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JYC

Dielectric Loss /Tan Delta (δ) Tester (10kV)

Table of Contents

Please read this Operation Manual carefully before operating this Instrument and it is responsibility of users to ensure safety.

Version No. of this Manual: JY3.25-2016

1. Characteristics and Performance

JYC Full-automatic Frequency Conversion Anti-interference Dielectric Loss Measuring Instrument is used for on-site anti-interference dielectric loss measurement or precision dielectric loss measurement in laboratory. The instrument is an integrated structure with built-in dielectric loss bridge, frequency conversion power supply, test transformer and standard capacitor. It adopts frequency conversion anti-interference and Fourier Transform digital filtering technology so as to realize automatic intelligent measurement and stable measurement data under strong interference. The measurement results are displayed by a large LCD screen, with a small printer for printing output.

1.1

Main Technical Indicators

Accuracy: Cx: ±(Reading×1%+2pF)

Tgδ: ±(Reading×1%+0.00040)

Anti-interference Indicators: frequency conversion anti-interference, it can still reach the accuracy mentioned above under 200% interference;

Scope of Capacitance: internal high voltage: 3pF-60000pF/10kV 60pF-1μF/0.5kV

External high voltage: 3pF-1.5μF/10kV 60pF-30μF/0.5kV

Resolution: 0.001pF at the maximum, 4 valid digits.

Tgδ Scope: not limited, resolution is 0.001%, the test products can identify automatically the capacitance, induction and resistance.

Test Current Scope: 5μA-5A

Internal High Voltage: the voltage scope is set to be 0.5～10kV;

The maximum output current: 200mA

Buck-boost mode: continuous smooth adjustment

Voltage accuracy: ± (1.5%×reading+10V)

Voltage resolution: 1V

Test frequency: 45, 50, 55, 60, 65Hz single frequency

Automatic dual frequency conversion of 45/55Hz, 55/65Hz, 475/52.5Hz

Frequency accuracy: ±0.01Hz

External High Voltage: the maximum test current is 5A for positive wiring, power frequency or frequency conversion is 40-70Hz

The maximum test current is 10kV/5A for inverse wiring, power frequency or frequency conversion is 40-70Hz

Low Voltage Output of CVT Self-excitation Method: output voltage 3-50V, output current 3-30A

Measurement Time: about 15s, related to the measurement mode;

Input Power: 180V-270VAC, 50Hz/60Hz±1%, supplied by municipal power grid or generator;

Computer Interface: standard RS232 interface

Store Data: 100 groups

Printer: miniature thermal printer

Ambient Temperature: -10℃-50℃

Relative Humidity: <90%

1.2 Main Function Characteristics

1.2.1 Frequency Conversion Anti-interference

It adopts frequency conversion anti-interference technology, which can still accurately measure under 200% interference, the test data is stable and it is suitable for anti-interference dielectric loss test on site.

1.2.2 High-precision Measurement

It adopts digital waveform analysis and bridge self-calibration technology, combined with high precision three-terminal standard capacitor, to realize high precision dielectric loss measurement. The input resistance of all the ranges of the instrument is lower than 2Ω, which eliminates the influence of additional cable capacitance of measurement cable.

1.2.3 Multi-level security protection ensures the safety of personnel and equipment

High voltage protection: the output can be cut off quickly in the short circuit mode in case of short circuit, breakdown or high voltage current fluctuation of test product.

Low voltage protection: protection can be started so as not to cause over-voltage in case of incorrect connection with 380V, power fluctuation or sudden power failure.

Grounding protection: it is started when the instrument is not grounded properly so that the shell has a dangerous voltage.

CVT: four protection limits of high voltage and current as well as low voltage and current will not damage the equipment; the incorrect menu will not output excitation voltage. There is no 10kV high voltage output in CVT measurement.

Error-proof operation: two-level power switch; real-time monitoring of voltage and current; multiple key pressing confirmation; high/low voltage of terminal are clear; slow boost, quickly reduce the voltage, sound and light alarm.

Resist "Capacitive Rise": “Capacitive Rise” effect of raising voltage may occur during measurement of test products with large capacitance. The instrument can automatically track the output voltage and keep test voltage constant.

Seismic performance: the instrument adopts unique seismic design, which can withstand strong long distance transportation vibration and shock without damage.

High voltage cable: it is high voltage resistant insulated wire, which can be towed on the ground.

1.2.4 Powerful Functions

（1）It has multiple working modes of positive/inverse wiring, internal/external standard capacitance and internal/external high voltage; with an integrated structure, it can be used to do various conventional dielectric loss tests, without any need for external auxiliary equipment.

（2）Liquid crystal display, menu operation, rich test data, automatic identification of capacitance, inductance and resistance type test products, with a small printer to print output.

（3）It has external an interface for standard capacitor, it can connected to external oil cup to do precision insulating oil dielectric loss test, measurement electrode of solid materials can be connected to do

dielectric loss test of precision insulation material, and it can also be connected to high voltage standard capacitor for high voltage dielectric loss test.

（4）It can automatically identify 50Hz/60Hz system power supply and support the power supply of generator, and it can measure normally in spite of large frequency fluctuation.

（5）Two dielectric loss measurement models for series connection and parallel connection are built in to facilitate instrument verification.

（6）CVT self-excitation method frequency conversion measurement interface, C1/C2 can be measured at the same time during one wiring, the influence of differential voltage of busbar grounding and standard capacitor are compensated automatically, without the need of changing wire and connecting with accessories, and self-excitation method of high voltage cable can be towed on the ground.

（7）It has the function of low voltage shielding for inverse wiring. Under the condition of 220kVCVT busbar grounding, inverse wiring dielectric loss measurement of C11 without disconnecting 10kV can be carried out.

（8）It can automatically identify the frequency of 40Hz-70Hz of external high voltage test power source and support power frequency power, frequency conversion power and series connection resonant power to conduct high capacity high-voltage dielectric loss test.

（9）It is equipped with text and picture menus in Chinese, LCD display with large screen backlight is clearer, and the current voltage is monitored in real time.

（10）It has a calendar clock, which can store 100 groups of measurement data.

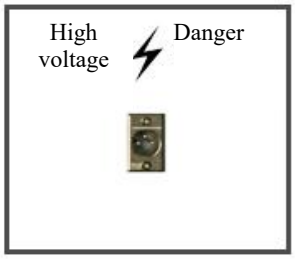
（11）It has a computer interface.

1.3 Supply Scope

（1）Instrument Host　　（2） Instructions for Use and Product Certification

（3）Special test cable　　（4）Power cord

（5）Printing paper and fuse　　（6）see the *Packing List* for other details.



High Voltage Output Panel Diagram

Upper Panel Diagram

2. Instructions for Panel

2.1 High Voltage Output Socket (0.5-10kV, 200mA at the Maximum)

Installation position: the front side of the cabinet, protective door is equipped with externally.

Function: internal high voltage output; detect current of test products in inverse wiring; high voltage end of internal standard capacitor.

Wiring method: pin 1 of the socket is connected with core wire of high voltage wire (red clamp), pins 2&3are connected with shielding of high voltage wire (black clamp). Both core wire of high voltage wire (red clamp) and shielding (black clamp) can be used as the compression wire when the positive wiring is made. Only the core wire can be used to add voltage to the high voltage end of the test products during inverse wiring. If the high voltage end of the test products has a shielding electrode (such as the shielding ring at the high voltage end), it can be connected with the high voltage shielding and high voltage shielding is suspended in case of no shielding.

Notices:

（1）The measurement cable of the instrument is universal, and it is recommended to connect the socket with the high voltage wire. High voltage socket and high voltage wire have dangerous voltage; it is absolutely forbidden to touch high voltage socket, cable, clamp and charged parts of test products! Connect the wire after confirming it is powered off, and be sure to keep away during measurement!

（2）When standard dielectric loss tester (or standard capacitor) is used to verify the accuracy of inverse wiring, the test product shall be connected with full shielding plug, otherwise, exposed core wire will cause errors.

（3）The high voltage wire and high voltage end of the test products shall be connected with zero resistance, otherwise, it may cause errors or data fluctuation or it may also cause instrument protection.

（4）When wiring is demolished under strong interference, the connection shall be disconnected under the condition of keeping the cable grounded to prevent inductive shock.

2.2 Test Product Input Cx Socket (10μA-5A)

Function: input current of test products during positive wiring.

Wiring method: pin 1 of the socket is connected with core wire of measurement wire (red clamp), pins 2&3 are connected with shielding of measurement wire (black clamp). The core wire (red clamp) is connected with low voltage signal end during positive wiring, if the low voltage end of the test products has a shielding electrode (such as the shielding ring at the low voltage end), it can be connected with the shielding and shielding is suspended in case of no shielding.

Notices:

（1）It is strictly prohibited to unplug the plug in the measurement to prevent the current of test products from flowing through the human body into the ground!

