PS-EA Capactiance&Tan-Delta Tester

Product Manual

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Preface

1. Sincerely thank you for using our products, so you will get the company's comprehensive technical support and service guarantee.

2. This instruction is suitable for PS-EA Capactiance&Tan-Delta Tester.

3. Before you use this product, please read the instructions carefully and keep them properly for reference.

4. Please strictly follow the instructions and procedures. Improper use may endanger personal safety.

5. If you have any doubts in reading this instruction or using the instrument, you may consult with our company.

Before using this instrument, please read the operation manual carefully to ensure that safety is the user's responsibility.
We reserve the right to amend this instruction.
Where the product does not conform to the instructions, the actual product shall prevail.

Catalog

PS-EA Capactiance&Tan-Delta Tester

One、Overview of Instruments

Dielectric loss measurement is a very basic method in insulation test. It can effectively detect the whole damp deterioration and partial defects of electrical equipment insulation. It is widely used in electrical manufacturing, installation of electrical equipment, handover and preventive testing. Measurement of dielectric loss of transformer, transformer, reactor, capacitor, bushing and arrester is the most basic method to measure their insulation performance.

PS-EA Capactiance&Tan-Delta Tester breaks through the traditional bridge measurement mode, adopts frequency conversion power supply technology, uses single chip computer and modern electronic technology to automatically convert frequency, analog/digital conversion and data operation; achieves strong anti-interference ability, fast testing speed, high accuracy, fully automatic digitization and easy operation; power supply uses high-power switching power supply, and outputs 45Hz and 55Hz pure. Chord wave, automatic pressure, can provide up to 10 kilovolts of voltage; automatic filter 50Hz interference, suitable for field testing of large electromagnetic interference such as substations. It is widely used in dielectric loss measurement of transformer, transformer, bushing, capacitor, arrester and other equipment in power industry.

Two、Safety measures

1. Be sure to read this manual carefully before using this instrument.
2. Instrument operators should have general knowledge of the use of electrical equipment or instruments.
3. The instrument can be used both inside and outside the house, but it should be used in places such as rain, corrosive gas, excessive dust, high temperature and direct sunlight.
4. Instruments should avoid severe vibration.
5. The maintenance, nursing and adjustment of the instrument should be carried out by professional personnel.
6. Before any connection, the instrument ground terminal must be reliably connected with the earth by grounding cable.
7. Because the test equipment produces high voltage, the tester must strictly abide by the safety operation rules to prevent others from contacting high voltage components and circuits. Personnel directly engaged in testing must fully understand the high-voltage test circuit and the operating points of the instrument. Non-testers must stay away from the high-voltage test area, which must be clearly indicated by fences or ropes, police signs, etc.
8. The adjustment, maintenance and maintenance of the instrument must be carried out without power-up. If power-up is necessary, the operator must be very familiar with the high-voltage dangerous parts of the instrument.
9. When the safety pipe is damaged, it is necessary to ensure that the same insurance is replaced. It is forbidden to replace different types of insurance or to use the insurance directly by short circuit.
10. When the instrument fails, turn off the power switch and wait for one minute before checking.

Three、Performance characteristics

1. The instrument uses Fourier transform digital filtering technology to measure capacitance, dielectric loss and other parameters. The test result has high precision and is easy to realize automatic measurement.
2. The instrument adopts frequency conversion technology to eliminate 50Hz power frequency interference in the field. Even in the environment of strong electromagnetic interference, reliable data can be measured.
3. It is easy to operate with full touch LCD. Full touch LCD screen, super full graphics operation interface, each process is very clear, operators can use without additional professional training. The whole process can be

measured by touch.

4. Storage data: It is equipped with a calendar chip and a large-capacity memory, which can save the test results at any time, view the historical records at any time, and print out. The current time and storage time can be displayed and printed at any time.

5. Scientific and advanced data management: Instrument data can be exported through U disk, and can be viewed and managed on any PC by special software.

6. The instrument is easy to operate and the measurement process is controlled by microprocessor. As long as the appropriate measurement mode is selected, the measurement of data can be completed automatically under the control of microprocessor.

7. Integrated model, with standard capacitor and high voltage power supply, is convenient for field test and reduces field wiring.

8. The instrument has high accuracy and can meet the requirements of oil dielectric loss measurement. Therefore, only standard oil cup and special testing line are needed to realize oil dielectric loss measurement.

9. It has the function of low voltage shielding for reverse wiring. Under the condition of 220 kV CVT bus grounding, it can measure the dielectric loss of 110 kV reverse wiring without disconnection.

10、Can do AC voltage withstand test. It is convenient for PT and CT to do AC voltage withstanding test twice and 400V low voltage system to do voltage withstanding test.

11. It can identify the frequency of external high-voltage power supply from 40Hz to 70Hz, and allow large capacity and high voltage dielectric loss test with power frequency power supply or series resonant power supply.

12. It has the function of CVT test and can realize the self-excitation test of CVT. It can set four protection restrictions of high voltage/current and low voltage/current to ensure the safety of person and equipment.

13. When testing CVT, not only the capacitance and dielectric loss values of C1 and C2 can be automatically tested, but also the total capacitance and dielectric loss values of CVT equipment can be tested.

14. With a thermal printer, it can print out, with a calendar clock, to facilitate users to produce test reports, with U disk output.

15. With computer interface. A computer can control 32 instruments, which can be integrated into an integrated high-voltage test vehicle to realize measurement, data processing and report output.

16. Grounding protection function. When the instrument is not grounded or grounded badly, the instrument does not enter the normal procedure and does not output high voltage. Overcurrent protection function, the instrument will not be damaged when the sample is short-circuit or breakdown.

17. Electric shock protection function. When the instrument operator accidentally electric shock, the instrument will immediately cut off the high voltage to ensure the safety of the test personnel.

Four、Technical Indicators

1、Accuracy:Cx ±(reading×1%+1pF)

tgδ ±(reading×1%+0.00040)

2、Anti-interference index：Frequency conversion anti-interference, in 200% interference can still achieve the above accuracy

3、Capacitance range：internal high voltage 3pF~60000pF/10kV 60pF~1μF/0.5kV

external high voltage 3pF~1.5μF/10kV 60pF~30μF/0.5kV

Resolution maximum to 0.001pF, 4 significant digits

4、tgδ range：No limitation, resolution 0.001%, capacitance, inductance, resistance can be automatically identified

5、Test current range：5μA~5A

6、Internal high voltage：voltage setting range 0.5~10kV

maximum output voltage 200mA

voltage lifting mode voltage setting arbitrarialy

test frequency single frequency set at will(40-70Hz).

Automatic dual variable frequency set at will (from 50±0.1Hz to 50±10Hz)

Automatic dual variable frequency set at will (from 60±0.1Hz to 60±10Hz)

frequency resolution ±0.01Hz

7、External high voltage：Maximum test current 5A, power frequency or variable frequency 40-70Hz, during positive connection

Maximum test current 10kV/5A, power frequency or variable frequency 40-70Hz, during reverse connection

8、CVT self-exciting low voltage output：Output voltage 3-50V, output current 3-30A

9、Measuring duration：About 40s, depending on measuring method

10、Input power：127V AC, 60Hz ± 1%

11、Computer interface：Standard RS232 interface

12、Pinter：mini-type thermal printer

13、Ambient temperature：-10℃~50℃

14、Relative humidity：<90%

15、Dimensions：460×360×350mm

16、Weight：28kg

Five、Measurement Method and Principle

According to whether the tested object is grounded or not, there are two kinds of measurement methods: positive connection measurement and reverse connection measurement. The principle of the two measurement methods is shown in Fig 1.

