, ought to be well maintained. The effective capacity of rechargeable battery will fall gradually with time passing when the instrument is in use, which shortens the effective time of use. In order to prolong the service life of battery as long as possible, please pay attention to the following maintenance measures:
  - 2.1 When the instrument is out of service for a long period, please charge and discharge the battery regularly at least once each month. Please use the compatible charger provided by our company to charge the battery so as not to damage the battery.
  - 2.2 Insufficient-voltage use is strictly prohibited. The over discharge of the battery power will seriously shorten its life, and even make the battery scrapped; when the instrument prompts that power is low, you should stop using it as soon as possible and charge the battery to avoid battery failure due to excessive discharge of power.
  - 2.3 Charging indicator: During charging,the indicator is red, and after charging, it is green.
  - 2.4 When charging, the charger should be inserted into the AC220V power supply, and then the charging output plug will be inserted into the instrument for charging. Otherwise, the charger may not work properly.
3. Before using, the instrument must be Reliable grounded.
4. Correct wiring according to different testing methods.
5. When using wireless test mode, the instrument host and voltage collector must use the same wireless communication channel, otherwise, it will be impossible for wireless communication.
6. When using the wireless test mode, voltage collector must correctly install the antenna, otherwise, it is easy to burn the collector voltage wireless communication module; the instrument host must also correctly install the antenna,or it will greatly shorten the

distance of wireless communication.

7. When using the wireless test mode, the distance between the host and the voltage collector should be more than 1 meter. Otherwise, the wireless signal of the instrument host can be saturated due to the over-strength of the wireless signal, thus the instrument host will be unable to receive the radio signal sent by the voltage collector.

## **II.Overview**

Zinc Oxide Arrester Comprehensive Tester is used to check the electrical performances of the zinc oxide arrester (MOA).The instrument is suitable for on-site inspection of zinc oxide arrester at all voltage levels, as well as the factory test and acceptance test in the library when power is failed.By measuring the full current and resistive current and other parameters,it can be found that it is possible to detect the dangerous defects such as the internal insulation of the zinc oxide arrester and the aging of the valve.

## **III.Functions And Fearutres**

- 3.1 Being miniaturized and hand-held, small in size and light in weight, the instrument is easy to carry and operate.
- 3.2 Using a high-performance and low-power ARM processor with DSP floating-point processing units, the computing speed is faster, the operation accuracy is higher, and the processing data is larger. Thus, the accuracy and stability of the test data can be ensured.
- 3.3 High precision sampling filter circuit and digital filter technology can filter out the scene interference signal.
- 3.4 The floating-point fast Fourier algorithm is adopted to realize high precision analysis of the fundamental wave, harmonic voltage and current signal.
- 3.5 Using the industrial grade 5.6 inch 640 × 480 dot matrix high-brightness color LCD screen, it displays clearly and provides friendly man-machine interface; For some

important operation and parameter settings, it displays the tips and help instructions; the top of the screen status bar can display each peripheral working status and test status information.

- 3.6 The electrical parameters of the three phase zinc oxide arrester can be measured at the same time, and the interphase interference can be compensated automatically. It can also be measured in single phase to support the PT secondary voltage of phase B as the reference voltage. The compensation angle can be automatically calculated when the measured phase and the reference voltage phase are different.
- 3.7 Provide both wired and wireless test methods, and wireless test mode operation is more simple and flexible which can greatly reduce the work intensity of the field test personnel.
- 3.8 The unique sensor board replaces the PT secondary voltage measurement technology, making the measurement safer and faster.
- 3.9 Voltage collector integrated local display (128 × 64 dot matrix OLED LCD screen) and phase sequence checking function can display three-phase full voltage, voltage fundamental wave, three, five and seven times harmonic RMS, system frequency values and three-phase voltage phase difference. It is easy for field testers to quickly check the connection between the voltage collector and PT secondary voltage output terminal and the parameters of the three-phase voltage.
- 3.10 The voltage collector adopts double digital isolation technology, which is more securer and reliable.
- 3.11 AC and DC: built-in lithium battery power supply or 220V AC charger power supplyself-adaptively.
- 3.12 With the built-in high-capacity rechargeable lithium battery inside the host and the voltage collector, the instrument can continuously work for 8 hours after a complete charge.
- 3.13 Intelligent battery management: the remaining power display, low power alarm, long idle reminder and backlight automatic regulation.
- 3.14 Built-in real-time clock can display the current time and date,and automatically record

the test date and time.

3.15 The test data storage is divided into native storage and U Disk storage. The native storage can store 100 test data, and those data can be transferred into the U disk. U disk storage can save the test data and waveform pictures, with the test data in TXT format and the waveform picture in BMP format, which can be edited and printed directly on the computer.

3.16 The selected external thermal printer can print test data and the saved test record, and the printed content can be selected so as to save the paper.

## **IV. Technical Index**

### **4.1 Reference Voltage Measurement**

4.1.1 Reference voltage input range: 25V~250V RMS, 50Hz/60Hz

4.1.2 accuracy of reference voltage measurement:  $\pm (\text{reading} \times 5\% + 0.2\text{V})$

4.1.3 accuracy of voltage harmonic measurement:  $\pm (\text{reading} \times 10\%)$

4.1.4 reference voltage channel input resistance:  $\geq 1500\text{k}\Omega$

### **4.2 Current Measurement**

4.2.1 Whole current measurement range: 0 ~ 20mA RMS, 50Hz/60Hz

4.2.2 Accuracy:  $\pm (\text{reading} \times 5\% + 5\mu\text{A})$

4.2.3 fundamental wave measurement accuracy of resistive current:  $\pm (\text{reading} \times 5\% + 5\mu\text{A})$

4.2.4 Current harmonics measurement accuracy:  $\pm (\text{reading} \times 10\% + 10\mu\text{A})$

4.2.5 Current channel input resistance:  $\leq 2\Omega$

### **4.3 Electric-field Intensity Measurement**

4.3.1 input range of electric field strength: 30kV/m~300kV/m

4.3.2 accuracy of electric field intensity measurement:  $\pm (\text{reading} \times 10\%)$

4.3.3 accuracy of electric field harmonic measurement:  $\pm (\text{reading} \times 10\%)$

### **4.4 Service Conditions And Shape**

**4.4.1** power supply: built-in lithium battery or external charger, charger input 100-240VAC

50Hz/60Hz,output DC8.4V 2A

**4.4.2** Charging time: 4 hours

**4.4.3** Battery life: host:8h, Voltage Collector: 8h

**4.4.4** size of the host: 246mm (length) × 156mm (width) ×62mm (height)

**4.4.5** weight of the host: 1.0kg (excluding cables)

**4.4.6** size of the voltage collector : 115mm (length) × 120mm (width) × 65mm (height)

**4.4.7** voltage collector : 0.6kg (excluding cables)

**4.4.8** service temperature: -10℃～50℃

**4.4.9** relative humidity: <90%, No condensation

## V.Measurement And Compensation Principle

### 5.1 Measuring Principle

The instrument adopts the projection method shown in Figure 1 to calculate the resistive current of the fundamental wave and each harmonic wave.

