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## **PCLC-906D POWER CABLE FAULT LOCATOR**



# TIANJIN GREWIN TECHNOLOGY CO.,LTD.

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## **1. GENERAL DESCRIPTION**

The PCLC-906D Power Cable Fault locator is an easy operation device used for distance locating . It's easy to operate,support both touch screen/button operation and with friendly interface.

Low voltage pulse mode (TDR ) can be used independently; In impulse current mode (ICM), it needs to be used with HVSG-500GN series high voltage signal generator; In the multiple impulse mode(MIM) must also be tested with PCLC-900C cable multiple impulse filter coordination; After the distance measurement is completed, the PCLD-904P series digital multifunctional cable fault pin-pointer shall be used for accurate point pinpointing. Together, they form a high-performance cable fault finding system that offers a variety of innovative features.

### **1.1 FUNCTION FEATURE:**

- Multiple distance locating method:
  - ✓ Low current impulse method: apply to the locating of the low resistance fault. Short circuit fault, open circuit fault. It also can be used in the measurement of the cable length, the intermediate joints, T joints, and cable termination joint. This method also can be used to correct the wave velocity.
  - ✓ Impulse current method: apply to the high resistance fault, breakdown fault. Use the current coupler to gather signal from the earth wire
  - ✓ Multiple impulse method: improvement of the SIM method.Waveform is

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clear and easy to identify, high ranging accuracy.

- 400MHz real-time sampling
- ✓ Advance tech.Upgrading for SIM method
- ✓ Max. 0.1m measurement resolution,PCLC-906D has small blind zone and is special for the short cable and nearly-terminal fault cable
- Auto measurement function
- ✓ Automatic selection of appropriate range and gain, given fault location, easier testing.
- ✓ Only low voltage pulse mode supports this mode.
- Automatic calibration function
- ✓ Automatically analyze the characteristic waveform of the fault waveform and display the possible fault location .
- ✓ Only low voltage pulse mode (TDR) supports this mode.
- Enhance the picture-in-picture temporary comparison function
- ✓ PIP copy (pic. temporary storage). There'll be a main window and three temporary storage windows could check three waveform at same time.
- ✓ Support low-voltage pulse and pulse current waveform comparison function, fault distance multi-direction verification, more accurate judgment.
- Overall display function
- ✓ When the waveform zoom, the overall waveform is displayed at the same time, which is more convenient for calibration and ranging.
- Touch screen and press key operation
- ✓ Touch operating screen with smart gesture operation

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- ✓ Support cursor drag-drop function and double-click function,easy to locate
- Big color LED screen, friendly interface
- ✓ Waveform clear, especially in the multiple impulse test, multiple waveform using different colors, easier to identify
- ✓ 8" LED screen,bright with 1500cd/m2 to view under sunshine
- ✓ Support automatic backlight brightness adjustment function
- Waveform storage and PC communication
- ✓ A large number of waveforms can be stored in the machine
- ✓ Use USB disk to export waveform data
- ✓ Waveform storage and communication with computer.
- ✓ Provide computer background management software to manage data dumped by U disk or online data.
- Power management
- ✓ Back light weakens if no operation in 1 min and power off in 30 min. if no operation.
- ✓ When the battery is under voltage, the instrument will automatically shut down to protect the battery.
- ✓ Built-in Polymer Lithium-ion battery.
- ✓ Working time could reach 10 hours for each use.
- Solid case, light and portable.

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## **1.2 SPECIFICATION:**

- Working mode: low voltage pulse(TDR), pulse current(ICM), multiple pulse(MIM).
- Signal gain adjustment range: 70dB.
- Low voltage pulse emission voltage: 30V.
- Measurement error:  $\pm (0.5\% \times L + 1M)$ ,  $L \geq 20m$
- Low pressure pulse pulse width: 40ns~ 20.5us
- Highest resolution: 0.1m.
- Maximum sampling frequency: 400MHz real-time sampling.
- Maximum ranging range: 100km.
- Wave speed setting range: 100m/ US ~300m/us
- Ranging blind area: 2M.
- Number of waveform saved: 100 pcs
- Communication interface: USB, Bluetooth (optional)
- Power supply: lithium-ion battery pack, nominal voltage 7.4V,6000mAh.
- Battery power supply time: Use a fully charged polymer lithium ion battery, can last for more than 10 hours (with the battery aging, continuous service time will be reduced).
- Charger: input AC220V, 50Hz, charging current 2A, charging time 6 hours.
- Volume: 274×218×81mm
- Quality: host unit 2.6kg
- Conditions of use  
Temperature: -10℃ ~ +40℃

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Humidity: 5% ~ 90% RH (25℃)

Altitude: H <4500m

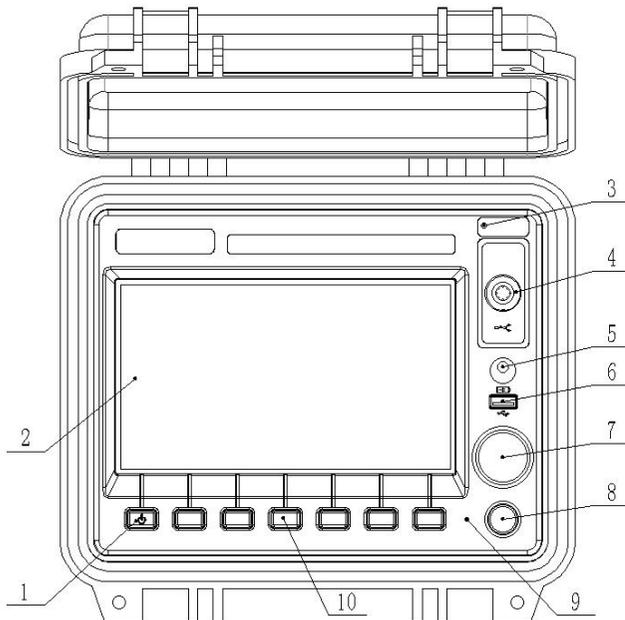
## 2. INSTRUMENT STRUCTURE AND OPERATION METHOD

### 2.1 THE MACHINE INCLUDES

Instrument host, low voltage pulse test line, pulse current signal coupler, charger, etc

### 2.2 UNIT PANEL

Panel as below fig. 1



1--Power button: Hold down the power button.

2--Display screen: displays various information, which will be described in detail in

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the following chapters.

3--Environment light detection: environment light detection window, used for automatic brightness adjustment of backlight.

4--Signal interface: connect to the test connection line, automatically identify the working mode after connecting to the corresponding test line.

5--Charging port: connect to the charger, which is used to charge the built-in lithium-ion battery pack of the instrument.