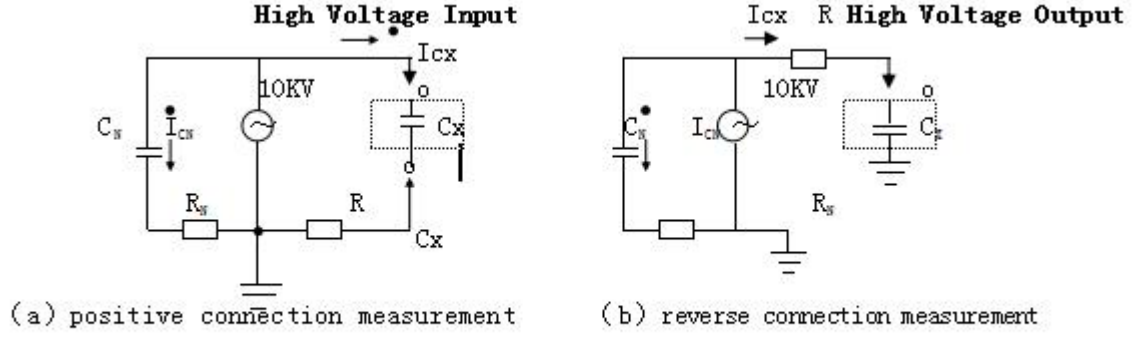
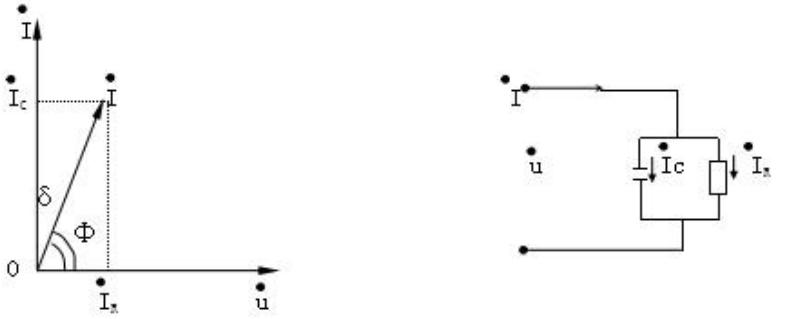


Fig 1

On the 10kV side of the high voltage power supply, the high voltage is divided into two paths, and the standard capacitor C_N in the machine is supplied along the way. The capacitor dielectric loss is very small. It can be considered that the dielectric loss is zero, that is, the pure capacitive current. This current I_{CN} can be used as the capacitive current reference. On the side of Cx sample, the sample current Icx is introduced into the machine by sampling resistance R. The Icx can be decomposed into horizontal and vertical components as shown in figure 2. The value of tgδ delta can be obtained by calculating the ratio of horizontal component to vertical component.

In Fig. 1 (a), Cx is a non-grounded sample. The current Icx enters the sampling resistance R

from the end of the sample and gets the full current value. In Fig. 1 (b), Cx is a grounded sample. The Cx terminal in the machine is grounded directly. The current Icx obtains the full current value from the high voltage end of the sample to the sampling resistance in the machine.



(a) Current vector method (b) Test Equivalent Circuit

Fig 2

Six、Wiring method of common equipment

1．Instrument lead-out terminal instructions：

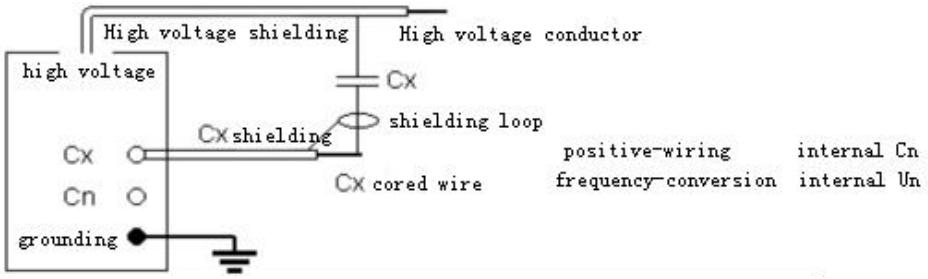
HV —The instrument measures the high voltage end of the lead (with dangerous voltage) 。

CX —The current input terminal of the test sample is in the positive connection.

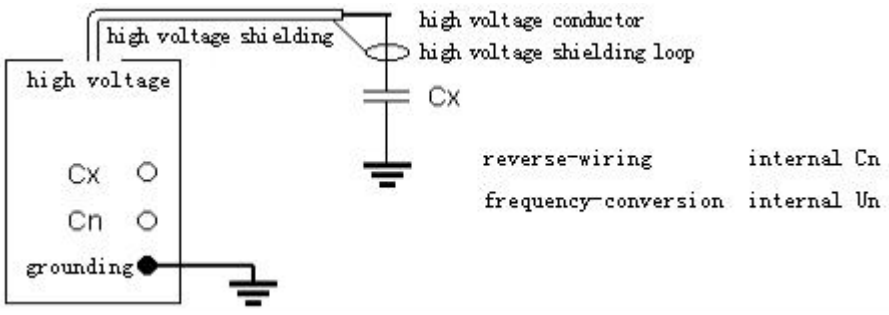
⏚ —The grounding end of the instrument is reliably connected with the earth when used.

2.Reference wiring

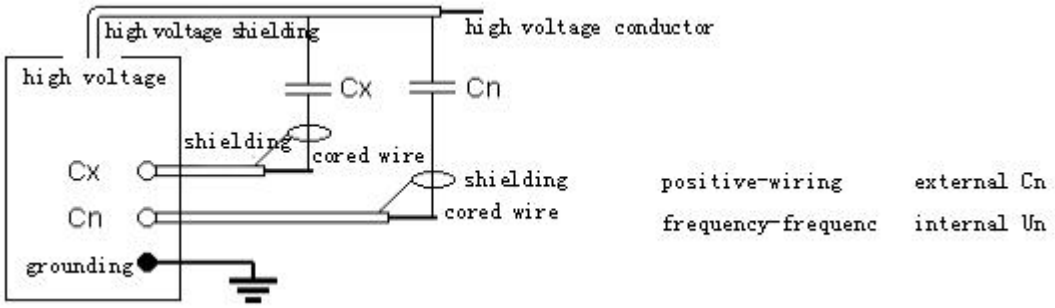
2.1Positive wiring, internal standard capacitance, internal high voltage (conventional positive wiring):



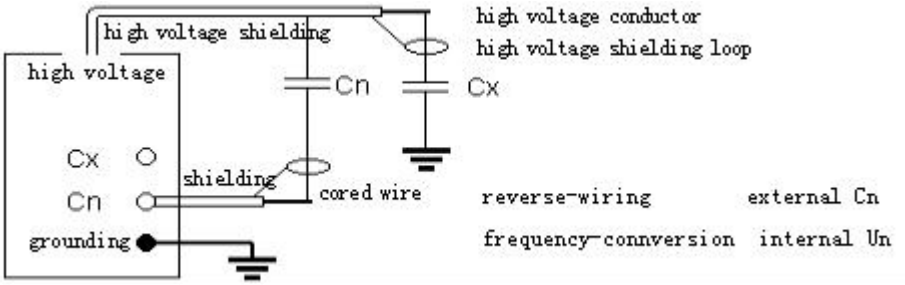
2.2 Reverse Wiring, Internal Standard Capacitance, Internal High Voltage (Conventional Reverse Wiring)



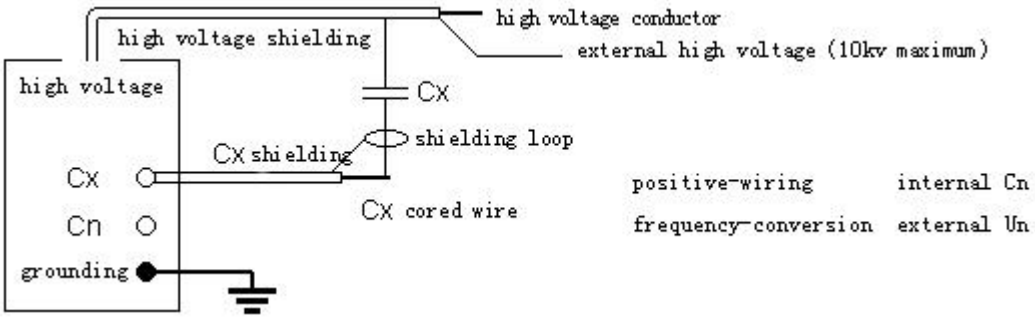
2.3Positive wiring, external standard capacitance, internal high voltage:



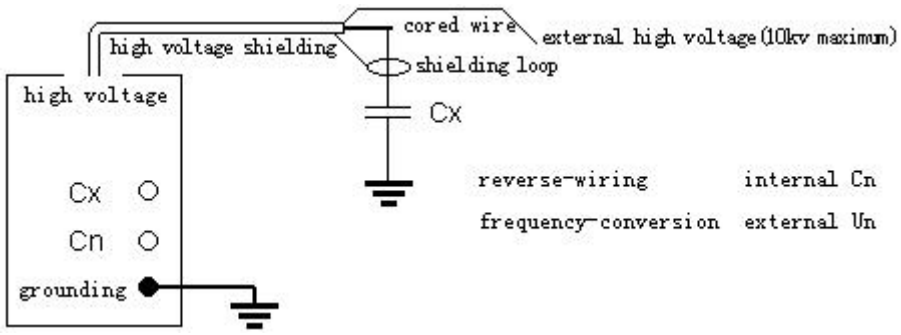
2.4Reverse wiring, external standard capacitance, internal high voltage:



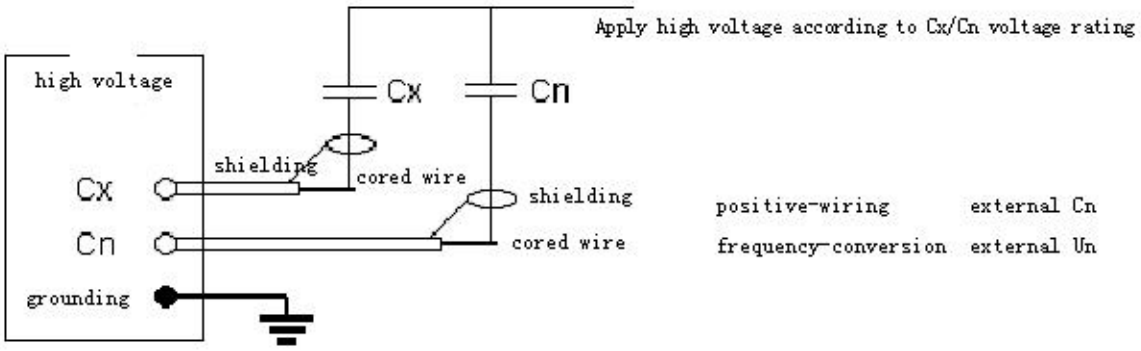
2.5Positive wiring, internal standard capacitance, external high voltage:



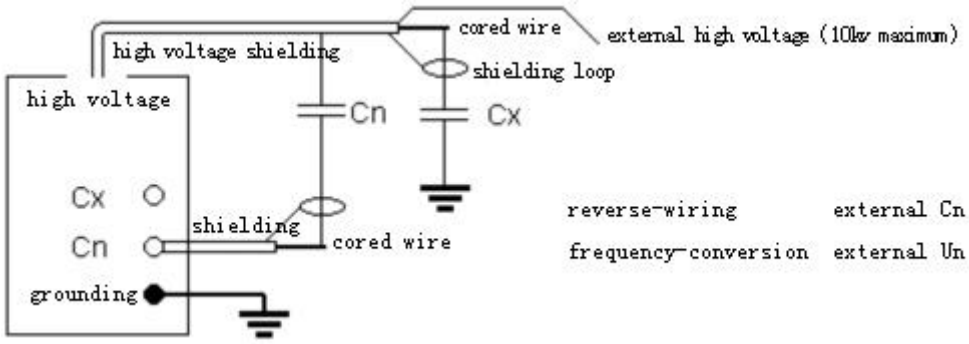
2.6Reverse wiring, internal standard capacitance, external high voltage:



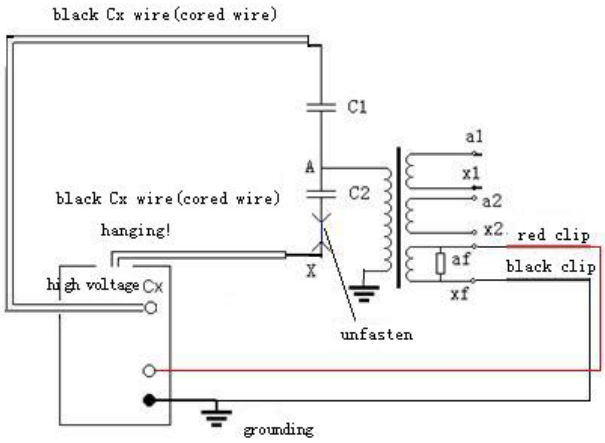
2.7Positive wiring, external standard capacitance, external high voltage (high voltage dielectric loss):



2.8Reverse wiring, external standard capacitance, external high voltage:



2.9 CVT Self-excitation measurement：



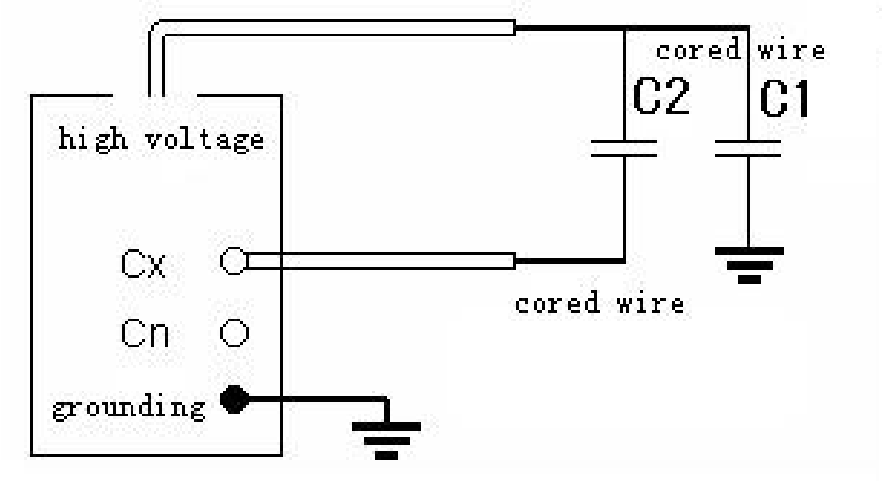
CVT self-excitation method can be connected according to the following figure. If C1 is a single capacitor, the bus can not be grounded; if C1 is a multi-capacitor, the bus can be grounded; C11 and C12 can be measured by conventional positive and negative wiring; C13 and C2 can be measured by self-excitation method.

In CVT self-excitation measurement, the instrument first measures C1, then automatically reverses the line to measure C2, and automatically calibrates the effect of partial pressure.

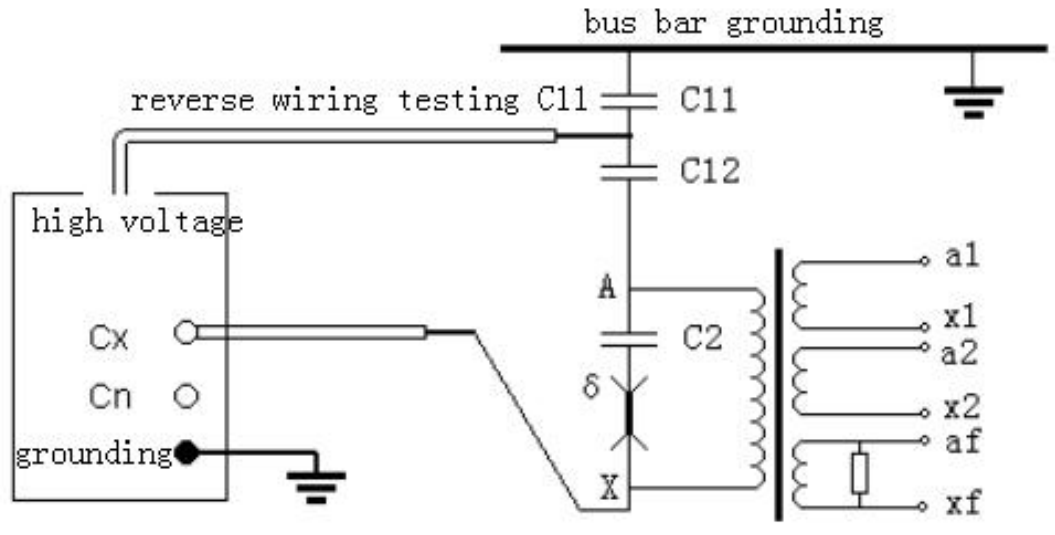
It should be noted that the high-voltage cable should be suspended and not touch the ground, otherwise the additional dielectric loss will cause errors to the ground. It can be connected with the high-voltage socket and the CVT test sample by thin cable and lifted.

2.10 Low Voltage Shielding Test of Reverse Wiring

Reverse wiring low voltage shielding function, one wiring can simultaneously measure the capacitance and dielectric loss of C1 and C2.



By choosing the low voltage shield of reverse connection, the dielectric loss of 10kV reverse connection can be measured without disconnecting the bus bar of the upper capacitor C1. As shown in the figure below, the busbar is connected with ground wire, the upper end of C1 is not disconnected, the lower end of C1 is connected with high-voltage core wire, and the C2 end is connected with Cx core wire. The capacitance and dielectric loss of C11 and lower shielding parts can be measured simultaneously by using reverse wiring/10kV/M measurement mode.