（2）When standard dielectric loss tester (or standard capacitor) is used to verify the accuracy of positive wiring of the instrument, the test product shall be connected with full shielding plug, otherwise, exposed core wire will cause errors.

（3）The lead wire and low voltage end of the test products shall be connected with zero resistance, otherwise, it may cause errors or data fluctuation or it may also cause instrument protection.

（4）When the wire is demolished under strong interference, the connection shall be disconnected under the condition of keeping the cable grounded to prevent inductive shock.

2.3 Standard Capacitance Inputs Cn Socket (10μA-5A)

Function: input the current of external standard capacitor.

Wiring method: similar to Cx socket, the difference is:

（1）When external standard capacitor is used, it shall be connected with full shielding plug. This method is often used for external high voltage grade standard capacitors to realize high voltage dielectric loss measurement.

（2）Select "External Standard" mode from the menu.

（3）Place C and tgδ of external standard capacitor into the instrument to realize the absolute value measurement of capacitance dielectric loss of Cx. In principle, capacitor with any capacity and dielectric loss can be made into standard capacitor by placing parameters into the instrument. The difference is that standard capacitors provide better long-term stability and precision.

（4）No matter it is positive wiring measurement or inverse wiring measurement, the wiring method of standard capacitor is always positive wiring.

2.4 CVT Self-excitation Method Low Voltage Output Socket (3-50V, 3-30A)

Function: such socket and grounding terminal output low voltage frequency conversion excitation power source for measurement of CVT.

Notices

（1）Due to the large low voltage output current, secondary winding of CVT shall be connected with special low-resistance wire of the instrument, and bad contact will affect the measurement.

（2）Select the appropriate voltage and current protection limit from the menu according to the CVT capacity.

（3）When CVT measurement is started, output 2-5V trial voltage and stop automatically if there is any fault in the external wiring. If the instrument fault is suspected, the trial voltage can be measured.

（4）When the positive/inverse wiring is selected, the output is closed.

2.5 Measurement of Grounding Terminal

It is connected to the housing and the ground wire of the power socket. If high voltage wire equipped for the instrument has a grounding shielding, plug the grounding shielding into the jack socket of the terminal.

Notices:

（1）Although the instrument has grounding protection, no matter what kind of measurement is, the instrument shall be reliably and independently grounded.

（2）Ensure zero resistance grounding. The grounding conductor shall be carefully checked for no paint or rust; otherwise, the grounding conductor shall be scraped clean. Minor grounding fault may cause error or data fluctuation, and serious grounding fault may cause danger!

2.6 Power Supply Input Socket (180V-270V 50Hz/60Hz)

Notices:

（1）The instrument has the function of fast break protection and high voltage output is cut off quickly in short circuit mode when the power is suddenly cut off at low voltage. This function requires that the low voltage power supply (socket and disconnector) of the instrument shall be connected reliably; otherwise, power failure over several ms will cause protection.

（2）If the input voltage is greater than 270V (such as misconnecting with 380V), the instrument shall be protected immediately and the internal power shall be cut off. After protection, only the main power switch light is on, but the screen does not display. Check the power supply at this time and restart it

（3）If the voltage is too low and the device cannot output the set high voltage, it can be adjusted by voltage regulator.

（4）The instrument can automatically adapt to 50Hz/60Hz power supply frequency.

（5）When the generator is used for power supply, the frequency fluctuation is large and there is no interference in the place where the generator is used, "Fixed Frequency" mode can be selected to eliminate the influence of the frequency fluctuation of the generator's power supply.

2.7 Fuse Base

The fuse base is integrated with the low voltage power socket. The specification of the fuse is 5A/250V and the dimension is φ5×20mm.

Notices: fuse of the same specification shall be used. If it still burns out after replacing the spare fuse, you may inform the manufacturer to deal with the malfunction of the instrument.

2.8 Internal High Voltage Allowance Switch

Function: the general power switch of built-in high voltage system or CVT self-excitation low voltage output system. Turn off this switch and the instrument is automatically set to external high voltage measurement mode. This switch is controlled by the main power switch.

Notices:

（1）Turn on the switch during the measurement with the built-in high voltage. After starting the

measurement, the instrument will automatically raise/lower the voltage, accompanied by sound and light alarm. High voltage can be output during alarm period!

（2）In case of emergency, this switch shall be turned off immediately or the general power switch shall be turned off.

（3）After the occurrence of protection information, the machine shall be restarted after troubleshooting.

2.9 General Power Switch

Turn on the general power switch, the name and number of the instrument are displayed firstly, and then enter in measurement menu automatically after a few seconds. Turn off the switch and turn off the power of the internal high voltage system. Turn off the switch immediately in case of emergency.

2.10 Key

（1）Use “→” key to move the cursor, use “↑” and “↓” key to modify the contents at the cursor, and “On/Off” key is used to confirm or stop. See the "Instructions for Use" of each type of instrument for detailed functions.

（2）Press any key to terminate the measurement during the measurement.

2.11 LED

It displays menu, measurement results or error messages. It shall avoid exposure under sunlight for a long time and avoid heavy pressure.

2.12 Printer

Automatic Printing: the measurement results are automatically printed at the end of the measurement after automatic printing is selected in the menu. After that, the power supply of the instrument can be cut off at a distance to make the operation safer.

Manual printing: in the result interface, select the print icon, press On button for manual printing.

Change paper and color ribbon: thermal printer uses 58mm thermal printing paper. When the paper is changed, open the printer's paper cover, put in the paper roll, leave a few parts on the outside, and then close the cover.

2.13 Communication Interface

Function: RS232 interface is connected with the serial communication port of PC or laptop. To ensure normal communication, both parties shall set the same Baud rate and communication address.

Communication protocol: the instrument and PC communicate according to the specified protocol, and the instrument is operated in real time to realize functions of setting, measurement and data storage and transmission. Notice: the instrument shall be remotely controlled within the visual range to ensure to start the measurement after the personnel are far away.

3. Operation Instructions

3.1 Contrast Adjustment

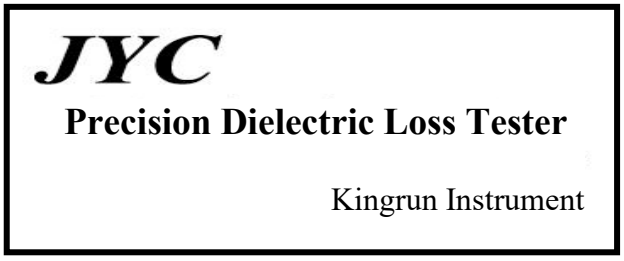
The contrast of liquid crystal display screen has been adjusted at ex-factory. If you don't feel it clear enough, you can adjust it as follows:

Hold on ↑ or ↓, then turn on general power switch, then press ↑ or ↓ to adjust the display contrast and

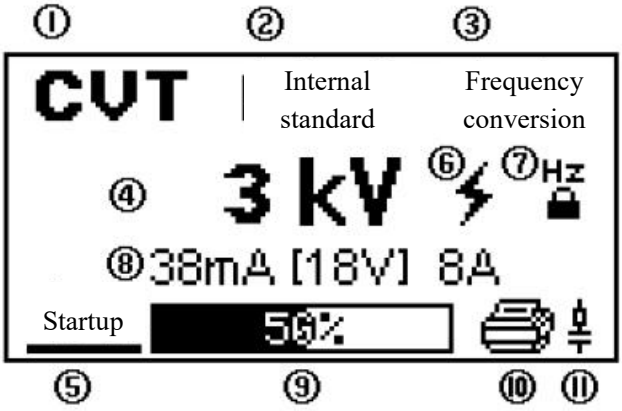
press "On/Off" button to exit after adjustment.

3.2 Enter in Menu

When the general power switch is turned on, the startup screen is displayed first and then the production date is displayed:



Then enter in measurement menu automatically. Please turn on the switch to allow internal high voltage for the use of high voltage in the machine.



 is displayed at ⑥ after internal high voltage allowance is turned on, which indicates that internal high voltage is in place, and the cursor can be moved to ① ② ③ ④ ⑤ at this time.

“External High Voltage” is indicated at ③ after internal high voltage allowance is turned off and the cursor can be moved to ① ② ⑤.

