

Dear Client,

Thank you for choosing our UHV-405 Circuit Breaker Analyzer.
Please read this manual carefully before your initial use, and this manual will help you use our equipment skillfully.



There may be a little bit differences between the equipment you got for our trial to improve and perfect our products. You can find the changes in the appendix. Sorry for all the inconvenience caused to you. You can contact us if you have any doubts of our tester.



Voltage of terminals side may be Hazardous that would cause Electrical Discharge when you attach and detach test side. Be careful for risk of electric shock and personal injury.

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◆ **SERIOUS WARRANTY**

All products of our company carry a three-month limited warranty from the date of shipment. If any such product proves defective during this warranty period we will provide a replacement in exchange for the defective product without charge. In one year (including one year) the product will be maintained and repaired for free if it proves to be defective. Beyond one year, lifetime maintenance and repair with charge is available.

◆ **SAFETY REQUIREMENTS**

Please read the following safety precautions to avoid personal injury and to prevent this product or any other attached products being damaged. In order to avoid possible danger, this product can only be used within the scope of the provision.

Only qualified technician can carry out maintenance or repair work.

—To avoid fire hazard or personal injury

Use Proper Power Cord. Use only the product-specific power cord and the power cord must be in line with the specifications of the product.

Connect and Disconnect Correctly. When the testing wire is connected to the charged terminal, do not connect or disconnect to test wire at will.

Ground the Product. In addition to this product being grounded through the grounding conductor of the power cord, the grounding

column of the product shell must also be grounded. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, please do check that the product is properly grounded.

Pay Attention to the Ratings of All Terminals. In order to prevent the fire hazard or electric shock, please be care of all ratings of this product and labels. Before connecting this product, please read the product manual to acquire information about the ratings in further detail.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Use Proper Fuse. Use only the fuse type and rating specified for this product.

Avoid Touching Bare Wire and Conductor. When the product is charged, do not touch the bare connection point and parts.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in Explosive Atmosphere.

Keep the Surface of the Product Clean and Dry.

— Security Terms

Warning: Warning statements identify conditions or practices that could result in injury or loss of life.

Caution: Caution statements identify conditions or practices that could result in damage to this product or other property.

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I. Overview

i. Product introduction

With the development of society, people are demanding higher and higher security and reliability of electricity. High voltage circuit breakers are responsible for the dual tasks of control and protection in power system. Their performance is directly related to the safe operation of power system. Mechanical characteristic parameters are one of the important parameters to judge the performance of circuit breakers.

High-voltage breaker dynamic characteristic tester is a special instrument developed by our company to meet the needs of various high-voltage breaker operation characteristics testing. It can accurately measure the mechanical dynamic characteristic parameters of low oil, multi-oil, vacuum, SF6 and other high-voltage circuit breakers of various voltage levels. Its main feature is that besides satisfying the dynamic characteristic test of high voltage breaker in the market, it also satisfies the test of Siemens graphite contact breaker, and can reliably test the dynamic resistance waveform of three breaks of graphite contact breaker. The instrument is operated by means of large screen display, English character prompting man-machine dialogue, English character display results and print out. It has the advantages of intellectualization, multi-function, accurate data, strong

anti-interference, simple operation, small size, light weight and beautiful appearance.

ii. Instrument characteristics

(1) It is suitable for all types of metal contact SF6 breakers, GIS combination appliances, vacuum switches and oil breakers.

(2) The linear sensor and the rotary sensor are very convenient and simple to install.

(3) The host is large screen, straight through background light LCD, and contrast electronic adjustment. All English menu prompt operation, breaker action once, show all data and waveform atlas.

(4) The host can store the many group of opening and closing test results, and the real-time clock in the host can facilitate the archiving of the test date and time.

(5) Built in fast micro printer, print all data and curver.

(6) The instrument has powerful data analysis function, which can effectively analyze the mechanical characteristics of circuit breakers.

iii. Performance introduction

(1) Time: The opening and closing time of 12 Inherent contactor. one phase the period, each phase the period.

(2) Reclosing: The C-O, O-C, O-C-O time of each switch, the time of opening once, the time of closing once, the time of opening

twice, C-O time, O-C time.

(3) Bounce: Closing time of each switch, bounce times, bounce process, bounce curve, the rebound amplitude of each switch.

(4) Velocity: the Velocity of immediate opening, immediate closing, max velocity, time and travel curve.

(5) Current: the opening and closing current value and current curve.

(6) Action voltage: DC30-250V/20A digital adjustable circuit breaker action power supply is provided in the machine to automatically complete the low voltage operation test of the circuit breaker and measure the action voltage value of the circuit breaker.

iv. Product parameters

(1) Applicable environment

Input voltage: $AC220V \pm 10\%$ $50Hz \pm 10\%$

Atmospheric pressure: $86 \sim 106kPa$

Temperature: $-10 \sim 45^{\circ}C$

Humidity: $\leq 80\%RH$

(2) Safety performance

Insulation resistance: $> 2M\Omega$

Dielectric strength: the power supply can withstand 1 minutes of power frequency 1.5kV, no flashover and arcing.

(3) Basic parameters

①Time range: 16000.0ms Resolution: 0.1ms

Time error: Within 200 mm $\pm 0.1\text{ms}+1\text{d}$

More than 200 mm $\pm 2\%$

Period $\pm 0.1\text{ms}$

②Velocity range: 20.00m/s Resolution: 0.01m/s

Velocity error: Within 0-2m/s $\pm 0.1\text{m/s}$

More than 2m/s $\pm 0.2\text{m/s}$

③Travel:

	Range	Resolution	Error
Vacuum breaker	50.0mm	0.1mm	$\pm 0.5\text{mm}$
SF6 breaker	300.0mm	0.1mm	$\pm 2\text{mm}$
L-Oil breaker	600.0mm		

④Current range:20.00A Resolution: 0.01A

⑤Closing resistance range:0-2000 Ω Resolution:1 Ω

Closing resistance accuracy: 1%

⑥Contactor type: 12 metal contactor

6 closing resistance

3 graphite contactor

⑦Output voltage: DC30~250V adjustable

Output current: 20A (instantaneous)

⑧Dimensions and quality:

Host: 360mm×290mm×280mm 6kg

Enclosure: 370mm×280mm×220mm 9kg

v. Definition of terms

(1) The time of opening(closing) time: The voltage on the opening (closing) coil is used as the starting point of the timer to reach the time when the moving and static contacts are opening (closing).

(2) Average velocity: In the process of switching closing or opening, 10% of the total travel of the movable contacts is removed before and after each trip, and 80% of the total travel of the movable contacts is taken in the middle. The ratio of the travel of the movable contacts to the time is obtained.

(3) Maximum velocity: In the process of switching closing or opening, after the moving contacts begin to move, the moving contacts are taken as a speed unit every 10 ms until the moving contacts stop, and several velocity units are obtained, among which the maximum velocity of the moving contacts is the maximum speed of switching closing or opening.