Seven、Introduction to Instrument Function

1. U-disk socket - used to export data stored in the instrument.

2. RS232 interface - used to connect computers, control instruments, upload data.
3. CX socket - is the measurement input of test signal, which is connected by a special low-voltage cable. This cable has a special crocodile clamp with a single shielding belt, 8 m long, and connects to the low end of the test. This end is empty during reverse wiring.
4. Color touch screen display - 640*480 resolution, control and display menus and various prompt information and measurement results.
5. Printer - Print measurement data.
6. CN socket - is the measurement input of the external standard capacitance signal, which is empty when using the internal standard.
7. Self-excitation current output terminal - special terminal for measuring CVT, usually connected with auxiliary winding dn.
8. Self-excitation current output terminal - special terminal for measuring CVT, usually connected with auxiliary winding da.
9. Power Switch - Turn on and off of the whole power supply.
10. High Voltage Switch - Responsible for starting and closing the high voltage power supply inside the instrument. Only turn off when using external high pressure, the rest of the time should be in the open state.
11. Power socket - AC 127V±10%, 60±1Hz power input, with 5A safe.
12. Grounding terminals - Earthing terminals.

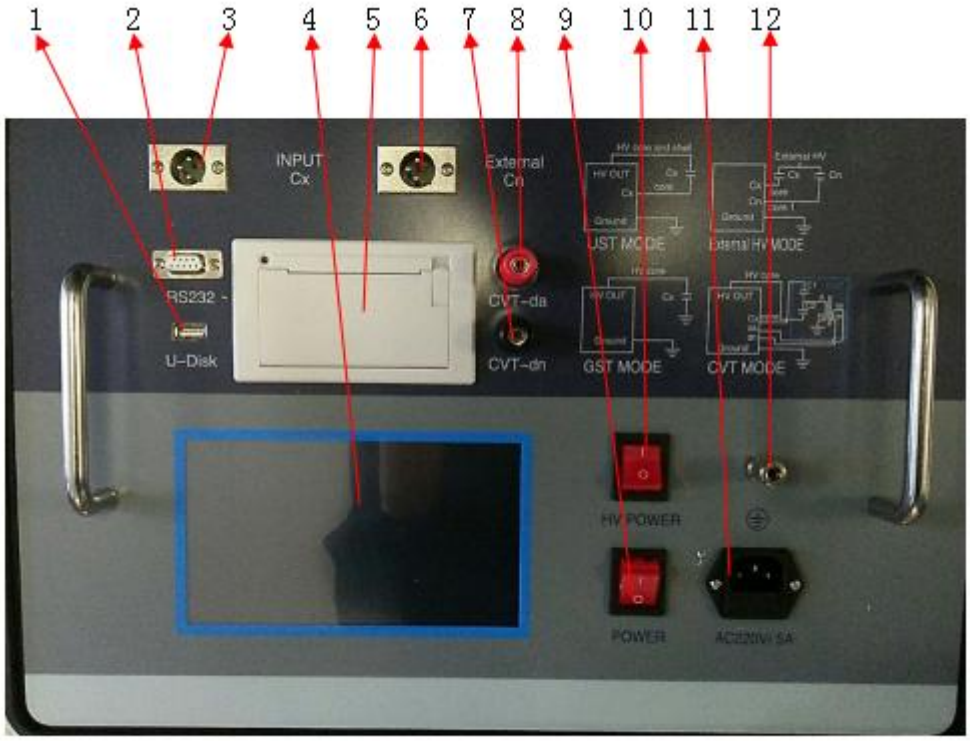


Fig.9 Instrument Panel

13. High Voltage Wiring Diagram of Instrument Side

A:Small black clip is high-voltage shielding and generally suspended (with high-pressure)
B:Red clip connects the tested high-pressure part

Eight、Instrument operation steps

1． Open the power switch, the instrument self-check, if the self-check is good, the LCD screen display 10 start-up interface.

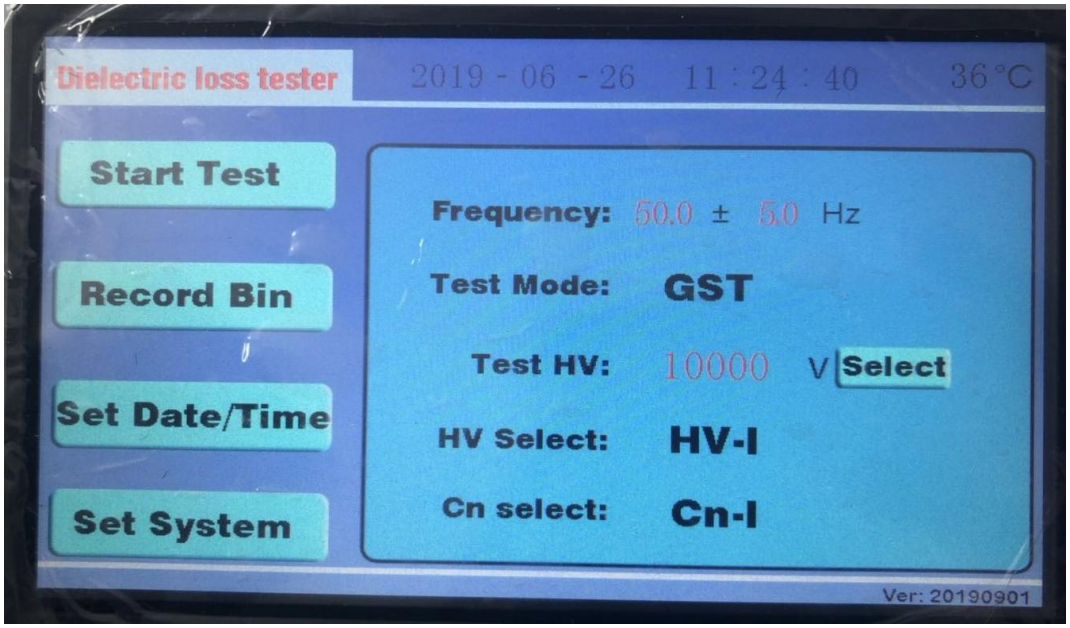


Fig.10 Boot-up Interface

2. Explanation of Test Parameter Selection

1) Test frequency: 50.0 ±5.0Hz represents the use of 45/55Hz dual frequency conversion test. Field testing is usually selected as

50 ±5Hz or 60 ± 5Hz. Of course, you can choose something else. If you want to test single frequency, such as 50Hz, you can choose 50.0 ± 0.0Hz. The frequency resin is set at will in the range of 40-70.

2) Test mode: Reverse wiring represents the use of reverse wiring mode to test the sample. Here is the drop-down menu, you can choose

Positive wiring, reverse wiring, CVT dielectric loss, low voltage shielding of reverse wiring.

3) Test voltage: 10000V represents the test voltage value. Minimum 100V, maximum 10000V. Voltage can be set at will here, such as 7892V.

4) High Voltage Selection: Internal High Voltage represents the use of internal high voltage power supply. In general, it must be set to internal high pressure.

External high voltage is only used when external high voltage power supply is connected.

5) Standard selection: Internal standard represents the use of internal standard capacitors. General testing must be set to internal standards.

External standard is used only when external standard capacitor is used.

Note: External standard, external high voltage is used when large capacity or high voltage dielectric loss. The general and permanent standby of substation can complete the test with the internal standard and internal high voltage of the unit.

3.Modification and selection of test parameters:

1) Modify the test frequency by clicking on the red character "45.0±0.0Hz" 45.0 with a touch-screen pen or finger. Appearance of Fig.11

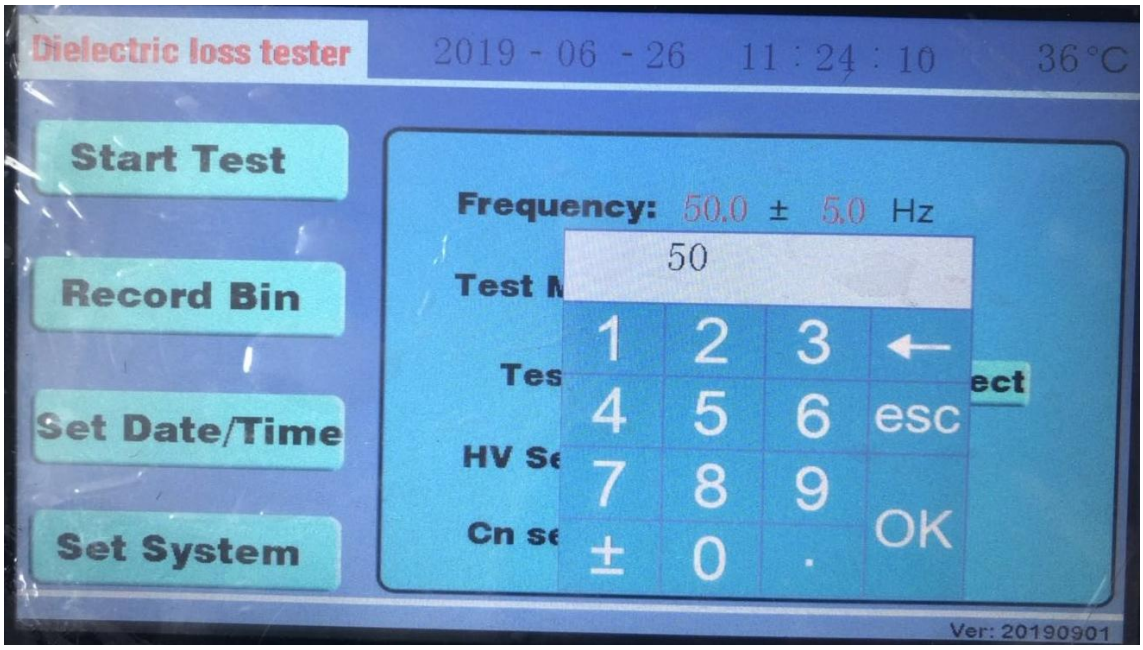


Fig. 11 Frequency modification chart

Input the frequency value of 50 directly from the keyboard, then press OK. If the frequency in the figure above is 45.0±0.0Hz, it will change to 50.0±0.0Hz after pressing OK.

