Huazheng®

Cable Fault Location System

USER MANUAL

Huazheng Electric Manufacturing(Baoding) Co.,Ltd

Catalogue

Section 1 HZ-501A Cable Fault Pre-Locator

I. Warning

Note: Thank you for ordering the Cable Fault Pre Locator

For safe use, the tips are as follows:

1.Please read this manual carefully and observe the relevant precautions.

2.It is strictly forbidden to hit the instrument violently.

3.Illegal shutdown is strictly prohibited.

4.Please connect the test wires correctly, especially the ground wire and high voltage wire.

5.When the high-voltage flashover and multiple pulse methods are connected, it is strictly forbidden to use the low-voltage pulse mode for the instrument software.

6.The high-voltage flashover method and multiple pulse method sampling work are strictly prohibited in the charging state of the instrument.

7.When the battery is low, please use it after charging.

8.This instrument is both AC and DC, with a built-in large-capacity lithium battery. If the instrument is not used for a long time, it is recommended to charge and maintain it every 2 months to avoid self-discharge and damage to the battery.

II.Overview

The cable fault pre locator adopts an industrial-grade 12.1-inch touch all-in-one computer and a simple operating software interface to realize human-computer interaction testing. Using industrial-grade integrated circuits and devices, built-in large-capacity lithium-ion battery, stable and reliable, easy to use. This cable fault pre locator is a special instrument for measuring and analyzing power cable status and fault distance. This cable fault pre locator adopts the combination of modern electronic technology and computer technology to realize signal filtering, acquisition, data processing, graphic display, graphic analysis, to complete Cable speed measurement, cable length testing, testing of cable fault distances. This cable fault pre locator is suitable for low-resistance, short-circuit, open-circuit and disconnection faults of power cables, high-frequency coaxial cables, street light cables, and buried wires of various materials with different sections and different media, as well as high-resistance leakage and high-resistance flashing. network failure. The technical parameters meet the requirements of "GB/T 18268.1 Anti-interference Degree of Test Equipment for Industrial Sites", "DL／T 849.1-2019 General Technical Conditions for Special Testers for Power Equipment Part 1: Cable Fault Flash Tester", "JJF1042-2020" Standard Requirements for Calibration Specifications for Cable Fault Testers.

2.1 Classification of power cables

2.1.1 Classification according to the withstand voltage level of power cables:

Low-voltage cables: cables with voltage levels of 6kV and below

Medium and high voltage cables: cables of 6kV and above, 35kV and below

High-voltage cables: cables with voltage levels of 66kV and above

2.1.2 Classification according to the insulating medium of power cables:

Oil-impregnated paper dielectric cables: mostly medium and high voltage cables

Non-drip paper medium cables: mostly medium and high voltage cables

Cross-linked polyethylene (XLPE) dielectric cables: mostly medium and high voltage and high voltage cables

Other rubber and plastic dielectric cables: mostly medium and high voltage and low voltage cables

Oil-filled cables: mostly high-voltage cables

2.1.3 Classification by structure type:

Cables without outer metal shielding layer: mostly low-voltage cables

Cables with outer metal shielding layer: mostly cables with medium and high voltage levels and above

Cables with metallic inner sheath: mostly high-voltage cables

2.2 Analysis of Power Cable Fault Types and Fault Properties

2.2.1 Power cable fault classification:

Classification by fault location:

Connector fault; body fault.

Classified according to the form of fault:

Closed fault; exposed fault.

Classification by cable structure:

Main insulation fault; inner and outer sheath fault.

Classification by traveling wave measurement principle:

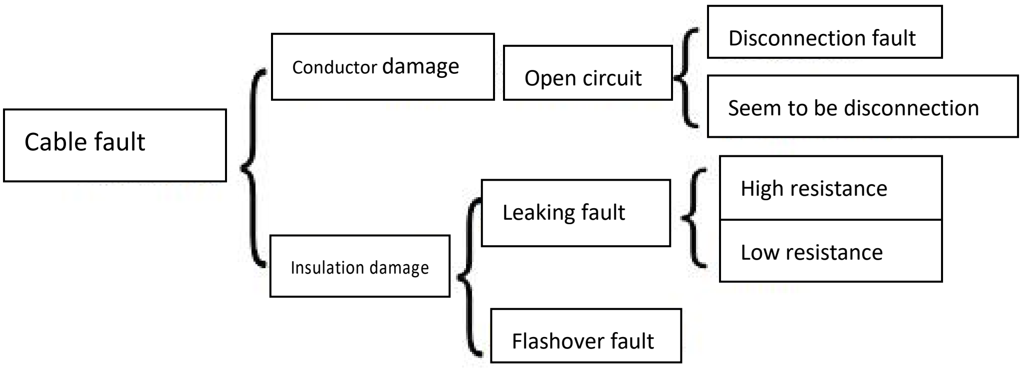


Fig 2-1

2.2.2 Analysis of Cable Fault Properties

Open circuit fault: If the cable insulation is normal, but a type of fault that cannot transmit voltage normally due to conductors, it can be considered as an open circuit fault, such as the core wire or ground wire seems to be broken and broken, and there is a large wire resistance and disconnection in a certain part of the core wire, etc. Generally, simple open circuit faults are rarely seen, and most of them coexist with low-resistance or high-resistance faults.

Low-resistance fault: If the insulating medium of the cable is damaged, a type of phase-to-phase or phase-to-ground fault that can be directly tested by the "low-voltage pulse method" is called leakage low-resistance fault. Often called a low resistance fault. The general resistance value is below several hundred ohms. If the resistance value is "zero", it is called a short-circuit fault, which is a special case of a low-resistance fault.

Leakage high-resistance fault: If the insulating medium of the cable is damaged and a fixed resistance channel is formed, but a type of fault that cannot be directly measured by the "low-voltage pulse method" of the cable fault flash detection instrument is called a leaky high-resistance fault. The resistance value is usually above hundreds of ohms. When the DC leakage withstand voltage test is performed on the cable in the field, the leakage current value increases continuously with the increase of the applied DC voltage, and far exceeds the standard value required by the cable itself. Leakage high-resistance faults are relative to low-resistance faults, and there is no strict distinction.

Flashover high resistance fault: within the pre-test voltage range of the cable, when the pre-test voltage of the cable is added to a certain value, the leakage current value of the cable suddenly increases, and its value greatly exceeds the specification value required by the tested cable , this type of fault is called a flashover high resistance fault. At this fault point, although the cable insulation is damaged, it does not form a fixed resistance channel.

2.2.3 Discrimination method of fault nature of power cable

There are generally three methods for judging the nature of cable faults:

（1） Judging by insulation resistance meter and multimeter;

（2） Judging by the cable pre-test results;

（3） Judging by the "cable fault pre locator";

In general, low-resistance and open-circuit faults (high-resistance) can be directly judged by the "low-voltage pulse method" test waveform of a multimeter or a "cable fault pre locator".

2.2.4 Test Procedures for Power Cable Faults

The cable fault pre locator generally goes through the following steps to find the fault of the buried power cable:

(1) Analyze the nature of the cable fault and understand the withstand voltage level and insulation medium of the faulty cable.

(2) Use the "low voltage pulse" of the cable fault pre locator to test the length of all phase wires of the faulty cable and calibrate the transmission speed of the faulty cable.

(3) Select an appropriate test method, and use a cable fault pre locator to perform a rough test of cable faults.

(4) Accurately measure the fault point of the cable, including the search and fault of the direction and depth of the buried cable

precise location of points.

(5) Perform error analysis on the cable fault test results (measurement error, transmission speed error, misinterpretation error, instrument error).

III. Features

• 12.1-inch industrial-grade computer control, touch operation mode;

• XP operating system, convenient operation;

• It has the function of measuring wave speed and fault distance;

• Fully automatic continuous sampling, waveform capture is timely and accurate;

• The instrument adopts the latest technology of embedded industrial computer and has impact high-voltage flashover method and low-voltage pulse method;

• Features user-friendly software and full Chinese menu as well as on-screen touch button operation. Simple button definition

Shan Ming. The measurement method is simple and fast;

• The failure detection success rate, testing accuracy and testing convenience are superior to any domestic testing equipment;

•Ultra-high brightness and large LCD screen as a display terminal, which can be clearly observed in an environment exposed to direct sunlight

Screen waveform. The instrument has powerful data processing capabilities and friendly display interface;

• It has the function of storing massive test waveforms: the waveforms tested on site can be conveniently stored in the instrument in a specified order for recall and observation at any time;

• With standard printer USB interface;

• Simple operation and high reliability. Extremely cost-effective;

• Built-in polymer lithium battery power supply, can test cable open circuit and low resistance short circuit fault in no power supply environment.

IV.Technical Parameter

• Sampling frequency: 400MHz;

• Low voltage pulse amplitude:400V

•Minimum resolution：0.1m；

•Low voltage pulse width：0.25uS/2uS/4uS；

•Test blind spot：≤10m；

•Ranging range：≥68km；

•Measurement error：≤±（0.5％×L+1m），L is the cable length；

• There are three types of test cable lengths: <1km (short distance); <3km (medium distance); >3km (long distance);

• Power supply mode: charging AC110V～240V, 50Hz/60Hz;

Built-in 10400mAH lithium battery power supply;

• Working conditions: temperature -25℃ ～ +65℃, relative humidity90%, atmospheric pressure 750±30mmHg;

• Volume and weight: Cable fault pre locator 430×380×220mm-10kg;

Pulse coupler 430×380×220mm-10kg.

V. Working Principle

5.1 The cable fault pre locator adopts the principle of traveling wave method

（1）Traveling wave method: When the electric wave is transmitted in the transmission line, if the transmission line is not uniform, that is, the characteristic impedance of a certain point in the transmission line changes, when the electric wave is transmitted to this point, the electric wave will not only continue to transmit farther, but also will be transmitted in the opposite direction. Returning to the test end, we call this reversely transmitted radio wave the reflected wave, and the phenomenon that the radio wave transmits in the opposite direction is called the reflection phenomenon of the radio wave. The so-called traveling wave refers to the general term of the incident wave and the reflected wave.

（2）When the electric wave is transmitted in the transmission line, the polarity of the echo at the short-circuit point is opposite to that of the transmitted pulse, and the polarity of the echo at the open-circuit point (including the cable end) is the same as that of the transmitted pulse. For general low-resistance and open-circuit faults, by using the low-voltage pulse method, the distance between the fault point and the test terminal can be easily determined according to the polarity of the echo.

（3）For high-resistance faults, we use the high-voltage flashover method to test. For leaky high-resistance faults, a high-voltage pulse signal source is used to make the cable fault point flashover and discharge, so that the fault point generates a reflected signal, and the fault reflected wave is detected at the test end. The high-resistance flashover fault uses the DC high-voltage power supply to make the fault point of the cable flashover and discharge, so that the fault point generates a reflected signal, and the fault reflected wave is detected at the test end.

（4）The signal processing process of the cable fault tester: the signal applied to the cable generates a reflected signal after encountering the fault point, and the reflected signal is given to the input circuit. These two signals pass through the high-speed A/D converter and the computer control system successively to convert the analog signal into Store it as a digital signal, process it digitally, send it to the display to display the test waveform, and perform waveform analysis, that is, to complete the rough measurement of the fault distance. As shown in Figure 5-1.

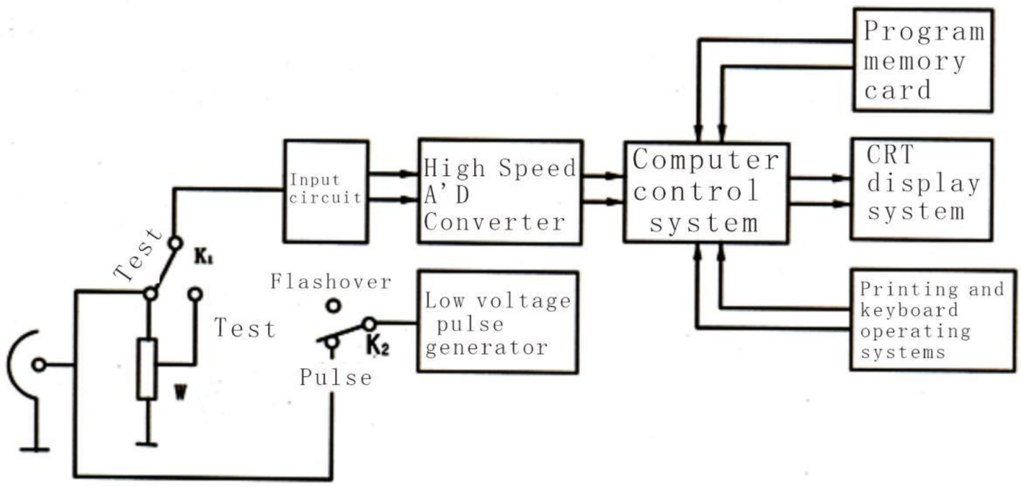


Fig 5-1

5.2 Low-voltage pulse method test principle

The cable fault pre locator applies a low-voltage pulse signal to the tested cable, and the pulse signal generates a reflected signal through the fault point of the cable. The cable fault tester processes the reflected signal and presents a waveform diagram. The rough fault distance of the tested cable is judged by analyzing the reflected waveform. The wiring is shown in Figure 5-2.

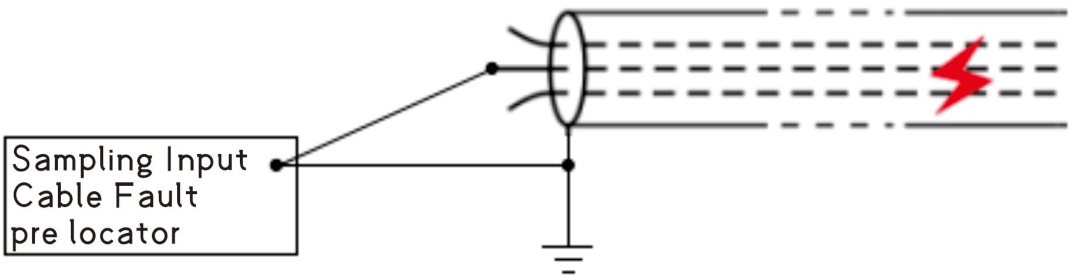


Fig 5-2

5.3 Test principle of high pressure flashover method

The high-voltage flashover method includes two test methods, the direct flash method and the impulse flash method.

（1）Direct flash method: It is mainly used to test the high resistance fault of power cable flashover. The DC high voltage power supply applies DC voltage to the faulty cable under test. When the DC voltage is added to a certain value, the fault point suddenly flashes over and discharges, and the DC high voltage is in the fault. The reflected signal is generated at the point, and the reflected signal is received by a special sampler and transmitted to the cable fault pre locator. The cable fault pre locator processes the reflected signal and presents a waveform diagram. The rough measurement of the fault distance of the tested cable is judged by analyzing the reflected waveform. The wiring is shown in Figure 5-3.

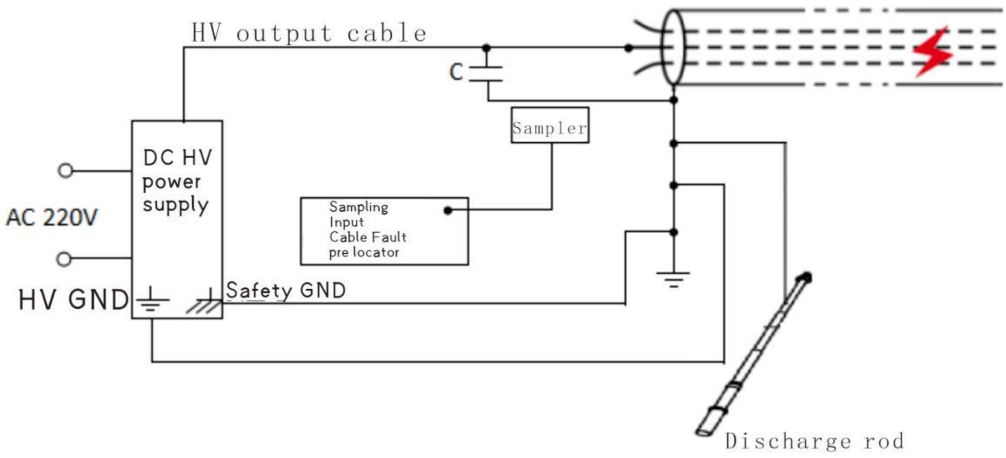


Fig 5-3

（2）Flash-over method (universal method): mainly used to test high-resistance faults of power cable leakage The reflected signal is received by a special sampler and transmitted to the cable fault tester. The cable fault tester processes the reflected signal and presents a waveform diagram. The rough measurement of the fault distance of the tested cable is judged by analyzing the reflected waveform. Field wiring is shown in Figure 5-4.