(4) Velocity definition

General 10ms	some oil breakers and some SF6 breakers.
General 5ms	some oil breakers
General 6ms	some 10kV vacuum breakers
General 10ms	some 35kV vacuum breakers
Average speed	some SF6 breakers
LW6	LW6 SF6 breakers
LW8	LW8-35 SF6 breakers

ABB-HPL550B2	ABB breakers
ABB-HPL245B1	ABB breakers
LW33-72.5/T	SF6 breakers
LW33-126	SF6 breakers
3AQ1E	SIEMENS breakers
3AT2	SIEMENS breakers

Tip: If the above definitions are not adopted, users can define the speed sampling section of rigid point and rigid point on the curve according to the time travel characteristic curve measured by the tester (the travel direction), and the instrument can automatically calculate the user defined immediate opening point and immediate closing point velocity (the travel-time ratio in the sampling section).

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II. Product introduction

i. Panel layout

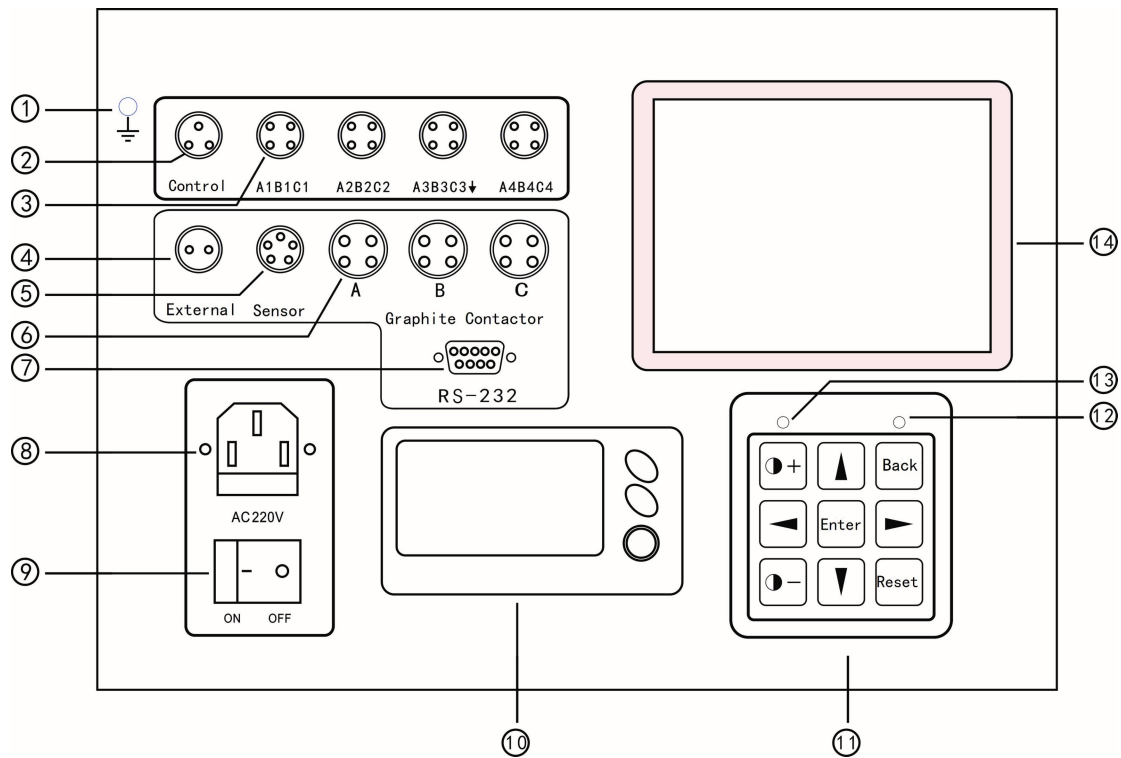










Figure 1 Panel Layout diagram

No	Panel indication	Function description
1	Protective grounding	Connect with the earth
2	Control	Output voltage control
3	A1 B1 C1 - A4 B4 C4	Time measurement channels
4	External	External trigger
5	Sensor	Sensor signal input
6	Graphite contact	Testing graphite contacts
7	RS-232	Connect with PC
8	Power socket	Power input $\sim 220V/50Hz$

9	Power switch	Input power control
10	Panel printer	Print test reports and curves
11	Function button block	 Contrast adjustment
		 Up and down move operations
		 Left and right move operations
		 Confirmation operation
		 Return or cancel operation
		 Instrument reset
12	Indicator lamp	Opening indicator lamp
13	Indicator lamp	Closing indicator lamp
14	LCD panel	Display all data and curves

ii. Operation description

Turn on the power switch, press  or  , Electronic adjustment of display contrast until the best display. Press the "Enter" button to enter the menu operation interface. At the top of the screen is the main menu of the instrument operation, as shown in Figure 2, from left to right are "View", "Test", "Set", "File", "Help" , five main menu.

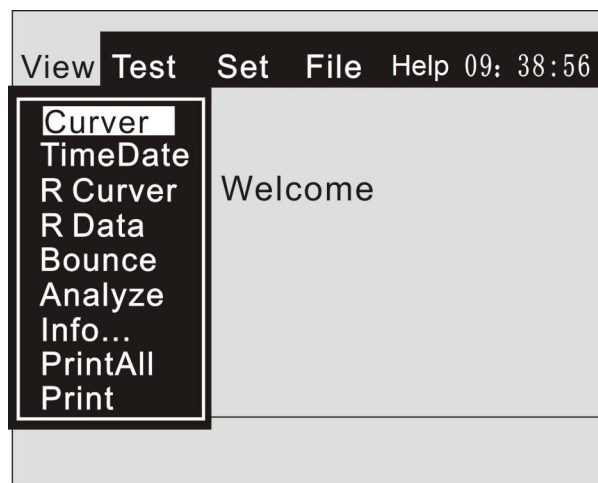


Figure 2. Main menu

(1)Set

Before the test, the various operating conditions of the instrument are set. There are 'TestSet', 'VolSet', 'DateTime', 'Option', 'Status' under the settings menu. As shown in Figure 3

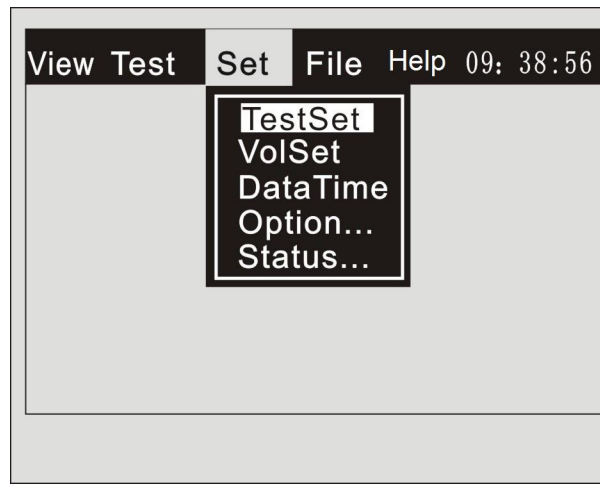


Figure 3. Settings menu

① TestSet

<Velocity> Fifteen speed definitions have been solidified for the instrument (Note: These 10 definitions can be redefined and solidified by PC according to the need). The corresponding definitions are selected according to the breaker type. If the corresponding definition can not be found, the time-travel characteristic curve can be measured by "10 ms before and after closing" and then the corresponding velocity value can be obtained by corresponding analysis on the curve.