If you change the "45.0±0.0Hz" to "±0.0", click on the red letter 0.0 with a touch-screen pen or finger. A keypad appears, and then enter 5.0 from the keypad, then press OK.

2) The modification of the test voltage is the same as the modification frequency. Use a stylus or finger to click on the scarlet letter part of "Test Voltage 5000V". The screen will pop out of the keyboard. Input the test voltage value of 10000 directly from the keyboard, then press OK, the keyboard disappears. The value of the test voltage will become the value you just entered from the keyboard.

3）Modify the test mode by clicking on the "reverse wiring" with a touch-screen pen or finger. Appearance Figure 12

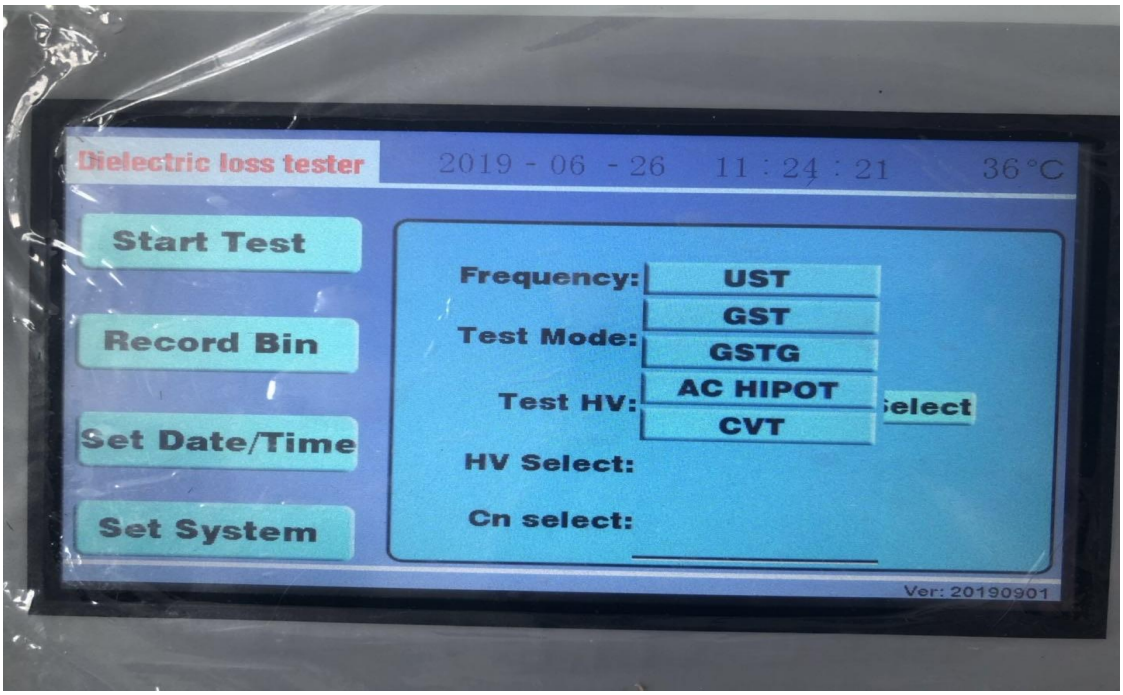


Fig. 12 Mode Selection Modification Diagram

All test modes are on the drop-down menu. Click on the mode you want to select.

Positive wiring, reverse wiring, CVT dielectric loss, low voltage shielding of reverse wiring.

4) The modification of high-voltage selection is the same as the modification of test mode. With a touch-screen pen or finger click on the "internal high pressure", the drop-down menu appears in the high pressure, external high pressure, click on the high pressure you want to choose.

5) The modification of standard selection is the same as the modification of test mode. With a touch-screen pen or finger, click on "Internal Standard" to display the "Internal Standard" and "External Standard" in the drop-down menu. Just click on the standard you want to select.

4. Prepare before measurement:

1) One end of the grounding wire is connected with the grounding column of the instrument, and the other end is connected with the earth reliably to ensure that the instrument shell is on the ground potential.

2) Positive wiring: insert the high-voltage cable plug into the HV socket of the back door, clamp the red pliers at the other end to the high-end lead of the tested product, and hang the black pliers or clamp them on the red pliers. Insert the CX low voltage cable into the CX socket, and the red clamp at the other end, the Black clamp suspended or connected with the shielding device at the lower end of the sample.

3) Reverse wiring: insert the high voltage cable plug into the HV socket of the back door, clamp the red pliers at the other end to the high-end lead of the tested product, and suspend the red pliers or connect the shielding device. Cx socket is not used.

5. Testing process:

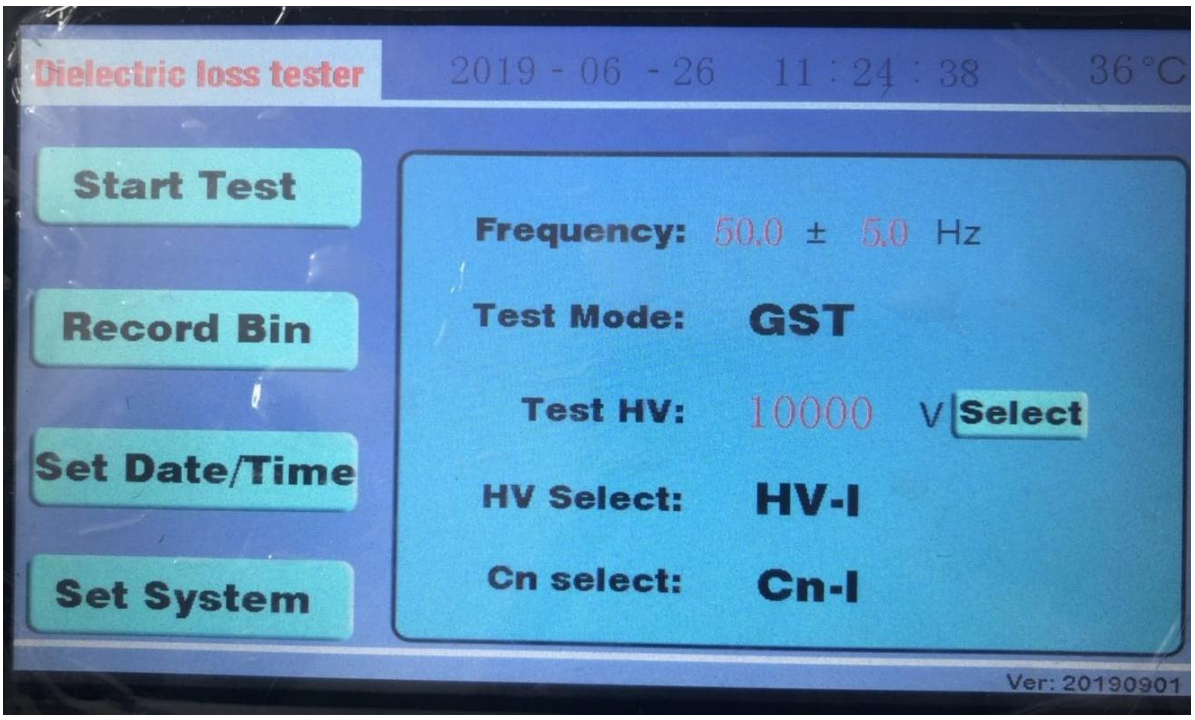


Fig.13 Interface before instrument start-up test

Choose test items, test frequency, test voltage and so on, as shown in Figure 13.
After making sure the connection is correct, click "Start Instrument Testing" with a touch-screen pen or finger. The instrument starts to boost and measure, as shown in Fig. 14 and Fig. 15.
The instrument adopts dual frequency conversion test. Fig. 14 is 55 Hz test and Fig. 15 is 45 Hz test.