Figure 1:

U1 Reference voltage of fundamental wave

Ix1p Full current peak of fundamental wave

Ir1p Resistive current peak of fundamental wave

Fig.1 projection

Ic1p Capacitive current peak of fundamental wave

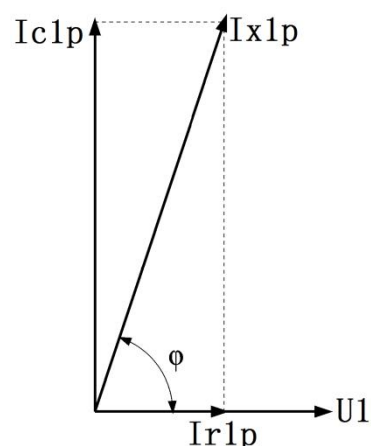
Φ The angle of fundamental full current advanced  
fundamental reference voltage

The formula:

$$Ir1p = Ix1p \cdot \cos\Phi$$

$$Ic1p = Ix1p \cdot \sin\Phi$$

The full current of zinc oxide arrester contains high harmonics both generated by the





non-linearity of the zinc oxide arrester and by the bus voltage harmonic. Compared with  $I_{r1p}$ ,  $I_{r1p}$  is more stable and real, so  $I_{r1p}$  is suggested to be the resistance current index. Both  $\Phi$  and  $I_{r1p}$  can directly measure the performance of zinc oxide arrester.

## 5.2 Interphase Interference And Automatic Compensation

### Principles

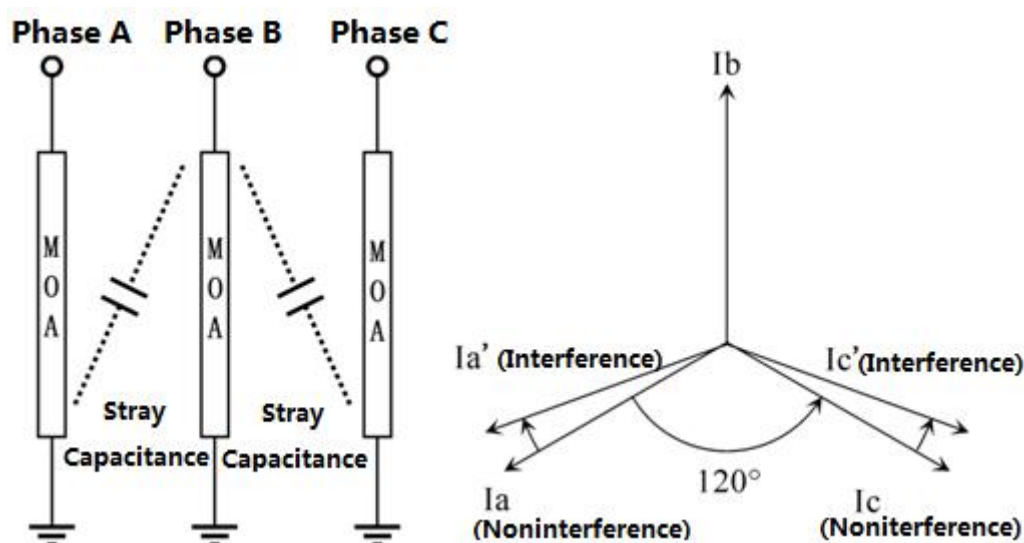


Fig.2 Interphase Interference

When the three phases test the zinc oxide arrester arranged in-line at the same scene, as shown in Figure 2, due to the existence of stray capacitance, the current phase of A and C offset to B phase, and the general offset angle is  $2^{\circ} \sim 4^{\circ}$  or so, which will make phase A  $\phi$  decrease, resistive current increase, phase C  $\phi$  increase, and resistive current decrease or even become negative. This phenomenon is called interphase interference.

The method to solve this problem is to adopt automatic compensation algorithm, which is the built-in "automatic edge repair" function. Assuming that the phase difference of  $I_a$  and  $I_c$  is  $120^{\circ}$  when there is no interference, and the interference of B to phase A and C is the same, and then measure  $\Phi_{ca}$ —the angle of  $I_c$  advanced  $I_a$ , phase A compensation  $\Phi_A = 0 (\Phi_{ca} - 120^{\circ}) / 2$ , phase C compensation  $\Phi_C = - (\Phi_{ca} - 120^{\circ}) / 2$ . This method actually averages the resistance of phase A and C, and it is greatly likely to cover up the existing problems. Therefore, it is recommended to assess the original data

without automatic compensation, (namely the compensation angle is  $0^\circ$ ), and assess the trend of change.

## VI.Functions Of Panel Aand Components

### 6.1 Host Panel Diagram And Interface Board Diagram

Host panel diagram and interface board diagram are shown in figure 3.

#### 6.1.1 Current input:

Phase A, B and C are three input channels, when measured in single phase, currents of phase A, B, and C are channeled from A.

#### 6.1.2 Reference signal input:

For cable test mode, compatible communication cableis used to connect voltage collector; and for induction test mode, it is used to connect the sensor plate and input the electric field signal.