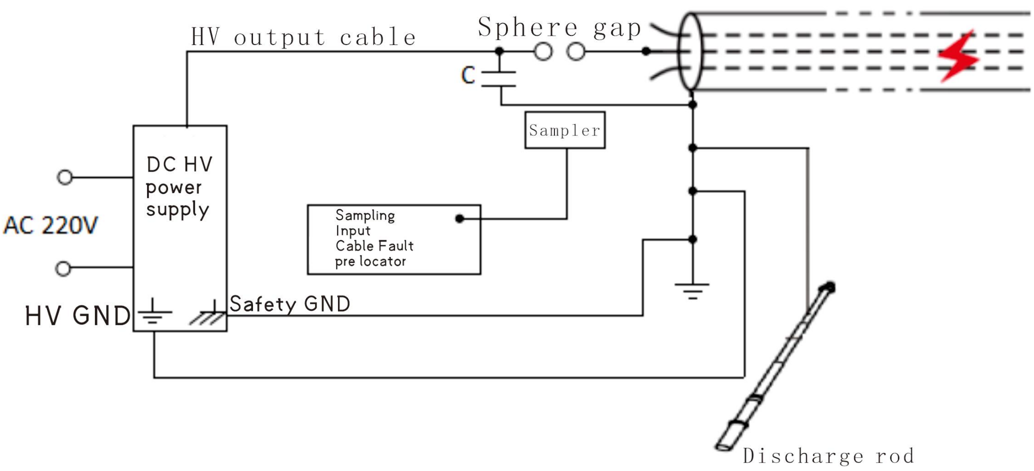


Fig 5-4

VI.Instrument Layout And Description

6.1 Composition of the instrument

Cable fault tester: a unit that tests and analyzes cables by using low-voltage pulse method, high-voltage flashover method;

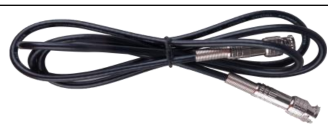
Stylus: easy to operate and touch the integrated screen, precise positioning and selection of the display area;

Output line (single Q line): connect the cable fault tester and the tested cable in the low-voltage pulse test method;

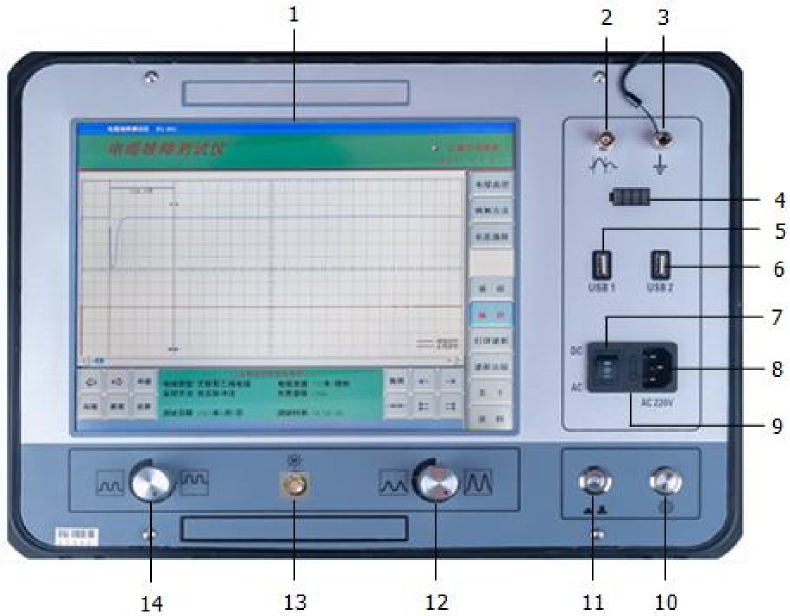
Input line (double Q line): connect the cable fault tester and the sampler in the high-voltage flashover test method;

Sampler: In the high-voltage flashover method, it receives the signal reflected from the high-voltage signal to the sampling ground;

Power cord: cable fault tester charging cable;

Instrument composition list and diagram					
Name	Qty.	Photo	Name	Qty.	Photo
Cable fault tester	1		Sampler	1	
Stylus	1		Double Q line	1	
Single Q line	1		Power cord	1	

6.2 Operation interface introduction



1. **Display**: 12.1-inch industrial-grade touch screen;

2. **Communication**: low-voltage pulse method pulse signal output interface, high-voltage flashover method sampler receiving signal input interface;

3. **Grounding**: safety grounding terminal;

4. **Power indicator**: Indicates the internal battery power, displayed in 4 grids;

5. **USB-1**: External wireless network card and USB communication device;

6. **USB-2**: External wireless network card and USB communication device;

7. **Power switch**: "I" position, use AC 220V power supply to supply power to the system;

The “II” gear uses the internal battery to power the system; when the “power socket” is connected to the AC 220V power supply, it also charges the battery at the same time;

"O" gear, turn off the system power;

8. **Power socket**: working power supply of the instrument, AC 220V connection port;

9. **Fuse**: the place where the fuse of the AC 220V power supply system is installed;

10. **Self-check**: transmit signals under multiple pulses;

11. **On/Off**: Turn on and off the working power of the industrial computer;

12. **Amplitude**: Adjust the amplitude knob when collecting waveforms to change the amplitude of the collected waveforms;

13. **Indicator light**: the indicator light reflecting the inspection method;

14. **Displacement**: Adjust the displacement knob when acquiring waveforms to change the baseline

height of the acquired waveforms;

6.3 Software operation interface and description

6.3.1 start the system

The system startup interface is shown in Figure 6-1:

Fig 6-1

6.3.2 Software main interface introduction

Double-click the shortcut key of "Cable Fault Tester" on the desktop to start the program. After the software is opened, the main menu of the program is displayed, as shown in Figure 6-2.

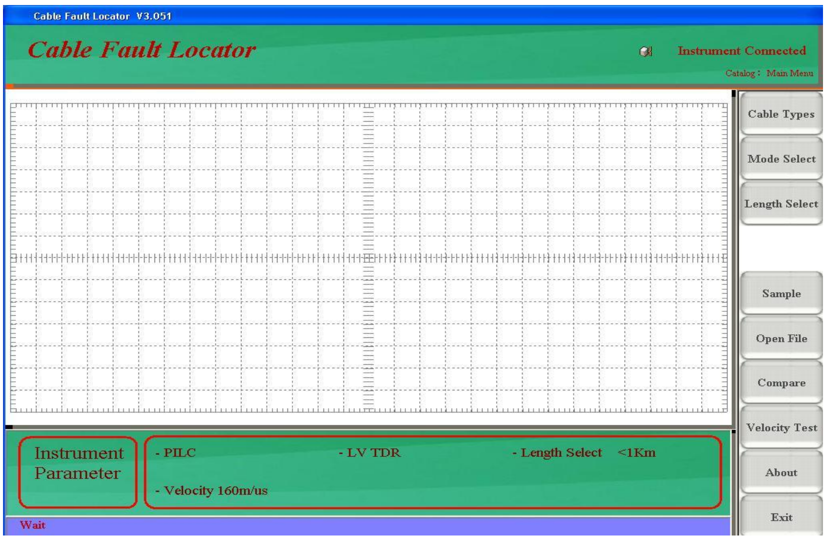


Fig 6-2

The main interface is divided into working status indication area, waveform display area, instrument parameter display area and function setting area.

1. Description of working status display area:

Through this area, it can be judged whether the instrument is in working state. When it displays "The instrument is connected", it means that the instrument is working normally, and when it displays "The instrument is not connected", it means that the instrument is working abnormally.

2. Function setting area description:

Cable types: XLPE cables, PVC cables, rubber sheathed cables, oil-impregnated paper cables, other types of cables (cable propagation speed can be customized).

Inspection methods: low pressure pulse method, high-voltage flashover method-1, high-voltage flashover method-2 (reserved)

Length options: <1km, <3km, >3km.

Delay setting: reserved

Sampling: start sampling and stop sampling; click to enter the waveform display interface.

Open File: Open a previously saved test history waveform.

Waveform Comparison: Open previously saved waveforms for comparison.

Wave Velocity Measurement: Calculate velocity using real-time communication data or opening saved files.

About: software version information and manufacturer information.

Exit: The instrument automatically returns to the desktop system of the computer, and can be shut down or other application states.

3. Description of waveform display area:

The upper part is the real-time waveform display area, which displays the real-time sampling waveform, and the lower part is the compressed waveform display area, which displays the whole picture of the real-time sampling waveform.

4. Description of the instrument parameter display area:

Display the currently set instrument parameters, or click the parameter simulation button to quickly set the required parameters.

6.3.3 Low-voltage pulse method operating instructions

A. In the function setting area of the main interface, select the cable type, select the detection method of low-voltage pulse method, and the working indicator is displayed in green. Select the appropriate test length range. As shown in Figure 6-3.

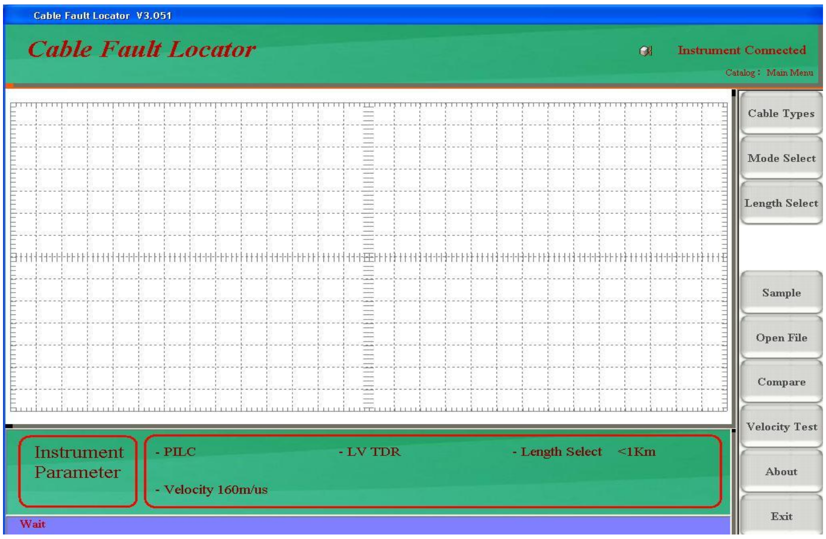


Fig 6-3

B.After completing the equipment parameter settings, click the "Sampling" button, and the screen will enter the test and waveform processing interface. The instrument will automatically perform low-voltage pulse test sampling. The operator should adjust the "Vertical Displacement" and "Input Amplitude" knobs according to the waveform needs, and observe the sampling The echo is received so that the waveform does not have upper and lower amplitude limits until the amplitude and displacement of the echo are suitable for analysis. As shown in Figure 6-4.

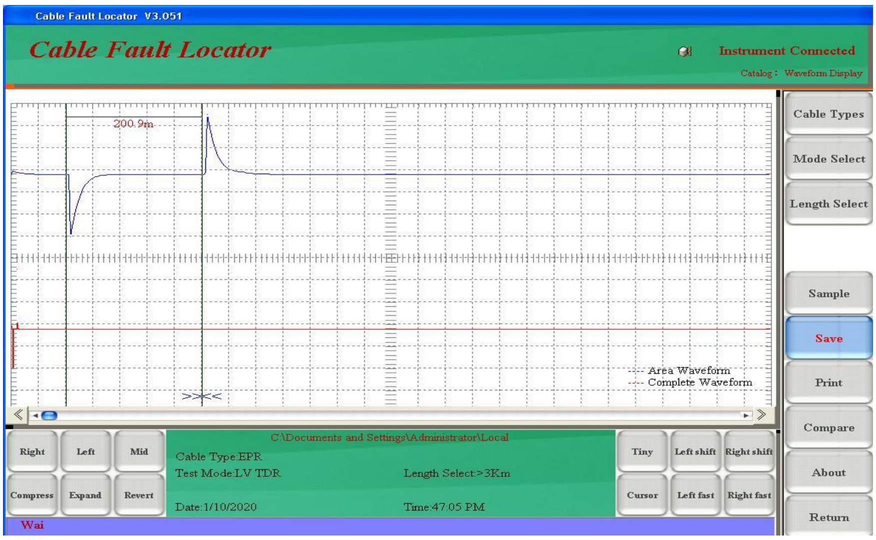


Fig 6-4

C. Press the "Cancel Sampling" key, and the instrument will stop sampling. The interface is shown in Figure 6-6 below. Move, expand and compress the waveform left and right through the overall waveform control area to make the waveform reach the best analysis state. Then use the touch pen to drag the double cursors (click the cursor and move it after it turns green) or switch and move the cursor left and right in the cursor control area (you can move it in coarse, medium and micro gears) to judge the waveform.

D. Click the "Save" button to save the current waveform for later viewing and comparison.

E. If you need to print the current waveform, you can click the "Print Waveform" button to print the waveform. After clicking the button, you can also set the page size and modify the parameters (test time, cable type, detection method, fault distance, detection location, operator and remarks).

F. The existing waveform can be compared with the previously saved waveform. Click the "Waveform Comparison" button to select the previously saved waveform, and open the waveform display area to display the existing and compared waveforms.

G. After the test, click the "Back" button to return to the main interface.

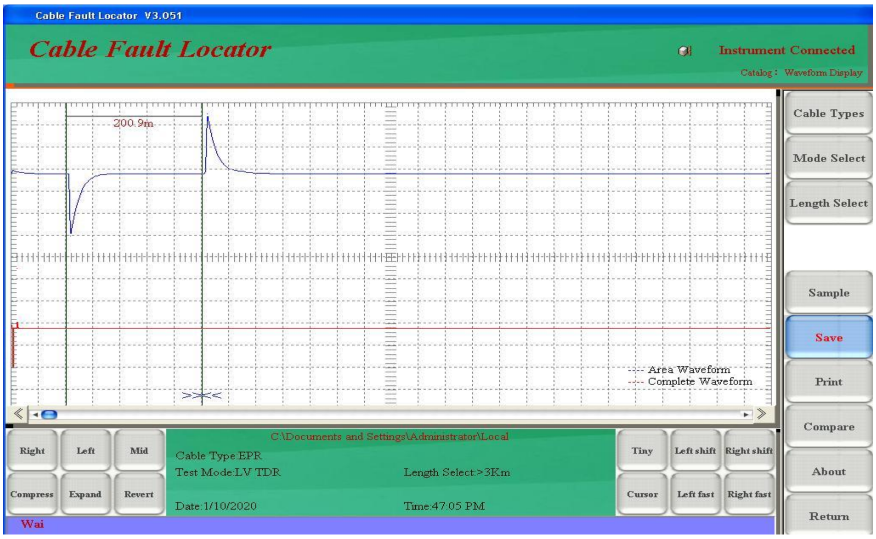


Fig 6-5

6.3.4 Use high voltage flashover-Ⅰ method to test cable fault

A.n the function setting area of the main interface, select the cable type, select the detection method high-voltage flashover method, and the work indicator light displays red. As shown in Figure 6-6.

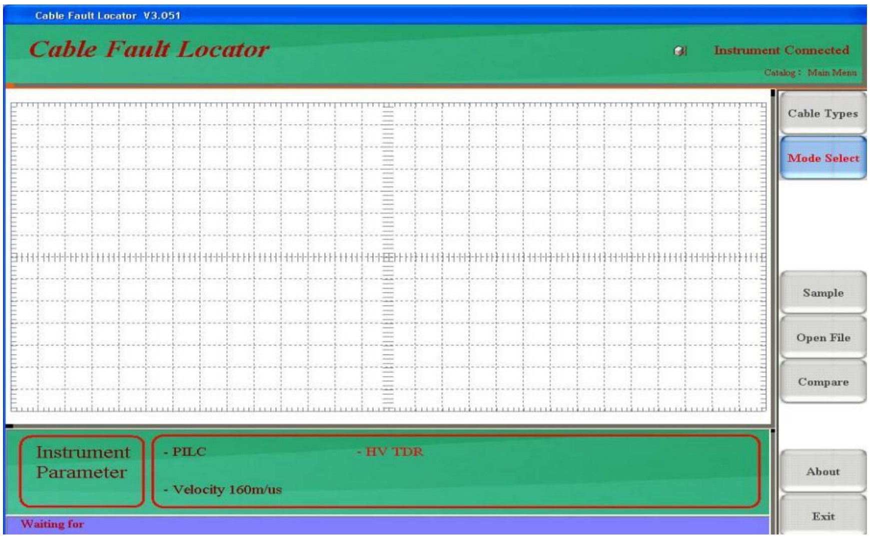


Fig 6-6

B. After setting the equipment parameters, click the "Sampling" button to enter the testing and waveform processing interface. After receiving the reflected signal through a special sampler, the operator should adjust the "Vertical Displacement" and "Input Amplitude" knobs according to the waveform needs, and observe the collected echo, so that the waveform does not appear upper and lower amplitude, until the echo amplitude and displacement are suitable for analysis.As shown in Figure 6-7.

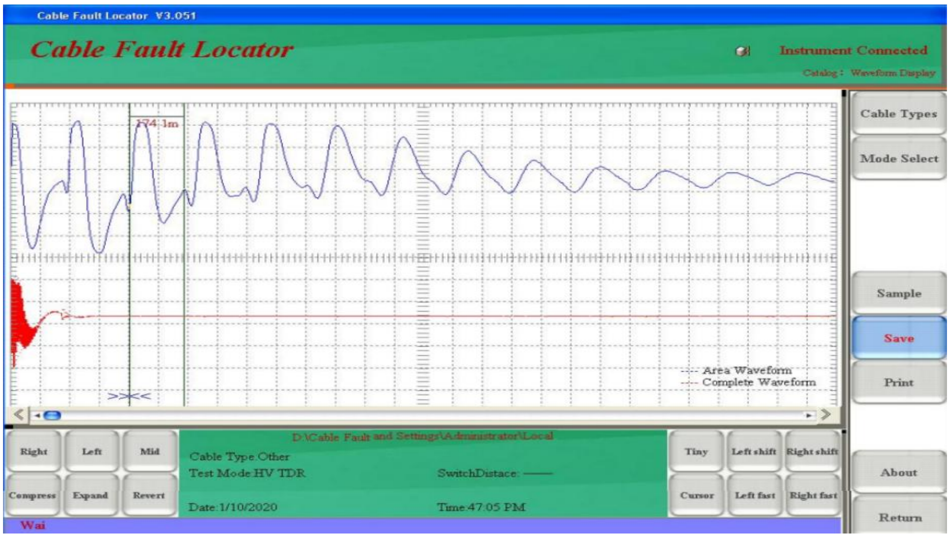


Fig 6-7

C. Press the "Cancel Sampling" key, and the instrument will stop sampling. The interface is shown in Figure 6-8 below. Move, broaden and compress the waveform left and right through the overall waveform control area to make the waveform reach the best analysis state. Next, drag the double cursors with the touch pen (click the cursors and move them after they turn green) or switch and move the cursors left and right in the cursor control area (move them in coarse, medium and micro positions) to judge the distance between the fault points at the front inflection point of the transmission pulse and the fault echo pulse.

D.Click the "Save" button to save the current waveform for later viewing and comparison.

E. If you need to print the current waveform, you can click the "Print Waveform" button to print the waveform. After clicking the button, you can also set the page size and modify the parameters (test time, cable type, detection method, fault distance, detection location, operator and remarks).

F. After the test, click the "Back" button to return to the main interface.

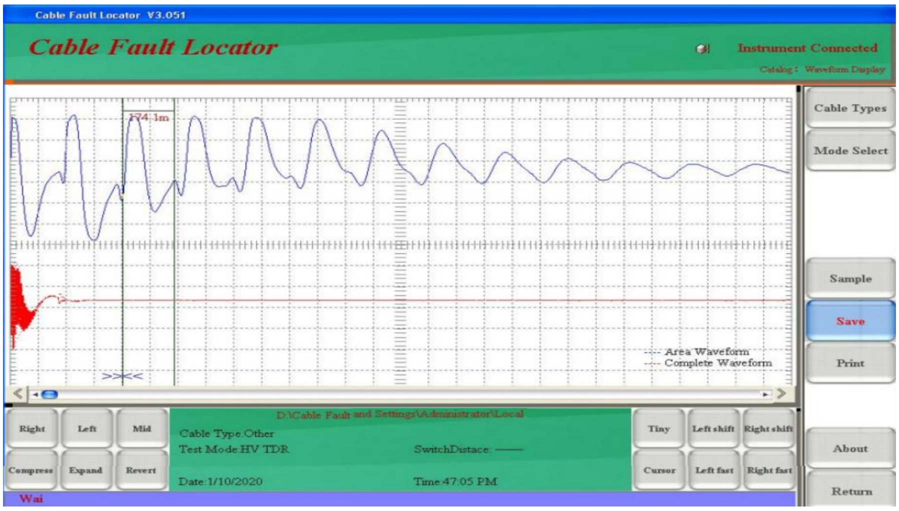


Fig 6-8

6.3.5. Waveform printing

A.Open pre-saved test results

If you need to observe the historical test records during the test, you can click the "Open File" simulation button on the right side of the screen to observe the historical records of previous tests. After clicking the "Open File" button, a secondary menu pops up on the interface. As shown in Figure 6-9 below.