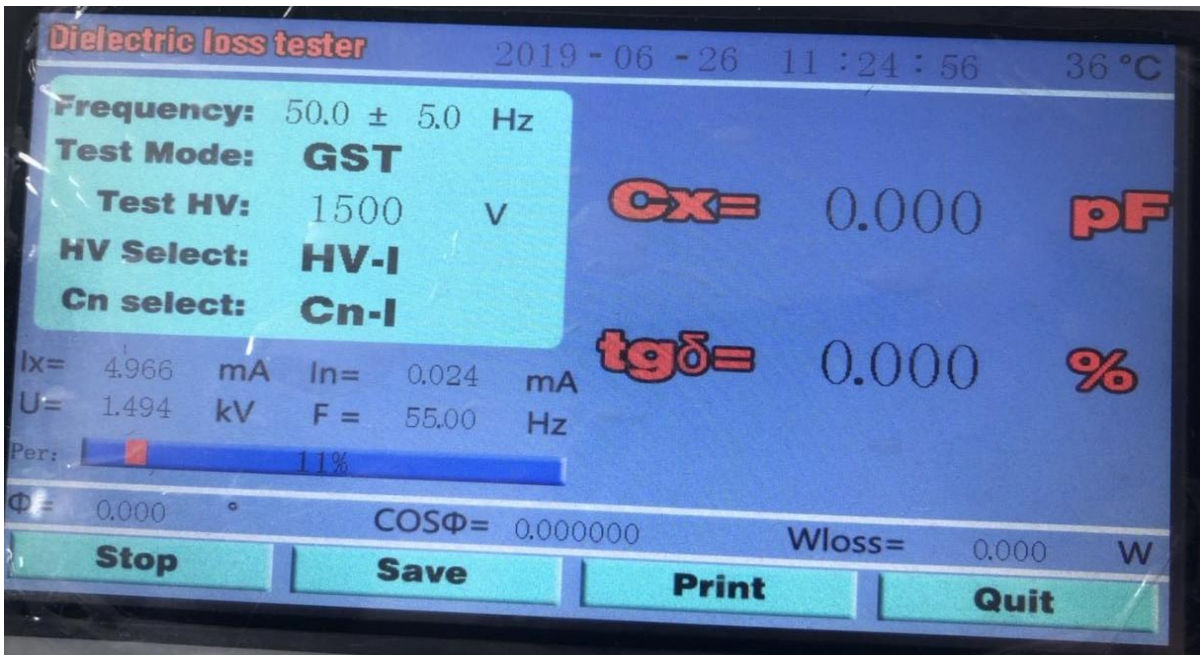


Fig.14 55Hztest

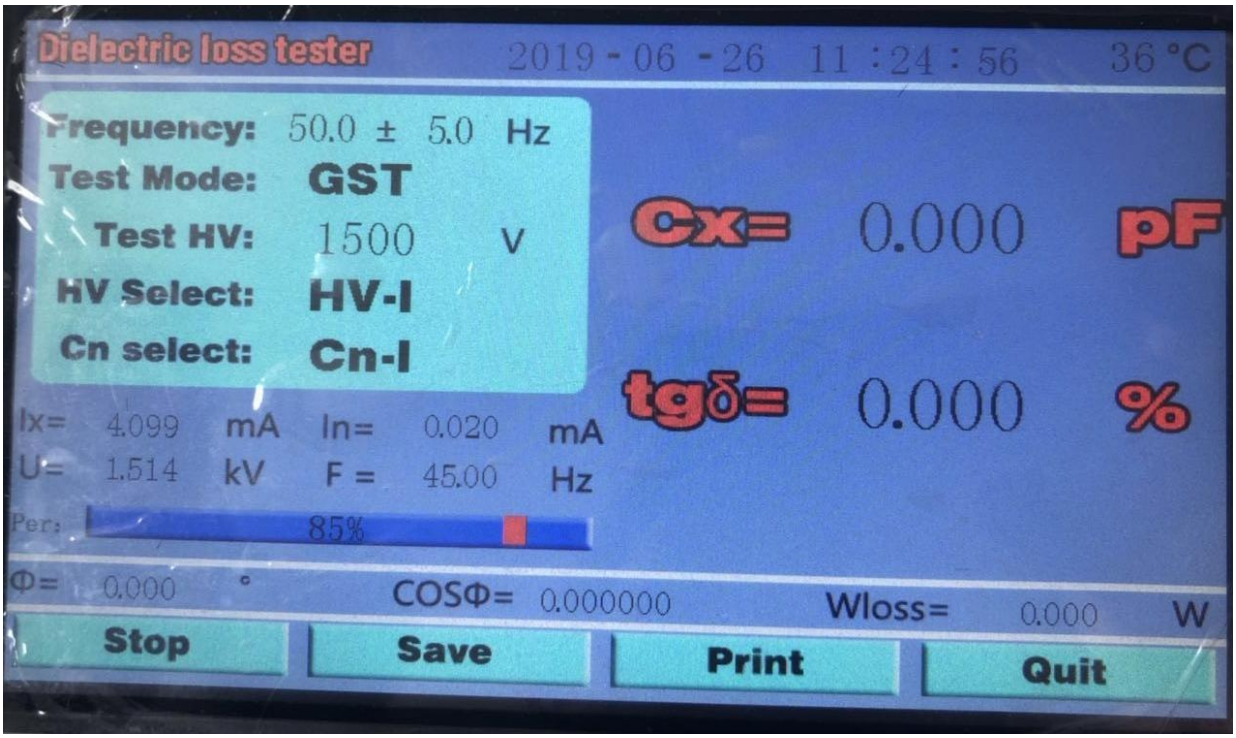


Fig 15 45Hz test

6.Test result：

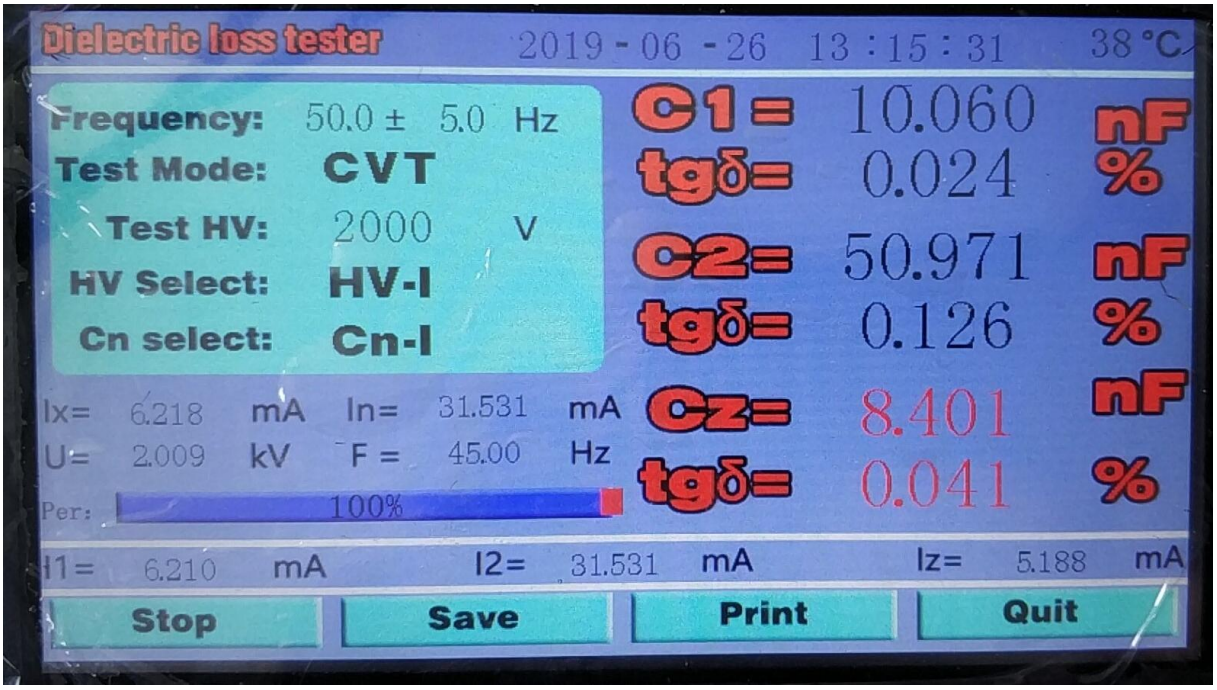


Fig 16 Test results of reverse wiring

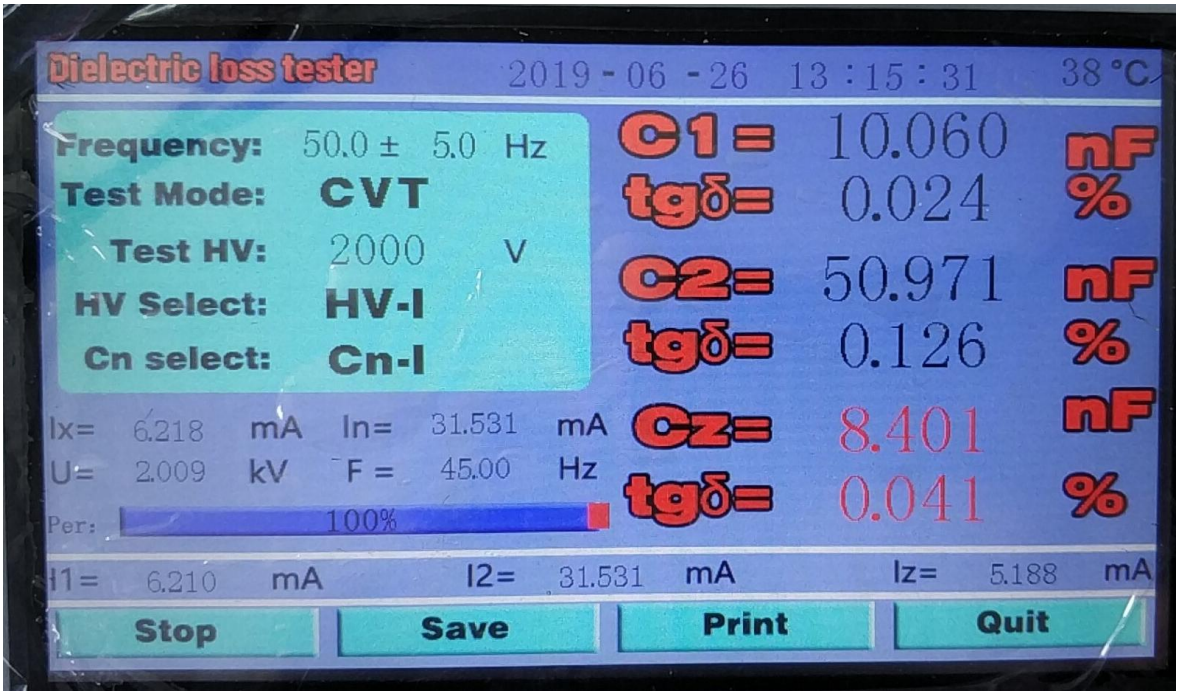


Fig 17 CVT test result

The capacitance and dielectric loss of C1 and C2 are the values of C1 and C2 of CVT equipment.

The capacitance and dielectric loss values of CZ are the total capacitance and dielectric loss values of CVT equipment.

7.After testing, event handling