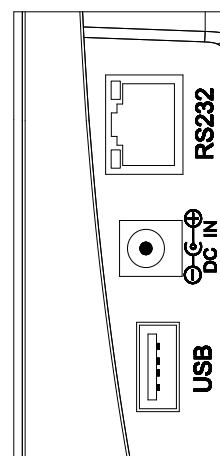
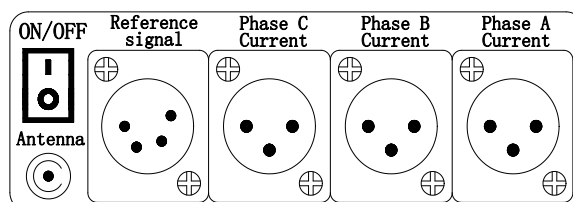
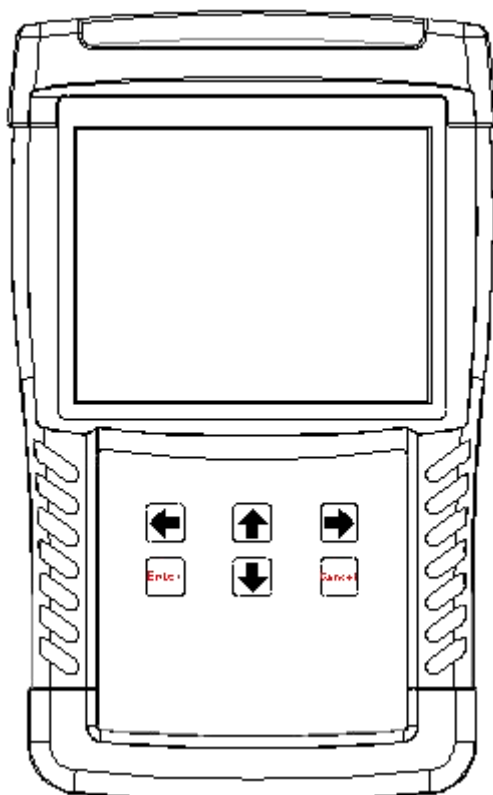
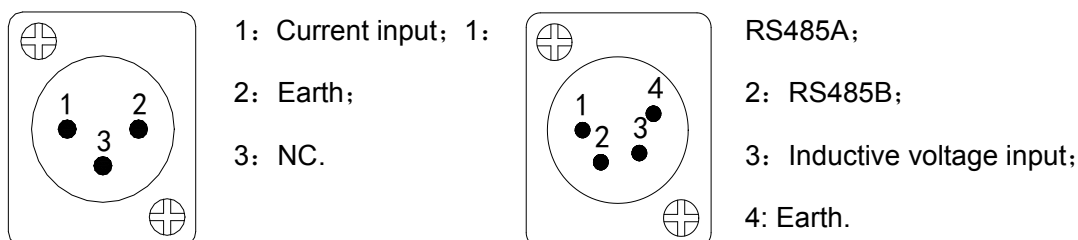


Fig.3 Host panel diagram and interface board diagram

**5.1.3 LCD screen:**

Industrial grade 640 \* 480 dot matrix high brightness color LCD screen, displaying operation menu, test data, waveform and so on.

**5.1.4 Keys:**

Used for operating the instrument. "↑ ↓" refers to "up and down", used to move or modify the data; "← →" refers to the "left and right", used to move or modify the data; "ENTER" is used to confirm the current operation; and "CANCEL" is used to give up the current operation.

**5.1.5 Antenna:**

When using the wireless test mode, please install the compatible antenna on the antenna seat so as to receive the wireless signal well. The wireless communication distance will be greatly shortened if not installing the antenna.

**5.1.6 USB interface:**

Used to connect the external U disk. Please use FAT or FAT32 format U disk to store test data. In the storage process, it is strictly prohibited to dial out the U disk.

**5.1.7 RS232 interface:**

This interface is an external printer interface for connecting external printer. It can print test results, and the printed content can be selected. There is no need to print the unconcerned data so as to save printing paper.

**5.1.8 DC IN:**

Instrument charger interface, please use the compatible charger of the instrument.

**5.1.9 Switch:**

Instrument power switch, please switch off the instrument power supply when it is

not in use in order to save battery power.

## 6.2 Front And Rear Panels Of The Voltage Collector

The front and rear panels of the voltage collector are shown in Figures 4 and 5.

### 6.2.1 Communication interface:

For wired test mode, compatible communication cable is used to connect instrument host reference signal input.

### 6.2.2 Antenna:

When using the wireless test mode, please install the compatible antenna on the antenna seat so that the voltage collector can transmit the wireless signal effectively. **Without installing an antenna, the wireless communication distance will be greatly shortened, and the internal wireless module may be burned if the using time is too long.**

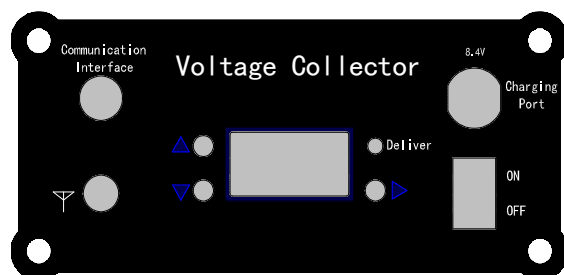


Fig.4 front panel of voltage collector

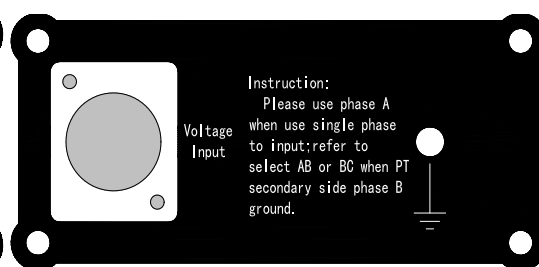


Fig. 5 rear panel of voltage collector

### 6.2.3 Keys:

Used for operating instruments. "↑ ↓" refers to "up and down", used to move or modify the data; "→" refers to "right", used to move or confirm the operation; and long press "→" will enter the setup menu interface.

### 6.2.4 LCD screen:

Industrial grade 128 × 64 dot matrix OLED LCD screen, display the operation menu and test data.

### 6.2.5 Send indicator:

The data indicator flashes once when the voltage collector sends date through wireless or wired way.

### 6.2.6 Charging port:

Instrument charger interface, please use compatible charger for the instrument.

#### 6.2.7 Switch:

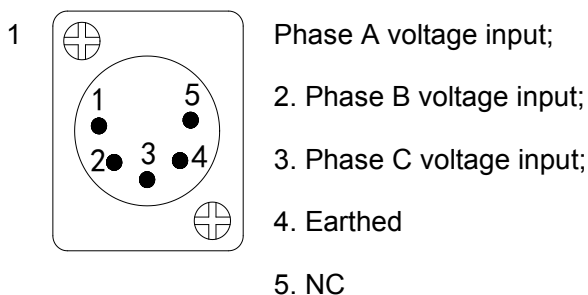
Power switch of voltage collector, please switch off the power supply when it is not in use in order to save battery power.

#### 6.2.8 Voltage input:

Reference voltage input is divided into phase A (yellow line), phase B (green line), phase C (red line) and neutral point or ground line (black line). Choose the reference phase for the single phase, and both phase A, B, C, AB, and CB are input from phase A (yellow line) and black line.

**Note:** If the PT secondary side is phase Bearthed, phase A (yellow line) is connected to PT secondary side phase A, the black wire is grounded, and the reference phase of the instrument host selects "A-B"; or phase A (yellow line) is connected to PT secondary side phase C, black line is grounded, and the reference phase of the instrument host selects "C-B".