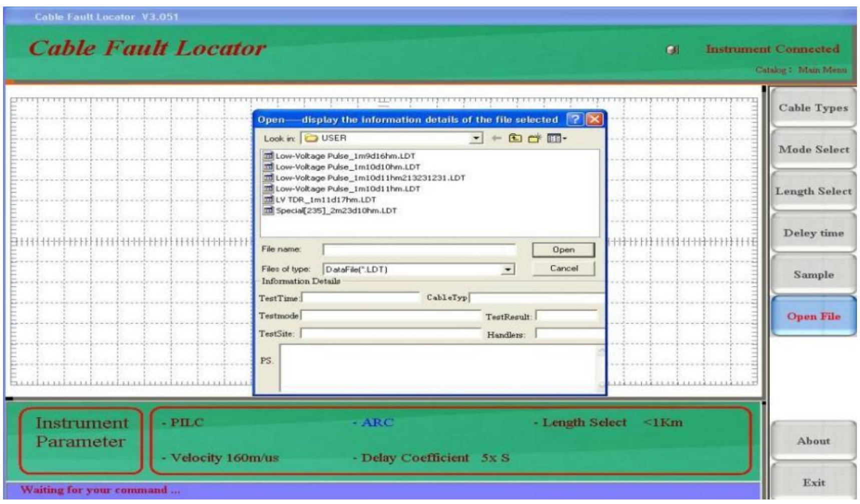


Fig 6-9

B.Select the file name to be opened in the "USER" folder file name column in the prompt interface, double-click the file name or select the file, and then click the "Open" simulation key in the secondary menu to call up the required file waveform on the screen

C. "Print file": If you need to print, you can print the test results on an external printer through the "USB" interface.Generally, because the external printer driver does not necessarily match the instrument, it cannot be printed directly. If you really want to print, you can insert the "U" disk into the "USB" interface on the instrument panel, select the test result file to be printed from the "USER" folder in the "DLY" folder in the "Local Disk D" disk of the instrument, and then copy it to the "U" disk. Put the "U" disk on the computer connected with the printer in the office to print.

D.The test waveform needs to be printed and output in the form of document, which can be completed by using the printing function of the instrument.As shown in Figure 6-10 below.

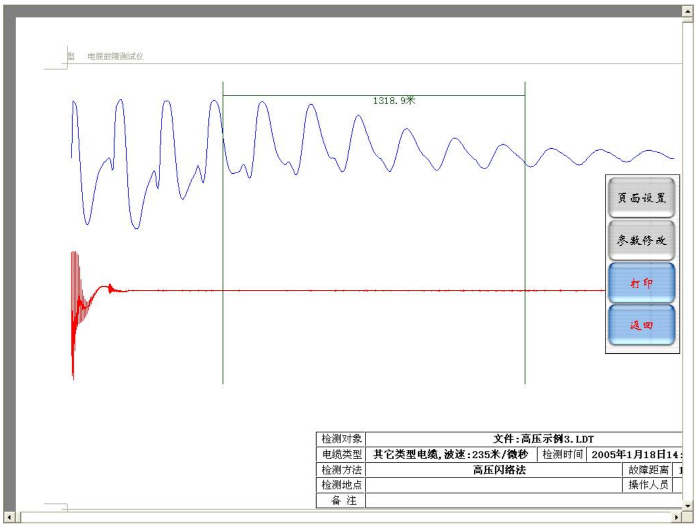
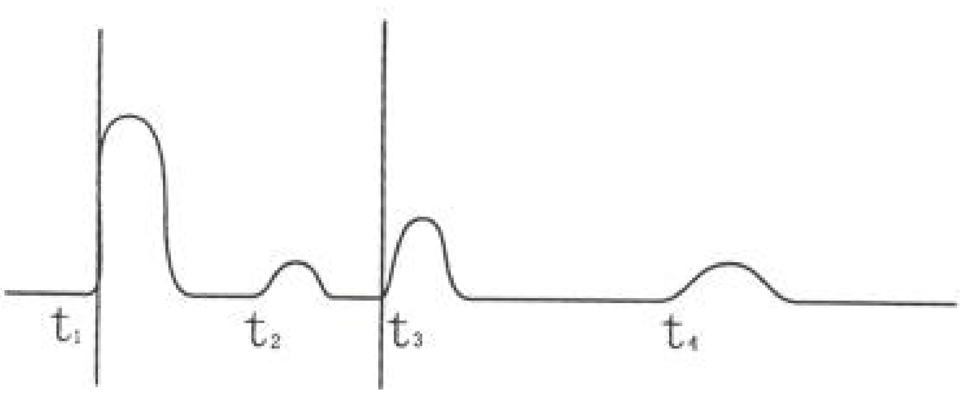
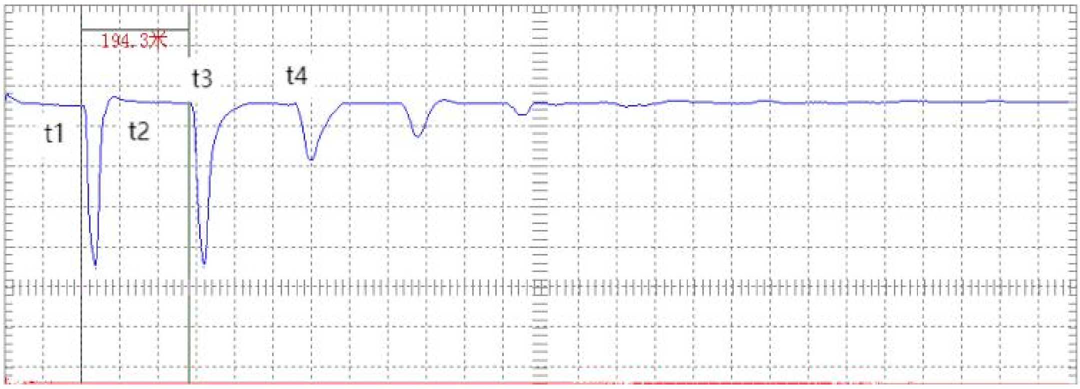


Fig 6-10

6.4 About waveforms

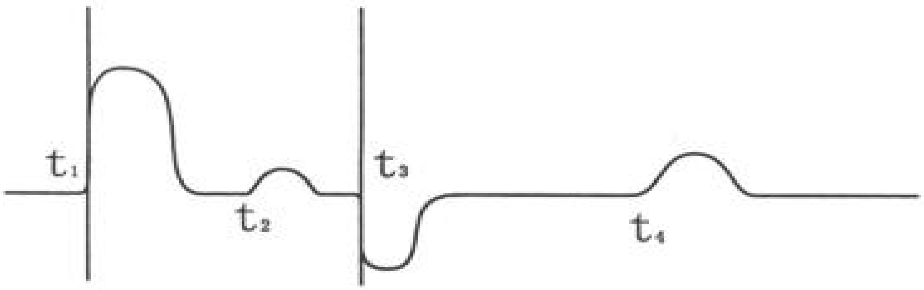
6.4.1 Open circuit fault standard waveform

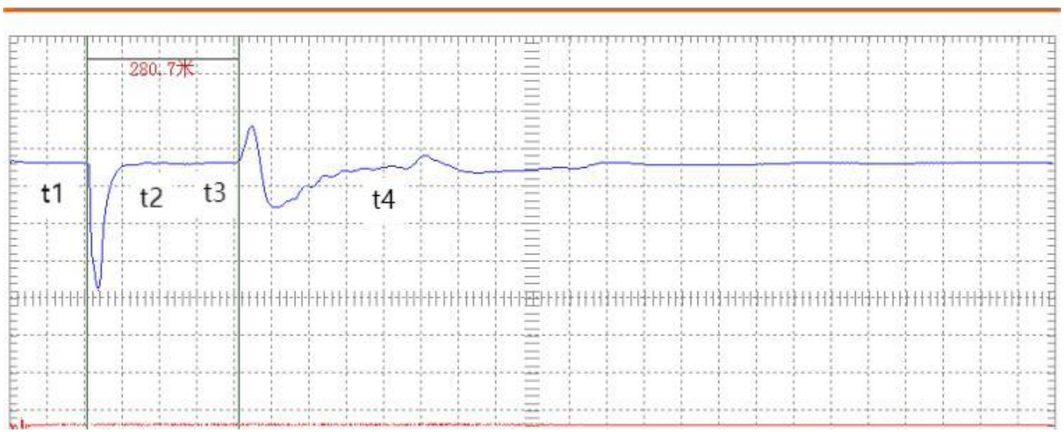




Analysis: t1 refers to pulse wave shape of the flash tester and has positive polarity (it can also be negative such as original); t2 refers to cable center butt joint reflective pulse wave shape (the reflective wave of joint has the same polarity in general; but it is related to the joint structure); t3 refers to reflective pulse wave shape of open route malfunction and has positive polarity. It refers to reflection with same polarity (polarity of malfunction wave shape is same as pulse wave polarity of instrument); t4 refers to second reflective pulse wave shape of open route malfunction. Given the attenuation of pulse wave, second reflection ratio of t4 is smaller than one-time reflective wave amplitude of t3. The distance S between malfunction point and measurement end is as follow s= $|t_1 - t_3| = |t_3 - t_4|$. During the real operation, the instrument will automatically display and calculate the distance of malfunction point by moving the cursor.

6.4.2 Low resistance fault standard waveform

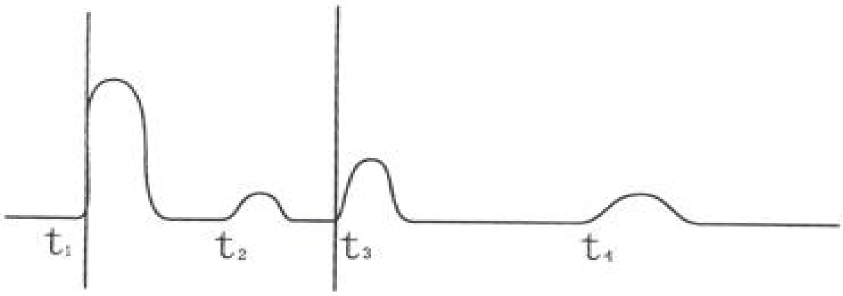


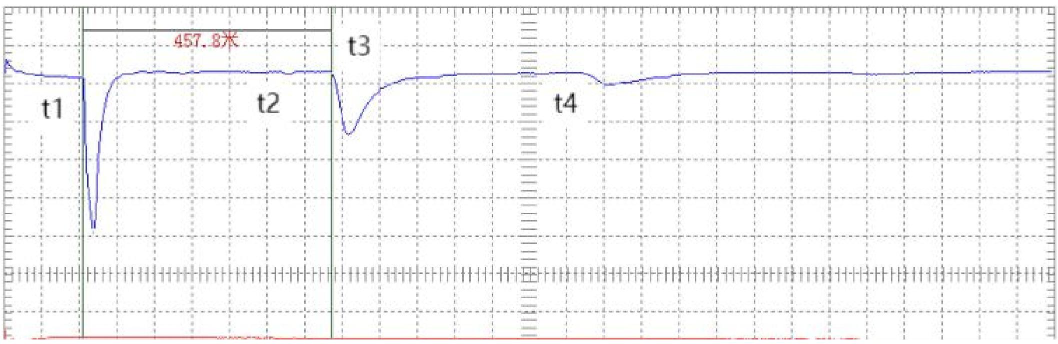


Analysis: Time t1 is the pulse waveform generated by the flash tester, and the polarity is positive (or negative); time t2 is the reflected waveform of the middle butt joint in the cable; time t3 is the reflected waveform of the low-resistance fault point, and the polarity is negative , is the reflection of the opposite polarity (the polarity of the pulse wave generated by the instrument is opposite); the time t4 is the reflection waveform of the cable terminal.

Distance from fault point to measurement terminal $S = |t_1 - t_3| = |t_3 - t_4|$

6.4.3 Full-length and mid-butt joint standard waveform

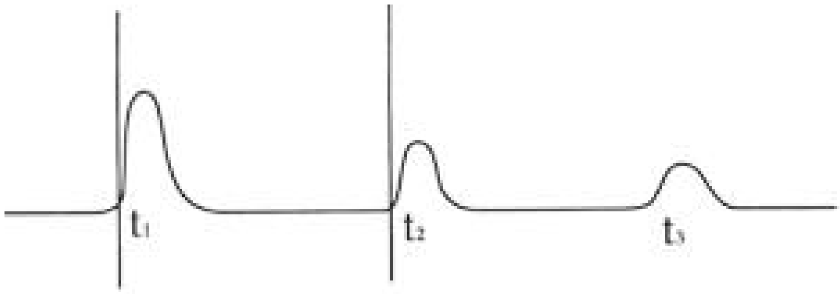




Analysis: Time t1 is the pulse waveform generated by the flash tester, and the polarity is positive (or negative); time t2 is the recoil waveform of the middle butt joint in the cable; time t3 is the full-length (terminal) reflected pulse waveform. The polarity is positive, it is the reflection of the same polarity, (similar to the open-circuit disconnection fault); the time t4 is the full-length (terminal) secondary reflection waveform. Due to the attenuation of the pulse wave, the amplitude of the secondary reflected pulse wave at time t4 is slightly smaller than that of the primary reflected pulse wave at time t3.

The full length of the cable $S_{全} = |t_1 - t_3| = |t_3 - t_4|$ and the distance between the connectors. $S_{头} = |t_1 - t_2|$ 。

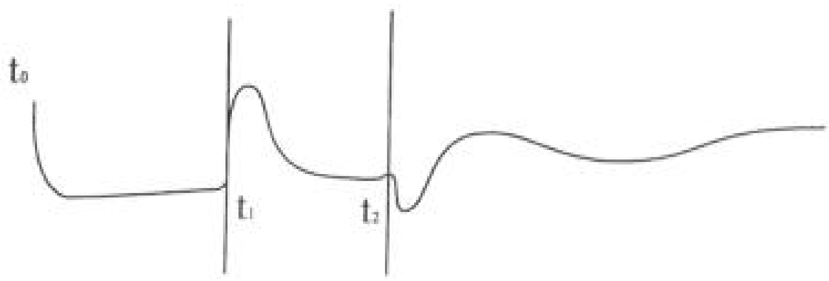
6.4.4 Standard Waveform of Radio Transmission Speed

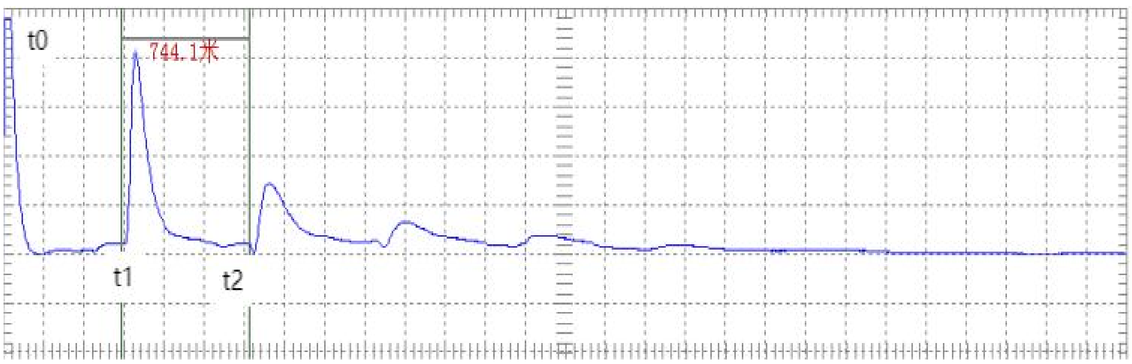


Analysis: Time t1 is the pulse waveform generated by the flash tester, and the polarity is positive (or negative); time t2 is the full-length reflection pulse waveform of the cable, the polarity is positive, which is the reflection of the same polarity; time t3 is the cable Full-length secondary reflection waveform.

The speed of electric waves in cables $v = \frac{2S}{|t_1 - t_2|}$。

6.4.5 Standard dash waveform overview



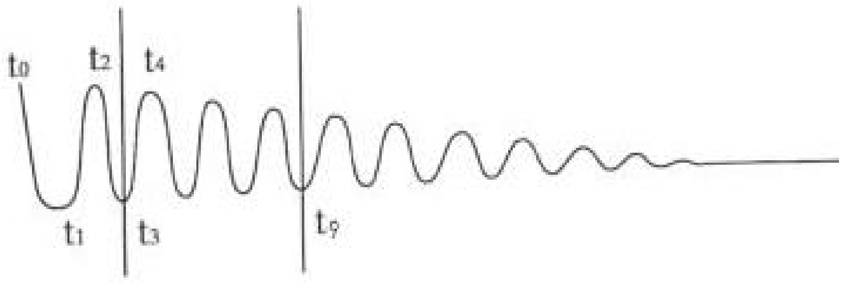


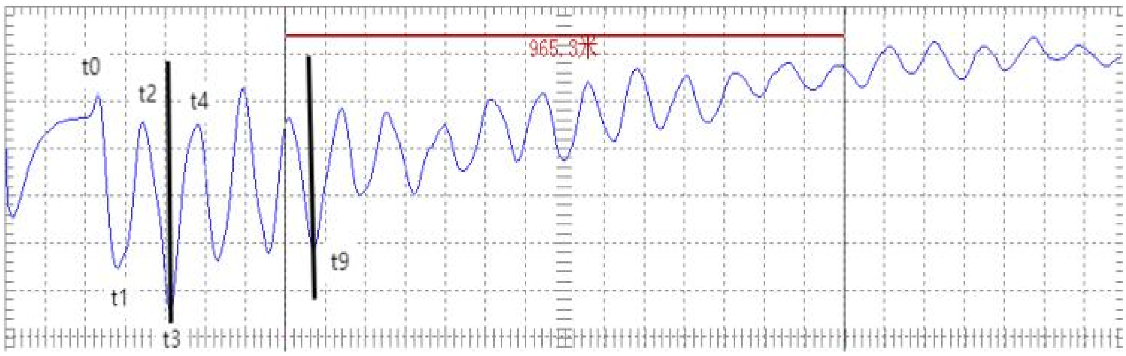
Analysis: Time t0 is the spherical gap discharge waveform; time t1 is the primary reflection waveform of the cable fault point, and time t2 is the secondary reflection waveform of the cable fault point.

Distance from test terminal to fault point $S = |t_1 - t_2|$。

Note: In general $|t_0 - t_1| > |t_1 - t_2|$。

6.4.6 Standard waveform near the test terminal





Analysis: Time t0 is the spherical gap discharge waveform; after time t1 is the multiple reflection wave formed by the fault point, and the waveform is a decaying cosine oscillation as a whole. Such a waveform is different from the previous waveform analysis, we should take a few more reflected waves, and then take their average. First calculate the distance S from time t3 to time t9, and then divide it by the number of rising and falling edges n (n=6) (twice the cosine wave period) between time t3 and time t9 (twice the cosine wave period), that is, the test terminal to the fault point distance. It can also be calculated using the following formula:

$$S = \frac{t_n - t_3}{n-3} \bullet \frac{v}{2} = \frac{S_n}{n-3}$$

VII. Example Of Use

7.1 General on/off and charging operation instructions

7.1.1 Charging of the built-in battery of the cable fault tester: connect the "power socket" to AC 220V, and select the power switch to "II" to start charging.

7.1.2 The built-in battery of the cable fault tester is turned on: the power switch is selected to the "II" gear, and the "ON/OFF" button is activated, and the industrial computer system is activated. After the XP operating system is started, run the computer desktop cable fault tester software to conduct a comprehensive test of the cable fault tester.