6. USB flash drive port: The USB flash drive is inserted to import or export waveforms.

7. knob:

Operation mode	Operate	Function
Location cursor set	Spin	Adjust the virtual cursor position
	Short time press	Toggles the virtual cursor and the real cursor
	Long time press	Enable gain adjustment and rotate to adjust gain
Menu set	Spin	Adjust the menu focus position
	Short time press	Enter button

8. Test button

Operation mode	Operate	Function
Location cursor set	Short time press	Single press
	Long time press	Automatic test (in low voltage pulse mode)
Menu set	Short time press	Enter button

9. Buzzer

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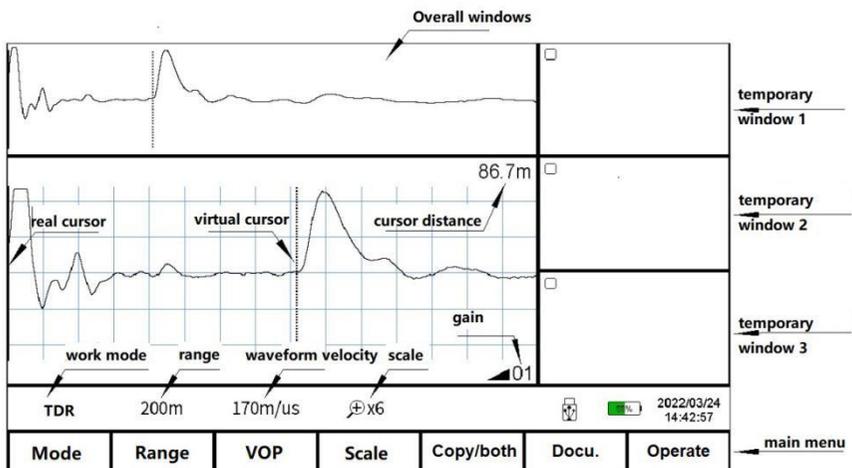
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10. function button: A total of 7 buttons, the leftmost red button is the power on/off button, long press to start or off. Function Key Indicates the corresponding function on the main menu of the display. Click to enter the corresponding menu mode, and click again to exit the menu mode.

### 2.3 DISPLAY INTERFACE AND MENU ADJUSTMENT

Display panel as below fig.2



This instrument adopts the unique menu operation mode, can use touch screen operation, can also use the mechanical keys, the operation is more flexible, clear, and friendly. The operable menu is displayed on the lower part of the display, as shown in Figure 2. Main menu single keys are Mode, Range, VOP, scale, copy/both, Docu., Operate. The menu adopts pop-up operation. After pressing the main menu single key, the corresponding sub-menu will automatically pop up. Use the knob or click the menu key to select the operation, and press the main course single key again to exit the sub-menu.

Refer below list of the sub-menu.

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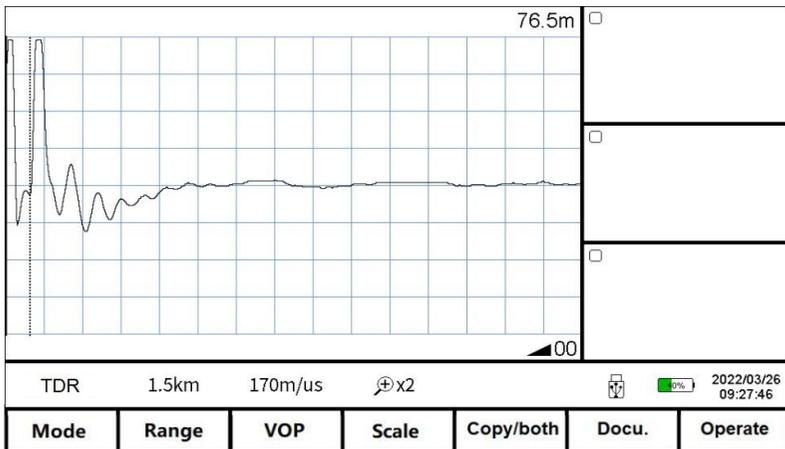
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Main menu	Sub-menu
Mode	The working mode is automatically identified by the access cable. There is no sub-menu in the mode.
Range	25m、50m、100m、200m、400m、800m、1.5km、3km、6km、12km、25km、50km、100km
VOP	Cross-linked cable, oil-immersed paper, plastic cable, rubber cable, wave speed increase, wave speed reduction
Scale	Full extent, zoom in, zoom in, Max
Copy /both	Zone 1 temporary storage, ZONE 2 temporary storage, zone 3 temporary storage, Zone 1 both, ZONE 2 both, zone 3 both
Docu.	Docu., internal ,USB, I ->U disk, recall
Operate	Location,Auto test, Screen setting, Screen correction

Example: As shown in Figure 3



Observing the waveform found that the fault point may be located in the first half of the waveform, the test range of 1.5km is too large, and the range needs to be adjusted to 100m, the operation process is as follows:

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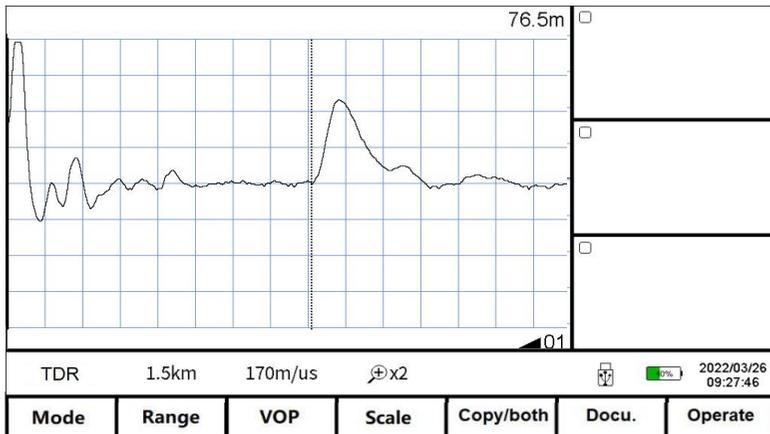
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After clicking the **Range** menu, pop up the sub-menu, display the range that can be selected in the current mode, as shown in the range sub-menu in **Figure 2-4-1**, click the **100m** button, click the valid after automatically exit the menu mode. Check the range value is 100m, indicates that the modification is successful. The TDR( low-voltage pulse) is automatically measured once after the range is modified.

Location waveform as below Fig.4



Use the keys to operate:

Click the **Range** button to pop up the range sub-menu, and the main menu of the current selection is highlighted in the main menu. Rotate the knob to select the **100m** range, press the **Test** key to perform the operation. The range value is 100m, indicating that the modification is successful. If you do not perform any menu actions, click **Test** to exit menu mode.