The input line is connected in series with 120mA self-healing insurance.



#### 6.2.9 Grounding Pole:

During the test, the instrument must be **earthed** reliably. Connect the ground wire before connecting other test wires. After the test, the ground wire is removed to ensure personal safety.

## VII. Operating Instructions

Before testing, the instrument host and voltage collector shell should be reliable earthed (the host is grounded by the black clamp of the current test wire), and correctly

connect wires according to different test ways. Please refer to the "7 test wiring" for wiring instructions under various test modes. When using the wireless test mode, the voltage collector should be placed in a higher position (e.g. on the PT terminal box), which can prolong the wireless communication distance.

## **7.1 Intelligent Power Management**

When the instrument is not in operation for a long time, it will automatically reduce the brightness of the backlight of the LCD screen to save the power, and display the prompt window to prompt the user to turn off the power of the instrument by voice. The instrument has the function of low-power prompting. When the instrument is low in power, the charger can be plugged in for charging, and the instrument can be operated normally during charging.

## **7.2 External Printer Instructions**

The external printer is connected to the instrument host with the compatible connection wire. The green indicator on the external printer interface is the power indicator, and the yellow one is the data indicator. After the external printer is connected successfully, the green indicator light on the RS232 interface of the instrument host is on, and the top status bar of the screen displays the icon of the printer.

The keys and indicator lights of printer are integrated. When the printer is powered on, normally the indicator light keeps on, while the indicator light flashes when the paper is out. Press the key once, and the printer will feed paper. When there is pink edge on the printed paper, it indicates that the paper is about to run out, please feed the printing paper in time. Self-check of the printer: Press and hold the key when the device is turned off, and

connect the instrument to the power to print out the self-check bar.

Feed the printing paper: Pull out the revolving wrench, open the cover, load the paper and pull out a length of paper (a little bit more than the tearing paper knife). The paper must put in order, and the direction of the paper is the liquid side (smooth surface) up. Close the

paper cover, after the print head axle pressed paper straight,  
push the print head axle hard back as while as reset the  
rotary wrench, and push the rotary wrench into the reset.

## 7.3 Host Operating Instructions

Turn on the power switch of the instrument host and enter the boot screen after the instrument is initialized (see figure 6), on which it will display the device model, software version number and hardware version number; then the instrument will automatically



Fig. 6 Boot Screen

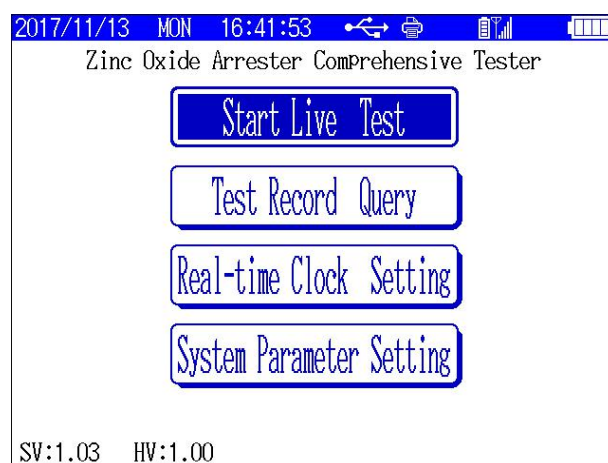


Fig. 7 Main menu





### 7.3.1 Main Menu

The "main menu" screen is shown in figure 7. The top status bar shows the current date, time, the insert status of the U disk, the connection status of the external printer, the test mode (and corresponding additional information), and the battery power of the instrument host. The bottom displays software version number, hardware version number and device number. The middle is the model name of the instrument and the optional function menu.

Press the up and down keys to select the corresponding function menu; press the "ENTER" key to enter the selected function menu; "system parameter setting" menu is for debugging in the factory, and it is not open to users.

-  Wireless test mode, which shows the battery power of the voltage collector and

the received wireless signal strength. When the power is low, the battery symbol flickers. When the wireless signal is not received, the wireless signal strength shows "?", and the alarm will be issued the sound like "di.. di ..di .." during the test.

-  Wired test mode, which displays the status of voltage collector battery and wired connection. When the power is low, the battery symbol flickers. Connection success shows up and down arrow mark, and connection failure displays "?", and the alarm will be issued the sound like "di.. di ..di .." during the test.
-  Induction test mode, which does not display related status of voltage collector .
-  This icon indicates that the U disk has been inserted and initialized successfully.
-  This icon indicates that the external printer is successfully connected.

### 7.3.2 Test Parameter Setting

Select "start live test" on the "main menu" screen and press "ENTER" key to enter "test parameter settings" screen, as shown in figure 8.

Press the up and down key to select the setting items, and press "ENTER" or right key to enter the specific numerical setting. When the cursor is in the specific numerical position, press the up and down key to adjust the value, and press "ENTER" key or left key to return to the project selection.

The prompt window on the right shows the operating instructions and important tips for the corresponding settings.


2017/11/13 MON 16:43:05    					
Start Live Test > Test parameter settings					
Test ID	000000	<Instruction> Please connect test wires according to requirement, press the ENTER key to start the test.  <div>Start Test</div>			
Device ID	000000				
Test Mode	Wireless 0				
Reference	ABC				
Tested	ABC				
COMP Mode	No COMP				
COMP Angle	$\phi_a$	0.00°	$\phi_b$	0.00°	$\phi_c$ 0.00°
PT Ratio	Preset Ratio	220kV/57.7V			

Fig.8 Test parameter setting



- **Test ID** : Set the current test number.
- **Device ID**: The number of the device being tested, which cannot be set.
- **Test Mode**: The test mode can be wired, wireless and induction. When choosing wireless test mode, the number at the right of the word "wireless" indicates the channel value used by the current wireless module.
- **Reference**: Reference phase.It can be set as ABC, A, B, C, A-B and C-B; **when selecting the induction test mode, it is fixed to phase B.**

The ABC represents the simultaneous use of the three-phase voltage as the reference voltage.

The A, B, and C indicate the use of the single-phase voltage as the reference voltage.

**A-B and C-B indicate the case where the phase B of PT is grounded,using A-B or C-B as the reference voltage.**

**When the single-phase voltage is used as the reference voltage, the reference voltage is input by phase A of the voltage collector(yellow wire) channel.**

- **Tested** : Tested phase.It can be set as ABC, A, B and C.

ABC represents three-phase simultaneous measurement, namely three phase currents is entered simultaneously in the three phase current channels of A,B and C .