7.1.3 Power on the cable fault tester when AC 220V mains power supply: connect the "power socket" to AC 220V, select the power switch to the "I" file, activate the "ON/OFF" button, and the industrial computer system starts. After the XP operating system starts, run the computer desktop cable fault tester software.

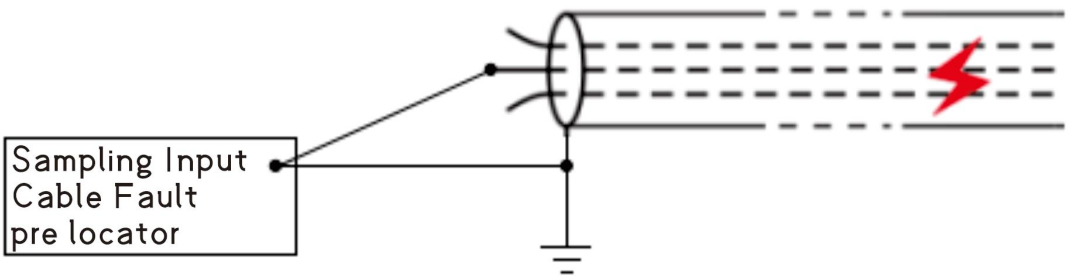
Note: It is strictly forbidden to conduct high-voltage flashover sampling test when AC 220V is powered.

7.1.4 Cable fault tester shutdown: XP operating system runs the "Start" menu, shuts down the computer, and waits for the computer to shut down normally. Activate the "On/Off" button to turn off the computer power supply, and select the power switch to "0" to turn off the system power supply.

Note: It is strictly forbidden to directly activate the "On/Off" button or disconnect the power supply to shut down the computer before it is safely shut down.

7.2 Example of Low Voltage Pulse Method

Note: During the test, it must be confirmed that there is no electricity stored in the cable body.



Low voltage pulse method wiring diagram

（1）Open the 501A2(502) host and enter the main test interface.

（2）Select "Cable Type" - XLPE Cable

"Detection Method" - AC Low Voltage Pulse Method

"Length selection" - <1km

（3）Wiring according to the low voltage pulse wiring diagram

（4）Click "Sample" to take the waveform

(5)Adjust "Displacement" and "Amplitude" to make the waveform more distinguishable. The standard waveform is shown in Figure 7-1.

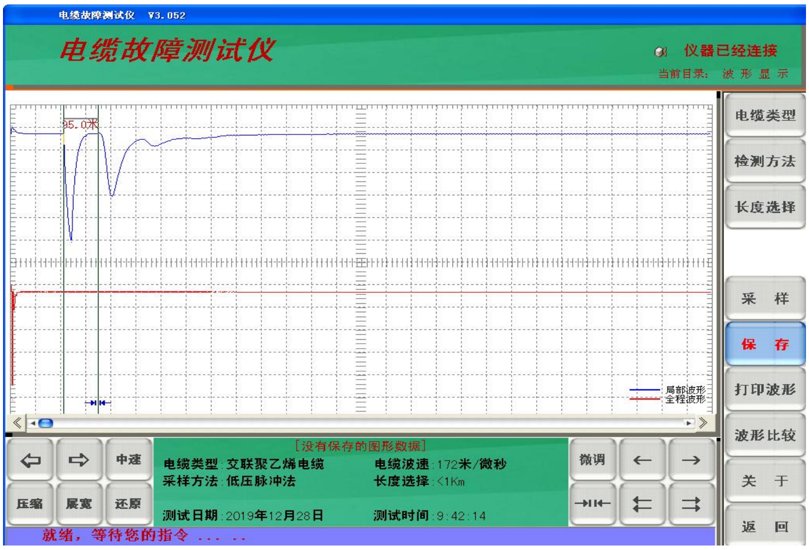


Fig 7-1

（6）Refer to "6.4 About Waveform" to analyze the waveform, and drag the cursor to measure the waveform distance.

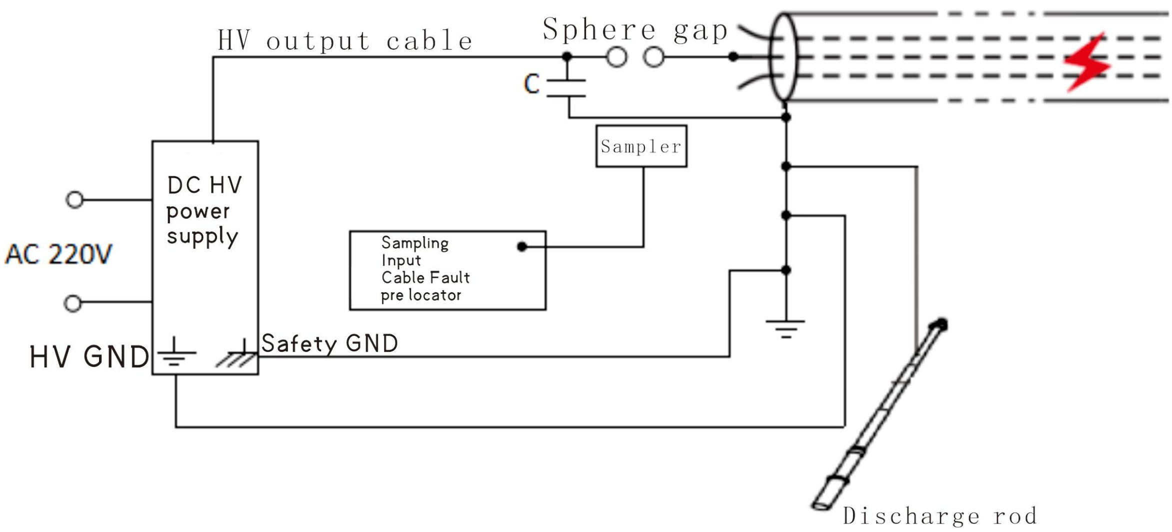
If the waveform is too small to be measured, you can click "Expand"

（7）Exit the software, click the "Start" menu, shut down the computer, and wait for the computer to shut down normally machine. Turn off the "System Switch" button, select "0" for "Power Switch", and turn off the system power supply.

7.3 Example of high voltage flashover method

Note: 1. It is strictly forbidden to use the AC 220V power supply for high-voltage flashover sampling test.

2.It is strictly forbidden to connect the "sampler" for high voltage sampling when the cable fault tester software is in "pulse 1" or "pulse 2"



High voltage flashover method wiring diagram

（1）Open the 501A2(502) host and enter the main test interface.

（2）Select "Cable Type" - XLPE Cable

"Detection method" - high pressure flashover method

（3)Connect according to the high-voltage flashover wiring diagram, and do not connect the 501A2(502) host first.

（4）Adjust the volt value of the impulse discharge voltage of the high-voltage source, so that the impulse voltage forms a high-voltage breakdown discharge phenomenon on the fault point of the faulty cable. When the impact of high voltage makes the fault point fully discharge: the voltage indication of the high-voltage equipment instantly returns to zero; the current indication instantly increases.

（5）Click "Sample" and wait for the "sampler" sampling feedback.

（6）Use the "sampler" to connect the special "double Q line" with the "cable fault tester host", and move the "sampler" slowly parallel to the "sampling ground wire (capacitive ground)". (Usually within 10cm distance, the "sampler" can capture the reflected signal).

（7）Adjust the "Amplitude Knob" and "Displacement Knob" so that the sampling waveform is fully and completely displayed in the real-time sampling area, as shown in Figure 7-2.

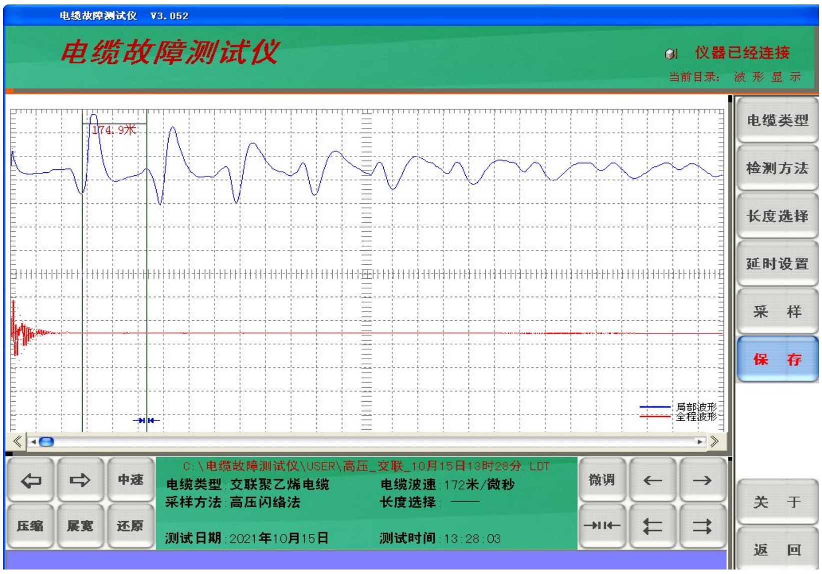


Fig 7-2

（8）Press the "Cancel Sampling" button to stop sampling; refer to "6.4-About Waveform" to analyze the waveform; if you feel that the sampled waveform is not standard, you can click the "Sampling" button again to sample; after the waveform analysis is completed and the fault distance is obtained, press "Save" ” key to save the waveform.

（9）Exit the "sampler", exit the "cable fault tester software", exit the host XP system, turn off the "system switch", turn off the power switch to "0" position, and withdraw from the "cable fault tester".

（10）Use the acousto-magnetic synchronizing spotter to make precise spotting just above the cable and within the rough measurement range. (If the cable path is not clear, you should first find the exact path of the cable, and then make the precise point).

（11）Stop the boost of the high-voltage source after accurately determining the point, and use the "discharge rod" to properly and fully discharge the high-voltage energy storage capacitor and the cable under test.

VIII. Precautions For Use Of The Instrument And Common Faults

8.1. When using the cable fault tester, you should read the instrument manual carefully, and master the operation steps, the wiring method of the instrument and the precautions.

8.2. Before using the instrument, check whether the power is sufficient to prevent the illegal shutdown/restart of the industrial computer due to insufficient power, or damage to the system files. Charging for 1 hour, standby for 2 hours; charging for 4 hours, the battery is fully charged from zero.

8.3. When the instrument is only tested by the low-voltage pulse method, it can be connected to AC220V for power supply.

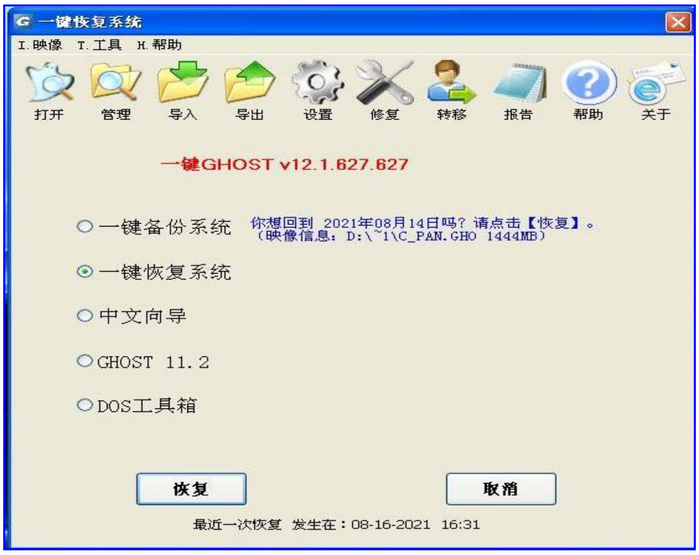
Note:It is strictly forbidden to connect AC220V for high-voltage flashover method and multiple pulse method sampling test.

8.4. The instrument is a highly sophisticated electronic device. Non-professionals are not allowed to disassemble it, handle it with care during handling and transportation, and strictly prohibit brutal operation or impact.

8.5. If the instrument is abnormal, please contact the dealer or our company in time. If the instrument is damaged due to human factors, you will lose the right to the instrument warranty.

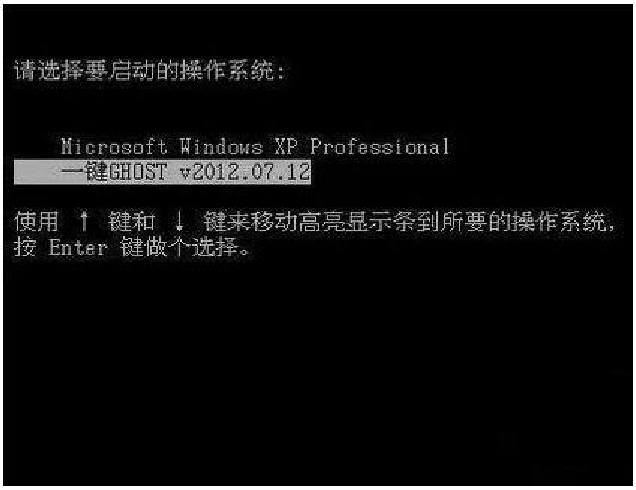
8.6 If the system is abnormal or fails to operate normally due to crash, the following methods shall be used for factory recovery. Do not replace the operating system at will.

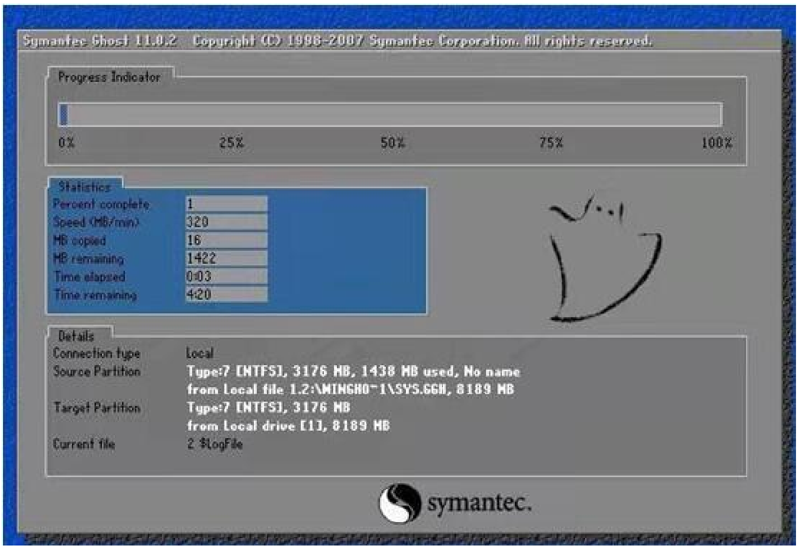
8.6.1 Open the "One-click system recovery" software on the desktop, as shown in the figure below:



8.6.2 Select the second "One-click system recovery", click the recovery button, and then click OK.

8.6.3 The system will automatically restart and start the recovery program. The recovery program is a fully automatic operation mode. During this period, you do not need to select options by yourself, so please do not operate the instrument. The recovery process is shown in the figure below:





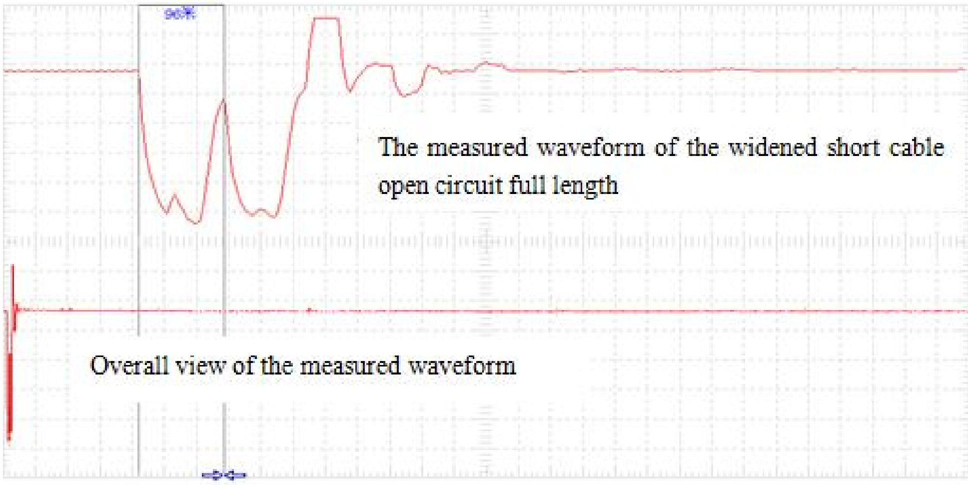
The system can be recovered after the operation of the above interface is completed. If the system crashes and cannot enter the desktop, please contact the manufacturer in time.