In summary, the general steps of menu operation are as follows:

- Select the main menu and press the corresponding Menu key
- Select the sub-menu key and press the corresponding function key

In the following paragraphs, menu operations are described in the form of **Main course - Sub-menu key** (for example, **Range -100m**).

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## 2.4 BASIC OPERATION

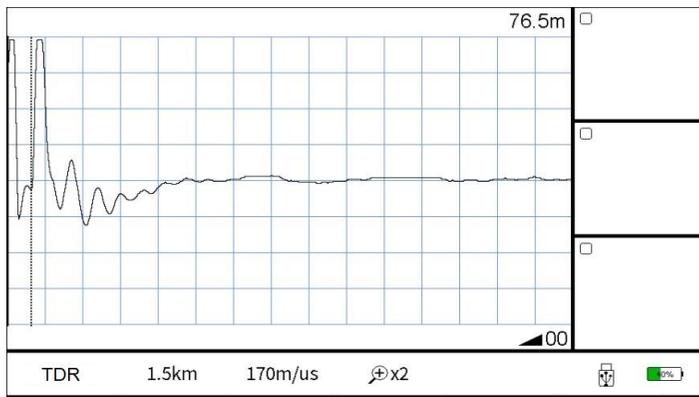
### 2.4.1 Select test range:

The test range is the measuring range of the instrument. Different ways of working under the test range selection method is different.

TDR (Low-voltage pulse mode )and multi-pulse mode: The range selected for the initial test should be greater than or equal to the full length of the cable. Selecting the test range closest to the point of failure allows for the highest positioning accuracy, and if the suspect point is found to be near, the range can be appropriately reduced.

ICM impulse current mode: The selection range should be greater than 3 to 5 times the total length of the cable during the initial test. If the total length of the cable is 200m, the test range of 800m ~ 1.5km should be selected. If the suspicious point is found to be closer, the range can be appropriately reduced in order to obtain higher ranging accuracy.

Select the **Range** main menu item to make a range selection, the interface is shown in Figure 5

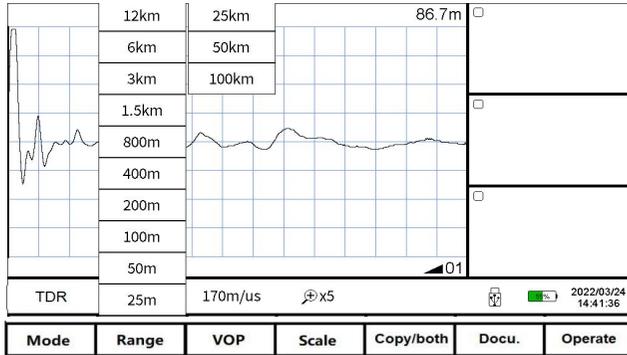


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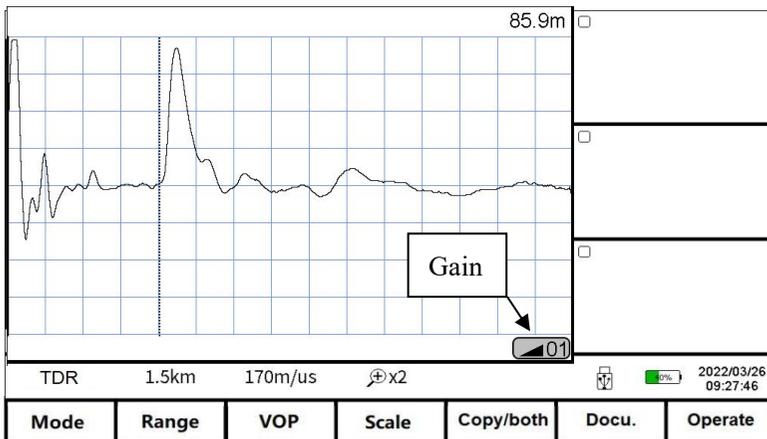


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### 2.4.2 Adjust the gain

Press and hold the knob to enable the gain adjustment as shown in Figure 6;  
 Press and hold the knob and rotate to adjust the gain.



### 2.4.3 Adjust the VOP

The instrument uses the traveling wave method for ranging, and the traveling wave propagation time is multiplied by the wave velocity to get the fault distance,



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and the traveling wave velocity is directly related to the insulation medium of the cable, so choosing the correct wave velocity according to the cable type is the premise of the correct ranging. Wave speed can be set and adjusted by selecting the main course of wave speed, as shown in Figure 7

Select the **VOP** and select the corresponding wave speed according to the cable type.

Set the wave speed directly according to the commonly used cable type:

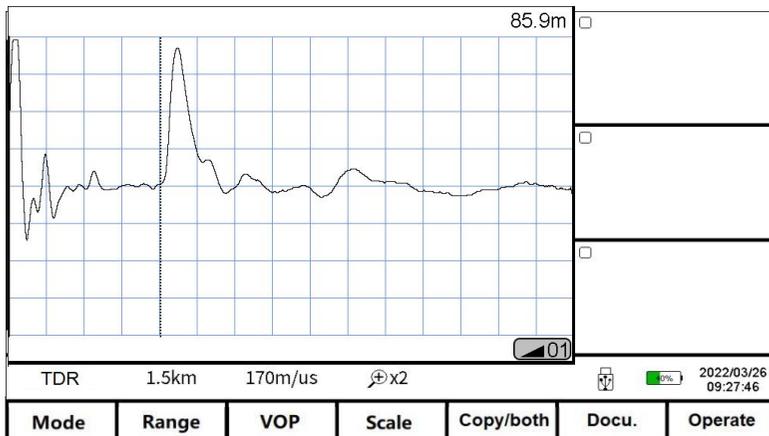
Cross-linking: cross-linked polyethylene cable, wave speed 170m/ US (default value on startup);

Oiled greper: oil-immersed paper cable, wave speed 160m/ US;

Plastic: polyethylene plastic cable, wave speed 201m/ US;

Rubber: Rubber cable, wave speed 220m/ US.

The wave speed can be fine-tuned using the wave Speed + and wave Speed - keys. At this time, click the wave speed plus or the wave speed minus sub-menu will not disappear automatically, click the VOP button or other position on the screen after the sub-menu will disappear **automatically**.