**A, B, and C represent single phase measurement, and phase A current channel is used to input current.**

- **COMP Mode**: Compensation mode.It can be set as"No COMP", "Manual COMP"and "Auto COMP".

"No COMP": disable compensation.Namely the compensation angle is 0°.

When the reference phase is single phase, and it is different from the tested phase, the instrument automatically sets up the theoretical compensation angle, as shown in the table below.

	Tested Phase A	Tested Phase B	Tested Phase C
Reference Phase ABC	0°	0°	0°
Reference Phase A	0°	120°	240°
Reference Phase B	240°	0°	120°
Reference Phase C	120°	240°	0°
Reference Phase A-B	30°	150°	270°
Reference Phase C-B	90°	210°	330°

"Manual COMP": manual compensation. Manually set the compensation angles of phase A, B and C, and the setting range is  $\pm 360.00^\circ$ .

**Note: There must be a basis for setting the compensation angle. Arbitrary setting is not allowed!**

"Auto COMP": auto compensation. According to the principle of "4.2 phase interference and automatic compensation principle", the compensation is automatically carried out.

**Note: The angle of compensation is always added to the phase difference between current and voltage, for example, the phase difference between current and voltage is  $80^\circ$ , and the compensation angle is  $1^\circ$ , then after compensation, the final angle of current and voltage is  $81^\circ$ .**

- **COMP Angle:** Compensation angle. Here, the user can view or set the compensation angle of phase A, B and C. The single phase measurement only shows the compensation angle of the tested phase.
- **PT Ratio:** The PT voltage turn ratio is set up under the wired and wireless test modes, and the turn ratio of the induction test method is invalid. The PT turn ratio has two sets of settings, which are "custom value" and "preset ratio". The "custom value" mode can set the turn ratio at will and the "preset ratio"

mode automatically calculates the PT turn ratio by selecting the PT first rated voltage and the PT secondary rated voltage.

- **Start Test:** After the parameter is set and the cursor is moved to this point;press the "ENTER" key to start the test process and enter the test data display screen. In addition, the instrument will save this parameter settings for the next time to use.

### 7.3.3 Test Data Display Screen

Test data display screen is divided into the following five ones: main test data, detailed test data, harmonic test data, waveform test data and parameter settings view. Afterthe cursor moved to the "Switch", press "ENTER" to switch the screen. For single measurement,there is no separate waveform test data display screen, and the waveform test data will be displayed on all the test data screens.

Here, the parameter settings view screen is mainly used to view the parameters of the test settings and cannot be modified, if the parameter setting is needed to modify, please return to the "test parameter setting" screen.

**Main test data screen** is shown in Figure 9; **detailed test data screen** is shown in Figure 10; **harmonic test data screen** is shown in Figure 11; **waveform test data screen** is shown in Figure 12; and **parameter setting view screen** is shown in Figure 13.

2016/12/01 FRI 08:06:38	Phase A	Phase B	Phase C	49.99Hz
U <sub>x</sub>	99.82V	99.96V	99.96V	ΦAB:
U <sub>3</sub>	9.963%	9.967%	9.972%	119.99°
U <sub>5</sub>	9.897%	9.914%	9.907%	ΦBC:
U <sub>7</sub>	9.802%	9.813%	9.812%	119.99°
I <sub>x</sub>	4.972mA	4.974mA	4.947mA	ΦCA:
I <sub>xp</sub>	6.593mA	6.594mA	6.559mA	120.00°
I <sub>r</sub>	0.742mA	0.744mA	0.742mA	
I <sub>rp</sub>	1.922mA	1.924mA	1.920mA	Test
I <sub>r1p</sub>	0.808mA	0.812mA	0.809mA	Switch
I <sub>c1p</sub>	6.881mA	6.883mA	6.846mA	
I <sub>r3p</sub>	0.234mA	0.234mA	0.234mA	Store
I <sub>r5p</sub>	0.378mA	0.377mA	0.377mA	
I <sub>r7p</sub>	0.501mA	0.499mA	0.499mA	Print
P <sub>1</sub>	56.25mW	56.63mW	56.38mW	
C <sub>x</sub>	157.4nF	157.2nF	156.4nF	
φ	83.29°	83.26°	83.25°	

Fig.9 Main test data screen

2016/12/01 FRI 08:05:18	Phase A	Phase B	Phase C	49.99Hz
U <sub>x</sub>	99.81V	99.96V	99.96V	ΦAB:
I <sub>x</sub>	4.973mA	4.974mA	4.945mA	119.99°
I <sub>r1p</sub>	0.812mA	0.812mA	0.807mA	ΦBC:
P <sub>1</sub>	56.49mW	56.63mW	56.24mW	120.00°
φ	83.27°	83.26°	83.27°	ΦCA:
I <sub>r</sub>				119.99°
CONCL	Excellent	Excellent	Excellent	Pause
				Switch

Fig. 10 Detailed test data screen

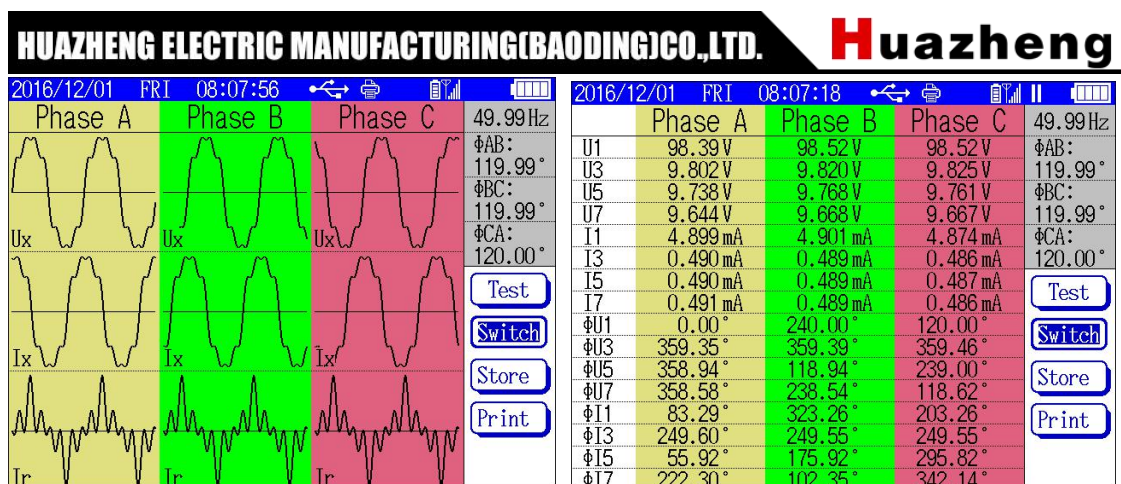


Fig. 11 Harmonic test data screen

Fig. 12 Waveform test data screen

- This symbol is displayed during the test and blinks.
- This symbol is displayed when the test is paused and blinks.