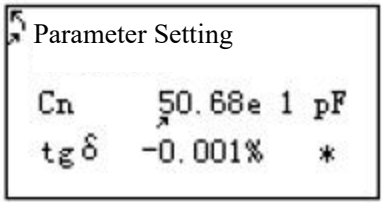
3.3 Selection of Wiring Mode

When the cursor is at ①, press ↑↓ to select “Positive Wiring”, “Inverse Wiring” “CVT” and “Ratio of Transformation” measurement mode;

3.4 Selection of Internal and External Standard Capacitance

When the cursor is at ②, press ↑↓ to select “Internal Standard” or “External Standard”, which indicates the use of internal or external standard capacitance. Usually internal standard can be used for measurement of inverse and positive wiring and CVT self-excitation method measurement, high voltage dielectric loss shall select external standard mode, and the parameters of external capacitance shall be placed in the instrument:

Hold on “On/Off” button at this place, until it displays:



External standard capacitance and dielectric loss can be set. Cn adopts scientific counting method, such as 5.000e1=5.000x101=50.00 and 1.000e2=1.000x102=100.0, and the scope is 0.000e0-9.999e5 (namely 0-999900pF).

The setting scope of tgδ is 0 to ±9.999%.

Move the cursor and use ↑↓ to modify the contents of the place at the cursor. Press and hold the “On/Off” button until the measurement menu is returned. Meanwhile, the parameters are stored and the data is valid. Display of "*" in the lower right corner indicates that other data are not allowed to be modified, as these data are ex-factory parameters of the instrument and it will influence the measurement once modified!

3.5 Selection of Test Frequency

3.5.1 Default Frequency of Startup

The cursor is at ③ and "Frequency Conversion" is displayed, representing 45/55Hz automatic frequency conversion. The instrument automatically uses 45Hz and 55Hz to measure once respectively, and then the data at 50Hz without interference is calculated. Automatic default mode for startup is this mode, which is recommended to use.

3.5.2 Selection of More Frequencies

The cursor is at ③ and press “On/Off” button for more than 1s to switch to the full frequency selection and then press ↑↓ button to display "45Hz /50Hz / 55Hz / 60Hz / 65Hz / 50±5Hz / 60±5Hz / 50±2.5Hz" in cycle:

“50Hz”: it is power frequency measurement; this setting cannot resist interference, which shall be adopted during measurement in the lab or calibration.

“45/55/60/65Hz”: it is single frequency measurement, which is adopted during the research into the change of dielectric loss under different frequencies.

“50±5Hz”: it is 45/55Hz automatic frequency conversion, which is suitable for measurement under power frequency interference in 50Hz power grid.

“60±5Hz”: it is 55/65Hz automatic frequency conversion, which is suitable for measurement under power frequency interference in 60Hz power grid.

“50±2.5”: it is 47.5/52.5Hz automatic frequency conversion, which is suitable for measurement under power frequency interference in 50Hz power grid.

Press “On/Off” button, 

is displayed or cancelled at ⑦. This symbol indicates that the power is supplied by a generator and the frequency strictly selected can be output. This method cannot track the interference frequency and cannot be used for anti-interference. The fixed frequency of 50Hz is recommended for generator power supply.

Press “On/Off” button for more than 1s to cancel full frequency selection.

3.6 Selection of Test High Voltage

3.6.1 Selection of High Voltage under Positive/Inverse Wiring Mode

When the cursor is at ④, press ↑↓ key to display test high voltage in cycle “0.5 /0.6 /0.8 /1 /1.5 /2 /2.5 /3/3.5 /4 /4.5 /5 /5.5 /6 /6.5 /7 /7.5 /8 /8.5 /9 /9.5 /10kV”; Select test high voltage according to high voltage test procedures.

After starting the measurement, it shows measurement high voltage and high voltage current (mA) will appear at ⑧.

3.6.2 Select High Voltage and Protection Limit under CVT Self-excitation Method Wiring Mode

Internal high voltage allowance switch must be turned on for CVT self-excitation measurement, and the excitation voltage is provided from the machine and output by "Low Voltage Output" and "Measurement Grounding". For the sake of safety, CVT self-excitation method also needs to set the following protection limits:

When the cursor is at ④, press “On/Off” button to display xxkV / xxmA / xxV / xxA in cycle, and press ↑↓ to select:

xxkV: 0.5/0.6/0.8/1/1.5/2/2.5/3/3.5/4kV can be selected, which is upper limit of high voltage, and 4kV voltage or below can be used.

xxmA: 10/15/20/25/30/35/40/45/50/60/70/80/100/120/140/200mA can be selected, which represents the upper limit of high voltage current of the products to be tested.

xxV: 3/4/5/6/7/8/9/10/12/15/20/25/30/35/40/50V can be selected, which represents the upper limit of low voltage excitation voltage.

xxA: 3/4/5/6/7/8/9/10/11/12/13/14/15/16/20/30A can be selected, which represents the upper limit of low voltage excitation current.

Notices:

（1）The four protection limits work at the same time during measurement, so the test high voltage may not reach the set value. If the high voltage does not reach the protection limit, restricted protection limit can be adjusted appropriately.

（2）Generally, low voltage excitation voltage can reach 20V during measurement of C1, and low voltage excitation current can reach 15A during measurement of C2. Generally, high voltage can be set to be 2-3kV, high voltage current limit is seldom adopted and it can be set to be 200mA at the maximum.

After starting CVT measurement, excitation high voltage will be displayed at ④. High voltage current (mA), low voltage (V) and low voltage current (A) will appear at ⑧, displayed quantity with a bracket, as is shown in [18V], represents such quantity reaches protection limit; if there is no bracket, it represents excitation high voltage reaches protection limit.

3.7 Automatic Printing

The cursor is at ⑤, press ↑ button to display or cancel the printer icon at ⑩, which indicates the end of measurement and the start of automatic printing.

3.8 Series Connection Mode

The cursor is at ⑤, press "On/Off" button quickly for 10 times to display or cancel the RC series connection symbol  at ⑪. This symbol indicates the simulation of the work of Schering Bridge. The

absence of this symbol indicates the simulation of the work of current comparator bridge.  shall appear when standard dielectric device is used to calibrate the instrument in the test room, and  shall be cancelled for on-site measurement.

3.9 Start Measurement

The cursor is at ⑤, press "On/Off" button for more than 1s to start the measurement.

Sound and light alarm is issued after starting measurement; 0-99% indicated at ⑨ represents measurement process.

During the measurement, press any key to cancel the measurement and turn off the main power supply in case of emergency.

3.10 View Data

After the results are displayed, press ↑↓ key to view the data and press Print key to print. Press "On/Off" button for 1s to exit.

The instrument can automatically distinguish capacitance, inductance and resistance type test products: Cx and tgδ are displayed for capacitance type test products; Lx and Q are displayed for inductance type test products; Rx and additional Cx or Lx are displayed for resistance type test products. The display unit is selected automatically.

Type of Test Products	Display data	Remarks
Capacitance	Cx, tgδ, U, I, Φ, P, F, t	|δ|>1, capacitance and series/parallel connection resistance will be displayed |δ|<1, inductance and series connection resistance will be displayed
Inductance	Lx, Q, U, I, Φ, P, F, t	
Resistance	Cx(Lx), Rx, U, I, Φ, P, F, t	

Cx- Capacitance of test products [1μF=1000nF nanofarad/1nF=1000pF], if 10.00nF is displayed, it is 10000pF;

tgδ- Dielectric loss factor [1%=0.01];

Lx- Inductance of test products [1MH Megahenry =1000kH / 1kH=1000H];

Q- Quality factor [no unit]

Rx- Resistance value of test products [1MΩ=1000kΩ / 1kΩ=1000Ω];

U- Test voltage [1kV=1000V / 1V=1000mV];

I- Current of test products [1A=1000mA / 1mA=1000μA];

Φ- The angle of the current of test products exceeding the previous test voltage [°degree] or the angle of primary voltage exceeding previous secondary voltage during the measurement of ratio of transformation.

K- When CVT ratio of transformation is measured, the ratio between the primary voltage and the secondary voltage;

P- Loss power of test products [1kW=1000W / 1W=1000mW];

F- Frequency [Hz] indicated frequency displays the actual frequency and automatic frequency conversion mode displays the intermediate frequency;

t-Temperature [℃], measured with sensor in the machine, and the error may be large due to the

influence of instrument heat. The instrument displays the data has no temperature conversion.

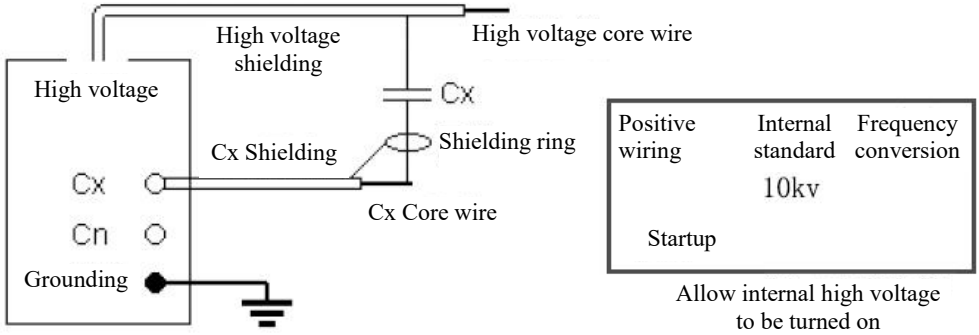
The displayed data with CVT self-excitation measurement are: C1, tgδ/C2, tgδ/U1, U2/F and t are connected according to the measurement, the definition of the connection with Cx socket of the test product input is C1and C2 is to connect with the high voltage wire. U1 is high voltage for measurement of C1and U2 is high voltage for measurement of C2.