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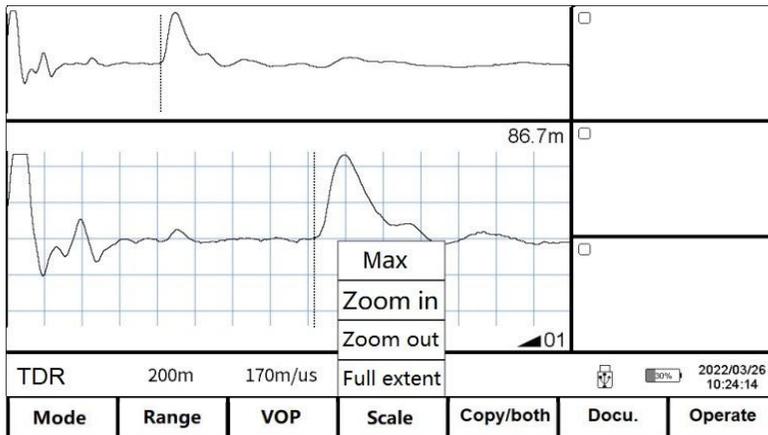
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#### 2.4.4 Adjust the Scale

If you need to pinpoint the point and analyze the details of the waveform, you can use the scale operation to scale the local waveform. When the waveform is amplified to the maximum, the ranging accuracy is highest. You can adjust the proportion of the main course, as shown in Figure 8



Select the **Scale** menu to open the sub-menu.

**Full extent** Displays the whole waveform of the current selected range.

**Zoom in** waveform is horizontally contracted with the virtual cursor as the center. The displayed waveform is part of the global waveform. The waveform will move automatically when the virtual cursor reaches the left and right boundary.

**Zoom out** waveform expands horizontally with the virtual cursor as the center, and the displayed waveform is part of the global waveform. When the virtual cursor is moved to the left and right boundary, the waveform will automatically turn the page.

**Max.** When the waveform is enlarged to the maximum, the cursor movement step

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is the smallest and the positioning is the most accurate.

When the main window waveform is not a global waveform, the global window is automatically displayed.

#### 2.4.5 Copy /both

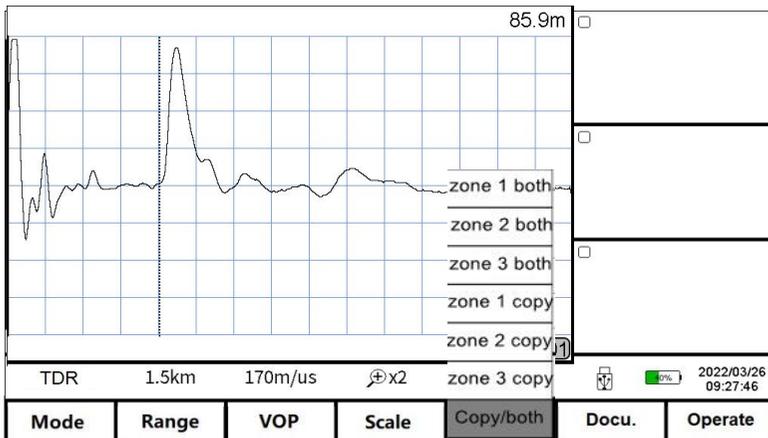
If you need to compare waveforms, you can use the Copy/both function. The instrument can temporarily store three waveforms, and the temporary waveform is displayed in the temporary window, so that the waveform to be compared can be selected more intuitively. As shown in figure 9

Support TDR (low voltage pulse) and ICM (pulse current)

waveform comparison function.

Function key Description:

**Zone 1 copy** **Zone 1 both** Display the waveform of **Zone 1 copy** in the main window. The other both button have the same function. And light up the **Zone 1 copy**. Other copy functions are the same. Refer below fig.10



Display the waveform of **Zone 1 copy** in the main window. The other copy button have the same function.

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Touch operation:

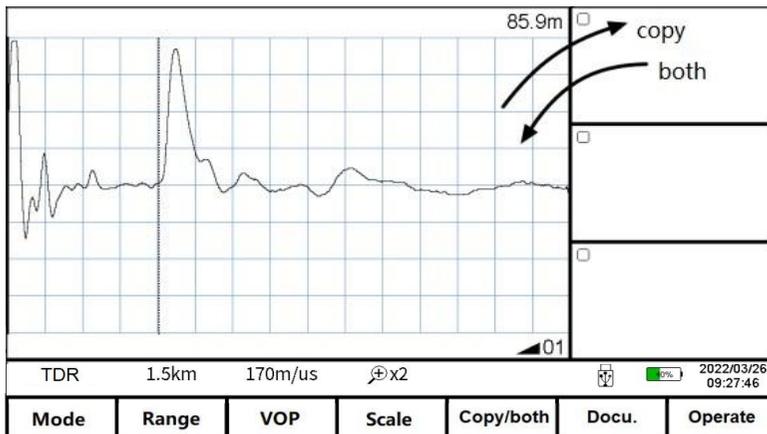
By drawing a specific shape on the screen, the instrument recognizes and performs the function represented by the drawing shape. The corresponding shapes of waveform staging and waveform comparison functions are shown in Fig. 10:

**Zone 1 copy** Draw curve on the screen.The starting point is in the main waveform display area, and the end point is **Zone 1 copy** .

**Zone 1 both** Draw curve on the screen.The starting point is **Zone 1 copy** , and the end point is in the main waveform display area.

The operation of **Zone 2 copy** and **Zone 3 copy** is the same as **Zone 1 copy**. Operate again and the comparison is canceled.

Double-clicking the corresponding staging area can also compare waveforms and cancel the comparison operation.Refer below fig.11



The operation method of copy/both function TDR and ICM:

1. Use the TDR( low-voltage pulse method) test and temporary storage test

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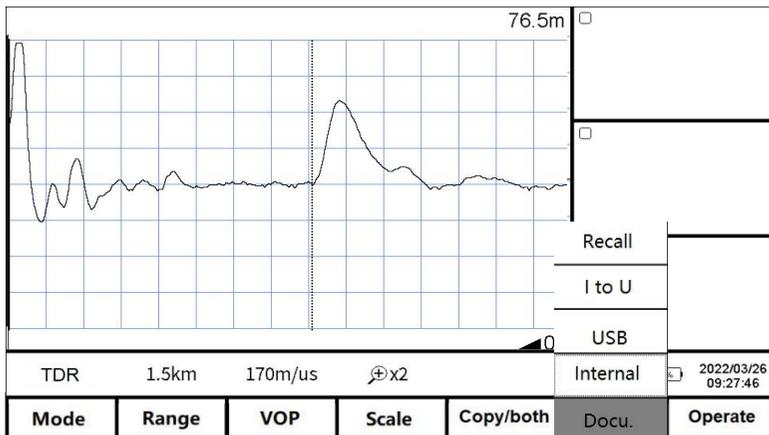
waveform.

2. Switch to the ICM (impulse current method) to test,2. To display low-voltage pulse waveform in the main window through the Copy function.