1）Test data can be stored after testing. Click on the "Storage" button with a touch-screen pen or finger. Fig 18 appears.

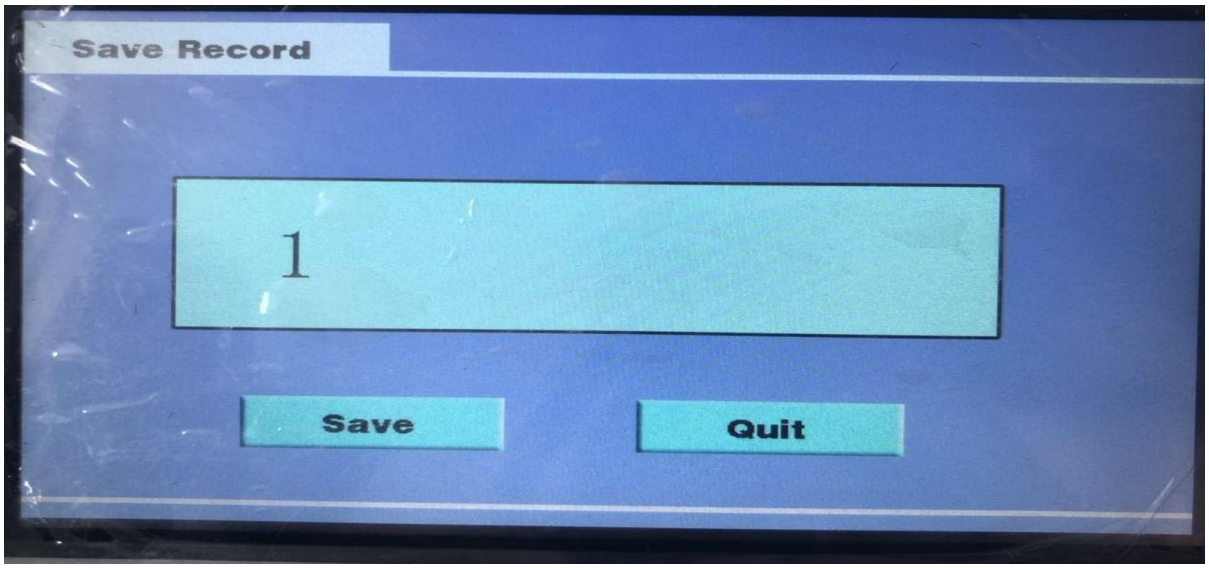


Fig 18 Data Storage Interface

A keypad appears when you click on the value "1" in the data numbering box with a stylus or finger.
Figure 19 Data Input Interface

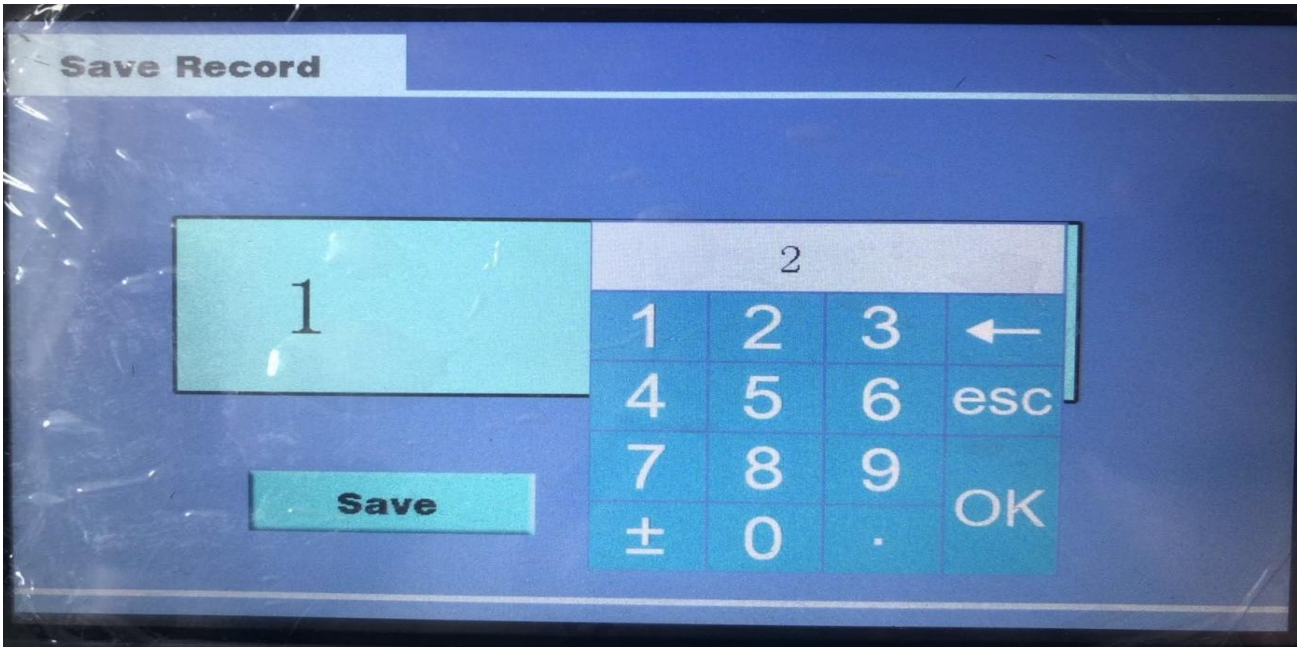


Fig 19 Serial Number Data Input Interface

Enter the storage number and press OK. Data number 5 will appear in the data number box. Press the storage and the instrument will beep and return to the test result interface. Represents that the storage is complete.