Compilation Of Some On-Site Measured Waveforms (For Reference)

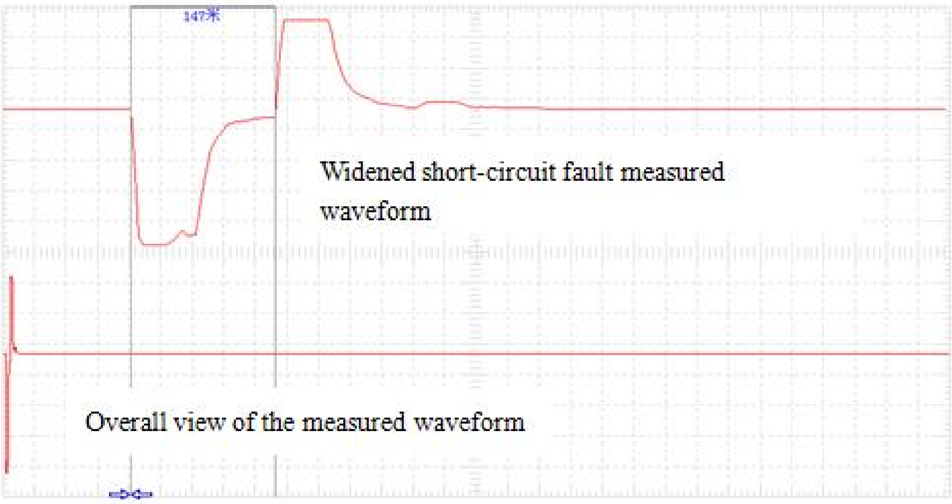
Compilation of measured waveforms of low voltage pulse method and

current sampling method

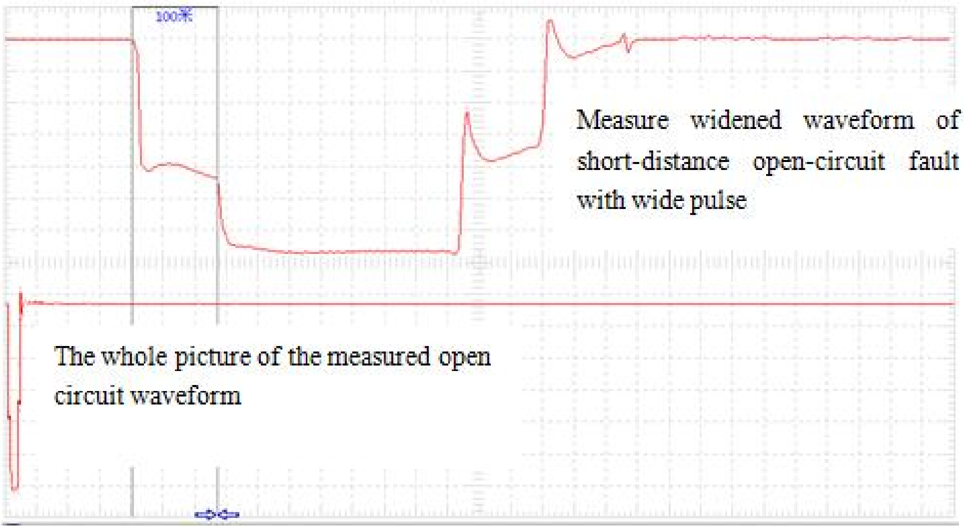
1. Short cable open circuit fault waveform



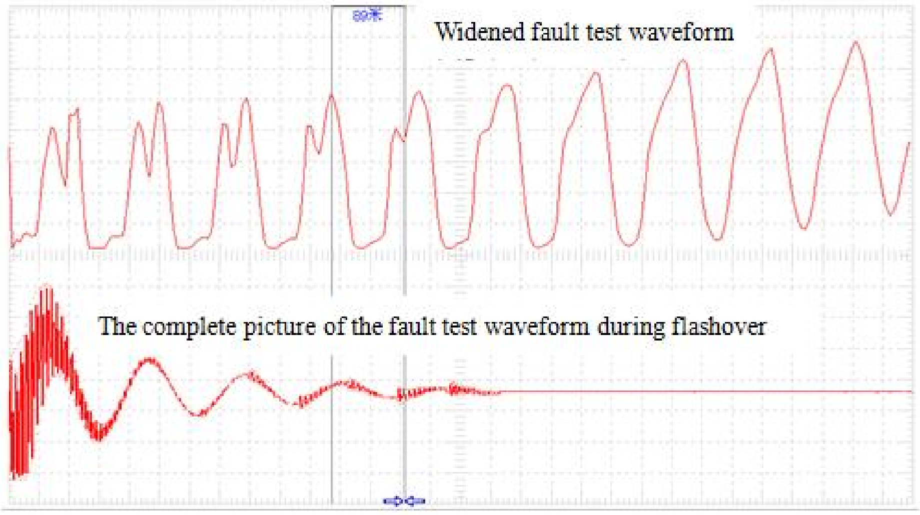
2. The test waveform when the cable fault point is short-circuited



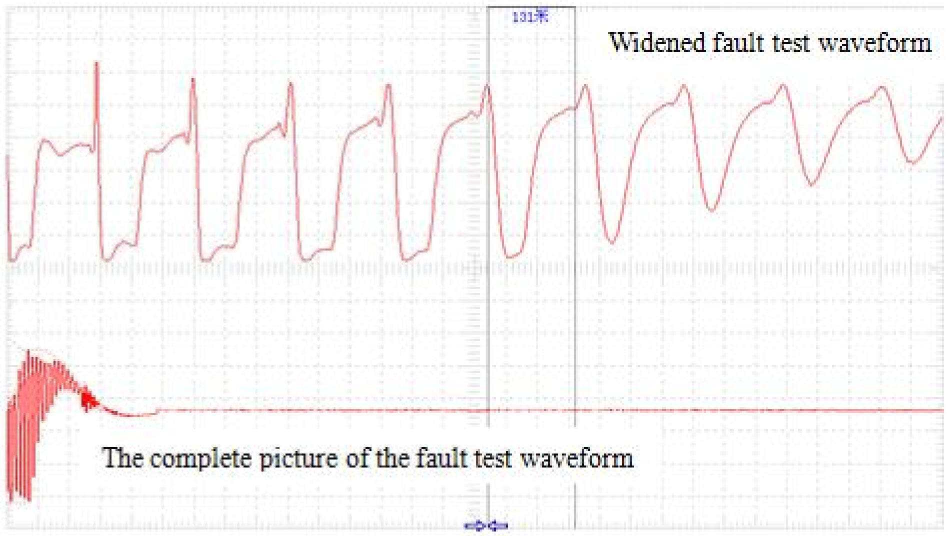
3. Short cable disconnection fault waveform measured with wide pulse (2 microseconds)



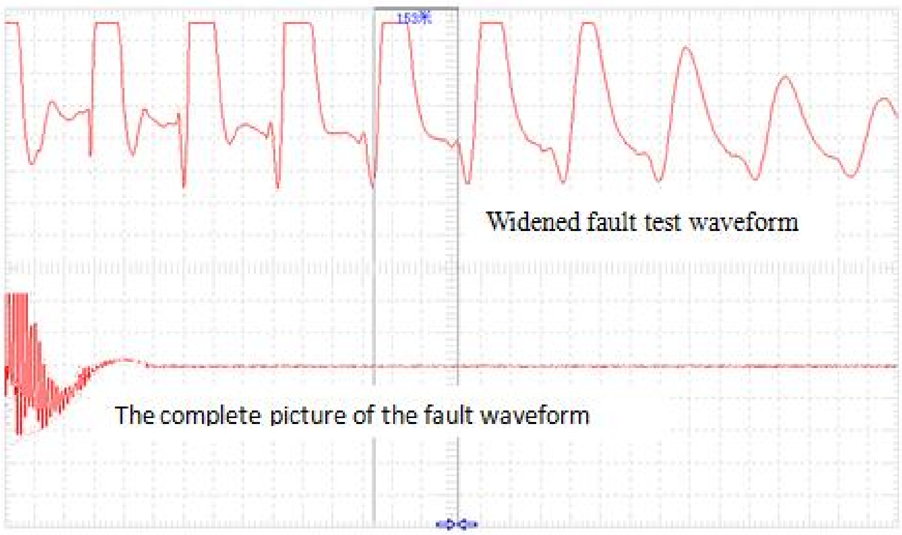
4.Various distance fault waveforms measured by flash current sampling method



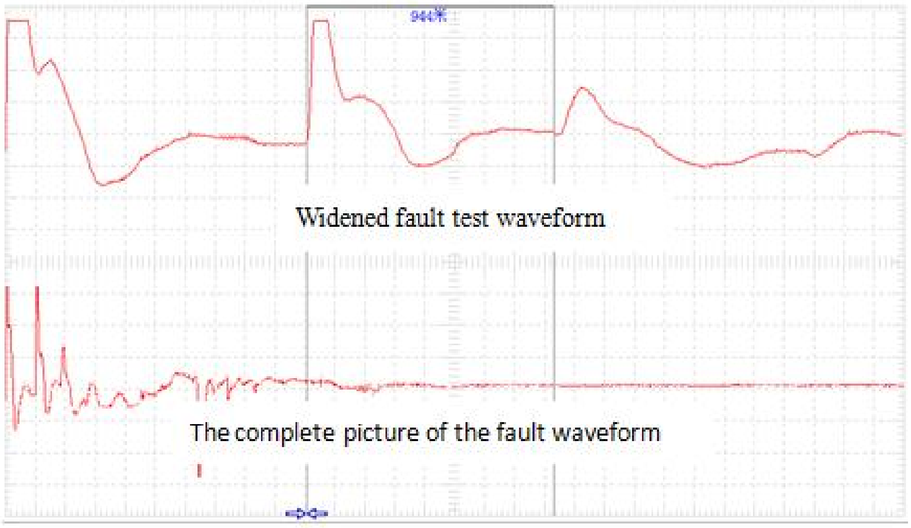
5.Measured waveforms of high-resistance faults of low-voltage cables in Xi'an 222 mailbox



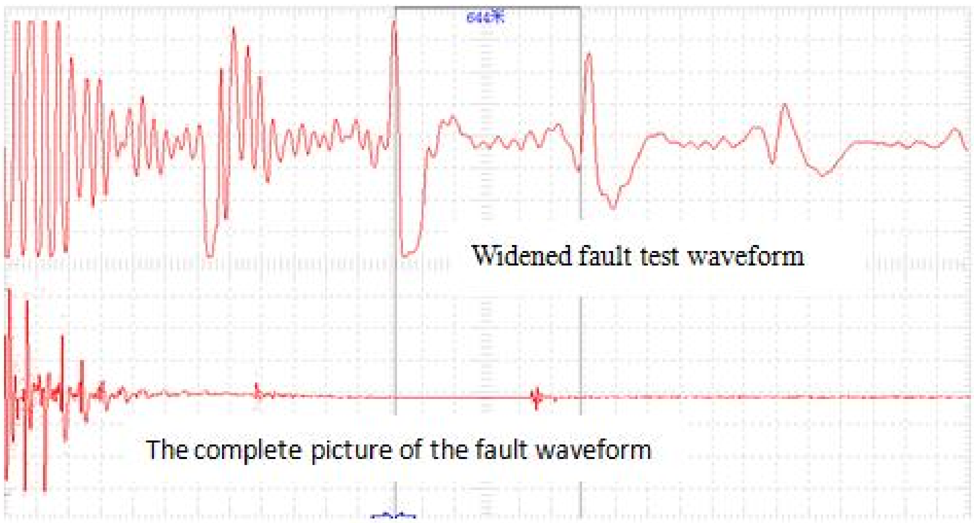
6.The test cable simulates high-resistance fault test waveform



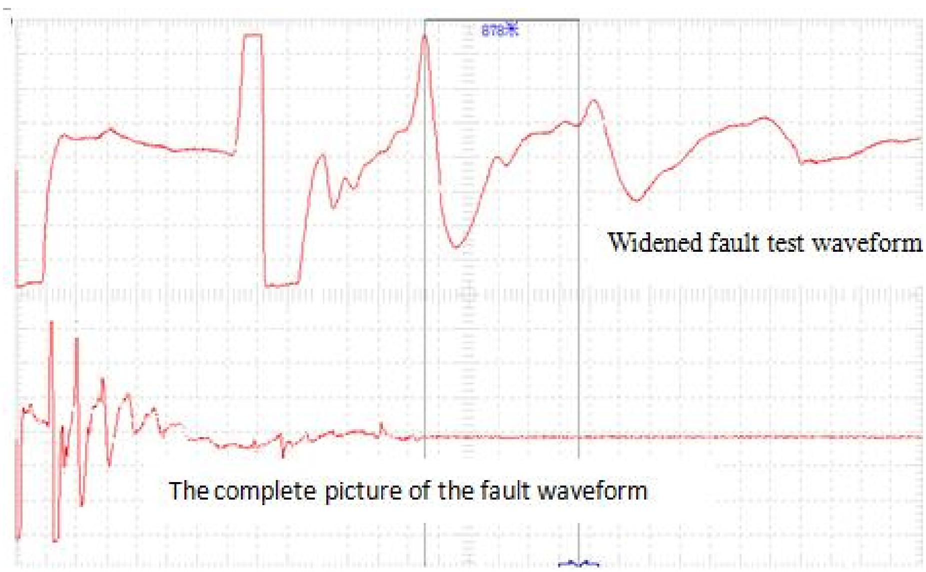
7. Measured fault waveforms of cross-linked cables in Huaneng Yueyang Power Plant



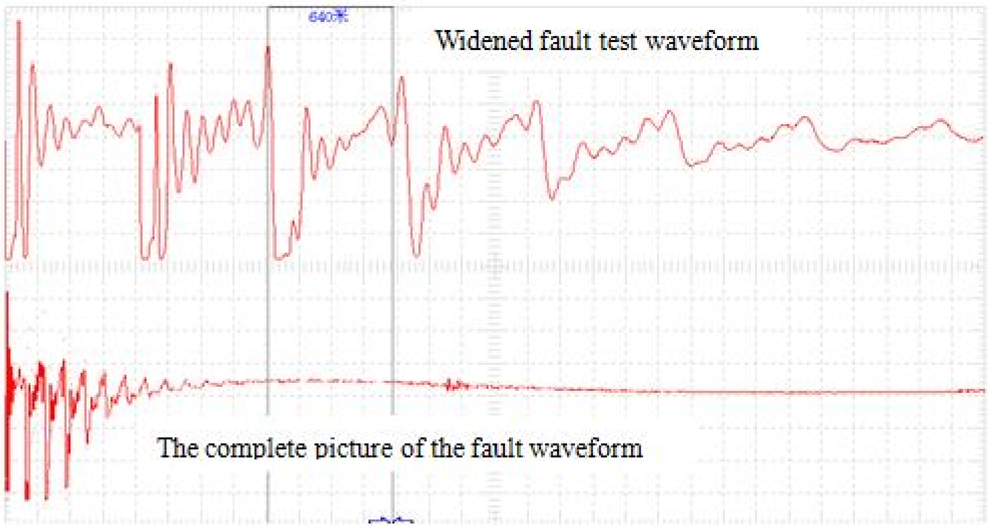
8. Measured waveforms of 10KV cross-linked cable faults in Guangzhou Central Power Supply Branch



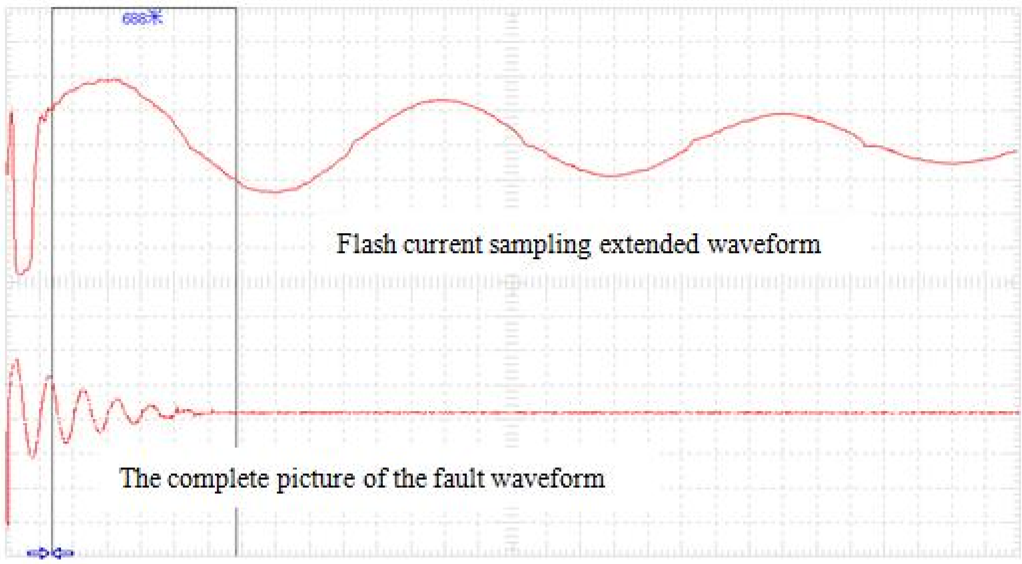
9. Measured fault waveform of 10KV cross-linked cable of Guangdong Zhaoqing Power Supply Branch



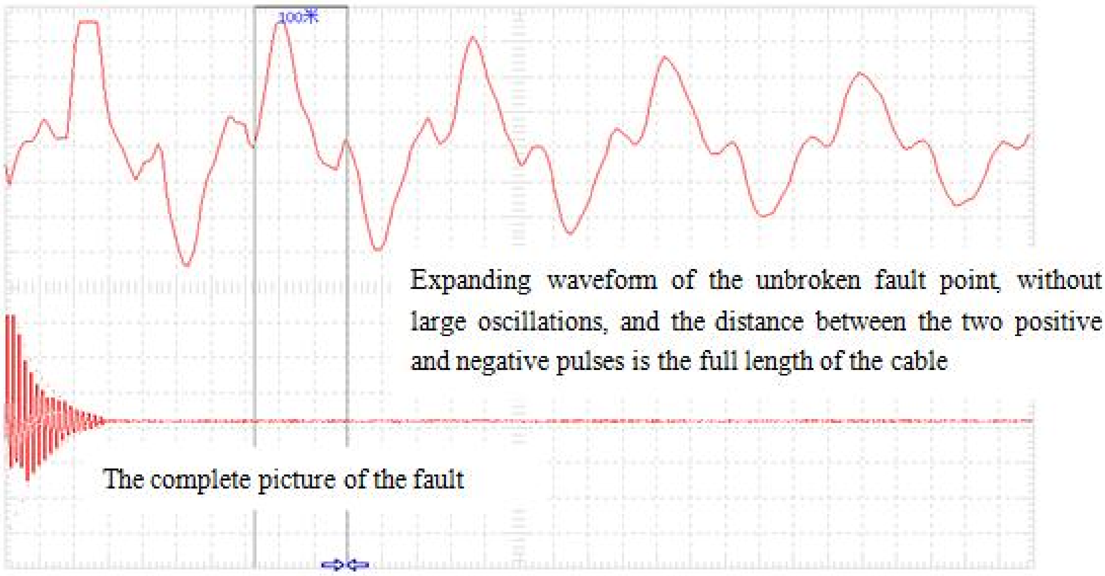
10.Measured fault waveform of high voltage cable in a company in Xi'an



11. When the fault point is at the beginning of the cable, the waveform measured by the flash current sampling method; the characteristic of the waveform is that there is no dense waveform string. There are only sleek large oscillations. The fault point is at the beginning of the cable test or very close to the beginning. The beginning (near beginning) waveform is shown in the figure below:



12． Sometimes because the breakdown voltage of the cable fault point is higher, when the impulse voltage is added lower, the breakdown point does not occur in the fault point. There is no large oscillation in the waveform obtained by current sampling. Only a series of positive and negative pulses with strong periodicity. And the distance displayed after the leading edge inflection point of the two positive and negative pulses is aligned with the cursor must be the total length of the cable. The cable fault distance cannot be measured. The solution is to increase the impact high voltage of the high-voltage generator as much as possible, and monitor the waveform recorded by the instrument while impacting, until a more standard fault echo occurs. The non-breakdown waveform of the cable is shown in the figure.



The above waveforms are only part of the on-site measured waveforms. In many cases, the situation in the field is more complicated, and the waveforms of different breakdown voltages are not exactly the same, and the waveforms vary more. Especially when the ultra-long distance echo is weak, the inflection point of the fault waveform is very smooth, which will cause a large reading error. The reflected echo at the close fault point will be caused by intensive multiple reflections. The reflected wave at the fault point is easily confused with the differential pulse of the sampling box, and it is difficult to determine the accurate distance. Hope to understand the essentials of interpretation after mastering the law of various fault waveforms. There are more opportunities for practice, and if you master the interpretation skills, you will naturally become proficient.

Section 2 HZ-535-4C High Voltage Pulse Generator

I. Warning

Note: Thank you for purchasing the cart-type high-voltage pulse generator.

For safe use, please note the following:

1. **Read this manual carefully before use and follow the relevant precautions.**
2. **Do not subject the instrument to severe impacts.**
3. **Connect the test leads correctly, and ensure a safe distance for high-voltage leads.**
4. **The high-voltage ground and sampling ground must be reliably grounded separately, with a resistance of less than 5Ω.**
5. **In an emergency, press the "Stop" button or turn off the power switch to ensure safety.**
6. **After the test, the high-voltage terminal must be fully discharged first.**
7. **Before boosting the voltage, the overcurrent protection switch must be pressed; otherwise, there will be no high-voltage output.**
8. **When the high-voltage indicator light is on, high voltage is being output. Be cautious.**
9. **When the overcurrent protection is triggered, the device must be turned off and then restarted to reset the overcurrent protection.**

II. Overview

The cart-type high-voltage pulse generator fully complies with DL/T846-2016 "General Technical Conditions for High-Voltage Testing Equipment" and DL/T474-2017 "Implementation Guidelines for On-site Insulation Testing". It is mainly used for impulse discharging and withstand voltage tests during low and high-voltage cable fault testing.