<Trigger> Internal trigger: use the internal DC power supply to breaker closing and opening; external trigger: the internal DC power supply of the instrument does not work, and use the external power supply (both AC and DC) to operate the breaker action. When the instrument closing (opening) the "external trigger" connection of the instrument is directly connected to the closing (opening) coil. When the breaker operates, the instrument takes the

voltage signal from the coil as the starting point for timing.

<Time Scope> Refers to the time length of the operation voltage of the internal power supply.

250ms: Single opening and single closing test of breaker.

500ms: Normal breaker 'C-O', 'O-C' operation.

1000ms: The closing time of the old-fashioned generator outlet switch is usually greater than 500ms,so choose 1000ms;

2000ms: When the breaker is testing 'O-C-O',choose 2000ms;

4000ms : Calibrate the internal operation voltage of the instrument. Choose 4000ms.

8000ms,16000ms: Special use.

<Sensor Pos> According to the different installation position of speed sensor, select different phase. If it is a three-phase linkage, it is usually selected in the "A" phase.

<Sensor> There are two options for rotary sensor and linear sensors, corresponding settings according to the sensors used.

<Contactor> According to the actual test parameters to select, the instrument has three types of Contact: metal, resistance, graphite for selection.

<Enable V> When the linear sensor is used to measure the velocity, the breaker stroke can be measured by turning on the instrument, and when the rotary sensor is used to measure the velocity, turn it off.

<Travel Set> The total linear resistance value of the input breaker is measured when rotating sensor and universal sensor are used to measure velocity. When using linear resistance sensor to measure speed and stroke, input the stroke value of sensor.

<No.> Input line number.

Tip: After all options are completed, move the cursor to the bottom of the screen and press the "Enter" button to complete all settings.

Internal power supply voltage calibration: Use multimeter measure "control power output" of the closing or opening, set the test time to 2000 ms or 4000ms, do single-closing or single-open operation, can be measured to the output power supply voltage.

Note: the power supply inside the instrument can't be used as the power source of the external power storage motor. After the calibration is completed, the test time must set back to 250ms. Otherwise, long time DC output will destroy the breaker and closing coil.

②Voltage set

Test Voltage: After entering the voltage setting menu, according to the needs of the field, according to the text prompt below the instrument screen, set the operating voltage of the breaker.

Note: the power supply inside the instrument can't be used as the power source of the external power storage motor. After the calibration is completed, the test time set back to 250ms. Otherwise, long time DC output will destroy the breaker and closing coil.

③DateTime

Screen display project options, set according to needs, date and time the instrument has been set up.

④Option

Under this menu, there are time curve, current curve, stroke curve, velocity curve, key tone. The above functions are customized options. If you need to specify the function, when you select the function, press the "Enter" key and change the status symbol to " [•] ", this means that the function has been selected, otherwise it is not selected. Finally, confirm it.

⑤Status

Enter the status detection menu and install the sensor according to the prompt at the bottom of the screen to check whether the sensor works properly and whether the installation is reasonable.

(2)Test

After the instrument is set, then test. Under the test menu, there are Auto Test, Open, Close, O-C,C-O, O-C-O, LV Test as shown in Figure 4.

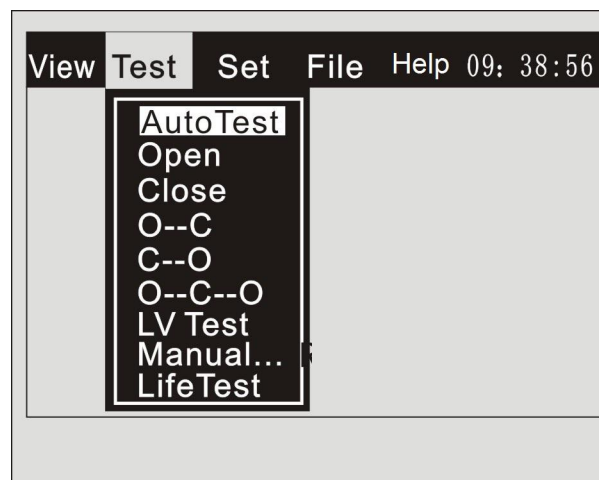


Figure 4 Test. menu

①Auto test

Automatic test, the instrument determines the type of test according to the state of channel A1. If it is closing, the

breaker-close operation is carried out; otherwise, the breaker-open operation is carried out.

②Open

Single open test of breaker

③Close

Single close test of breaker

④O—C

The "O--C" test of the breaker, after setting the "open-t2-close" control time interval, can directly get the value of the breaker's single-open time, single-close time and O-C time.

⑤C—O

The "C--O" test of the breaker, after setting the "close-t2-open" control time interval, can directly get the value of the breaker's single-close time, single-open time and C-O time.

⑥O—C—O

After setting the time interval of "open-t2-close-t1-open" control, the "open-close-open" test of the breaker can directly get the value of single open time, single close time, twice open time, C-O time and O-C time of the breaker.

⑦LV Test

The automatic low voltage operation test of closing and opening can be operated according to the screen prompt of the instrument after entering the interface.

⑧Manual

Under a set voltage, the breaker is repeatedly open and close.

Such as:

Under 30% rated voltage, the breaker should be operated three times continuously, and the breaker should be reliable and not operate, the function is completed.

Before the breaker factory does the breaker test, under the rated voltage, the breaker needs to be open and close several times before the breaker is tested, and this function is also used.

⑨LifeTest

It is used by breaker manufacturers for testing.

(3)View

Under the view menu, there are menus such as Curver, TimeData, Resistance Curver, Resistance Data, Bounce, Analyze, Information, Print All, Print, etc., as shown in Figure 5.

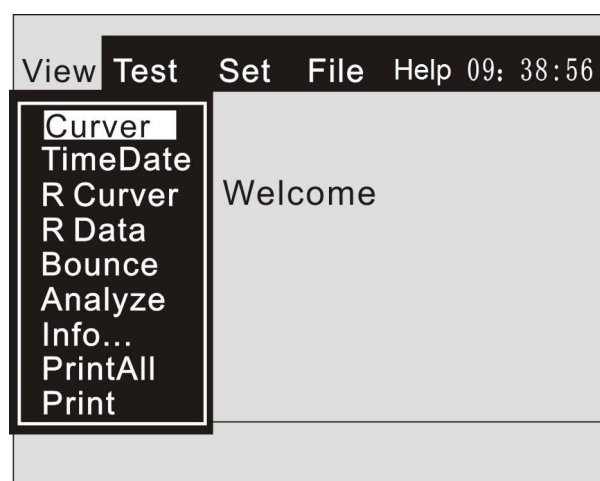


Figure 5. View menu



① Curver

The comprehensive curve Atlas of test results includes time waveform, bounce curve, time-stroke curve and coil current curve of each switch. These curves are all integrated atlas displayed on a coordinate chart with time as abscissa.

② TimeData

The measured results are shown in tabular form, including the open and close time, the one phase same period, the each phase same period, velocity, the maximum velocity, the coil current, the total switch stroke, the overrun or the rebound amplitude, etc.

③ Resistance Curve

The dynamic closing and opening curves of close resistance or graphite contacts are shown graphically. Press  or  to turn over the screen to see it one by one.