2）Test data printing. After the test is finished, under the test result interface, the test data will be printed by clicking the "Print" button with a touch-screen pen or finger. Figure 20 Data Print Chart

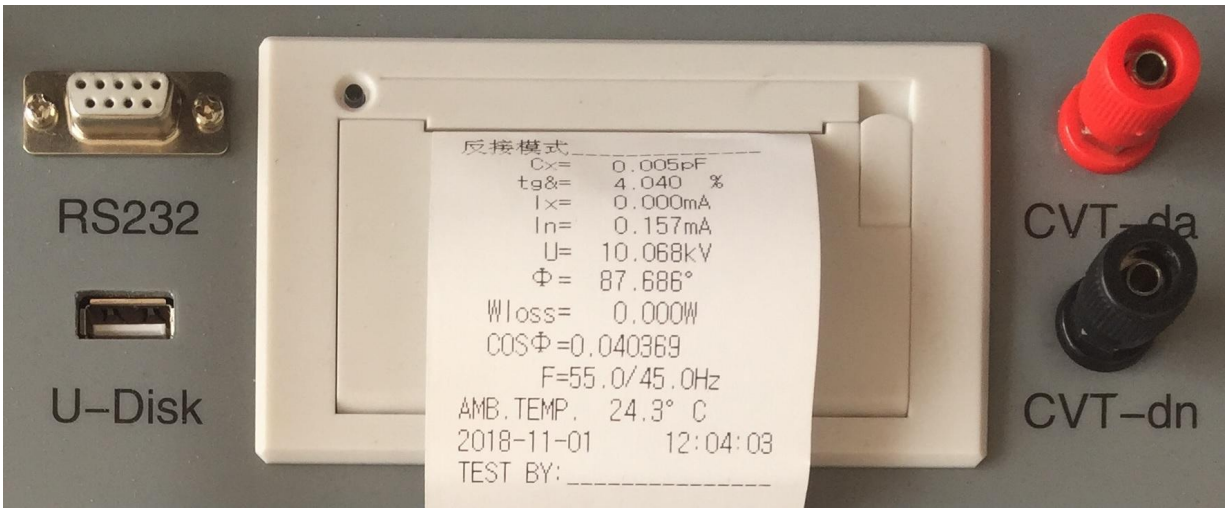


Fig 20 Data Print Chart

3）Test. After printing or storing the data, click the "exit" button with a stylus or finger, and the instrument will return to the initial boot-up interface.

Nine、Notes for Field Test

If the test data is obviously unreasonable in use, please find out the reasons from the following aspects:

1. Poor contact of red clip on high voltage wire

When the red clip is used to connect the sample in the field measurement, the red clip must be in good contact with the sample, otherwise the discharge of the contact point will cause serious fluctuation of the data. Especially the oxide layer of the drain line is too thick. Please scrape the skin to avoid bad contact.

2. Poor grounding contact

Poor grounding can cause serious fluctuation of instrument protection or data. The paint and rust on the grounding point should be scraped off, and zero resistance grounding must be guaranteed!

3. Direct Measurement of CVT or End Shielding Method for Measuring Electromagnetic PT

Direct measurement of the lower coupling capacitance of CVT will result in negative dielectric loss, so self-excitation method should be used instead.

When measuring electromagnetic PT with end shielding method, negative dielectric loss occurs due to "T-shaped network interference" caused by dampness. Blow-dry the three skirts of ceramic sleeve and terminal disc below. It can also be measured by conventional method or end pressure method.

4. Excessive air humidity

Air humidity makes dielectric loss measurement abnormally increased (or decreased or even negative) and unstable, and shielding rings may be added when necessary. This method is controversial because the electric field distribution of the test sample is changed by artificial shielding ring. The relevant regulations can be consulted.

5. Generator Power Supply

The output voltage of the generator is unstable when it is supplied with power, and there are high voltage burrs, which may lead to the wrong connection of 380V protection to start. Several power filters can be connected in series at the output end of the generator to solve this problem.

6. Test Line

Because of long-term use, it is easy to cause hidden circuit break, short circuit of core wire and shield, or bad contact of plug. Users should always maintain the test line.

When testing standard capacitors, full shielded plugs should be used to eliminate the influence of additional stray capacitance, otherwise the accuracy of the instrument can not be reflected.

When measuring CVT by self-excitation method, the non-dedicated high-voltage line should be suspended, otherwise additional stray capacitance and dielectric loss to the ground will cause measurement errors.

7. Choice of working mode

After wiring, please choose the correct measurement mode (positive, negative and CVT), not wrong. Especially in the interference environment, frequency conversion anti-jamming mode should be chosen.

8. Effect of test methods

Because dielectric loss measurement is greatly influenced by test method, it should be distinguished between test method error and instrument error. When there is a problem, the wiring can be checked first, and then whether it is a fault of the instrument.

9. Instrument failure

Use a multimeter to measure whether the test line is open, or whether the core line and shield are short-circuit; 127V input power supply is too high or too low; and whether the grounding is good.

Measure standard capacitors or capacitance samples with known capacitance and dielectric loss by positive and negative wiring. If the results are correct, it can be judged that there is no problem with the instrument.

Unplug all the test wires and carry out air test boost. If it does not work properly, the instrument may be out of

order.

Ten、Discussion on Frequency Conversion Measurement

1. Frequency conversion measurement

When the interference is very serious, the frequency conversion measurement can get accurate and reliable results. For example, when measuring at 55Hz, only 55Hz signal is allowed to pass through the measuring system, and 50Hz interference signal is effectively suppressed. The reason is that the measuring system can easily distinguish different frequencies. The effect of frequency selection measurement can be illustrated by the following simple calculation:

When two sinusoidal waves with one-fold difference in frequency are added together, the high frequency is the interference, and the amplitude is 10 times that of the low frequency.

Y=1.234sin(x+5.678°)+12.34sin(2x+87.65°)

At x=0/90/180/270°Four measurements were obtained.

Y0=12.4517，Y1= -11.1017，Y2=12.2075，Y3= -13.5576，

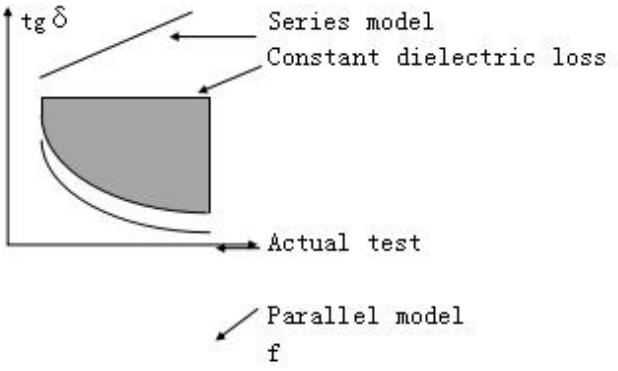
Calculation A=Y1-Y3=2.4559，B=Y0-Y2=0.2442，Be：

φ=tg-1(B/A)=5.678°　　V= $\sqrt{A2+B2}$/2=1.234

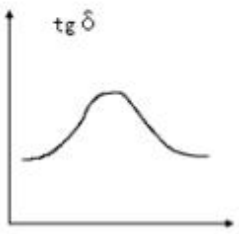
This happens to be the phase and amplitude of the low frequency part, and the interference is suppressed. The actual waveform has tens of thousands of measuring points and a large amount of calculation. The results reflect the overall characteristics of the waveform.

2、Relation between Frequency and Dielectric Loss

There are two ideal models of dielectric loss: series model tgδ=2πfRC, parallel model tgδ=1/(2πfRC), and tgδ delta is proportional and inverse to frequency f, respectively. As shown in the figure, f has great influence on the two models of full proportional and full inverse ratio. However, the actual capacitor is a mixed model interwoven by various models, and the effect of F is small at this time.



Low Frequency Dielectric Loss Curve (<1kHz)



High Frequency Dielectric Loss Curveor

Low Frequency Circuit Resonance

3、Automatic Frequency Conversion and 50Hz Equivalence

The instrument uses automatic frequency conversion to measure one point at each side of interference frequency 50Hz (45Hz and 55Hz), and then calculates the data at 50Hz frequency. Except for the low-frequency resonance of multiple component circuits, it is impossible for the medium in a single sample to cause energy absorption peaks at low frequencies, and the dielectric loss near the power frequency always varies monotonously with the frequency. Therefore, this measurement method will not bring obvious errors. In fact, the first two dielectric loss values are very close to each other, even if they are not equal, they are of great reference value. At present, frequency conversion dielectric loss meter has become a conventional instrument for dielectric loss measurement, and its excellent anti-interference ability and accuracy have been recognized.

Eleven、Packing List of Instruments

1．Host	1A
2．High Voltage Cable	1A
3． Low Voltage Cable	2A
4． Power cord	1A
5．Groundline	1A
6．CVTline	2A
7.5A Safety Pipe (Built-in)	2A
8.Printing paper	1A
9．Instruction	1A
10.factory test report	1A
11.Certificate	1A