Display over indicates the measurement data exceeding the range.

3.11 Reference Wiring

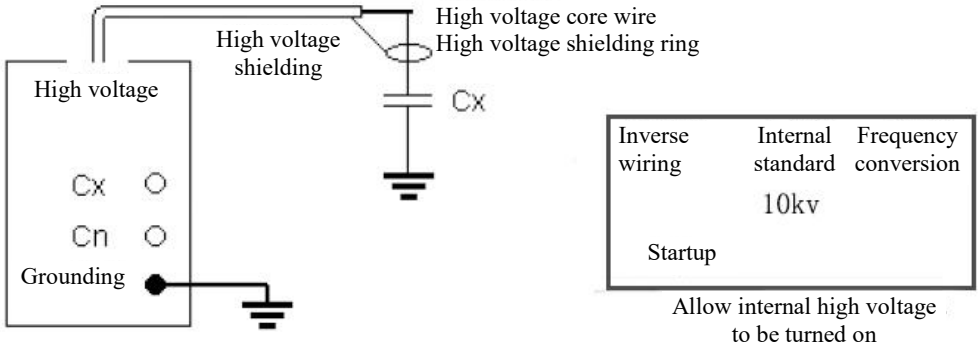
3.11.1

Positive Wiring, Internal Standard Capacitance and Internal High Voltage (Conventional Positive Wiring):



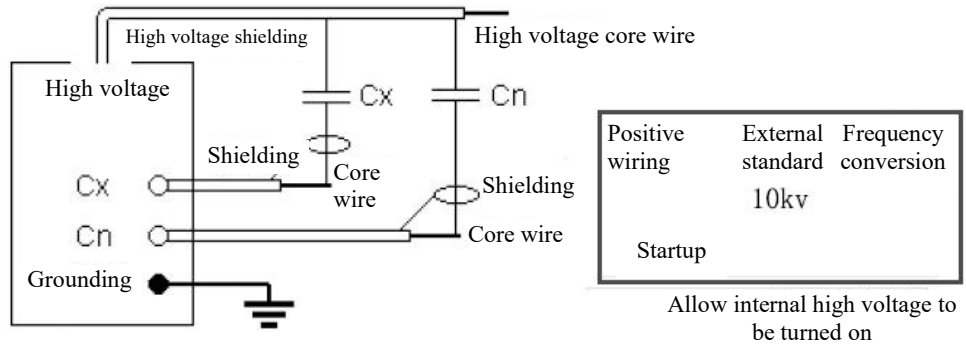
3.11.2

Inverse Wiring, Internal Standard Capacitance and Internal High Voltage (Conventional Inverse Wiring):



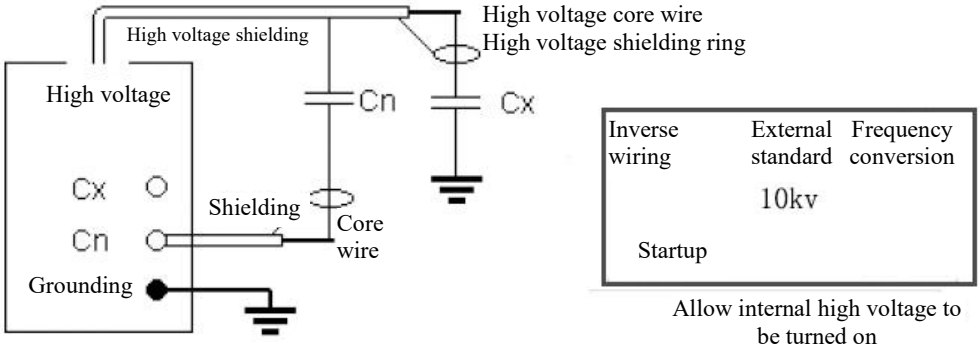
3.11.3

Positive Wiring, External Standard Capacitance and Internal High Voltage:



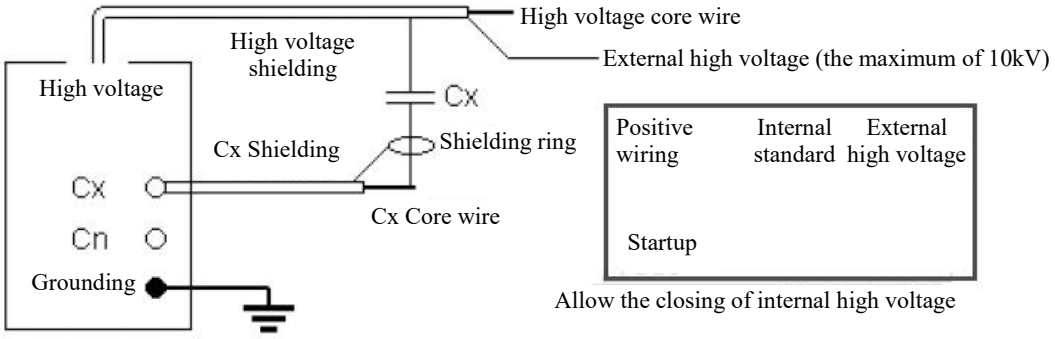
3.11.4

Inverse Wiring, External Standard Capacitance and Internal High Voltage:



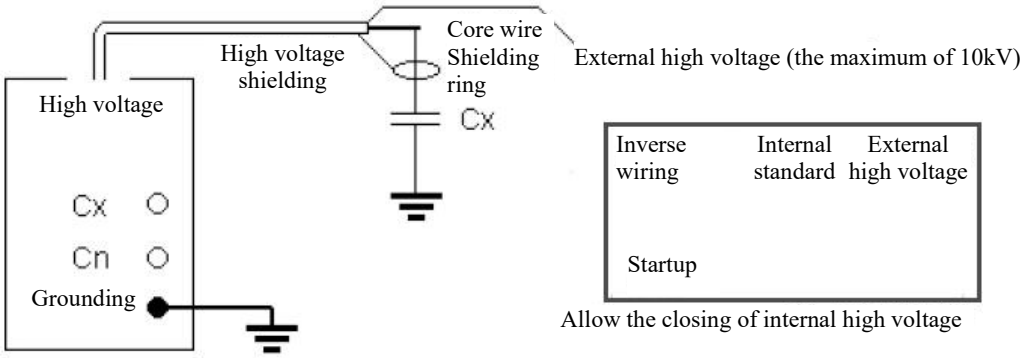
3.11.5

Positive Wiring, Internal Standard Capacitance and External High Voltage:



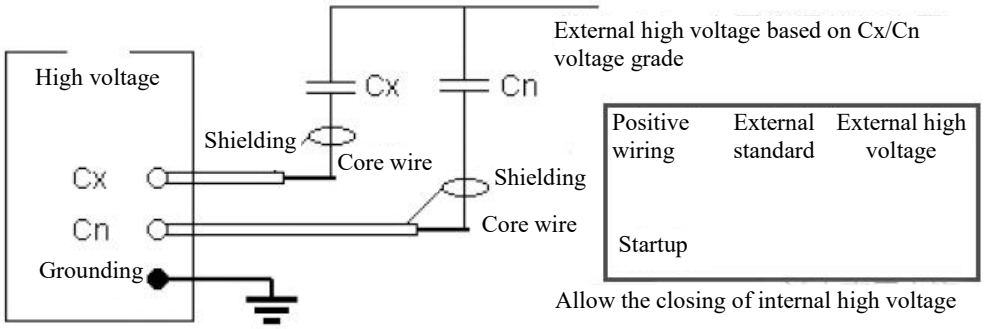
3.11.6

Inverse Wiring, Internal Standard Capacitance and External High Voltage:


Core wire
Shielding ring
External high voltage (the maximum of 10kV)
High voltage shielding
High voltage
Cx
Cn
Grounding
Cx
Inverse wiring
Internal standard
External high voltage
Startup
Allow the closing of internal high voltage