④ Resistance Data

For breakers with closing resistance, the list shows the switching time of closing resistance at each close test, the closing time of resistance T1, the closing time of main contact T2, and the resistance value.

⑤ Bounce

It shows the bouncing time and bouncing times of each contactor. If you want to see more detailed bouncing process of each contactor, you can see the first closing time, the first opening

time, the second closing time and the second opening time of the corresponding contactor by pressing the "Enter" button under the 'Detailed'. A more detailed bounce process. If you want to print the bounce result, press ◀ or ▶ key under the "Detailed" cursor to eliminate the "Detailed", then call out the "View" menu and select "Print" to print.

⑥ Analyze

By analyzing the measured "time-stroke" curve, we can get the relevant data. Of course, the most important thing is to get the open and close velocity data, as shown in Figure 6.

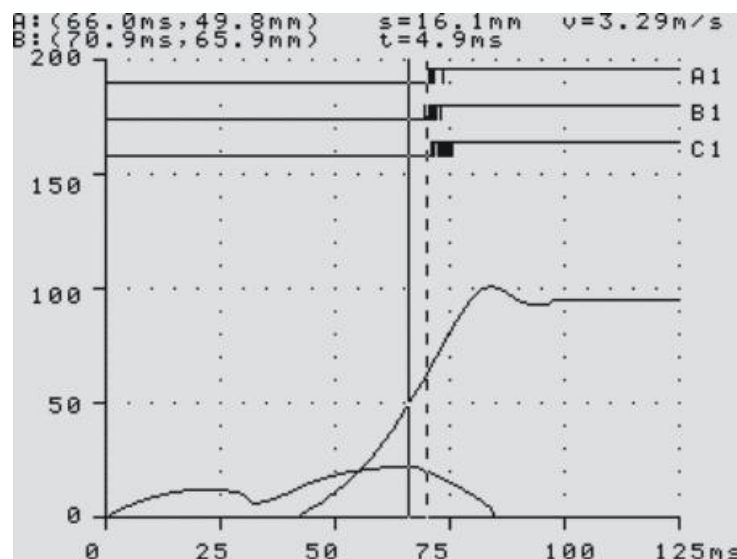


Figure 6. Time and travel curve

Operation hints:

Entering the interface of velocity analysis, there are two vertical coordinate lines on the "time-travel" curve: solid line and dotted line. The dotted line is at the opening and closing point of channel A, the solid line is the defining point of closing and opening velocity, and

the upper left corner of the screen is the coordinate value of the intersection of two coordinate lines and the travel curve. The abscissa is time, and the ordinate is the travel position point of the breaker contact at this time. The solid line can move left and right. When moving, the coordinate point will change in real time, and the dashed line can not move. By pressing up or down keys, the solid line and the dotted line can be switched.

a). $S = XX.X \text{ mm}$ the difference between the ordinate coordinates of the two coordinate points on the stroke curve.

b). $t = XX.X \text{ ms}$ the difference of the abscissa of the two coordinate points on the stroke curve.

c). $V = XX.XX \text{ m/s}$ It is the ratio of the difference between the ordinate and the abscissa of the two points. That is the average velocity between moving contacts. If we set these two points according to the definition of opening and closing velocity of breaker manufacturer, then V is the measured opening and closing velocity.

Of course, moving the two coordinate lines to the corresponding position and looking at the difference between the ordinate coordinates of the two coordinate points, we can see the data of the distance, the overrun, the Overshoot, the rebound amplitude and so on. On the curve, we can also see the data which are not shown in a series of "comprehensive data tables" such as the starting

point of the moving contact for analysis.

⑦Information

Test information before instrument test

⑧Print All

Print test date, test content, test curve map and comprehensive data.

⑨Print

Print the contents currently displayed on the screen.

(4)File

Under the File menu are Open File, Save File, Delete File and Delete Directory, as shown in Figure 7.

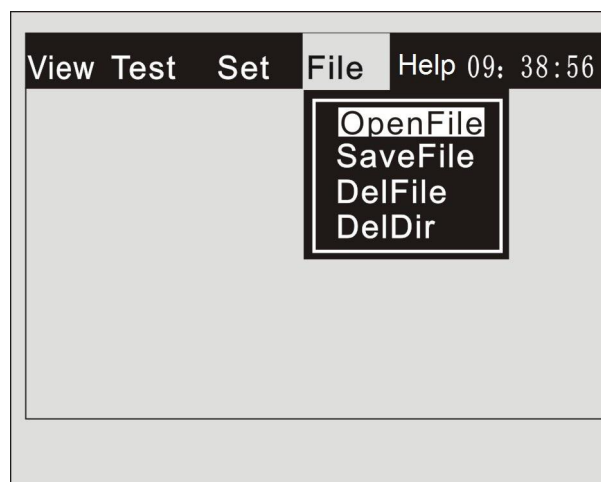


Figure 7. File menu

①Open File

Open the test results that have been saved in the instrument.

②Save File

The test results are stored in the instrument memory, and the test number is used as a folder. The test results on the same day

are stored in the same folder according to the test time. If the result is not refreshed, it can be permanently saved.

③Delete File

Delete one of the data files stored in the instrument.

④Delete Directory

Delete a data directory stored in the instrument.

(5)Help

After entering the copyright information menu, the copyright, software version and product serial number are displayed on the interface.

III. Operation wiring method

i. Wiring operation

The general steps of instrument use are summarized as follows:
wiring (sensor installation)→turn on the instrument→setting→
testing→viewing (analysis) results→saving (printing) results→turn
off the instrument→Disassembly line.

Special safety tips: after the instrument arrives at the scene,
please connect the protective area of the instrument to the ground
before other wiring and operation can be carried out; after the test,
turn off the power supply of the instrument, then dismantle other
wires, and finally dismantle the ground wire.

(1)switch wiring

①Three switches wiring of circuit breaker is shown in Fig 9.

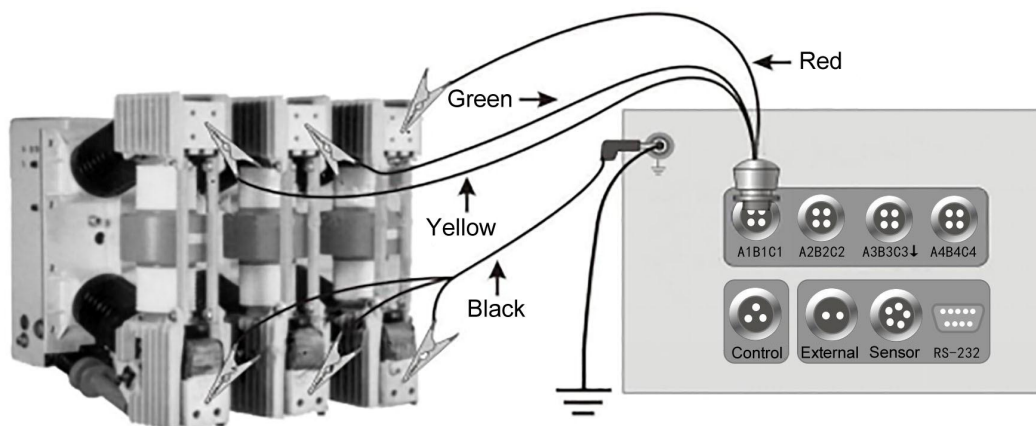


Figure 9. Three switches wiring

② six switches wiring of circuit breaker is shown in Fig 10.