## 2.5 FILE MANAGEMENT

1. Select the main course of the file for document operation, as shown in Figure

12



Button introduction:

**Internal**: Storage the wave in the device. The stored file name is default as 'working mode English abbreviation & wave storage date.All are xxx.wav file

Low voltage impulse mode: TDR

Impulse current mode: ICM

Multiple impulse mode: ARM

**USB**: save the data into the USB disk.

**I to U**: insert the USB disk into the

**Recall**: Open the waveform file stored in the device. Click this button to appear the file windows as below Fig. 13

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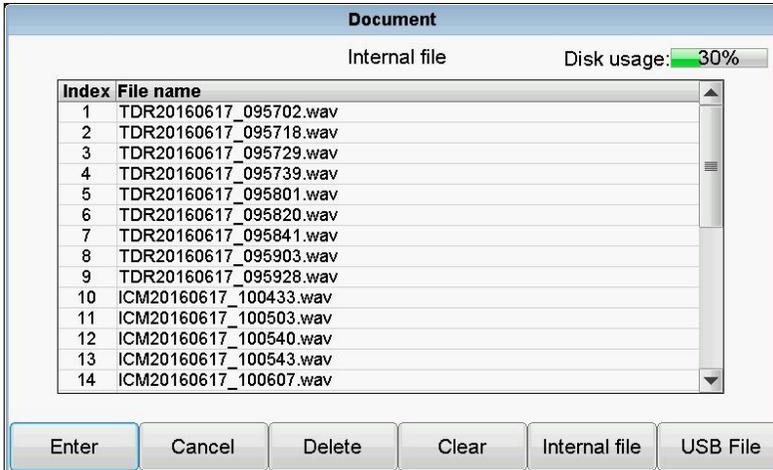
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Button introduction as below:

**Enter**: highlight the chosen waveform and the waveform will display in the main windows

**Cancel**: cancel operation or exit from this file window

**Delete**: delete the chosen file and the prompt information will appear.

**Clear**: clean the waveform file in the device (can't be restored)

**Internal file**: choose the files stored in the device

**USB file**: Choose the files stored in the USB disk, valid when insert the USB disk

**USB usage**: indicates the files storage in the device. If reach 100%, new waveform can't be logged. Delete old waveform before store new waveform.

## 2.6 PARAMETER SETTING

Parameter setting

Operate below steps:

**Operate** — **System setting**, pope window appears as below Fig.14

It's for impulse current delay setting, multiple impulse delay and date setting.

Steps as below:

- Click the parameters need to modify

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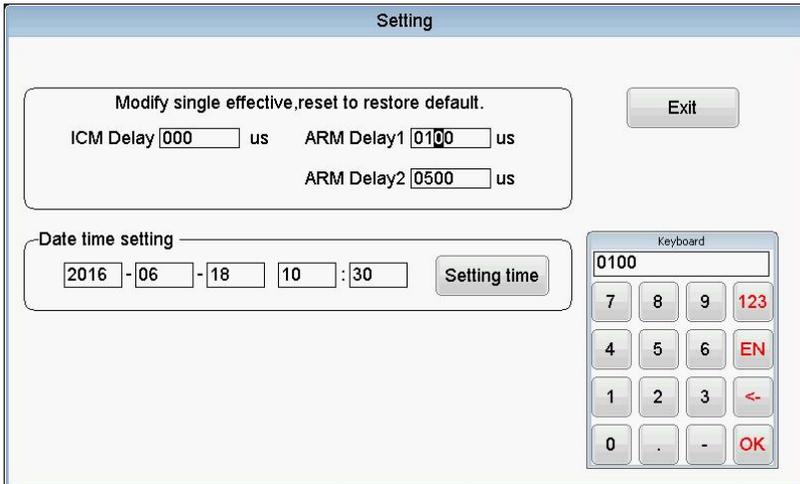
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- Use the number keyboard to modify
- Click the OK to confirm the modify

The change takes effect only after you click **Setting Time**.



## 2.7 DELAY ADJUSTMENT

When use the impulse current mode and mode to test, it is needed to adjust the delay. Details refer following chapter.

## 2.8 EXIT TESTING

When pulse current and multiple pulses are measured, press the test key to enter the waiting trigger state, and press the test key again to exit the waiting trigger state.

## 2.9 CURSOR MOVEMENT AND FAULT LOCATION

The device has two cursors, the real cursor and the virtual cursor, which can be switched by clicking the **knob**. Rotate the **knob** to adjust the position of the virtual cursor. Cursor Distance displays the distance between the real cursor and the

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virtual cursor.

Use the stylus to hold down the cursor to be moved and drag the cursor. You can also double-click the position to be calibrated on the screen. The virtual cursor automatically moves to the double-click position.

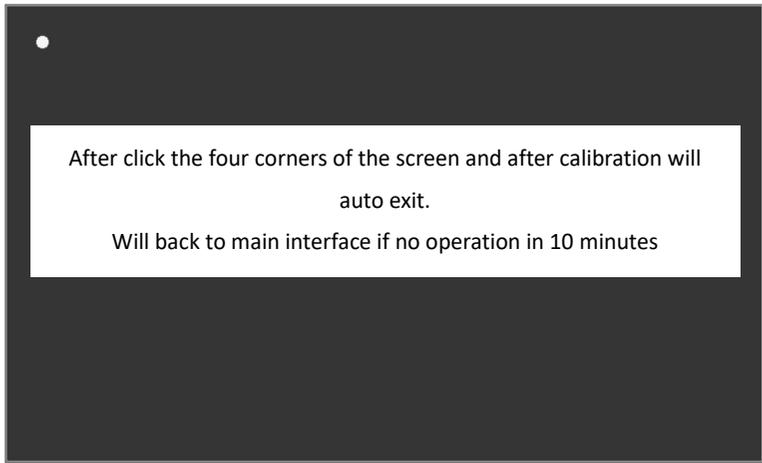
The touch operation is suitable for rough position, and the knob can be used for accurate location then.

## **2.10 DATE AND TIME SETTING**

Data setting

Date is the retrieval tag of stored the device time is correct. If there's error,it's needed to set again. Steps as below:

Choose  —  to set the data in the pop-up window. Refer Fig.15



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### 3. FAULT DISTINGUISH

#### 3.1 FAULT DISTINGUISH AND WORK MODE SELECTION.

Before locating, we must first judge the fault nature of the cable, according to the selection of appropriate ranging method:

Firstly, the insulation resistance of each phase is measured at one end of the cable with a megohm meter. If the megohm meter measurement value is zero, there may be zero to hundreds of ohm resistance, so must also use a multimeter to measure the resistance value; If the relative ground and phase insulation resistance is high and reaches the normal insulation level, test whether the conductor is broken. Short connect the three phases at one end of the cable and short-circuit it to the ground. Repeat the measurement at the other end to determine whether the conductor is broken.