Click the "Test" key to enter the test state; click "Pause" key to enter the pause state; Under the test state, the instrument can only switch the display screen, but cannot save data, print,upload and perform other functions. Under the pause state, the screen will display "Save", "Print", "Upload"keys, and the users can save, print,upload and perform other operations.

### 7.3.4 Test Data Specification

- **System frequency:** The upper right corner of the screen shows the frequency of the system collected by the instrument.
- **Three phase voltage angle:** Three phase simultaneous measurement shows three-phase voltage angle φa-b, φb-c and φc-a; single-phase measurement does not display those angles.

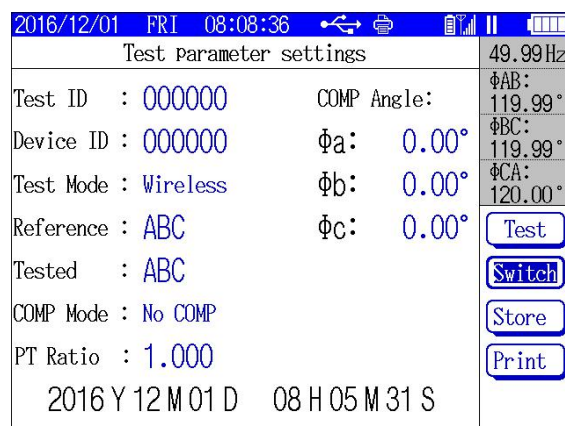


Fig. 13 parameter setting view screen

- **Ux:** The reference voltage effective value contains only the fundamental wave and the 3, 5 and 7 harmonics, the formula is:

$$U_x = \sqrt{U_1^2 + U_3^2 + U_5^2 + U_7^2}$$

When using an induction test mode, the Ex is shown to indicate the electric field induced intensity, and the unit is KV/m.

- **U1**: fundamental voltage effective value; When using induction testing mode, E1 is shown to indicate the fundamental electric field induced intensity.
- **U3, U5, U7**: 3, 5 and 7 harmonic voltage RMS and their relative content of fundamental voltage; When using induction test mode, the screen displays E3, E5 and E7.
- **Ix**: full current RMS, only including the fundamental wave and 3, 5, and 7 harmonics.
- **Ixp**: full current peak, namely the peak value of Ix.
- **Ir**: the resistance current RMS, including only the fundamental wave and the 3, 5 and 7 harmonic resistance currents.
- **Irp**: peak of resistance current, namely the peak value of Ir.
- **Ir1p**: peak of fundamental wave resistance current.
- **Ic1p**: peak of fundamental wave capacitive current.
- **Ir3p, Ir5p, Ir7p**: peak of 3, 5, 7 harmonic resistance current.

**Note:** If the Angle  $\Phi$  of advanced fundamental voltage of the fundamental wave current exceeds  $90^\circ$ , Ir1p is negative; when the angle is more than  $180^\circ$ , Ic1p is also negative. If the Ix waveform is flat, Ic1p can be greater than Ixp.

- **P1**: Fundamental power consumption, i.e., the product of the effective value of the fundamental wave resistance current and the effective value of the fundamental wave voltage. When using the induction test method, U1 = 1000V is assumed in the instrument, and the fundamental power consumption unit is shown as mW/KV and W/KV. The actual power consumption of the zinc oxide arrester under running voltage can be obtained by multiplying this value with the actual voltage value of the system (unit: KV).
- **Cx**: electric capacity of zinc oxide arrester, and the formula is as follows:

$$C_x = \frac{I_{c1}}{2 \pi f U_1}$$

Ic1 is the effective value of the fundamental wave capacitance current

F is the system frequency

U1 is the effective value of the fundamental wave voltage

When using induction test mode,  $U1 = 1000V$  is assumed in the instrument, and the unit of electric capacity is shown as  $\mu F \cdot kV$  and  $nF \cdot kV$ . This value is divided by the actual voltage value of the system (kV), and the actual electric capacitance of the zinc oxide arrester under running voltage can be obtained.

- $\Phi$ : The Angle of advanced fundamental voltage of the fundamental wave current, which already contains the compensation angle. The conclusions given by the instrument according to the judgment of  $\Phi$  are shown in the following table:

conclusion	Worse	Bad	Medium	Good	Excellent	Interfered
$\Phi$	$0 \sim 74.99^\circ$	$75 \sim 76.99^\circ$	$77 \sim 79.99^\circ$	$80 \sim 82.99^\circ$	$83 \sim 87.99^\circ$	$\geq 88^\circ$

**Note:** this instrument has the automatic amplification function of the waveform, so the amplitude of the waveform cannot represent the corresponding data value.

### 7.3.5 Test Record Query

2016/12/01 FRI 08:49:11	Phase A	Phase B	Phase C	49.99Hz
U <sub>x</sub>	57.62V	57.70V	57.69V	$\phi_{AB}: 120.00^\circ$
I <sub>x</sub>	4.974mA	4.974mA	4.944mA	$\phi_{BC}: 119.99^\circ$
I <sub>r1p</sub>	0.572mA	0.571mA	0.568mA	$\phi_{CA}: 119.99^\circ$
P <sub>1</sub>	23.00mW	22.96mW	22.87mW	001/003
$\Phi$	85.26°	85.27°	85.26°	Switch
I <sub>r</sub>				Store
CONCL	Excellent	Excellent	Excellent	Print

Fig. 14 Test record query

2017/11/13 MON 16:45:38	Real-time Clock Setting
2017 Y 11 M 13 D	
16 H 45 M 30 S	
Monday	

Fig. 15 Real-time clock setting

The test record query screen is shown in figure 14. All the test records, the test data, waveforms and corresponding parameter settings stored in the instrument can be viewed in the screen. The saved test records in the instrument can be transferred to the U disk or printed. The number before "001/003" represents the saved number of the test record currently viewed, and the number after indicates the number of saved test records, and



the instrument can hold up to 100 test records. Press "←→" key to switch the test record to view.

### 7.3.6 Real-time clock setting

The real-time clock setting screen is shown in figure 15. It is used to set the clock that comes with the instrument. Press "↑ ↓" to adjust the value, press "← →" to move the cursor, press "ENTER" to save the setting, and press "CANCEL" to give up the setting.