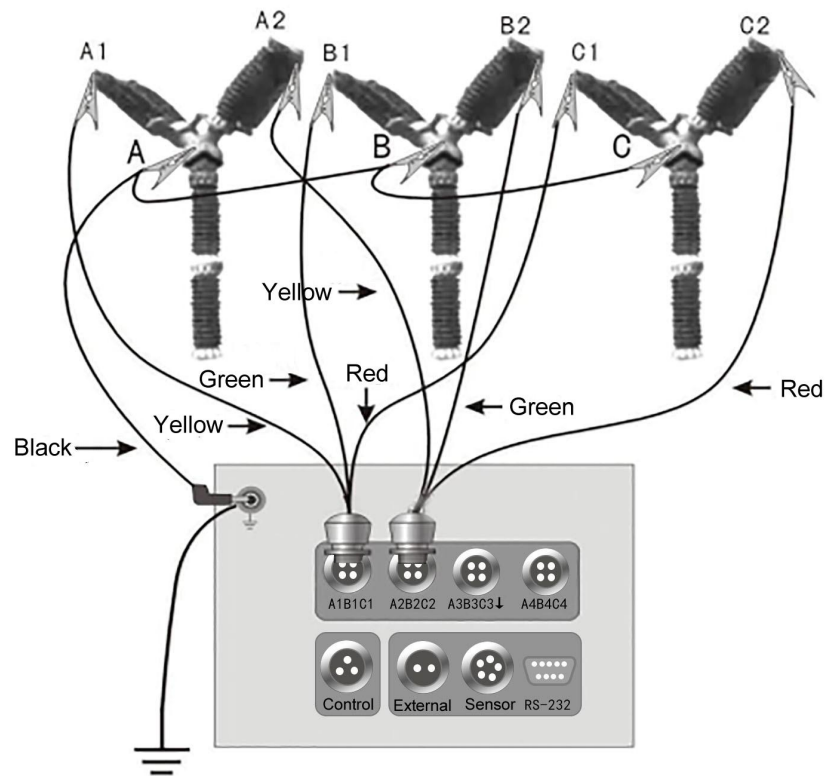


Figure 10. Six switches wiring

③ Double ended grounding switch: for double ended earthing switch, the instrument is equipped with a dedicated test line, as shown in Fig 11.

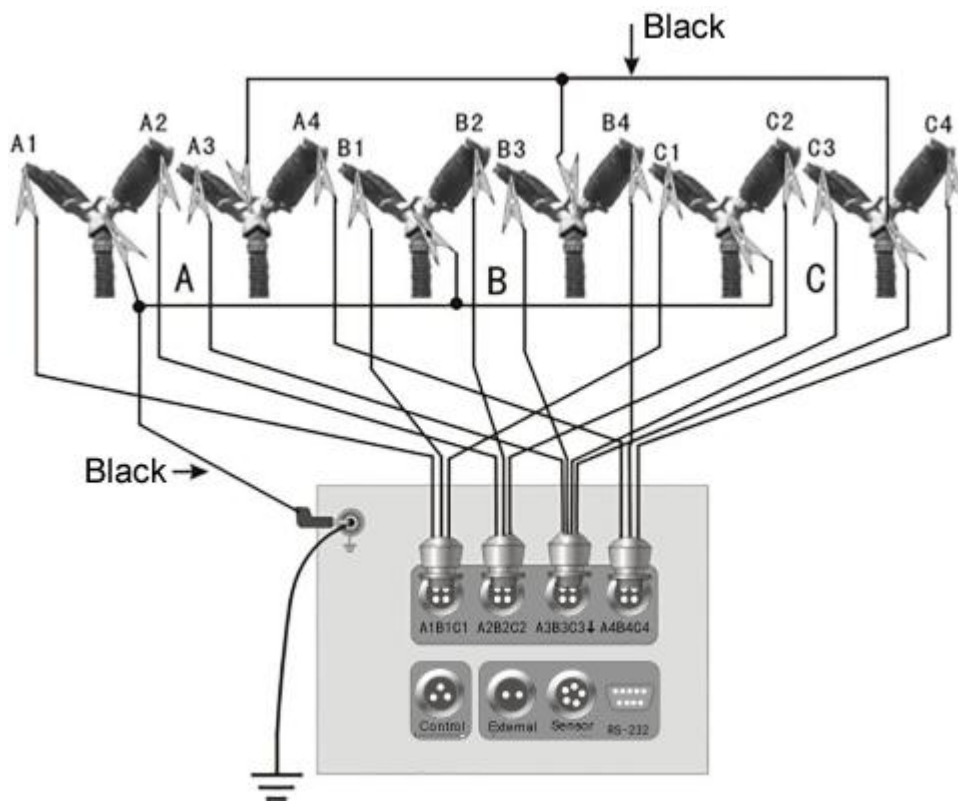


Figure 11. Twelve switches wiring

(2) Closing and opening control line

① When the closing and opening control power supply is provided by the instrument, disconnect the control power supply in the breaker control box under test (usually pull out the insurance connecting the control power supply in the control box with the control bus), but the energy storage power supply of the breaker mechanism can not be cut off, and Then follow the wiring shown in Figure 12.

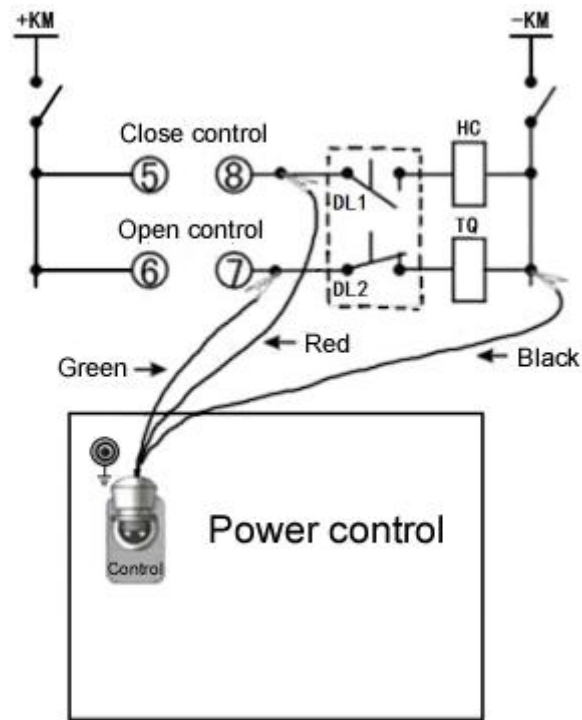


Figure 12. Control wiring diagram

Note: the instrument can only provide DC power inside, and the internal power use "Internal" trigger mode. If the breaker is an AC operation mechanism, please use the 'External' trigger mode.

②When the external operation power is used to open and close, the output of the control power disconnect. When the breaker is used for a single close test, the external trigger two lines is connected to the two ends of the closing coil in parallel.

③When the breaker is used for a single open test, the external trigger two lines is connected to the two ends of the opening coil in parallel.