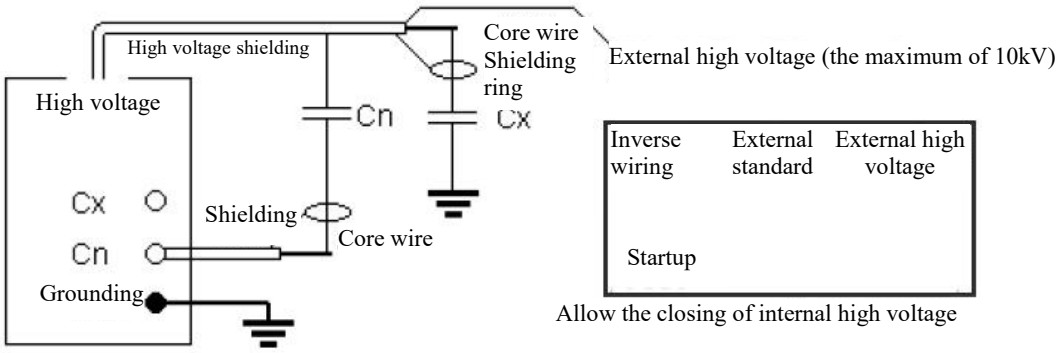
3.11.7

Positive Wiring, External Standard Capacitance and External High Voltage (High Voltage Dielectric Loss):



3.11.8

Inverse Wiring, External Standard Capacitance and External High Voltage:



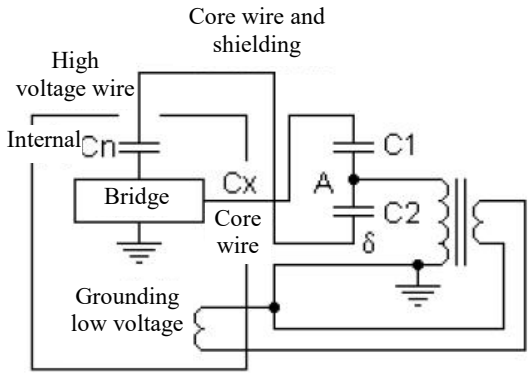
3.11.9

Traditional CVT Self-excitation Method:

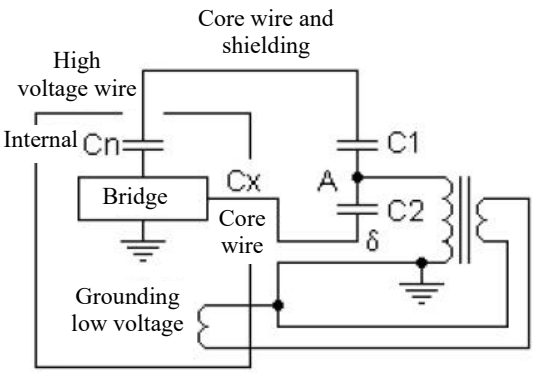
It shall be connected to standard capacitance, low voltage excitation power supply and volt-ammeter used for monitoring and the specific wiring refers to high voltage test procedures.

3.11.10

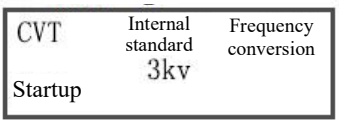
3.11.10 CVT Self-excitation Method Measurement with Busbar not Grounded



Measure C_1



Measure C_2



Allow internal high voltage to be turned on

It shall be noted that high voltage wire shall be suspended to avoid contact with the ground, otherwise, its additional dielectric loss to the ground may cause some errors, and a thin cable can be used to connect to high voltage socket and CVT test product and hoist them. In addition, taking into consideration the series connection differential voltage effect of C2 or C1and internal Cn, the capacitance can be calibrated based on the following Formula:

$$C_{1\text{Actual values}} = \frac{C_{2\text{Nominal values}}}{C_{2\text{Nominal values}} + Cc} C_{1\text{Measured values}} \qquad C_{2\text{Actual values}} = \frac{C_{1\text{Nominal values}}}{C_{1\text{Nominal values}} + Cc} C_{2\text{Measured values}}$$

Where, Cc is the calibration experience value, including the influence of Cn and high voltage wire on grounding capacitance, and its value is 110pF.

3.11.11

CVT Self-excitation Method Measurement with Busbar Grounded

It the busbar is grounded, it is suggested to adopt the following method for measurement:

Step 1: connect wires according to Figure 3.10.11.1 and use “Internal Cn” mode to measure C13:

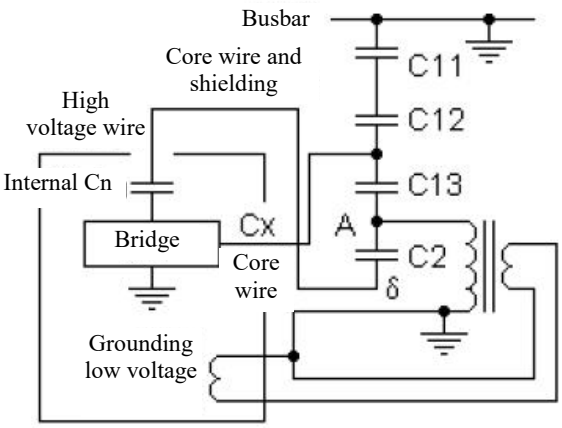


Figure 3.10.11.1 Measurement of C_{13} Connection

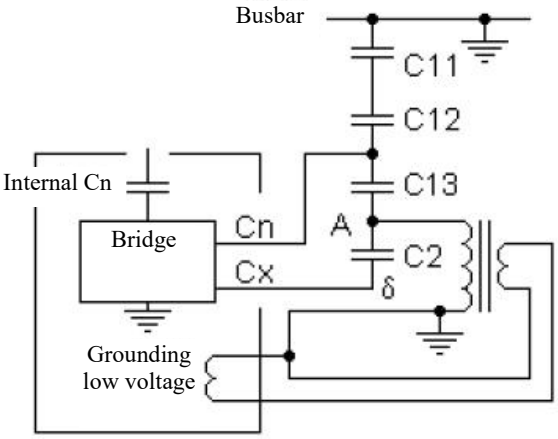


Figure 3.10.11.2 Measurement of C_2 with C_{13} as the Standard Capacitance

It shall be noted that high voltage wire shall be suspended to avoid contact with the ground, otherwise, its additional dielectric loss to the ground may cause some errors (as is shown in the increase of C13 dielectric loss). A thin cable can be used to connect to high voltage socket and CVT test product and hoist them.

To further compensate the influence of C2 crosstalk standard circuit on C13, the capacitance of C13 can be calibrated according to the following Formula:

$$C_{13\,\text{Actual values}} = \frac{C_{2\,\text{Nominal values}}}{C_{2\,\text{Nominal values}} + C_c} C_{13\,\text{Measured values}}$$

Where, Cc is the calibration experience value, including the influence of Cn and high voltage wire on grounding capacitance, and its value is 110pF.

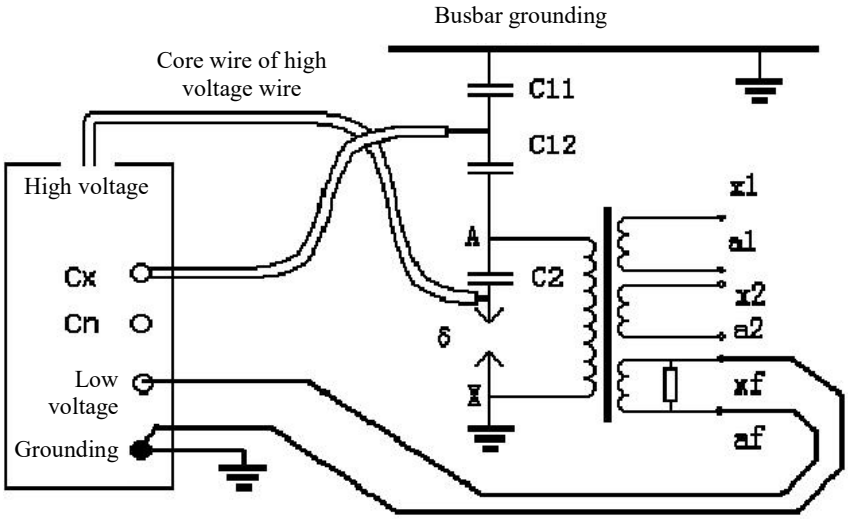
Step 2: connect wires according to Figure 3.10.11.2 and use C13 as the standard capacitor to measure C2. Before measurement, put the capacitance and dielectric loss of C13 in the external standard capacitance of the instrument (refer to 3.3) and select "External Cn" mode.

When the busbar is not grounded, it can also be measured in this way.

3.11.12

Dragging of High Voltage Wire with Self-excitation Method

When self-excitation method is adopted for measurement of CTV, high voltage wire can be connected to lower part of C2, Cx core wire is connected to upper end of C12, high voltage wire can be used by dragging it on the ground without the need of suspension (automatic compensation in internal equipment).