## 7.4 Voltage Collector Operation Instructions

Turn on the voltage collector power switch, the voltage collector is initialized into the boot screen (seen in Figure 16), which displays the voltage collector software version number, hardware version number and instrument number; then the screen will automatically enter the "test data" screen.



Fig.16 boot screen

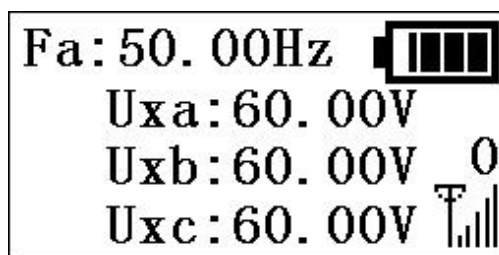




Fig. 17 test the data screen

### 7.4.1 Test Data Display Screen

The test data display screen is shown in figure 17. This screen shows:

- Battery power of voltage collector.
- System frequency tested by the phase A.
- **Voltage collector transmission mode:**

 is the wireless transmission mode (the value shown above is the symbol of the wireless communication channel), and  is the cable transmission mode. Press "→" key to switch mode.

- Three - phase reference voltage effective value, fundamental wave, 3, 5 and 7 harmonic voltage effective value.
- Phase difference of three-phase fundamental wave voltage.

Press the "↑ ↓" key to switch the display content. Voltage collector has the function of alarming phase sequence error, when the reference voltage is three-phase (collecting three-phase voltage at the same time), if the three-phase phase sequence is not positive, the alarm information will be displayed and an alarm tone will be sent out.

If the voltage collector does not perform voltage measurement (voltage is less than 1V), after a period of time, the voltage collector will issue a prompt voice and prompt message, prompting the user to shut down the instrument. If the measurement is carried out, no prompt voice or prompt message will be issued.

#### **7.4.2 Main Menu And Wireless Channel Settings**

Under the test data display screen, long press "→" key to enter the "main menu" screen, the "main menu" screen contains "1.Set RF channel" and "2.System setting", which can be selected by pressing "↑↓" key, and pressing "→" key to confirm. "2.System setting" is used for debugging in the factory and is not open to users.

Select "1.Set RF channel" and confirm it, then enter the "Password" screen and press the "→" key to move the cursor. When the cursor is in the position of password, press the "↑↓" key to change the password value. When the cursor is in the position of "ENTER" or "CANCEL", the "↑↓" key is same as the "ENTER" key. **The password of the wireless channel setting menu is "888888".**

**The value of the RF channel cannot be modified at will. The channel value must be same as that of the instrument host. When confronted with same frequency interference and the wireless communication channels needed to modify, after setting voltage acquisition and wireless channel, press "→" under the test data display screen to change the transmission mode of voltage collector to cable mode; Connect the voltage collector and instrument host with cable communication cable, and set the instrument host as cable test mode, after the success of communication, wireless communication channel of instrument host will automatically set to the channel value consistent with that of voltage collector. Then the test can be conducted under the wireless test mode.**



## VIII. Test Wiring

### 8.1 Notes

**8.1.1** Before testing, the instrument host and voltage collector should be reliable grounded (the host is grounded by the black clamp of the current test wire).

**8.1.2** Current sampling: For single phase test, the current sampling should be input from phase A channel of the instrument host; and for the three-phase test, the current should be input from phase A, B and C respectively. The instrument can only use low voltage and small current for signal sampling, so the test wire should be away from high voltage.

**Tip: Take the current from the zinc oxide arrester counter. When the test clamping is well connected, the counter ammeter pointer points to zero. If the pointer of the current meter does not point to zero, it indicates that the test folder is not well connected. At this moment, use the test clamp to rub the connecting part for several times so that the ammeter pointer would point to zero.**

**In order to ensure the safety of the test, the black clamp should be connected first, so that the instrument host is grounded first, and then the other color test clamps are connected.**

**8.1.3** Reference voltage sampling: For single phase test, the current is input from the voltage collector phase A (yellow) channel; and for the three-phase test, the current is input from phases A, B and C (yellow, green, red). The voltage test wire is connected with 120mA self-recovery insurance in series to prevent the short-circuit of the test wire, which will cause the secondary side fault of the PT.

**8.1.4** Induction test mode: The sensor plate must be placed on the base of phase B zinc oxide arrester, the current must be input from the reference signal channel of the instrument host; and the induction plate must be placed perpendicular to the phase B zinc oxide arrester and its horizontal position should be on the center wire of the

horizontal symmetry of phase A and C.

**8.1.5 Wireless test mode:** the voltage collector should be placed in a relatively higher position (for example: on the PT terminal box), which can prolong the distance of wireless transmission and reception. When the wireless signal is weak, the antenna direction can be adjusted appropriately to enhance the wireless signal. A suction antenna with extension cord can be used to improve the quality of the wireless signal under special circumstances.

## 8.2 Wiring Instructions Of Wired Test Mode

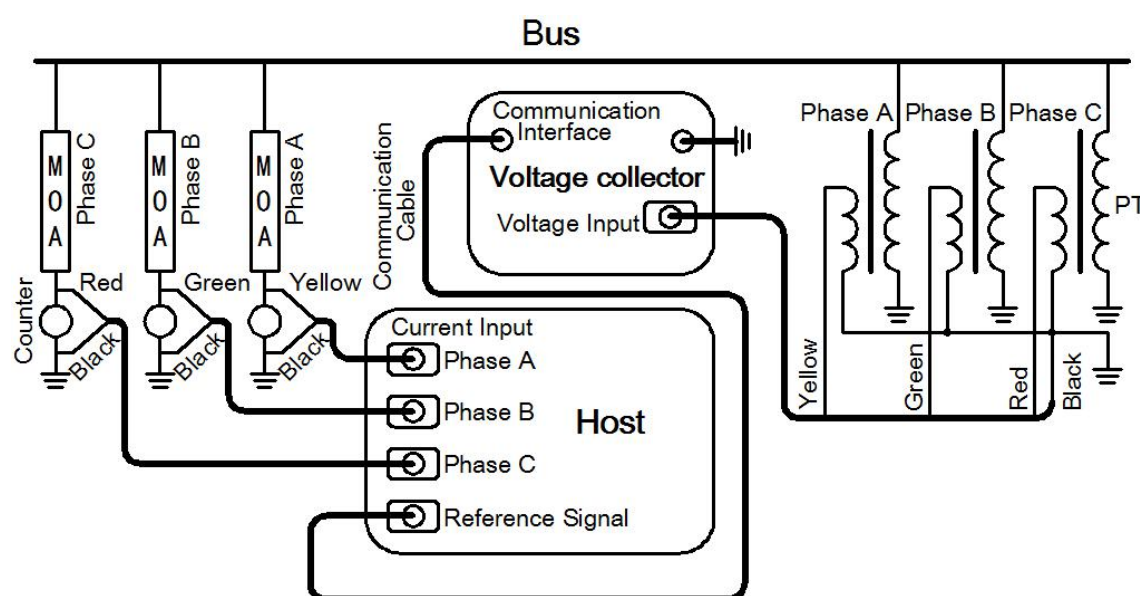


Fig. 19 wiring diagram of wired test mode (simultaneous measurement of three-phase)

The wired test method needs to use the communication cable to connect the instrument host and the voltage collector, and to transmit and synchronize the data through the wired mode. The wiring diagram is shown in figure 18.