Note: use external trigger when using external power. The external trigger mode can be tested regardless of whether the breaker mechanism is AC or DC. When external triggering is used, the instrument control power is disconnected.

(3) Connection diagram of graphite contact three switch(3AQ)

SIEMENS graphite contact breaker (3AQ)

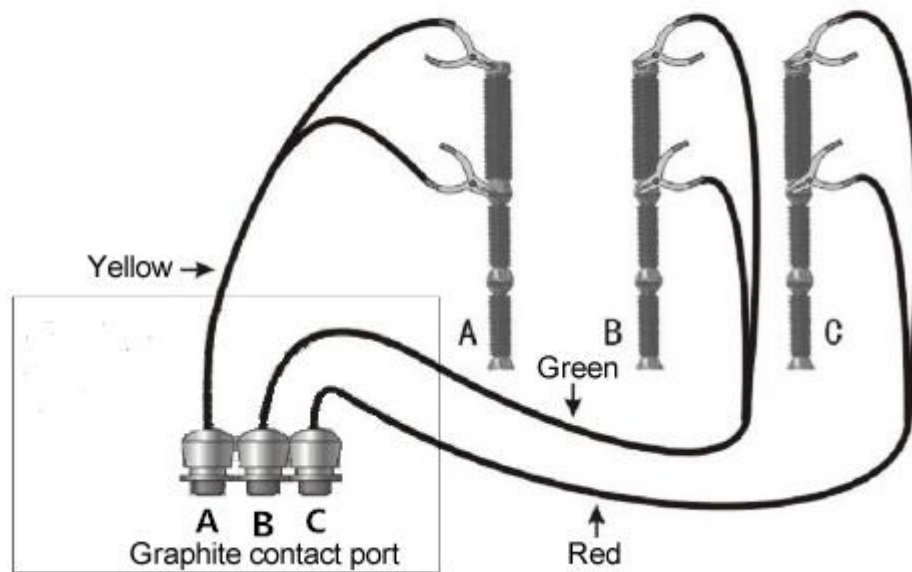


Figure 13.Connection diagram of graphite contact breaker

ii. Sensor installation

This instrument is equipped with two kinds of velocity sensors, which are used in different situations. All two sensors have a five-core sensor signal line, which is connected to the "Sensor" socket of the instrument.

(1) Rotary sensor

For some breakers, especially imported and joint-venture breakers, the linear transmission part is enclosed in the breaker body. When the breaker manufacturer makes the velocity test, the breaker splitting indicator or the rotating shaft of the arm are tested. In this case, the rotary sensor is selected. The installation method is shown in Fig. 14.

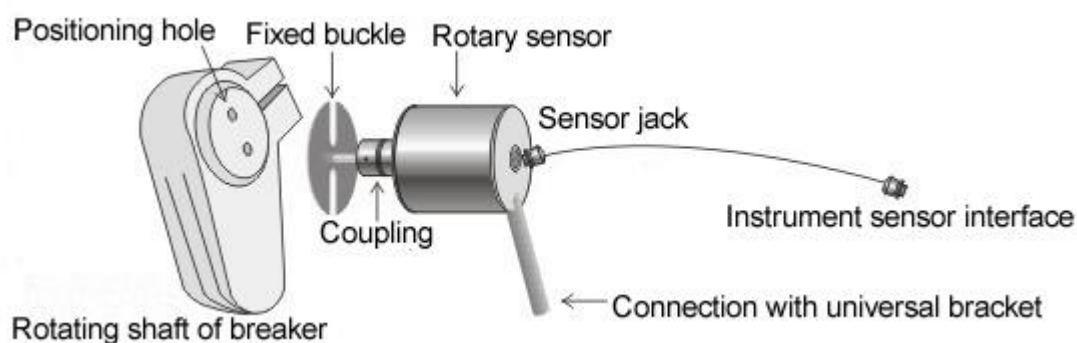


Figure 14. Schematic diagram of rotating sensor installation

Installation Note: The axis of the rotary sensor should be as concentric as possible with the breaker rotation axis, otherwise the rotation of the sensor will be hindered.

(2) Linear sensor

If you need to accurately measure the action stroke of the switch, you need to use the stroke sensor. There are three kinds of stroke sensors, namely 50mm, 200mm, 300mm.

50mm stroke sensor for measuring the travel speed of vacuum breakers.

200mm and 300mm stroke sensors are used for SF6 breaker stroke and velocity measurement, these two sensors are non-standard configurations.

Take a vacuum breaker as an example, when the linear sensor is installed, it is necessary to ensure that the motion axis of the sensor can move in a straight line and fix the sensor with a magnetic universal bracket. For the SF6 breaker and the oil breaker, the installation method is similar. The installation method is shown

in Figure 15.

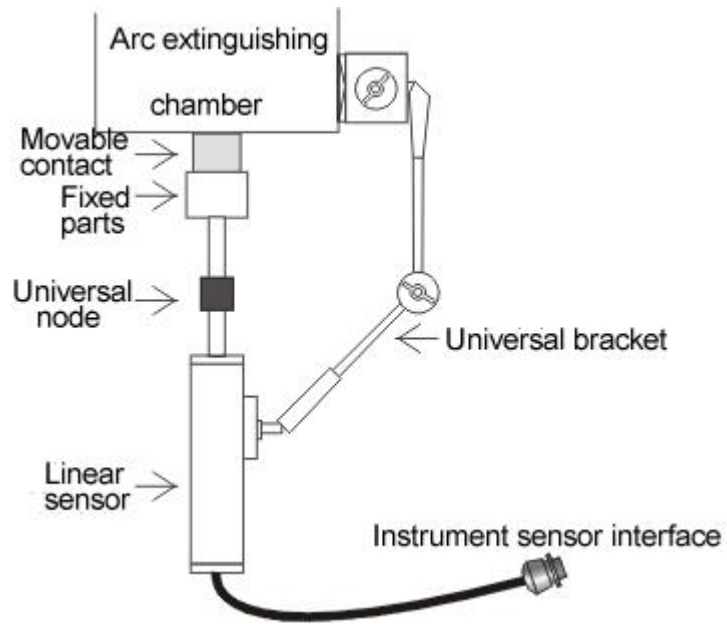


Figure 15. Schematic diagram of linear sensor installation

IV Common problems and Solutions

i. When the instrument is used for controlling opening and closing operation, the breaker does not action.

(1) There are some problems in the wiring of the open and close of breaker control.

Solution: Find the control wiring diagram of the field control cabinet, ask the relevant protection professionals, and find out the auxiliary contact points of the closing and opening coils and breakers respectively. See the control wiring diagram in Figure 12 of this specification and explain the re-wiring. Check the control loop to ensure smooth circuit.

(2) The instrument indicates 'the output is short circuit or the load is too high. Please turn off the instrument to check the control wiring'.

① Control wiring error, resulting in short circuit of instrument output, resulting in the start of short circuit protection function and instrument's control power supply no output".

Solution: After shutting down, refer to the above figures 9 and 10 to re check the wiring.



② The coil load is too large for the instrument to drive normally.

Solution: a). For the breaker of the electromagnetic mechanism, the driving current required by the switch closing coil is very large (up to 100A or several hundred amperes), while the maximum carrying capacity of the instrument operating power supply is 20A.