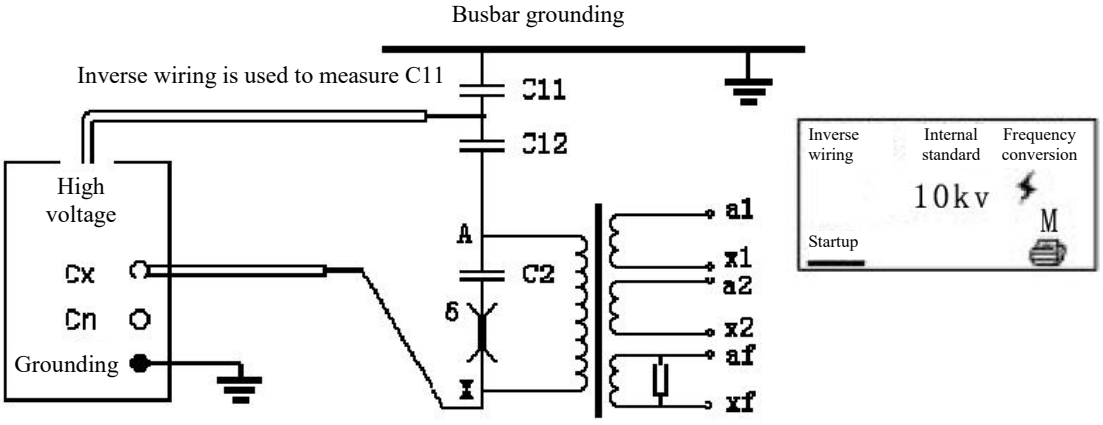


3.11.13

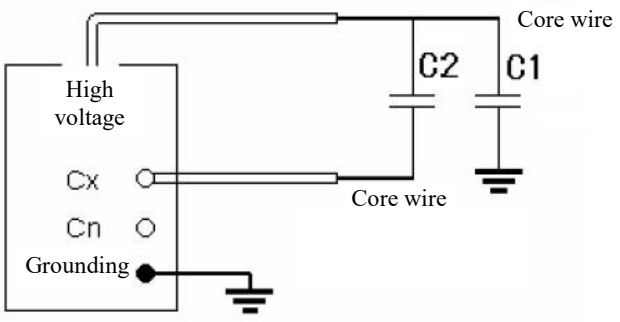
Low Voltage Shielding of Inverse wiring

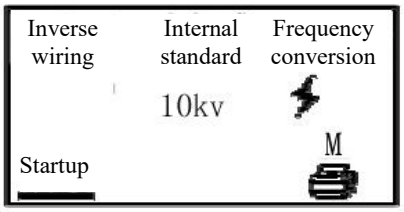
In the mode of inverse wiring, internal standard and internal high voltage, the cursor is moved to "Start" position, and "M" is displayed by pressing the right low corner of “↓” to start low voltage shielding function of inverse wiring.

Under the condition of 220kVCVT busbar grounding, 10Kv inverse wiring dielectric loss measurement without removing the wire can be conducted on C11. As is shown in the Figure below: the busbar is connected to ground wire, the upper end of C11 is not disassembled, the lower part of C11 is connected to core wire of high voltage wire, δ and X at the end of C2 are connected to Cx core wire. In this way, C12 and C2 are shielded by low voltage and the instrument adopts inverse wiring/10kV/M measurement method to measure C11.

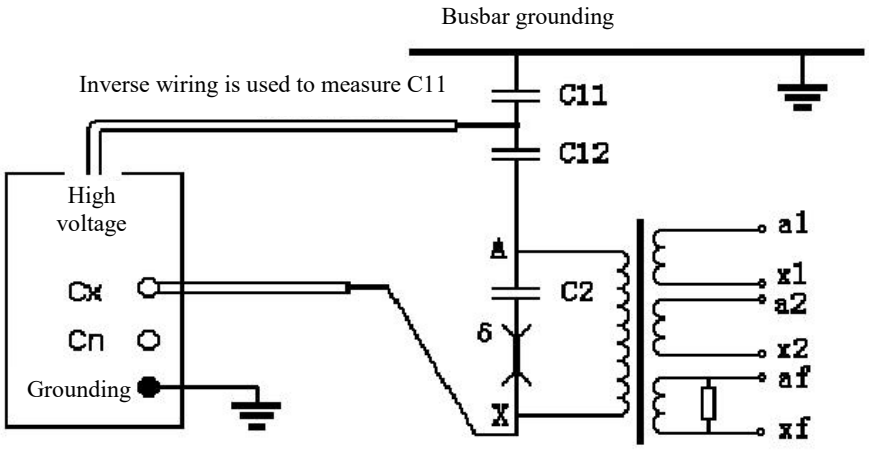


3.11.14 Low voltage shielding function of inverse wiring, a connection can simultaneously measure capacitance and dielectric loss of C1and C2 in an inverse wiring, internal standard and internal high voltage mode, the cursor is moved to the "Start", and press the right low corner of “↓” to show "M".





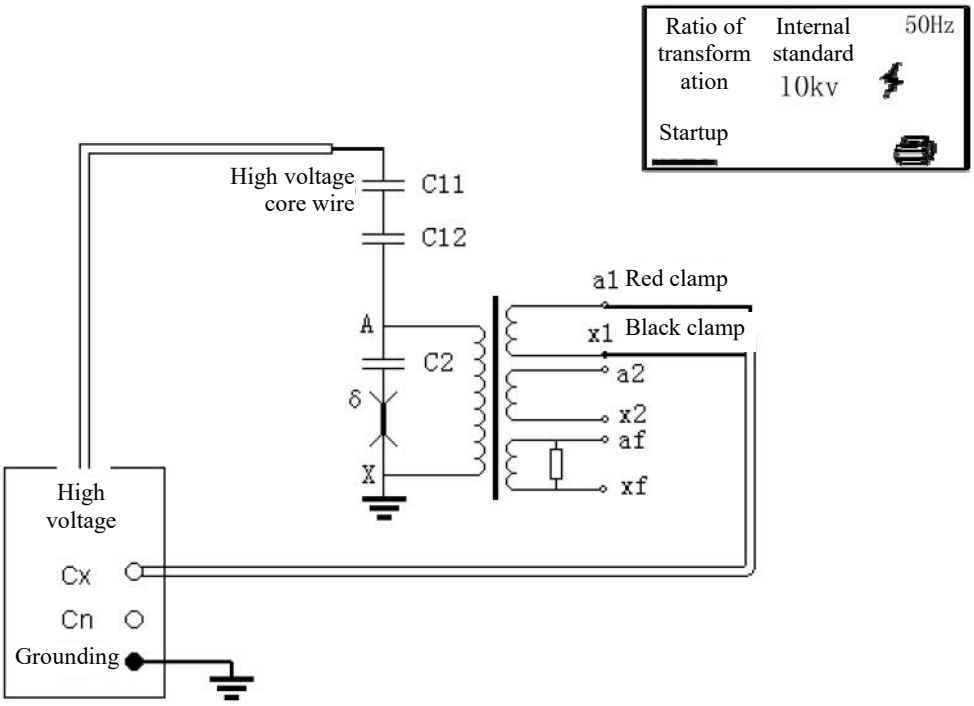
Turn on the low voltage shielding of inverse wiring and measure 10kV inverse wiring dielectric loss without removing the wire in the situations of not removing busbar of upper capacitance C1. As is shown in the Figure below, the busbar is connected to ground wire, the upper end of C1is not disassembled, the lower end of C1is connected to core wire of the high-voltage line, and C2 end is connected to Cx core wire. The instrument adopts inverse wiring/10kV/M measurement method, which can simultaneously measure the capacitance and dielectric loss values of C11 and the lower shielding part.



3.11.15

Test on Ratio of Transformation of CTV

Red clamp of core wire of high voltage wire of the instrument is connected to upper end of CVT, and the busbar is removed from the ground. The lower end of CVT is grounded and red and black clamps of low voltage wire are connected to secondary winding; notice: if the test angle is near 180 degrees, the red and black clamps shall be reversed.



3.12

Connection to Computer

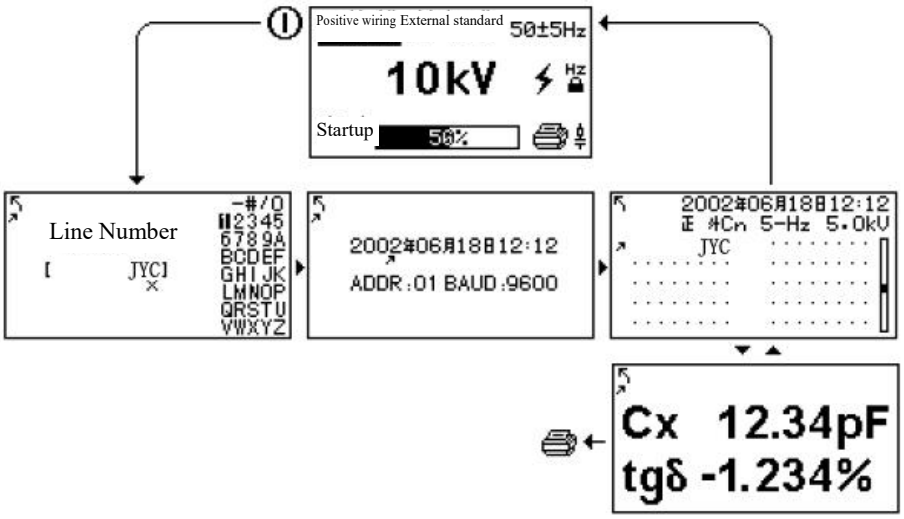
After the computer is connected, it can be used to operate the instrument and the specific operation is shown in the instructions for host software.