This device integrates a DC high-voltage source, energy storage capacitors, a discharge sphere device, an automatic discharge device, and a cable fault tester sampling module into a cart-type high-end experimental instrument. This equipment completely addresses the issues of convenience, portability, safety, and reliability associated with traditional experimental setups.

This instrument adopts high-precision, high-stability dedicated high-voltage electronic components and high-frequency high-voltage technology, resulting in a simple overall structure. To retain the habit of using transformers and operation boxes to generate DC high voltage, this pulse generator features a user-friendly design and operation mode, integrating a miniature and reliable circuit design. It is safe and reliable, with a visually intuitive interface. It truly achieves impact resistance and also features automatic timed impulses, manual impulses, and withstand voltage functions. It is currently the most user-friendly cart-type DC impulse high-voltage equipment in China and is an ideal product for power cable fault detection.

III. Product Features

★ Equipped with overcurrent, overvoltage, and overheat automatic protection functions;

★ Features dual 2.5-class analog meters for current and voltage display, providing a clear and straightforward view; whether the fault point is fully discharged is immediately apparent, providing real-time feedback on the discharge process;

★ Equipped with zero-position start protection for enhanced safety and reliability;

★ High-voltage pulse output is uniform and controllable;

★ High-voltage side voltage measurement is real-time and precise;

★ Unique high-voltage measurement design automatically discharges the internal capacitor charge when in the stop state;

★ Discharge time can be selected in timed or manual modes;

★ Features DC withstand voltage capability;

★ Internally installed with a high-precision test module for sampling cable fault waveforms;

★ User-friendly design with a cart for easy mobility;

IV. Technical Parameters

★ Impulse High Voltage: 0～35kV selectable

★ High-Voltage Division: Voltage accuracy of 2.5 class

★ Built-in Capacitance: 4μF

★ Output Voltage Polarity: Negative polarity

★ Discharge Power: 2550J

★ Impulse Duration: Automatic impulse for approximately 7 seconds, manual impulse with controllable duration

★ Impulse Power: 2000W

★ Overcurrent Protection: 10A (greater than 5S) on the low-voltage side

★ Dimensions: 534L×444W×805H

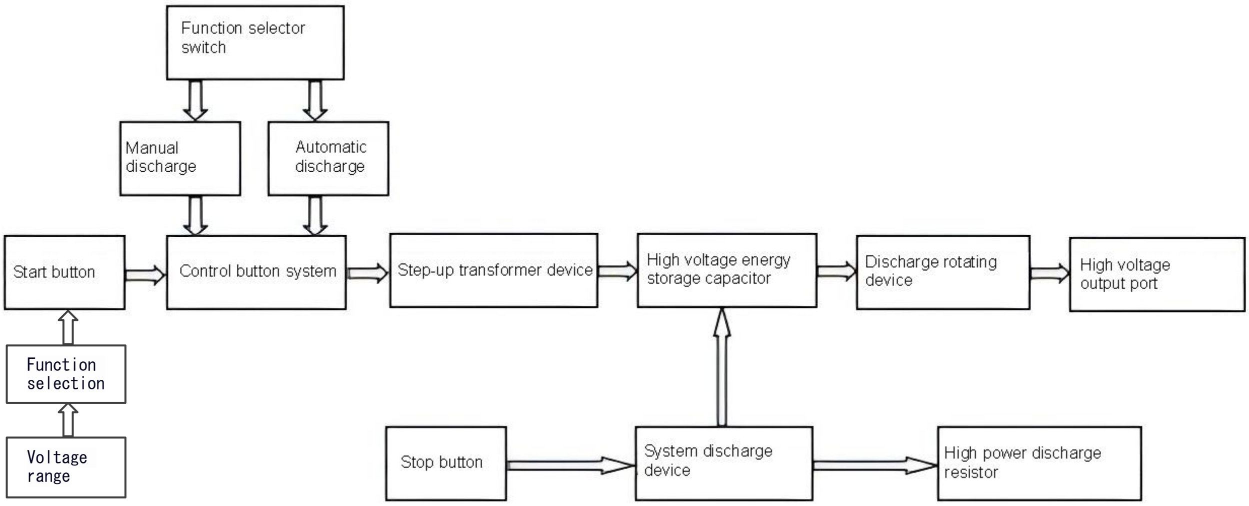
★ Weight: Not exceeding 130kg

★ Operating Power Supply: AC 220V±10%, 50Hz±2Hz

★ Ambient Temperature: -20～+60℃

V. Working Principle

Before using the cart-type high-voltage pulse generator, select the appropriate function switch, and press the start button to initiate high-voltage boosting. After use, press the stop button, and the internal system will automatically discharge any remaining high voltage in the energy storage device. The workflow diagram is as follows:



VI. Instrument Layout and Description

6.1 Composition of the Instrument

1. High-voltage Pulse Generator Main Unit: Applies high-voltage, high-energy pulse signals to the cable under test;
2. High-voltage Output Cable: Connects the high-voltage output terminal of the main unit to the core of the cable under test;
3. Grounding Wires: Includes high-voltage ground, sampling ground, and discharge rod grounding wire;
4. Power Cord: The power cord for instrument operation;
5. Discharge Rod: Used for DC current-limiting discharge or DC short-circuit discharge at the end of the cable under test;
6. Fuse: Spare fuse for the AC220V power supply system.

Instrument Composition List and Diagram					
Name	Quantity	Diagram	Name	Quantity	Diagram
Main Unit	1		Power Cord	1	
High-voltage Output Cable	1		Grounding Wire	1	
Discharge Rod	1		Fuse	5	

6.2 Introduction to the Operation Interface

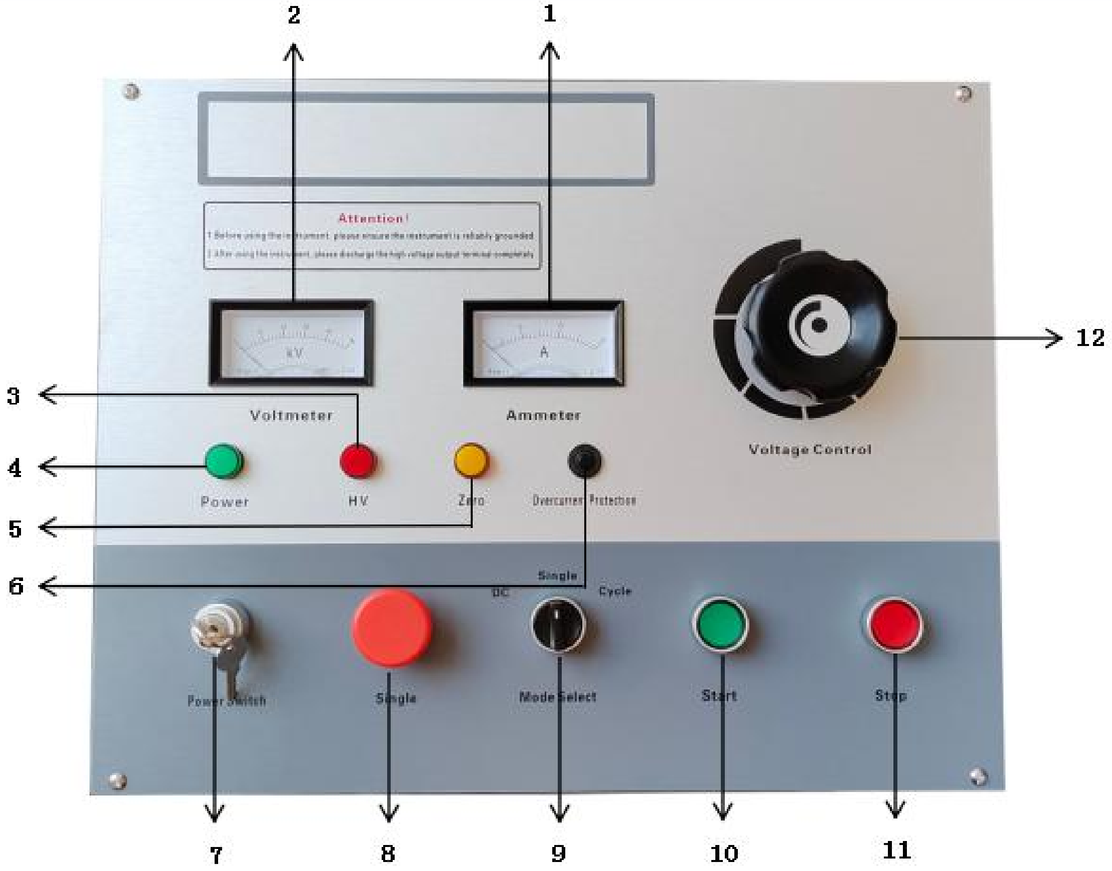


Figure 2: Panel Diagram

Panel Function Description

1. Ammeter: Indicates the current magnitude on the low-voltage side.
2. Voltmeter: Indicates the high-voltage output in kV.
3. HV Light: Illuminates to indicate high-voltage output; off indicates no high-voltage output.
4. Power Light: Illuminates when the power switch is turned on.
5. Zero Position Light: Indicates that the voltage adjustment knob is in the zero position; the high-voltage can only be activated when this light is on.
6. Overcurrent Protection Switch: Pressed down indicates that the overcurrent protection function is active; popped up indicates that the instrument has triggered overcurrent protection.
7. Power Switch: Turn clockwise to turn on the system power supply, and counterclockwise to turn it off.
8. Single Button: This button is active when the mode selection is set to Single function.
9. Mode Select: Divided into three modes: Withstand Voltage (DC), Single, and Cycle. DC is for withstand voltage testing; when selected, it performs a withstand voltage test on the cable. Single is for manual operation; when selected, the high-voltage starts and increases, and pressing the Single

button can manually trigger the impulse discharge. Cycle is for automatic operation; when selected, the high-voltage starts and increases, and the instrument automatically triggers the impulse discharge, approximately every 7 seconds.

10. Start Button: Press this button in the zero position to activate the high-voltage, and the high-voltage light illuminates. In a non-zero position, the high-voltage light does not illuminate.
11. Stop Button: When the test is complete or an abnormality occurs, press this button to cut off the high-voltage output and automatically discharge any remaining high-voltage.
12. Voltage Control Knob: When this knob is in the zero position, the zero position light illuminates, and the high-voltage can be activated. The voltage can only be increased using the voltage control knob after the high-voltage is activated.

Side Panel Description

Figure 3: Diagram of the Upper Side Panel

1. Power Socket (220V 50Hz): The working power supply for the instrument, AC220V connection port.
2. Fuse Holder: The installation location for the fuse in the AC220V power supply system.
3. Communication Port (Signal): Connects the instrument to the cable fault tester using a double Q-line for capturing waveforms during high-voltage flashover only.

Figure 4: Diagram of the Side Panel

1. Sampling Ground: The negative terminal of the pulse energy storage capacitor, which has a high voltage and must be reliably grounded. It is used for waveform sampling during high-voltage flashover of the cable fault tester. (Reliable grounding is still required even if sampling is not during high-voltage flashover.)
2. High-Voltage Ground: Also known as the high-voltage tail, it must be reliably grounded to prevent high-voltage leakage and discharge. Poor contact may result in inability to increase voltage, high-voltage breakdown and damage to internal components of the instrument, and safety hazards caused by internal leakage or discharge.
3. High-Voltage Output (HV OUT): Dedicated DC high-voltage output terminal.

VII. Usage Example

7.1 Cable Fault Testing Site

1.1 Connect the wires according to Figure 3, ensuring that the three ground wires are properly grounded.

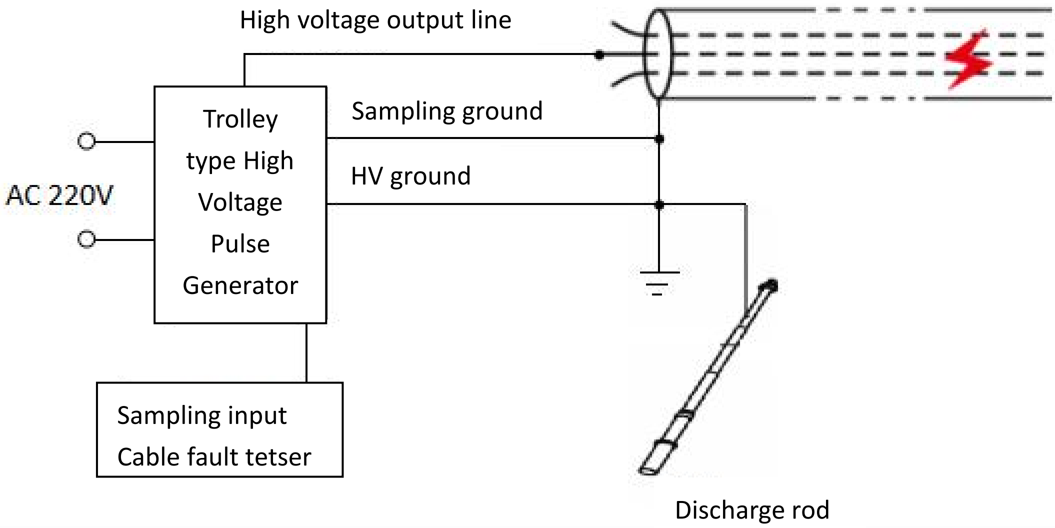


Figure 4: Sampling Wiring Diagram

1.2 Connect to AC 220V power supply.

1.3 Turn on the power switch. At this point, the power indicator light will illuminate, and the internal fan will start. Check if the zero position light is on. If not, rotate the voltage adjustment knob counterclockwise to the zero position.

1.4 Select the correct mode selection button. For cable fault testing experiments, generally choose the cyclic mode, and you can hear the internal motor working at this moment. If you select the single mode, you can trigger the single manual button at any interval. For cable withstand voltage tests, select the DC mode, and the system will automatically switch to the withstand voltage mode. When performing withstand voltage tests, please increase the voltage slowly. Ensure that the overcurrent protection switch is pressed, and then press the start button. At this point, the high voltage has been activated, and the red high voltage light is on.

1.5 Start increasing the voltage by rotating the voltage adjustment knob slowly until the fault point breaks down and discharges. The voltmeter and ammeter will discharge, and the pointers will swing.

1.6 Connect to the main unit for waveform sampling and analyze the waveform.

1.7 After the experiment, first rotate the voltage adjustment knob counterclockwise to the zero position to reduce the voltage, and then press the stop button. It is advisable to lower the voltage before pressing the stop button to protect the system's built-in discharge device.In an emergency, you can press the stop button first and then adjust the voltage knob to the zero position.

1.8 After stopping the high voltage, for personal safety, use a discharge rod to perform arc discharge on the cable before disconnecting the wires, and then short-circuit the cable to discharge it.

7.2 Example of 10kV DC Withstand Voltage Operation:

1. Inspect the site to ensure that all safety distances and measures meet the requirements.
2. Connect the instrument's high voltage ground, sampling ground, and discharge rod to a reliable grounding system, ensuring adequate grounding.
3. Confirm that the on-site installation is in good condition and that the wiring is correct and secure.
4. Connect the instrument's high voltage output wire to the terminal of the item under test.
5. Connect the AC220V power supply and turn on the power switch.
6. Select the DC position on the Mode Select.
7. Observe whether the Power indicator light and the Zero indicator light are illuminated. When they are illuminated normally, ensure that the overcurrent protection switch is pressed, and then press the Start button. The HV indicator light will illuminate.
8. Slowly adjust the Voltage control knob clockwise. The Ammeter and Voltmeter will display the voltage and current. When the voltage is increased to a certain level, the Zero indicator light will go out.
9. Slowly increase the voltage to DC10kV. At this point, a DC withstand voltage test is being performed on the item under test. Observe the swings of the Voltmeter and Ammeter to detect any leakage or breakdown.

10. After the test, rotate the Voltage control knob counterclockwise until it reaches the end, and the Zero indicator light illuminates. (Observe the voltage indicated on the Voltmeter to prevent rotating in the wrong direction, which could lead to an accident.)
11. Press the Stop button and observe whether the voltage displayed on the Voltmeter decreases from 10kV to 0kV. Then, use the discharge rod connected to the ground to fully discharge the tested terminal, and short-circuit the high voltage output to the ground to ensure complete discharge.
12. Turn off the instrument, disconnect and organize all wires, and the test is complete.

7.3 Example of 20kV Periodic Impulse Discharge Operation:

1. Inspect the site to ensure that all safety distances and measures meet the requirements.
2. Connect the instrument's high voltage ground, sampling ground, and discharge rod to a reliable grounding system, ensuring adequate grounding.
3. Confirm that the on-site installation is in good condition and that the wiring is correct and secure.
4. Connect the instrument's high voltage output wire to the terminal of the item under test.
5. Connect the AC220V power supply and turn on the power switch.
6. Select the Cycle position on the Mode Select.
7. Observe whether the Power indicator light and the Zero indicator light are illuminated. When they are illuminated normally, ensure that the overcurrent protection switch is pressed, and then press the Start button. The HV indicator light will illuminate. The periodic discharge device will start, executing a discharge action every 7 seconds (even when the voltage is not increased).
8. Slowly adjust the Voltage control knob clockwise. The Ammeter and Voltmeter will display the voltage and current. When the voltage is increased to a certain level, the Zero indicator light will go out.
9. Slowly increase the voltage to DC20kV. At this point, a periodic impulse discharge test is being performed on the item under test. Observe the significant swings of the Voltmeter and Ammeter. The Voltmeter will instantly drop from 20kV to 0kV during discharge, and the Ammeter will momentarily increase. If the swings are as described, it indicates a full breakdown and discharge.
10. Connect a cable fault tester to perform a high-voltage flashover sampling test for a rough estimation of the fault distance.
11. Use a cable fault locator to precisely pinpoint the fault location along the cable using acoustic and magnetic signals.

12. After the test, rotate the Voltage control knob counterclockwise until it reaches the end, and the Zero indicator light illuminates. (Observe the voltage indicated on the Voltmeter to prevent rotating in the wrong direction, which could lead to an accident.)
13. Press the Stop button and observe whether the voltage displayed on the Voltmeter decreases from 20kV to 0kV. Then, use the discharge rod connected to the ground to fully discharge the tested terminal, and short-circuit the high voltage output to the ground to ensure complete discharge.
14. Turn off the instrument, disconnect and organize all wires, and the test is complete.