Fault type and the distinguish method as below

No	Cable Fault	Representation	Testing method
1	Low resistance /short circuit fault	Tramegger value : 0 Multimeter value: < 200Ω	Low Voltage Impulse method
2	Break fault	Conductor disconnection	Low Voltage Impulse method
3	High resistance fault	Tramegger : 0 Or: Tramegger : 0 Multimeter: ≥200Ω	Impulse current method or Multiple impulse method
4	Flashover fault	Megohm meter measurement: normal insulation level Voltage withstand test: failed	

The use of different test methods, need to connect the corresponding test

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connection line, HVSG-500GN series signal generator working state must be converted accordingly, the instrument can automatically identify different test lines, and switch the working mode.

In different working modes, the main course has different functions.

## 4. LOW VOLTAGE IMPULSE MODE

### 4.1 GENERAL :

This TDR( low voltage impulse method) is used for the cable low resistance fault, short circuit fault and break fault. It also can be used to measure the cable length and the wave velocity. This is also a useful method to distinguish the cable Intermediate head, T-joint and terminal head.

### 4.2 WORKING PRINCIPLE:

Inject low voltage impulse into the cable when testing, and this impulse will, such as the short circuit point, fault point and intermediate joint. Then the impulse will reflect and this will be recorded by device, as the Fig.16

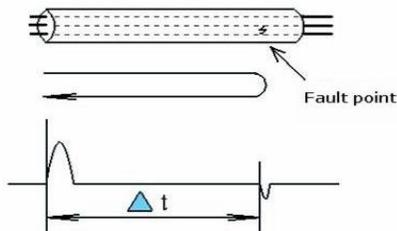


Fig.16 principle diagram

$\Delta t$  :Time from pulse transmitted to reflection received

V:Impulse transmitting velocity

Lx: Cable fault point distance

Suppose the impulse fault distance Lx is

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$$L_X = \frac{V \Delta t}{2} \quad (1)$$

Mismatch point reflectance  $\rho$ :

$$\rho = \frac{(Z_i - Z_c)}{(Z_i + Z_c)} \quad (2)$$

Here,

$Z_i$  : Input impedance of fault point

$Z_c$ : Characteristic impedance

From (2),we could know:

The polarity of the reflected pulse is the same as that of the transmitted pulse. The reflected pulse of short circuit fault is opposite to the transmitted pulse. Therefore, the nature of the fault can be determined by identifying the polarity of the reflected pulse. Reference 16-1 and 16-2



Fig.16-1 Left: break fault reflected waveform

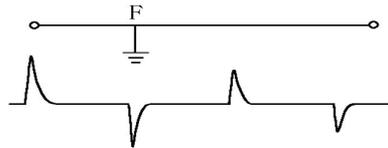


Fig 16-2 low resistance/short circuit fault reflection waveform

Fault type	Characteristic
Break fault, open circuit fault	<ol style="list-style-type: none"> <li>1. The polarity of reflected pulse and transmitted pulse is the same.</li> <li>2. The reflected pulse is gradually attenuated.</li> </ol>
Short circuit fault	<ol style="list-style-type: none"> <li>1. The reflected pulse and the transmitted pulse have opposite polarity.</li> <li>2. The reflected pulse is gradually attenuated.</li> </ol>



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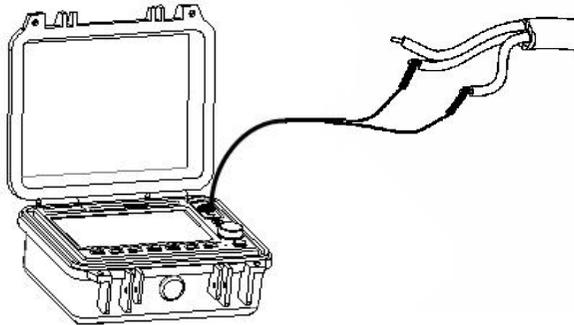
### **4.3 LOCATION STEPS**

#### **4.3.1 Wiring**

Use the discharging of the cable.

Insert the low voltage impulse testing lines into the device Signal interface, and connect the two clips to the fault phase and ground, or to the two fault phases.

Fig.17 shows



#### **4.3.2 Choose the locating range**

The initial locating range should be larger than the full length of the cable. If the suspect is found to be closer, in order to get higher ranging accuracy, should be appropriate to reduce the range. Each time the range is changed, the instrument automatically runs a test.

#### **4.3.3 Setting the waveform velocity,common cables refer below**

XLPE cable ,170m/us

Oil impregnated paper cable,160m/us

Plastic: Plastic cable,201m/us

Robber: Robber cable,220m/us

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Different manufacturers or different batches of cables, even the same model, will have slight differences in wave speed. When accurate ranging is required, the wave speed should be calibrated according to the known length of the cable, see Section 9.

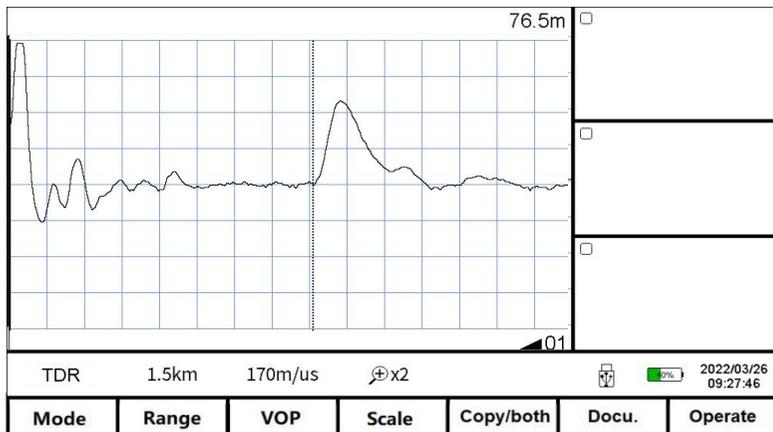
#### 4.3.4 Adjust the gain

Under normal mode, long time press **Multiple function button** to make it ready for gain adjustment. Press the **knob** and rotate to adjustment gain.

#### 4.3.5 Fault point locating

Cursor operate method reference **2.9 CURSOR MOVEMENT AND FAULT LOCATION**

Move the virtual cursor to the starting point of the reflected pulse, and move the real cursor to the leftmost part of the screen (the default position). The value displayed in the upper right corner of the screen is the distance between the fault point and the test end (the cursor is at another position, and the value is meaningless). As shown in Figure 18:



#### 4.3.6 Accuracy locating

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Operate **Scale** button can be horizontal waveform amplification or narrowing, get finer waveform and higher ranging resolution, proportional operation see 2.4.4

Adjust the Scale.