The load is too large for the instrument to drive normally.

Generally, the closing control wire is connected to the closing contactor coil of the front stage of the closing coil. The instrument controls the closing of the breaker contactor, and the contactor drives the closing coil of the breaker to make the breaker action. Or use the "External" trigger mode to operate the breaker.

b). For the breaker of hydraulic and spring mechanism, the default is "overload" when the output current of the instrument is greater than 6A. Please take a look or use a multimeter to measure the resistance value of the closing coil to confirm that the current of the closing coil is large. Then please check the wiring carefully and confirm that there is no short circuit in the closing output, then cancel the short circuit protection function of the instrument for testing. (Note: When the short circuit protection function of the instrument is cancelled, the output of "closing and opening control power supply" does not have the protection function. If the output of the control power supply is indeed in short circuit state at this time, it may cause damage to the control power supply of the instrument. Please be careful.

The specific way: Instrument shutdown → Hold down the '  ' key button all the time → Instrument boot, Until the "release button" screen prompts appear → Release the '  ' button, Short circuit protection function cancelled.

Note: as long as the instrument is turned off or reset, the short-circuit protection function is restarted.

(3) Check whether the operation power of the instrument has DC output.

Use multimeter to check the operation power supply inside the instrument. If voltage output is normal, other inspections should be carried out:

① The operation of the fuse on the operation control line is destroyed or damaged.

Solution: The new fuse should be replaced or the control line should be reconnected.

② Internal power failure of instrument

Solution: Operate the power supply in the locale switchgear, and use the "external trigger" mode to operate.

(4) There are protective latches (such as SIEMENS and ABB breakers).

Solution: ① During the closing and opening test of the internal power supply operation breaker provided by the instrument, the blockage must be released. Field technicians or breaker manufacturer personnel are requested to assist in releasing the blockade according to the control wiring diagram of the field control cabinet.

② Use field operation power supply and test with 'External'

trigger mode.

ii. When the instrument was tested for single close and single open, the breaker acted, but there was no data display.

(1)The ground wire is not connected.

Solution: Carefully check the ground wire and re tighten the ground wire.

(2)The resistance value of the closing coil or the opening coil is too large to cause the load to be too small (when the coil current is less than 1A, it is easy to occur), which makes the instrument trigger ahead of time and no data are collected.

Solution: Cancel short circuit protection function and retest

(3)If the closing test is not out of data, the closing control circuit is damaged, If the opening test is not out of data, the opening control circuit is damaged

Solution: The temporary test of the power supply control channel used in the field, If the closing test is not out of data, then the test closing is done by using the opening channel. The method is to connect the switch control line (green and black lines) to the closing coil and use the opening control to operate the breaker closing test process.

iii. When the instrument do the single close test, the breaker is closed and opened immediately.

(1)There are problems in the breaker control loop.

Solution: Check the breaker control circuit carefully and troubleshooting.

(2)Closing control channel damage

Solution: Remove the opening control line and use the closing control channel to do the test.

iv. Printers can carry paper out but not print words and graphics.

(1)The printing paper is reversed.

Solution: Correctly install thermal printing paper.

(2)The thermal printer's heating head is broken.

Solution: Back to factory maintenance thermal printer heating head.

v. When the velocity test was carried out, the test results appeared full screen vertical stripes.

(1)The sensor selection is incorrect (the linear sensor is selected in the test settings, the rotary sensor is installed).

Solution: Install the correct sensor.

vi. Technical question and answer

(1)When the instrument is grounded, why should the ground wire be first connected then connect the test line?

Answer: In the field test, there is often a high induction voltage between the breaks of the high voltage breaker (especially above 220kV), which is large and energy is small, but it is enough to threaten the safety of the instrument itself. Inside the instrument, a

discharge circuit is connected between the switch signal input end and the ground. The earth wire is connected first, and the discharge circuit is connected first in practice. When connecting the signal line of the switch, even if the switch induced a high voltage, it can be released to the earth through the discharge circuit, so as to ensure the safety of the instrument's switch channel.

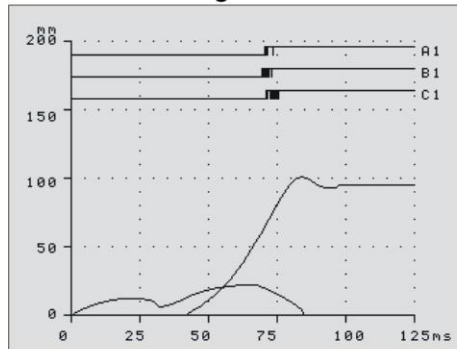
(2) How to determine whether the switch of the instrument is normal?

Answer : Choose [Test] - [Auto Test] to display the real-time status of 12 switch at the bottom of the LCD screen of the instrument. The screen display is shown in Figure 16.

Under this interface, we can check whether the switch channel of the instrument is intact. If the input of the switch is hanging in the air, it should show "O" , if it is short-circuit to the ground.,it should show "C".Therefore, each switch is connected to the ground separately, and the change of state display is observed to determine whether the time channel of the instrument switch is normal.

Appendix I Switch graph and text result

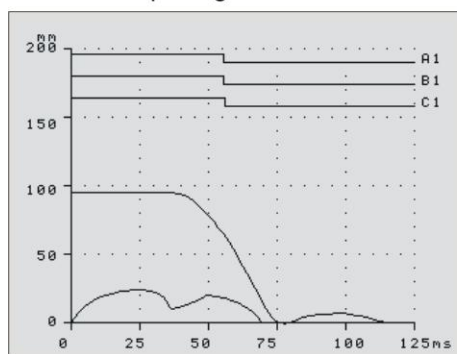
Closing test curve



Closing test data

C	Pole A	Pole B	Pole C	Diff
1	70.9	69.9	71.0	1.1
2				
3				
4	0.0	0.0	0.0	
Close V	3.29 m/s	Tral	95.0 mm	
Max V	3.75 m/s			
Coil Cur	2.27 A			

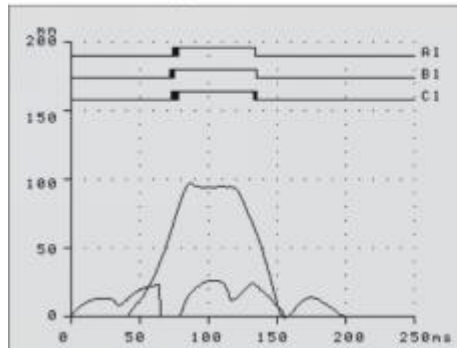
Opening test curve



Opening test data

O	Pole A	Pole B	Pole C	Diff
1	55.6	55.8	56.4	
2				
3				
4				
	0.0	0.0	0.0	0.8
Open V	3.39 m/s	Over	95.0 mm	
Max V	4.00 m/s	Sepa		
Coil Cur	2.41 A	Boun		