7.4 Example of a single discharge operation at 20 kV:

1. Inspect the site to ensure that all safety distances and safety measures meet the requirements.
2. Connect the high-voltage ground, sampling ground, and discharge rod of the instrument to a reliable grounding bar respectively, ensuring adequate grounding.
3. Confirm that the on-site installation is in good condition, with correct and secure wiring.
4. Connect the high-voltage output line of the instrument to the terminal of the test object.
5. Turn on the AC220V power supply and the power switch.
6. Select the "Single" mode on the mode selector.
7. Observe whether the power indicator (Power) and zero-position indicator (Zero) are lit. When they are lit normally, ensure that the overcurrent protection switch is pressed, and then press the start button (Start). The high-voltage indicator (HV) should light up.
8. Slowly rotate the voltage regulation knob (Voltage control) clockwise. The ammeter (Ammeter) and voltmeter (Voltmeter) will display the voltage and current. When the voltage is raised to a certain level, the zero-position indicator (Zero) will go out.
9. Slowly increase the voltage to DC20kV and press the "Single" button to execute a single discharge action. When a discharge action is required, press the "Single" button. Observe the violent fluctuations of the voltmeter (Voltmeter) and ammeter (Ammeter). The voltmeter should drop from 20kV to 0kV instantaneously during discharge, and the ammeter should show a sudden increase. If such fluctuations occur, it indicates a complete breakdown discharge.
10. Connect the cable fault tester to perform a high-voltage flashover sampling test to roughly measure the fault distance.
11. Use the cable fault locator to accurately pinpoint the fault along the line using acoustic-magnetic methods.

12. After the test is completed, rotate the voltage regulation knob (Voltage control) counterclockwise until it reaches the end, and the zero-position indicator (Zero) should light up. (Observe the voltage indication on the voltmeter to prevent rotating in the wrong direction, which could lead to an accident.)
13. Press the stop button (Stop) and observe whether the voltage indicated on the voltmeter (Voltmeter) drops from 20kV to 0kV. Then, use the discharge rod to connect to the ground wire and fully discharge the test object. Short-circuit the high-voltage output with the ground to ensure complete discharge.
14. Turn off the instrument, remove and organize all connections. The test is now complete.

VIII. Precautions for Instrument Use and Common Faults

8.1 Precautions

8.1 When using this device, please read the instrument operation manual carefully, familiarize yourself with the operating steps, wiring methods, and precautions for the instrument.

8.2 The instrument is a highly precise electronic high-voltage equipment. Non-professionals are not allowed to disassemble it. Handle it with care during transportation, and avoid rough handling or impact.

8.3 Before increasing the voltage, the high-voltage ground and sampling ground must be separately and reliably grounded. They must not be connected together to a single ground, as this may damage the equipment and possibly pose a risk to personal safety.

8.4 If any abnormalities occur at any time during the test, press the "Stop" button or turn off the power switch to ensure safety.

8.5 When removing high-voltage wires and grounding wires, to ensure safety, thorough discharge must be carried out.

8.6 If the overcurrent protection switch trips, to continue increasing the voltage, please turn off the instrument power. Rotate the voltage adjustment knob counterclockwise to the zero position, press the overcurrent protection switch, and reoperate the instrument to increase the voltage.

8.7 If the instrument malfunctions, please contact the dealer or our company promptly. If the instrument is damaged due to human factors, you will lose the right to instrument warranty.

8.8 Proper high-voltage discharge: When the high voltage exceeds 10kV, arc discharge must be performed first. When the high voltage is below 10kV, direct discharge can be performed.

8.9 Arc discharge: It refers to the process where an arc discharge occurs due to the slow separation or closure of moving/static contacts or two electrodes under high voltage, creating an air gap. When the voltage is high, the gap is small, and there is a certain amount of energy, an arc discharge occurs. We should first fully extend the telescopic part of the high-voltage discharge rod, connect the ground wire to the hole of the discharge resistor, and then use the one-hand discharge method to gradually move the discharge metal tip of the discharge rod from far to near the high-voltage terminal. When the distance is close enough to produce a (hissing) corona sound and arc phenomenon, stop or slightly adjust the distance. After the arc phenomenon disappears, continue to reduce the discharge distance until the discharge metal tip of the rod contacts the high-voltage terminal and hold for more than 1 minute. The arc discharge is complete.

8.10 Direct discharge: Insert the ground wire into the metal discharge tip of the discharge rod, and use the one-hand discharge method to gradually move the discharge metal tip of the discharge rod from far to near the high-voltage terminal until it makes contact. Hold for more than 1 minute, and the direct ground discharge is complete.

8.2 Common Faults

1. Instrument Fails to Power On

When the instrument is connected to an AC220V power source, no indicator lights up after powering on.

Solution: a. Check if the "8A fuse" on the instrument panel is blown.

b. Verify that the working voltage is within the range of AC220V±10%.

2. Instrument Burns Fuse upon Power On

When the instrument is connected to an AC220V power source, the fuse burns when powering on.

Solution: a. Check if the voltage is too high, exceeding the range of AC220V±10%.

b. When powered by a generator, check if the output waveform is a 50Hz sine wave and if there is a grounding phase. One of the two phases output by the generator can be connected to the ground as the neutral line; alternatively, a series-connected isolation transformer can be used to power the equipment, which will resolve the issue.

3. Instrument Fails to Start High Voltage after Power On

The high-voltage start button on the instrument fails to activate.

Solution: a. Check if the power supply voltage is below the range of AC220V±10%.

b. Check if the "voltage adjustment knob" is turned counterclockwise to the zero position and if the zero position indicator light (start button) is illuminated. If the "voltage adjustment knob" is at the zero position and the "zero position indicator light" is on, but it still fails to start normally, contact the manufacturer immediately for assistance.

4. Instrument Starts High Voltage, but Voltage Meter Shows No Reading after Boosting

The instrument functions normally, high voltage starts normally, but there is no voltage display after boosting.

Solution: a. Check if the grounding wire and high-voltage wire are connected securely.

b. If the connections are confirmed to be secure and the issue persists, contact the manufacturer immediately for assistance.

Notes:

A. In the event of an abnormality during testing, press the "Stop" button or turn off the power switch to ensure safety.

B. Regardless of the type of test being performed, to ensure personal safety, the tested cable must be fully discharged before removing the high-voltage wires.

C. When performing waveform sampling, use the high-voltage flashover mode on the main unit.

Tip: If there are any issues that cannot be resolved, please contact the manufacturer at any time. Do not modify the equipment privately to prevent accidents.

Section 3 HZ-503 Pinpointor

I. Precautions

Note：Thank you for purchasing the cable fault locator.

Please refer to the following tips to ensure safe use:

1、Please read this manual carefully and follow the relevant precautions.

2、Precision instruments, it is strictly prohibited to hit the instrument.

3、When the battery voltage is insufficient, the sensitivity of the instrument decreases, and the battery should be replaced immediately.

4、The probe is a sensitive element, it is strictly prohibited to disassemble.

5、Fixed point: must be "above the cable, within the range of rough measurement".。

II.Overview

The cable fault locator uses the principle of vibration pickup and electromagnetic induction to determine the specific location of the cable fault point. The physical phenomena such as vibration wave, sound wave and electromagnetic wave generated by the fault point flashover discharge are picked up by the special probe of the cable fault point detector, amplified by the cable fault point detector and displayed and output, and the exact location of the fault point is determined by the test person's hearing and vision. That is, the fault point of the cable is located **directly above the cable and within the range of rough measurement**.

The cable fault locator is suitable for low resistance, short circuit, open circuit fault, high resistance leakage and high resistance flashover fault of power cable, high frequency coaxial cable, street lamp cable and buried wire of various materials with different sections and different media. The technical parameters meet the standard requirements of "DL/T 849.2 General Technical Conditions for special tester for power equipment Part 2: Cable fault Locator".

III.Product Feature

1.Synchronous receiving of vibration waves, sound waves and electromagnetic waves generated by fault point discharge;

2.The acoustic and magnetic channels are designed separately, powered separately, and the anti-interference ability is stronger;

3.Super magnification, detection depth greater than 10 meters;

4.Ultra-low power design, static current less than 10mA, continuous work more than 20 hours;

5.Analog head design, signal strength and trend at a glance;

6.Zero level arbitrary adjustment, suitable for all kinds of strong and weak scene.

IV.Technical Parameter

1.Magnification, 500,000 times;

2.Positioning accuracy: Less than 0.1m;

3.Output impedance: 350Ω;

4.Working power supply: 4 standard 3.7V 3200mAh batteries;

5.Static current:＜10mA;

6.Working conditions: Ambient temperature: -25 ~ 65℃; Relative humidity: ≤90％.

V.Working Principle

Flashover discharge occurs at the fault point of the cable under the action of high voltage pulse, and there are physical phenomena such as echo, vibration wave, sound wave, electromagnetic wave, infrared wave and instant short circuit when the fault point is discharged. The cable fault tester detects the flashover discharge generated by the fault point and the instantaneous short circuit phenomenon to complete the rough measurement of the fault point. The cable fault locator uses vibration wave, sound wave and electromagnetic wave generated by flashover discharge to accurately locate the fault point.

The working principle of the instrument is shown in Figure 5-1. Independent design of acoustic and magnetic channels, separate power supply, greatly improve the anti-interference ability, suitable for various fault sites. Due to the large magnification and higher sensitivity, it is especially suitable for deep fault location; But the disadvantage is that the background noise is relatively loud.

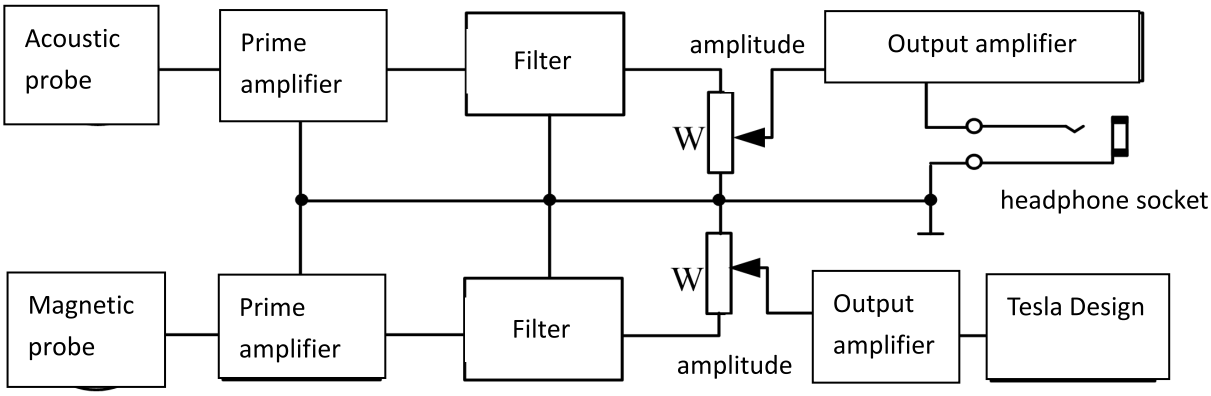


Figure 5-1 Working principle block diagram of cable fault locator

VI.Instrument Layout And Description

6.1 Composition of instrument

1. Cable fault locator: The cable fault point flashover discharge signal processing to achieve accurate positioning purpose;

2. Probe: Including probe needle, probe head, connecting rod, etc., to pick up the flashover discharge signal at the fault point;

3. Wear headphones: Connect the output channel of the cable fault locator to monitor the flashover discharge signal of the fault point;

4. Audio cable: Connect the cable fault locator and probe, so that the fault point flashover discharge signal input cable fault locator;

5.Charger: Open the back cover of the instrument to take out the battery and charge the battery.

Instrument composition list and picture					
Item	Qty.	Picture	Item	Qty.	Picture
Cable fault tester	1		Charger	1	
Probe head (including connecting rod and probe)	1		Headphone	1	
			Audio cable	1	

6.2 Operation interface introduction

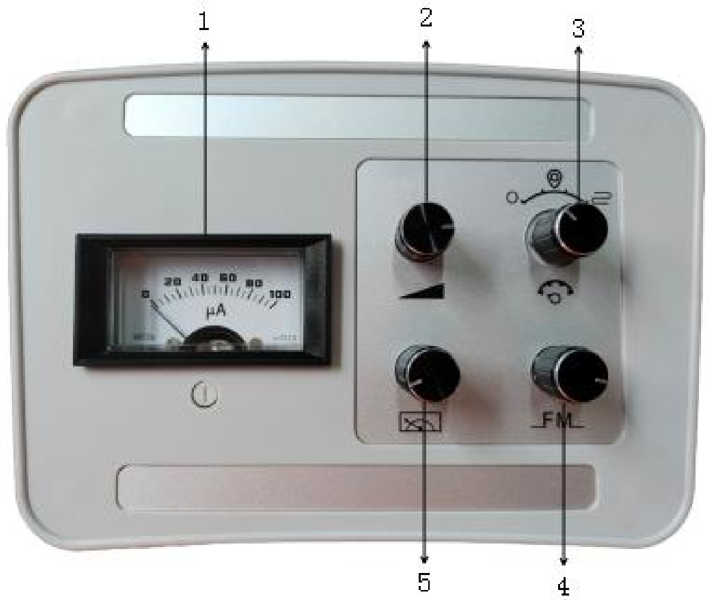


Figure 6-1 Instrument panel diagram

1. Pointer head: indicates the magnetic field strength when the fault point flashover discharge;
2. Volume adjustment: Adjust at fixed point and path, so that our ears hear more appropriate sound signals;

3. Working mode: Select working mode (shutdown, fixed point, path);

4. Frequency adjustment: Adjust the receiving frequency in the process of path detection, so that our ears can hear the path signal that is easier to identify, and the fixed-point adjustment can effectively avoid the radio signal;

5. Level adjustment: adjust the reference of magnetic field strength, so that the watch head can effectively swing;

Figure 6-2 Upper panel of the device

1. Input channel: precise fixed point time probe sensor, (path detection time probe rod sensor);
2. Output channel: Connect special earphones.

VII.Use Example

7.1 Live demonstration

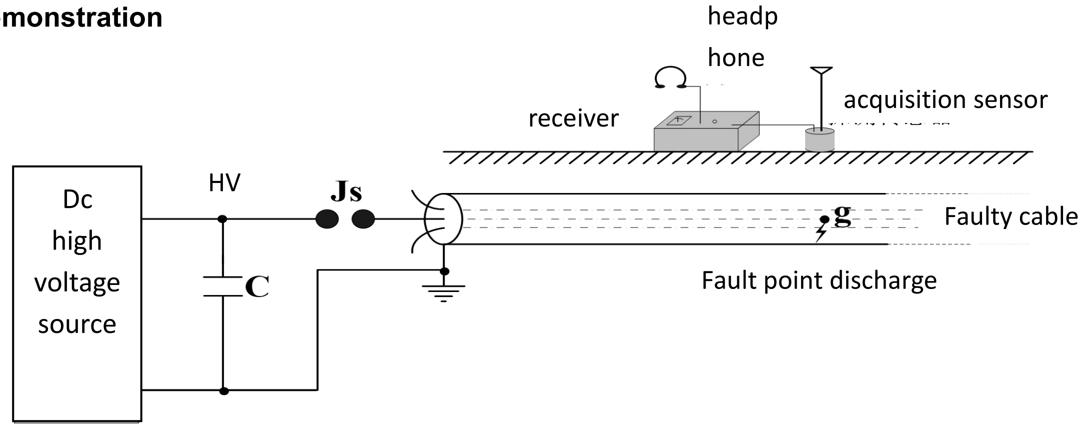


Figure 7-1 The cable fault locator is used onsite

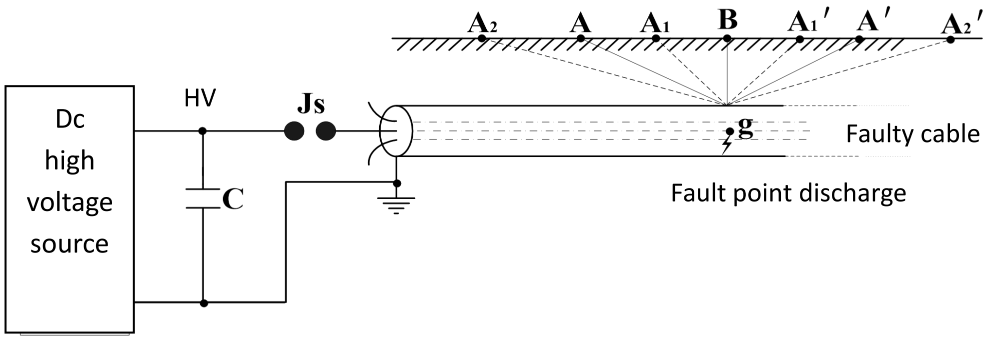


Figure 7-2 Procedure of using cable fault locator

7.2 Operation procedure

1.Assembly: Assemble the 9V battery, strap and cable fault locator host, and then assemble the probe head, probe needle (if necessary) connection rod;

2. Wiring: First insert the audio cable into the input channel and connect the probe; Then insert the headset into the output channel;

3. Adjust the "working mode" knob to the "fixed point" position (the knob rotates once and twice for the fixed point);

4. Adjust the "level adjustment" knob so that the hands of the "Tesla meter" swing effectively;

5. Adjust the "volume adjustment" knob to make the sound of the headset suitable for the user's ear monitoring;

6. After the adjustment, in the case of ensuring the fault click through the flashover discharge, go to the "right above the cable, within the range of rough measurement" accurate point;

7. Throughout the use process, be sure to ensure that the probe is directly above the cable and within the range of rough measurement; In the case of "volume adjustment" and "level adjustment" unchanged, when the signal strength of point A1 - point A2 gradually weakens, the headphones at point B have the largest sound, the Tesla meter hand has the strongest swing, and is synchronized with the sound, the point is the fault point. Point B in the figure above is the fault point.

VIII.Precautions And Common Faults of The Instrument

8.1 Notes

1.After the instrument is used, please adjust the "working mode" knob to "o" to shut down the instrument;

2. When the instrument is not used for a long time, the battery should be taken out to avoid

damage to the instrument by leakage;

3. When the battery voltage is insufficient, the sensitivity of the instrument decreases, and the battery should be replaced immediately. The two batteries independently power the instrument's sound channel and magnetic field channel;

4. When the instrument fails, it should be sent to the original factory for maintenance, and must not be disassembled at will to prevent accidents;

5. The probe is a sensitive element, it is strictly prohibited to disassemble.

8.2 Common fault

1.The magnetic pointer does not wobble, and the magnetic signal cannot be tested.

Solution：a、Check whether 9Vbattery power is sufficient;

b、Check whether the gain of the "level adjustment" knob is adjusted properly;

c、Check whether the "cable fault locator" and the "probe" connection line is connected reliably.

2.The headset has no sound when pointing or tapping the probe.

Solution：a、Check whether 9Vbattery power is sufficient;

b、Check whether the gain of the "level adjustment" knob is adjusted properly;

c、Check whether the "cable fault locator" and the "probe" connection line is connected reliably.

3.Can hear the FM broadcast signal occasionally when using the cable fault locator.

Solution: a、Indicates that the cable fault fixed-point instrument works normally, but does not affect the fixed-point work;

b、Adjust the "frequency adjustment" knob will be helpful.

Section 4 HZ-504 Cable Route Tracer

I. Precautions

Note：Thank you for purchasing the cable route tracer.

Please refer to the following tips to ensure safe use:

1.Please read this manual carefully and follow the relevant precautions.