#### 4.3.7 Auto locating

Long time press **Test** button to do one-time locating, device will auto all the range and choose the suitable range and gain,and to display the auto locating result.

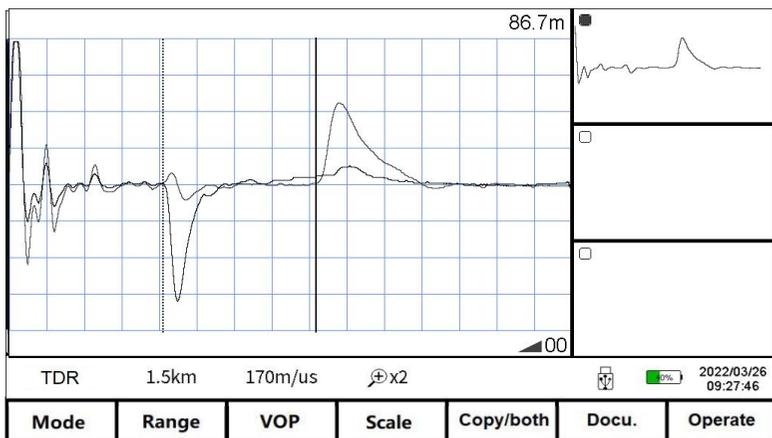
#### 4.3.8 Relative distance measurement:

To obtain the relative distance between the fault point and a reference point (such as a cable connector or peer end), perform the following operations:

Move one of the cursors to the point of failure.

- Press the knob key to switch the position of the real cursor and the virtual cursor.

- Move the other cursor to the full-length reflection waveform; The distance value is the relative distance, as shown in Figure 19



#### 4.3.9 Waveform compare

Through comparing the reflected ne and good phase line, it's easy to recognize the fault point.

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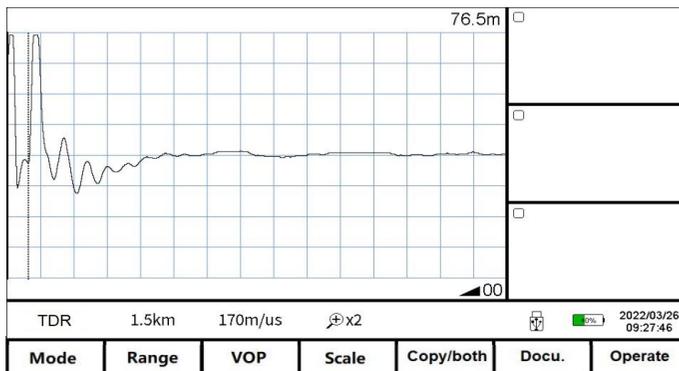
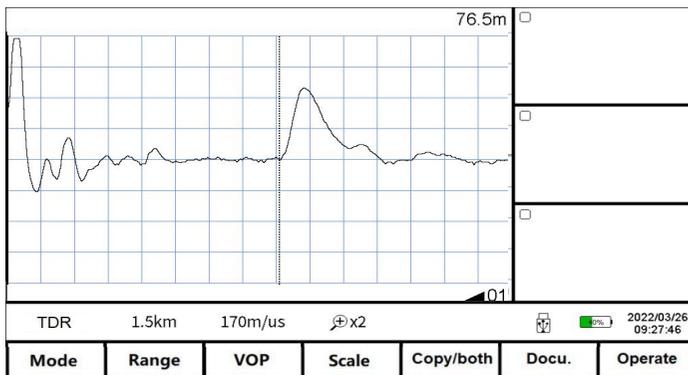
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Steps:

- Test the good phase of cable to get a waveform.
- Click **Copy/both** button — **Zone 1 copy** to store the current waveform in the device. The waveform will display in the window 1.
- To press the **Test** button again to get the fault waveform.
- Choose the **Zone 1 both** to display the window in different color. The start of the bifurcation is the fault point position. Refer Fig.20

(a) is the comparison waveform of the fault phase and the good phase of the cable; (b) is the comparison waveform of the artificial short circuit and open circuit at the opposite end of the cable.



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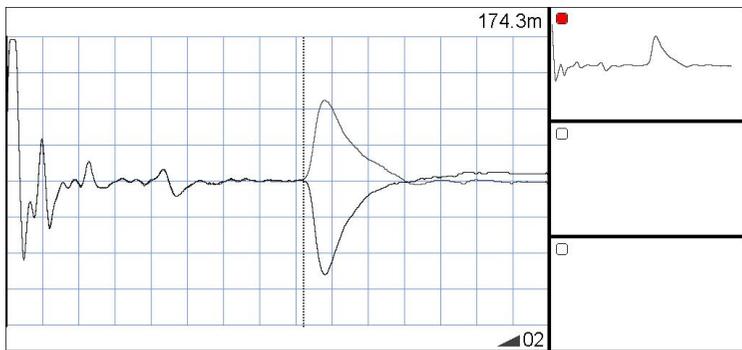
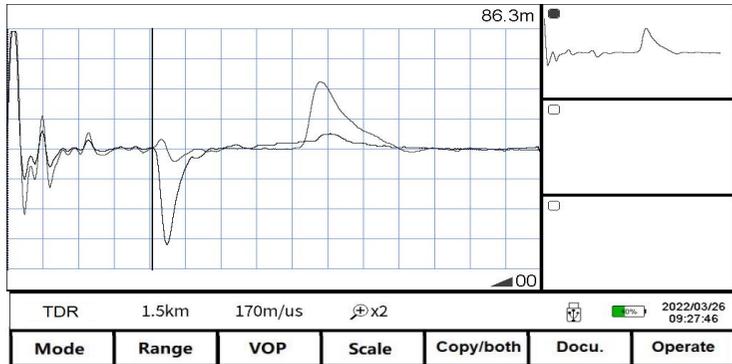
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#### 4.3.10 Waveform velocity correct

The wave velocity can be precisely calibrated according to the known length of the cable. Use a cable of the same type with a known length to measure and compare the open and short circuit waveform at the opposite end, move the virtual cursor to the obvious bifurcation of the waveform.

, adjust the wave speed so that the measured length is the same as the known length, then the wave speed at this time is the actual wave speed of this cable.

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## **5. IMPULSE CURRENT MODE**

### **5.1 GENERAL :**

Pulse current method is used for high resistance and flashover fault of cable. It needs to be used together with high voltage generator.