C-O test curve

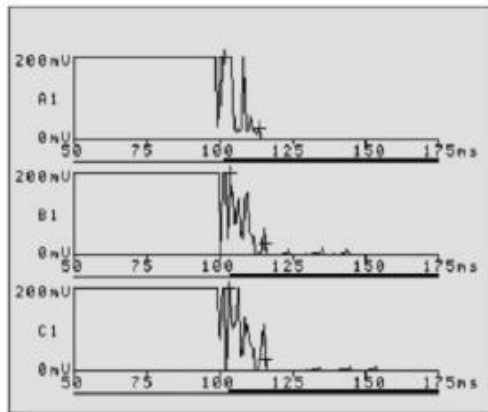


C-O test data

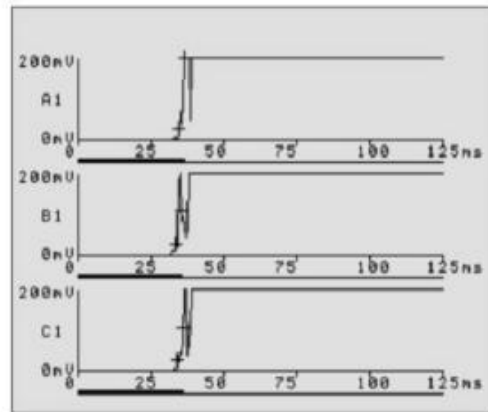
	close	open		
A1:	74.2	54.4		
B1:	72.0	54.9		
C1:	73.9	55.6		

	C-O time			
A1:	60.3			
B1:	63.0			
C1:	61.8			

Appendix ii Graphite contact test curve



Closing dynamic resistance curve



Opening dynamic resistance curve

Appendix III Operating instructions for mini printers

i. Change paper rolls

First step: press the round button to open the front cover of the printer and remove the remaining paper core, as shown in Figure 16.

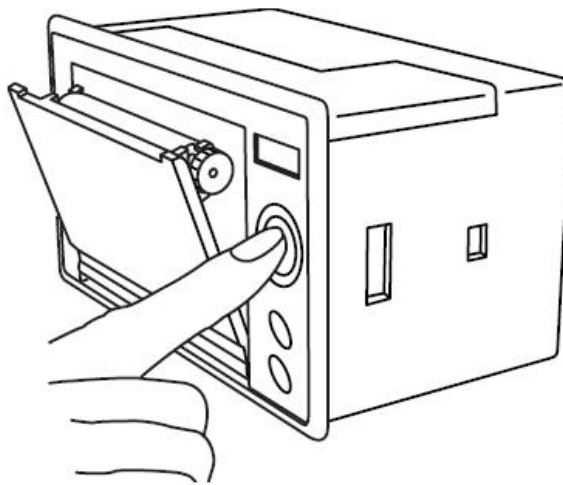


Figure 16.

Schematic diagram of opening front lid operation

The second step: put the new paper roll as shown in Figure 17.

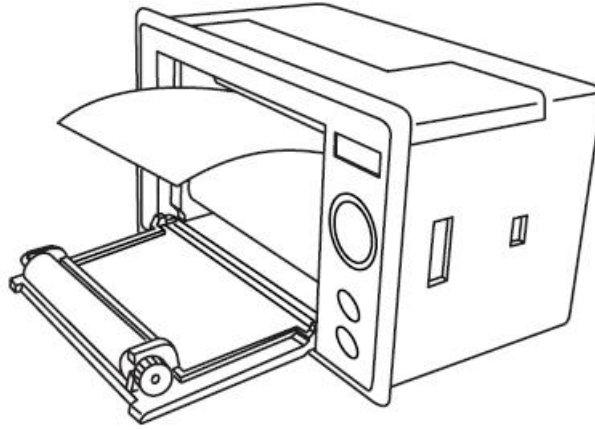


Figure 17. Sketch of operation in paper roll

The third step: pull out a piece of paper, place it in the middle position, and close the front cover, as shown in Figure 18.

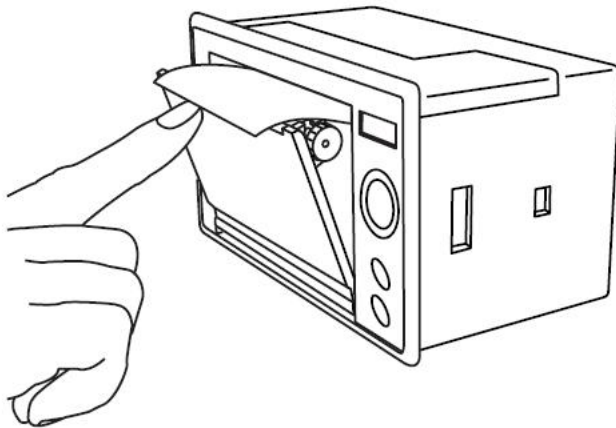


Figure 18. Operation diagram of closing front cover

Note: close cover to make a paper from the paper out of the mouth, let the glue shaft will fully roll down, otherwise unable to print. Thermal printer paper, thermal paper must confirm the thermal coating on the thermal paper in the printer position, if the thermal layer does not print on a handwriting. If the printing paper is out of alignment, you can reopen the front cover and adjust the position of the printing paper.

ii. Indicator and button operation

There are two transparent keys on the printer panel, which are marked with SEL (selection) and LF (aliasing). SEL transparent button can also display the red state, LF transparent button can also display the green state. The red light indicates the printer's online/offline status, and the green light often indicates that the printer is energized.

After the power is switched on, the green indicator light is always bright. If there is no good printing paper, the red indicator will flash intermittently for two times. When the printing paper is good, the red indicator light is always on.

Online / offline status selection:

After power-on or out of self-detection mode, the printer enters the online working state and the red indicator lights up; after pressing the SEL key, the red indicator lights out and enters the offline working state; after pressing the SEL key again, the red indicator lights up and re-enters the online working state. When offline, the printer no longer receives data from the host.

Another function of the SEL key is to pause in the printing process, that is, when the SEL key is pressed during the printing process, the red indicator lights out, and the printer will pause after printing the current line of text, at this time it can walk on the paper operation. Press the SEL button again, the red indicator light is on, and the printer continues to print.

Paper operation:

In the offline state, press the LF key, the printer will not print empty paper; then press the LF key, the printer will stop moving paper. Under the way of paper, press the SEL key printer to enter the online mode directly.

Annex IV Packing list

No.	Name	Quantity	Specifications
1	Host	1	
2	Accessory packing case	1	
3	C&O Control line	1	Three-core 6m
4	External trigger test line	1	Two-core 6m
5	Sensor signal line	1	Five-core 5m
6	Ground wire	1	4m
7	Test line	10	9m*4 4m*3 6m*3
8	Power line	1	
9	Switch test line	2	Three-core*1 Four-core*1
10	Shorting test line 40cm	2	
11	Shorting test line 80cm	2	
12	Rotary sensor	1	
13	Linear sensor	1	50mm
14	Magnetic base	1	
15	Rotating bracket	3	Ø60*1 、 Ø40*1 、 Ø25*1
16	Rotary bar	4	
17	Permanent magnet pedestal	1	
18	Screw	4	M5*35 、 M5*45 、 M8*35、 M8*25
19	Screwdriver 6*38mm	1	
20	Screwdriver 3*75mm	1	
21	Clips	16	
22	Graphite contact test line	3	
23	Inner hexagon spanner	2	2mm
24	Thermal printing paper	2	
25	Inserting needle	3	
26	Fuse	3	25A
27	Certification	1	
28	Inspection report	1	
29	User manual	1	