3.13

Extras Menu

3.13.1

Enter/Exit Extras Menu



The cursor is in the cursor position ① on the measurement menu, press the "On/Off" button to enter the "Line Number/Clock/Storage Menu" or exit. At any point, press "On/Off" button for more than 1s to exit directly to the measurement menu.

The arrow  on the upper left corner of the screen represents Exit, move the arrow to  and press "On/Off" button to exit, otherwise, move the arrow to  and press "On/Off" button to exit.

3.13.2

Set Line Number

Set the line number for printing and storage. It can be set to a space if you don't need it.

The cursor has three positions: Exit, Delete and Set.

Press "On/Off" button to exit in “Exit” position and enter in the clock menu.

Display the cross in the Delete position and press "On/Off" button to delete the last letter.

Display the flashing cursor in the Set position, move it to the desired letter and then press "On/Off" button to enter.

3.13.3

Set Clock, Communication Address and Baud Rate

Move the cursor to the desired position, ↑↓ revise and then press "On/Off" button to confirm and exit.

The first line is Clock.

ADDR is the communication address code of the instrument, which can be set from 01 to 32. A computer can control 32 measurement instruments and equipment at the same time.

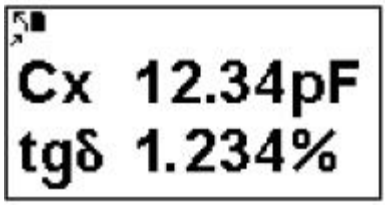
BAUD is the communication Baud rate, which can be set at 2400/36/4800/9600bps.

When connecting to a computer, both parties of the communication shall have the same address and Baud rate.

3.13.4

Store Operation

Store Data: set “Line Number” before the measurement. The following data picture is shown after the end of the measurement:



Move the arrow cursor to the black block that represents Store  , and press "On/Off" button to store.

Notice: the stored data is sorted in chronological order, and if 100 pieces of data have been stored, the earliest one will be automatically deleted.

View Data: the arrow cursor is moved to the front of the name (Line Number) and the measurement date and settings will be displayed on the upper right corner of the screen. Click "On/Off" button to view the measurement data and print it, and "MD" sign on the printed store data list represents the stored data. Click "On/Off" button once again to exit view.

Delete Data: before the arrow cursor is moved to the front of the name, press "On/Off" button quickly for

three times to delete it.

"..... “represents an empty storage unit.

The arrow is pointed to the exit sign and press "On/Off" button to return to measurement menu.

4. Notices for On-site Test

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

4.1 Poor Hook Contact

When the hook is used to connect the test product during on-site measurement, it must be contacted with the test product well, otherwise, discharge at the contact point will cause serious data fluctuation! Especially, the oxide layer of the drainage wire is too thick or the wind blows the wire to cause swinging, which is easy to cause bad contact.

4.2 Poor Grounding Contact

Poor grounding can cause serious fluctuation in instrument protection or data. The paint and rust shall be scraped off cleanly at the grounding point to make sure 0 resistance grounding!

4.3 Direct Measurement of CVT or Measurement of Electromagnetic PT with End Shielding Method

Dielectric loss will appear in case of the direct measurement of next coupling capacitance of CVT and self-excitation shall be adopted.

When electromagnetic PT is measured with end shielding method, negative dielectric loss will appear due to the occurrence of "T-shaped Network Interference" caused by dampness, the three skirt porcelain sleeves and the terminal plate below are blown dry. It can also be measured with conventional method or end pressure method.

4.4 Excessive Air Humidity

The measurement value of dielectric loss increases abnormally (or decreases even becomes negative) and is unstable due to large air humidity and shielding ring can be added if necessary. This method is controversial because the distribution of electric field of tested product is changed by adding shielding ring artificially.

4.5 Generator Power

The input frequency of the generator is not stable when it supplies power, so fixed frequency 50Hz mode can be adopted to work.

4.6 Test Line

Due to long-term use, it is easy to cause hidden circuit break of test line, or short circuit of core wire and shielding, or bad contact of the plug, so users shall maintain test line frequently.

When standard capacitance test product is tested, the full shielded plug shall be used to connect to eliminate the influence of additional stray capacitance, otherwise, the instrument precision cannot be reflected.

When CVT is measured with self-excitation method, non-special high-voltage line shall be suspended; otherwise, additional stray capacitance and dielectric loss to the ground will cause measurement errors.

4.7 Selection of Working Mode

After connecting the line, please choose the correct measurement working mode (positive, negative and

CVT) and never choose wrong mode; in particular, frequency conversion anti-interference mode shall be adopted in the interference environment.

4.8 Influence of Test Method

As dielectric loss measurement is greatly influenced by the test method, it shall be distinguished between the test method error and the instrument error. When there is a problem, you can first check the wiring and then check whether it is the instrument fault.

4.9 Instrument Fault

Use a multimeter to measure whether the test line is disconnected or whether the core wire and shielding are short-circuited; the input power supply of 220V is too high or too low; whether the grounding is good.

Test the standard capacitors or capacitance test products known with capacity and dielectric loss with positive and inverse wiring and the instrument can be judged without any problem if the result is correct;

Unplug all test lines and carry out air test and voltage lifting; the instrument may have fault if it cannot work normally.

Measure low-voltage output after starting CVT for measurement, 2-5V voltage shall appear, otherwise, the instrument has fault.

5. Instrument Calibration

5.1 Calibration with Standard Losser

Connect the standard losser with shielding cable with a plug. If the accuracy of the standard losser cannot be guaranteed, the comparison method shall be used for calibration. It is recommended to use 2801 bridge or other precision bridge as the comparison standard.

The instrument shall select "Internal Standard" and "RC Series Connection Test Product", and the frequency mode of working frequency of 50Hz or fixed frequency of 50Hz can be adopted.

5.2 Calibration with QSJ3

Connect QSJ3 with shielding cable with a plug, select the mode of "Positive/External Cn/External U" for measurement, the current ratio is Cx: Cn and proper values can be placed in Cn.

5.3 Anti-interference Ability

A circuit is set up to inject a constant amount of interference current into the instrument.

Notices:

1）Consideration shall be given to the possibility of the circuit becoming part of the test product.

2）220V power supply circuit will be equipped with the measured frequency component after starting the instrument and if the frequency component enters in the instrument through the interference current, the anti-interference ability of the instrument cannot be tested.

3） It is not recommended to use high voltage conductor nearby to exert interference, because it is easy to generate near distance tip discharge, the discharge resistance is non-linear and it is easy to generate the same frequency interference.

6. Brief Introduction to Working Principle of Instrument

6.1 Instrument Structure

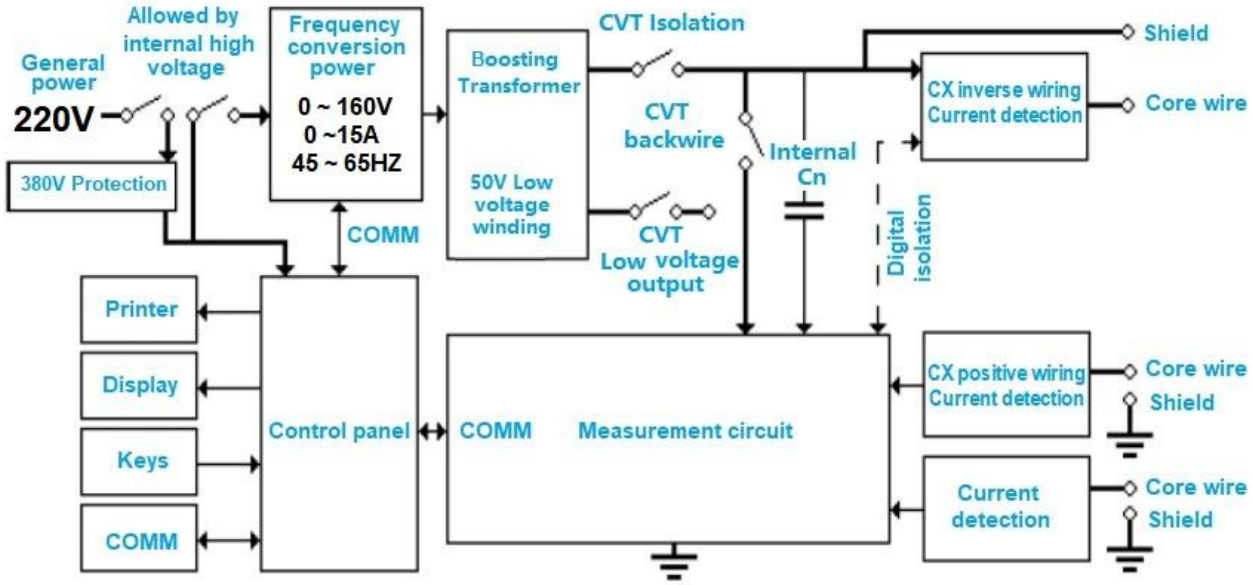


Diagram of Instrument Structure

Measurement circuit: Fourier Transform, complex operation and all the calculation and range switching, and control of frequency conversion power.