When connecting, the phase sequence of current and voltage must be connected according to the correct phase sequence. The instrument host is set to wired test mode, and the voltage collector is set to wired transmission mode.

## 8.3 Wiring Instructions Of Wireless Test Mode

The instrument host of the wireless test mode and voltage collector transmit and synchronize data through wireless communication, and the wiring diagram is shown in

figure 19.

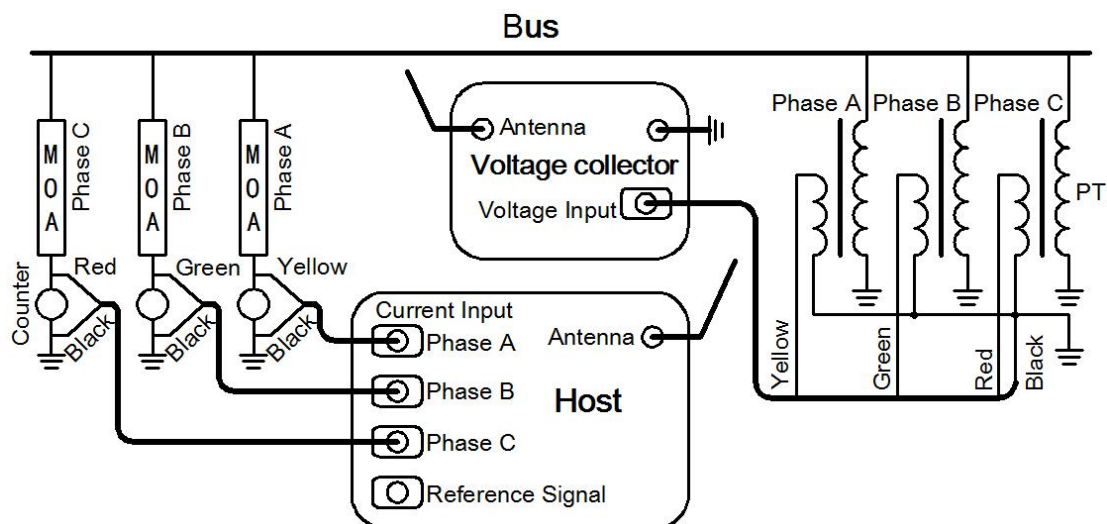


Fig. 19 wiring diagram of wireless test mode (simultaneous measurement of three-phase)

## 8.4 Wiring Instructions Of Induction Test Mode

The voltage collector is unnecessary to the induction test mode, the current sampling and the induction electric field sampling can be completed by the host. The induction plate should be placed on the base of phase B arrester, and the position should be symmetric with the arrester of phase A and C, and the sensor plate is perpendicular to the arrester of phase B. The wiring diagram is shown in figure 20.

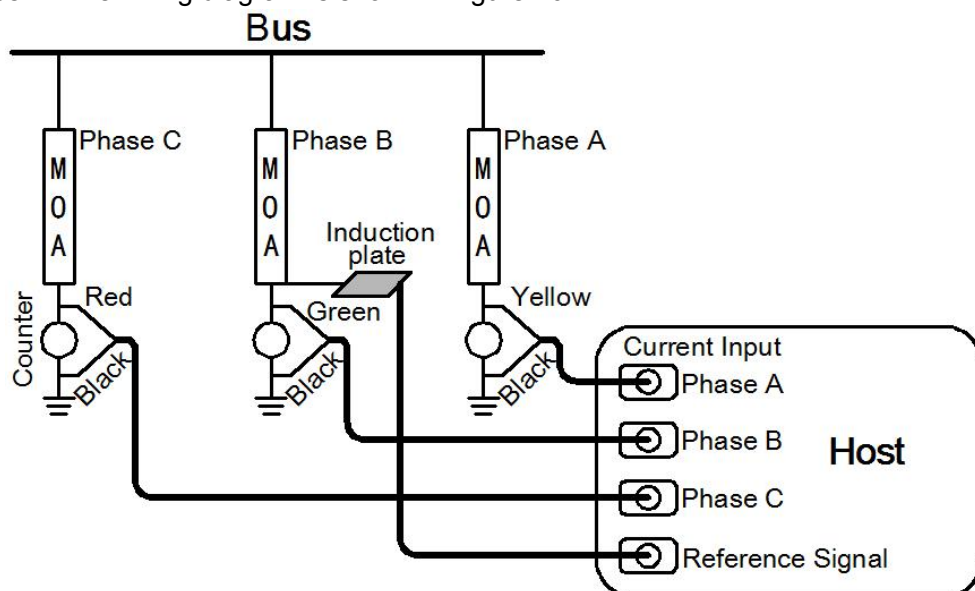


Fig. 20 wiring diagram of induction test mode (simultaneous measurement of three-phase )

## IX.After-sales Service

**9.1** Product warranty forms are provided for the products of our company.

Please check and fill out the warranty form on the spot when ordering goods for delivery.

**9.2** From the date of purchase, the maintenance fee will not be charged during the warranty period. After the warranty period, maintenance and commissioning will charge the appropriate fees.

**9.3** Batteries are consumable products and are not covered under warranty.

**9.4** One of the following conditions is not subject to warranty:

**9.4.1** The user disassembles the instrument or alters the technological structure of the instrument.

**9.4.2** Serious damage to the instrument due to user custody or improper use.

**9.4.3** Damages due to other causes of users.

## X.Packing List

No.	Item	Qty
1	Tester host	1
2	Voltage collector	1
3	External printer	1
4	Antenna	2
5	Printer cable	1
6	Voltage test line	1
7	Current test line	3

<b>8</b>	Current test extension cable	3
<b>9</b>	Induction test line	1
<b>10</b>	Wired communication cable	1
<b>11</b>	Ground wire	1
<b>12</b>	charger	2