2.Precision instruments, it is strictly prohibited to hit the instrument.

3.The output amplitude is adjusted from small to large to prevent overload.

4.When the access power switch is turned on and the indicator light is off, check whether the fuse is damaged.

5.Path: ensure that the cable without electricity; The loop must be clear.

6.Debugging the receiver state at the test end, and then "follow the lead" to detect.

II. Overview

Cable route tracer is a special instrument used to accurately detect the strike position and buried depth of buried cables within a certain range.

The path detection is completed by the cable path analyzer and the cable path signal receiver (cable fault locator additional path function). Through the cooperative operation between the two, the cable path is accurately detected.

The cable route tracer conforms to the relevant standard requirements of DL/T 849.3 General Technical Conditions for Special test instruments for power equipment Part 3: Cable Pathfinder.

III. Product Feature

1.Using the traditional electromagnetic induction principle, strong anti-interference ability, stable and reliable;

2. With overcurrent, short circuit protection function, safe and reliable;

3. High power output, not limited by cable length; Can also find the path under open circuit state;

4. Stepless output adjustable, suitable for various test sites, strong adaptability;

5. Super magnification, detection depth greater than 10 meters;

6. Ultra-low power design, static current less than 10mA, continuous work more than 20 hours;

7. Analog meter-head design, signal strength and trend at a glance;

8. Zero level arbitrary adjustment, suitable for all kinds of strong and weak scene.

IV. Technical Parameter

Transmitter: 1. Output signal: 15kHz intermittent

2.Output power: 100W

3.Output current: 0～2A

4.Power supply: 220V（1±10%） 50Hz/60HZ（1±5%）;

Receiver：1.Magnification, 500,000 times

2.Detection accuracy: ±0.2m

3.Output impedance: 350Ω

4.Working power supply: 4 standard 3.7V 3200mAh batteries; Static current: <＜10mA

V. Working Principle

The cable route tracer is composed of a high-power cable path finder and a receiver for detecting the buried cable path. The basic principle of the cable route tracer is to use the cable path analyzer (that is, the path signal transmitter host) to input the path pulse signal into the cable under test, thus generating electromagnetic wave, and then receive it with the probe. The received signal is amplified by the receiver and output, and sent to the headset and the pointer head. The tester determines the buried path and depth of the cable according to the degree of deflection of the sound peak, sound trough and pointer head in the headset. This pathfinder uses 15kHz audio signal and "cable fault locator" as a receiver to detect the cable path and depth.

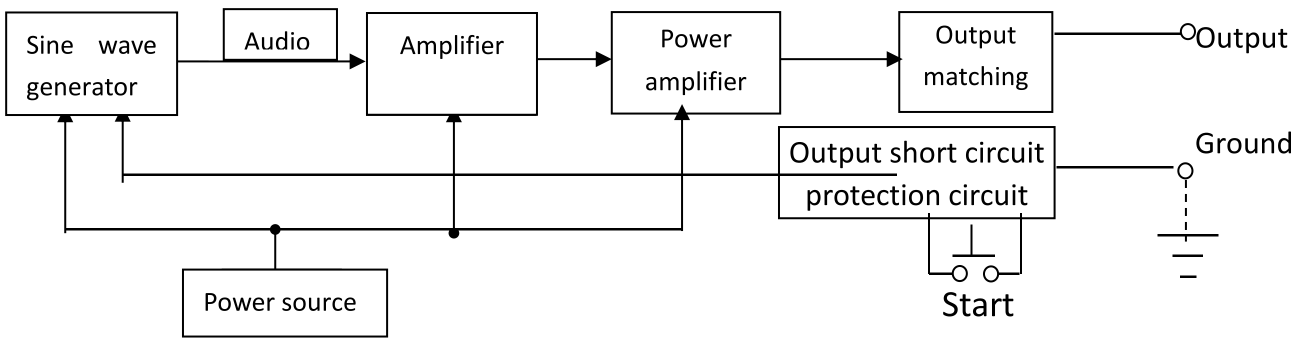


Figure 5-1 Working principle block diagram of the cable route tracer

VI. Instrument Layout And Description

6.1 Composition of the instrument

1.Cable route tracer: transmits high-power path signals;

2.Route tracer receiver: receive and judge the path signal, determine the cable path and depth;

3.Path output cable (red)：Connect the positive terminal of the path analyzer to the cable.

4.Path output cable (black) : Connect the negative terminal of the route tracer to the ground or earth;

5.Charger: Connect to the charging port of the path signal generator for charging;

6.Probe: path signal special receiving sensor, receiver input channel;

7. Wear headphones; Connect the receiver output channel to detect the path signal;

8. Ground wire: the cable route tracer is safely grounded.

Instrument composition list and figure					
Item	Qty.	Figure	Item	Qty.	Figure
Cable route tracer	1		Receiver	1	
Output cable (red)	1		Output cable (black)	1	
Charger	1		Headphones	1	

Probe	1		Grounding Wire	1	

6.2 Instrument composition list and drawing

6.2.1 Cable route tracer panel layout

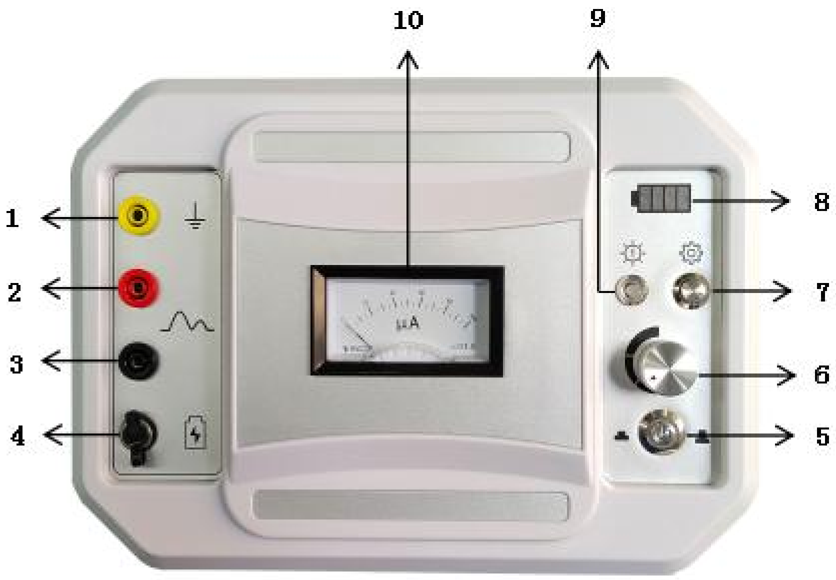


Figure 6-1 Cable route tracer panel diagram

1. Grounding Terminal: Safety grounding terminal for the equipment.
2. Positive Output: Positive output of the signal source, connect to the phase line or ground wire of the cable.
3. Negative Output: Negative output of the signal source, connect to the ground wire of the cable or to the earth.
4. Charging: DC12V charging port, connect to a 12V charger to start charging.
5. Power Switch: Turn on/off the working power supply.
6. Output Adjustment: Output amplitude adjustment knob, used to change the magnitude of the output amplitude.
7. Start Button: When the overload light is on, reduce the output amplitude and press this button to restart the signal generator, allowing the path signal to be output again.
8. Battery Indicator: Indicates the battery level in real-time when the built-in battery is in use.
9. Overload Indicator: Overload indicator light, which lights up when there is an output short circuit or the signal is too strong.

10. Output Meter: When the meter pointer swings, it indicates that there is an output signal; when the pointer does not move, it indicates no output signal; the amplitude of the pointer swing represents the magnitude of the output signal (i.e., the tendency of the output to increase or decrease, not the specific unit value).

6.2.2 Cable Path Receiver (Cable Fault Locator)

Receives pulse signals sent by the cable path instrument, enabling precise detection of the cable's route and burial depth (for detailed introduction, see the locator's instruction section).

VII. Use Example

7.1 Live demonstration

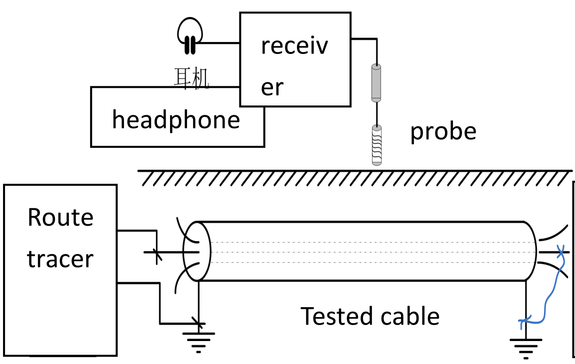


Figure 7-1

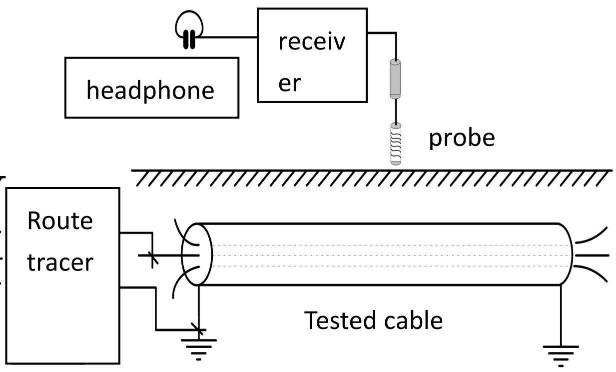


Figure 7-2

Schematic diagram of general path and depth probe connection

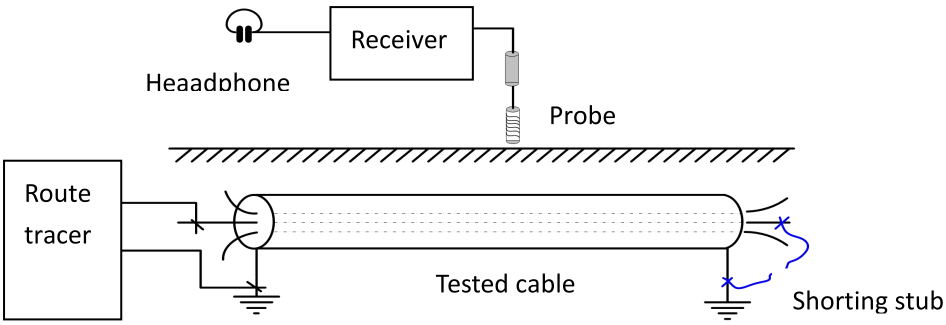


Figure 7-3

Schematic diagram of the route and depth detection of the ultra-long or broken cable

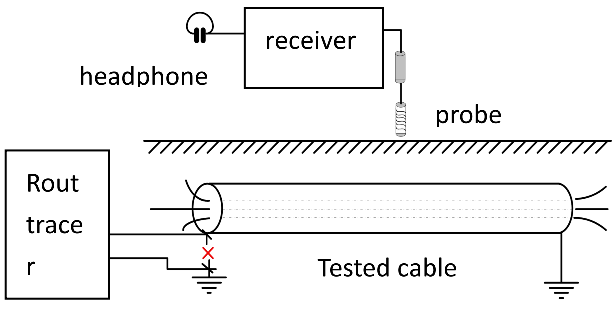


Figure 7-4

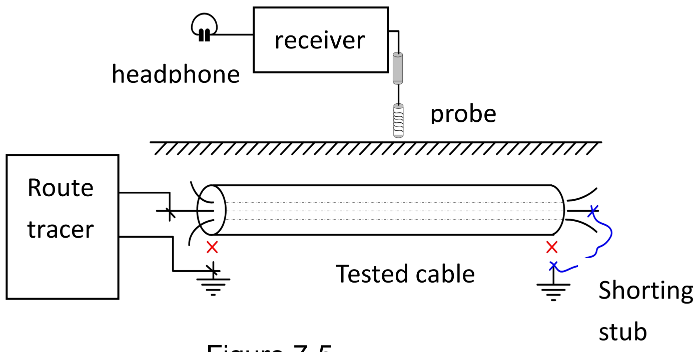


Figure 7-5

Schematic diagram of special path and depth probe wiring

7.2 Operation procedure

7.2.1 Operation and use of cable route tracer

（1） Probe wiring

a) connect power line;

b) Connect the red terminal to the phase wire or ground wire of the cable, the black terminal to the cable ground wire or ground, and the other end of the cable shall be processed according to the diagram in 7.1.

（2） Initial adjustment of output signal

Turn the Output Adjustment knob counterclockwise (left) to the minimum.

（3） Pre-adjustment after power on

Press the "Power" switch, the power indicator light up; Turn clockwise (to the right) to adjust the "output adjustment" so that the "output meter head" indicates the appropriate range (20% ~ 40%); If the measured cable is more than a few kilometers away or buried deep, the preset output amplitude can be increased (more than 50%). If the "Overload" light is on, turn the knob counterclockwise (left) to reduce the output amplitude, and then press the "Start" button to restart the signal.

7.2.2 Operation and use of receiver (cable fault locator), probe and headset

Note: Be sure to debug the receiver status at the test end of the cable, and then follow the lead for detection.

（1）Insert the probe into the receiver input channel and the headset into the receiver output channel;

（2）The receiver (cable fault locator) "work selection" is adjusted to the third gear "path" gear of the working mode, at which time the receiver should receive the audio path signal. Adjust the "volume" to the appropriate position, adjust the "frequency" knob, so that the headset can receive regular intermittent sound. When the "volume" knob does not move, the probe vertical and horizontal plane above the cable is the smallest sound, the sound on both sides is the largest, and then the sound becomes smaller. The line connected by the smallest points heard is the buried path of the buried cable;

（3）If you want to judge the depth of the cable buried, you can be measured above the cable position, the probe and the ground into 450 Angle, perpendicular to the path to "move outward", the same as the judgment principle of finding the path, the smallest point is found in the middle of the loudest sound, then the distance translated by the probe is the depth of the cable buried. The above operation principles can be referred to the following diagram of probe placement.

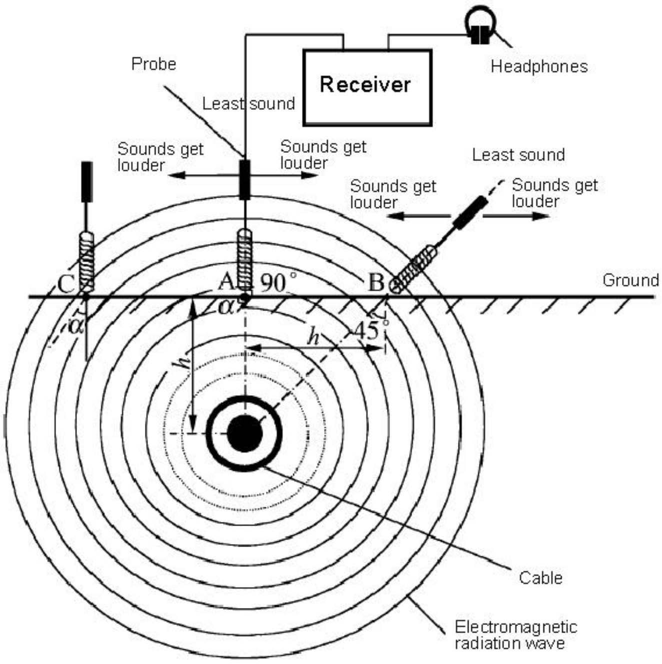


Figure 7-6 Probe placement diagram

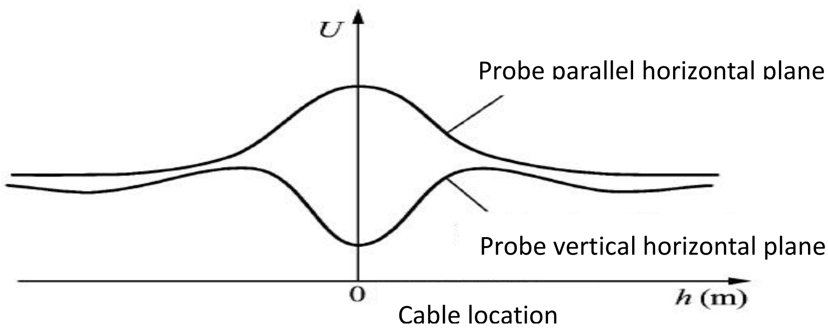


Figure 7-7 The relationship between the received amplitude and position of path detection

As shown in the figure: when the volume knob is not moved and the probe is perpendicular to the horizontal plane, point A is the least point of the loudest sound, which is directly above the cable. From point A to point C the sound goes from small to loud and then gradually smaller. The path of the cable is the line where we connect multiple A points.

When the path detection is accurate, we can also detect the buried depth, and the depth detection should make the probe and the cable path go perpendicular to the ground plane at an Angle of 45°; Moving the probe outward, the principle of sound judgment is the same as that of the path, and point B is the smallest point of the maximum sound, that is, the distance from point A to point B is equal to the buried depth h of the cable.

VIII.Precautions And Common Faults 0f The Instrument

8.1 Transmitter common faults

8.1.1 The power indicator is not on after the power is turned on

Solution: a) Use a multimeter to measure whether the AC 220V power supply is normal;

b) Use a multimeter to measure whether the fuse is in good condition.

8.1.2 No signal output

Solution: a) See whether the "overload" indicator light is on;

b) See if the "output knob" is in the zero position.

8.1.3 The Overload indicator is on

Solutions: a) Check whether the output amplitude is too large; If yes: At this time, the output of the signal source should be appropriately reduced, turn counterclockwise (left) to reduce the output amplitude, and then press the "start" button to restore the normal work of the signal source;

b) Check whether the cable is too short; It can be solved by a) reducing the output, or connecting ohm level high-power resistors in series in the test loop;

c) Check whether the fault point is short circuit; The test phase (" intact "phase) can be replaced.

8.2 The common faults of the receiver are described in section 8.2 of the Cable Fault Locator.

8.3 Always do the detection mark, so as to avoid unnecessary rework and retest phenomenon.

8.4 Safe operation is carried out in strict accordance with the operating procedures and norms of the power industry to ensure personal safety and equipment integrity, so as to make the detection work proceed smoothly.

Section 5 After-sales Service And Packing List

This instrument enjoys a one-year warranty from the date of purchase, we can also provide the lifelong maintenance and technical services. If you find that the condition of the instrument is abnormal or there is a fault, please contact us to arrange the most convenient and effective solution for you.

Instrument Name	No.	Parts name	Qty.
Cable Fault Tester	1	Cable fault locator	1
	2	Stylus	1
	3	power cord	1
	4	Single Q line	1
	5	Double Q line	1
	6	Sampling box	1
Cable fault locator, route tracer (test device accessories)	1	Cable fault locator	1
	2	Cable path tracer	1
	3	Charger (12.6V)	1
	4	Audio Cable	1
	5	Path Output Cable (Red)	1
	6	Path Output Cable (Black)	1
	7	Pinpointing Probe	1
	8	Path Detection Rod	1
	9	Headphones	1
	10	Charger (2-slot)	1
	11	Ground Wire	1
High voltage pulse generator	1	High-voltage pulse generator	1
	2	Power cord	1
	3	Transparent grounding wire	1
	4	High-voltage output wire	1
	5	Discharge rod	1
	6	Fuse	5