Control panel: printer, keyboard, display and communication transfer.

Frequency conversion power: SPWM switching circuit is used to generate stable voltage output in high power sine wave.

Boost transformer: boost the output of frequency conversion power to the measured voltage, and the maximum reactive power output is 2kVA/1 minute.

Standard capacitor: internal Cn, and the measurement reference.

Cn current detection: used to detect current of internal/external standard capacitors.

Cx positive wiring current detection: only used for positive wiring measurement.

Cx inverse wiring current detection: only used for inverse wiring measurement of inverse wire.

Inverse wiring adopts digital isolation communication: high speed digital isolation communication circuit is used to transmit inverse wiring current signal to the low voltage side.

6.2 Working Principle

High voltage set values are sent to frequency conversion power after starting measurement, frequency conversion power supply will adjust the output retarder to the set value with PID algorithm, measurement circuit transmits the measured high voltage to frequency conversion power, and low voltage is adjusted slightly to achieve accurate high voltage output. According to the setting of positive/inverse wiring and internal/external standard capacitance, measurement circuit will automatically select input and switch range based on the test current, and the measurement circuit uses Fourier Transform to filter out interference, separate the fundamental wave of signals and conduct vector operation on the standard

current and test product current, amplitude is used to calculate capacitance and angular difference is used to calculate tgδ. Repeated measurements are made and an intermediate result is selected by sorting. At the end of the measurement, the measurement circuit issues a step-down command and frequency conversion power slowly drops the voltage to 0.

CVT measurement: CVT isolation switch is disconnected and low-voltage isolation switch is connected to the output low voltage. When measuring C2, CVT backwire switch is switched on, C2 is connected to test product channel and C2 is measured with C1as the standard capacitance.

7. Discussion on Frequency Conversion Measurement

7.1 Frequency Conversion Measurement

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

When two sinusoidal waves with a frequency difference of 1 time are added together, the interference is the high frequency, whose amplitude is 10 times of that of low frequency:

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

4 measurement values are obtained if x=0/90/180/270°;

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

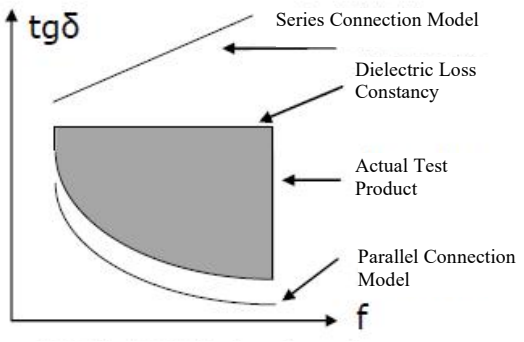
Calculate A=Y1 - Y3=2.4559, B=Y0 - Y2=0.2442, then,

φ=tg-1(B/A)=5.678° V= A2+B2 / 2=1.234

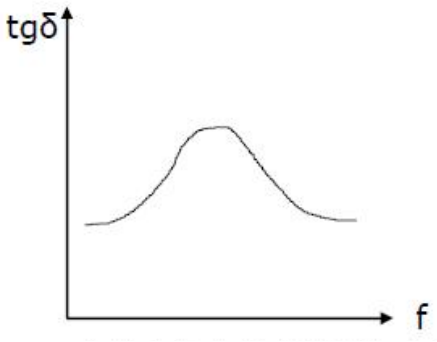
This is just the phase and amplitude of the low frequency part and the interference is suppressed. The measurement points of the actual waveform are up to tens of thousands, the calculation amount is large and the results reflect the overall characteristics of the waveform.

7.2

Dielectric loss has two ideal models of RC series connection and parallel connection: serial connection model is tgδ=2πfRC, parallel connection model is tgδ=1/(2πfRC), and tgδ is positively and negatively correlated to the frequency f respectively. As is shown in the Figure, f has a great influence on the two models of full direct proportion and full inverse proportion. However, the actual capacitor is a mixed model with multiple models interwoven, and the influence of f is small at this time.



Low Frequency Dielectric Loss Curve (<1kHz)



High frequency dielectric loss curve or low frequency circuit resonance

7.3 Automatic Frequency Conversion is Equivalent to 50Hz.

The instrument adopts automatic frequency conversion to measure one point respectively on both sides of the interference frequency 50Hz (45Hz and 55Hz), and then the data at 50Hz frequency is calculated. Except for low frequency resonance of multiple component circuits, it is impossible for the medium in a single test product to cause energy absorption peak at a low frequency and the dielectric loss near the working frequency always changes monotonously with the frequency. Therefore, this measurement method will not bring significant errors. In fact, two dielectric loss values before the average are very close, and they are completely referential even if they are not averaged. 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.

8. Error Message and Processing

error messages 1-4 are shown on full screen, error messages 5-21 are shown at position ⑧ (the right lower corner of the screen) of A, B and C type instrument or at position ⑨ of D, E and F type instrument (middle of lower side of the screen).

S/N	Screen Display	Instructions	Cause and Processing
1	HV-CT Error! Or inverse wiring of the instrument has errors!	Inverse wiring signal fault	Restart the machine or find technician of the manufacturer for processing;
2	Save-Data Error! Or storage parameters are wrong!	Internal parameters are wrong, which may be the fault of hardware.	Reset according to the original parameters on the ex-factory certificate or find technician of the manufacturer for processing;
3	RANGE ERROR! Or input circuit!	Range switching failure	Test product is short-circuit, please check wiring of the test product;
4	GROUND ERROR! Or poor grounding!	The instrument is not grounded or badly grounded;	Check whether grounding line is loose and whether the grounding point has rust and paint;
5	Er-Ps	Frequency conversion power software protection, it occurs during power failure;	Check whether input power socket is in good contact; Whether input power is stable; Whether high voltage wire of the test product is connected to signal line reliably;
6	Er-Ii	The input current of frequency conversion power is too large;	Find technician of the manufacturer for processing;
7	Er-Io	The output current of frequency conversion power is too large;	The load of test product is too heavy, please check whether test product is in short circuit, or try once again after lowering the voltage;
8	Er-Vi	The input voltage of frequency conversion power is too high;	Check the power voltage, which shall be lower than 270V;
9	Er-Vo	The output voltage of frequency conversion power is too high;	Find technician of the manufacturer for processing;
10	Er-Pi	Frequency conversion power hardware protection	Re-test and fail to restore, find technician of the manufacturer for processing;
11	Er-HL	Positive and negative power of frequency conversion power are not balanced;	Re-test and fail to restore, find technician of the manufacturer for processing;

S/N	Screen Display	Instructions	Cause and Processing
12	Er-Hz 或 Er-Lz Er-Hz or Er-Lz	Positive and negative power of frequency conversion power are too low;	Find technician of the manufacturer for processing;
13	Er-HT或 Er-LT Er-HT or Er-LT	Positive and negative power of frequency conversion power are too high;	Check the power voltage, which shall be lower than 270V;
14	Er-TT	Temperature rise of frequency conversion power is too high;	Shutdown and cool down;
15	Er-Zx	Output current and voltage of frequency conversion power fluctuate;	Check whether high voltage wire of the test product is connected to signal line reliably; Whether measurement setting is correct;
16	ER-cw	Wiring of CVT test products is wrong;	The instrument fails to detect test voltage, judge the error of wiring and check CVT self-excitation method wiring;
17	ER-cV	High voltage set exceeds the limit;	Check or reset;
18	ER-cv	Low voltage set exceeds the limit;	Check or reset;
19	ER-cI	High voltage current set exceeds the limit;	Check or reset;
20	ER-ci	Low voltage current set exceeds the limit;	Check or reset;
21	ER-Bd	Measurement signal fluctuates;	Please check wiring of the whole loop;

9. After-sales Service

The instrument with product quality problems shall be repaired and replaced for free within 24 months from the date of procurement, and warranty and technical services for life shall be provided. If there is any abnormal condition or failure of the instrument, please contact our Company in time so as to arrange the most convenient solution for you.