### **5.2 PRINCIPLE :**

When the insulation Resistance of the fault point 10 times cable characteristic impedance,  $R_f > 10Z_c \approx 200\Omega$ , the reflect factor is too small to distinguish the reflection impulse. So under this stats, the TDR mode can't used to locate.

The high voltage generator is used to apply high voltage to the fault cable, so that the fault clicks through the discharge, and the discharge pulse is reflected back and forth between the fault point and the test end. The distance of the fault point will be obtained by sampling and recording this signal with the instrument and measuring the time difference.

There are two methods to collect the discharge pulse signal: voltage sampling and current sampling, the current sampling is pulse current method: the current filter collects the current flowing back to the high-voltage energy storage capacitor from the test ground (cable metal outer skin), which is completely isolated from the high-voltage part, safe and reliable, and the waveform is easy to identify.

#### **5.2.1 Direct flashover method**

DC high voltage breakdown method fault.

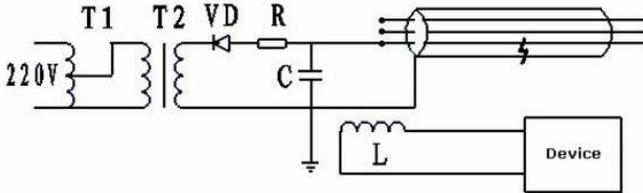
For flashover fault, the insulation resistance is very high but when withstand voltage testing ,the voltage rise and make breakdown fault .

The principle of the direct flash method is shown in Figure 21, where T1 is the voltage regulator. T2 is a high voltage transformer, the capacity should be about 1KVA; VD is high pressure silicon stack; C is a high-voltage energy storage capacitor with a capacity of more than 2uF; L is the current coupler. Adjust the T1

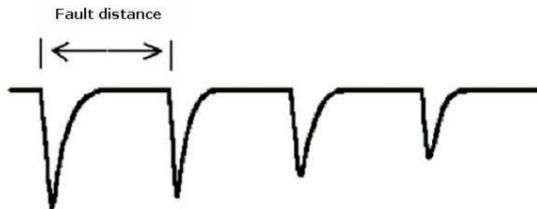
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voltage regulator to increase the output voltage gradually until the fault clicks through.



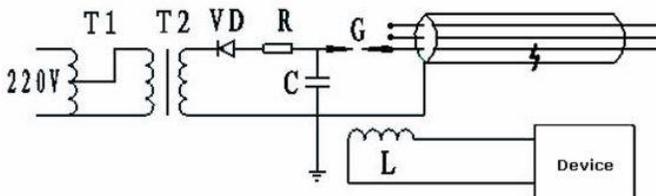
The waveform as below fig.22



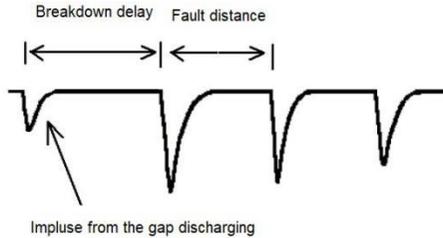
### 5.2.2 Impact flash method

If the resistance of cable fault point is not very high, but the current leakage of fault point is big, we have to use impact flash method. It's also used for most of the flashover fault. Principle diagram as below Fig.23.

It is basically the same as the direct flashover method, except that a ball gap G is inserted between the energy storage capacitor C and the cable. Adjust T1 voltage regulator to charge capacitor C. When the capacitor voltage rises to a certain extent, the ball gap G will break down and capacitor C will discharge the cable. Due to the minimal internal resistance of the capacitor, the output voltage will be high enough to make the fault click through.

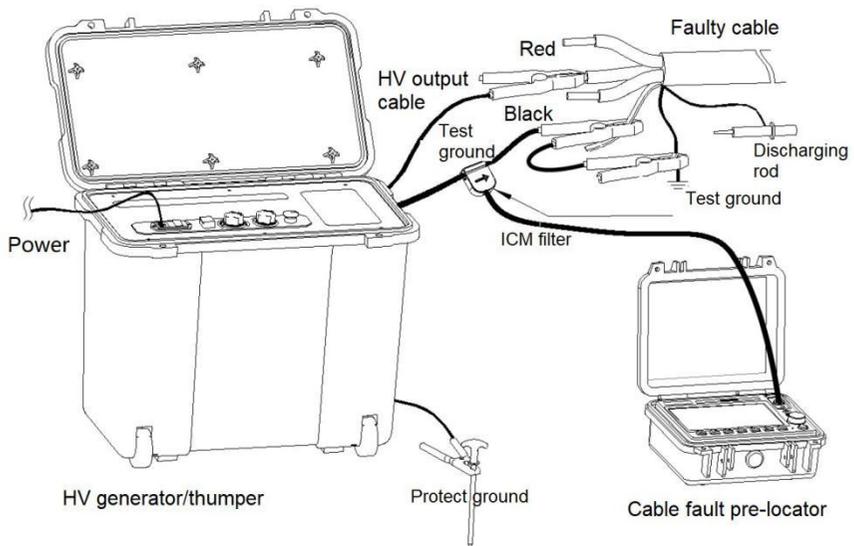


Impact flash method as below Fig24:



### 5.3 OPERATION STEPS :

5.3.1 Wiring: Matched with HVSG-500GN high voltage signal generator. Refer below Fig. 25



Connect the two clips of high voltage generator with the target cable.

If phase-earth fault, testing grounding line. Noticed the arrow of the filter is pointed to the cable and the grounding line is the straight. After connect with the filter ,work mode become to Impulse current mode. Change the discharging mode



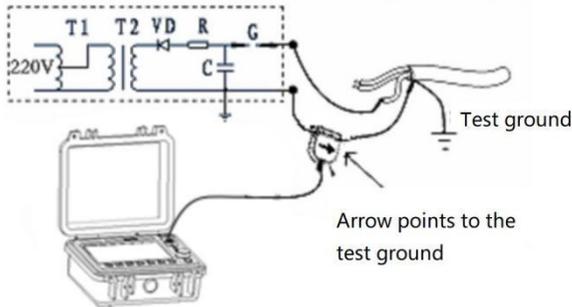
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of HVSG-500GN generator into DC mode. If use the method, use the generator as By hand or period.

The instrument can also be used with the high voltage equipment provided by the third party or the high voltage discharge device assembled by the user. The wiring is shown in Figure 26



### 5.3.2 Choose the testing range

#### **Attention!!!**

- Completely discharge before wiring
- Connect with protective ground line of generator, don't connect the ground directly
- When phase-ground fault, the black clip of HV unit HVSG-500GN must be connected with the testing ground. When phase-phase fault, please ground the black clip with the connection of the cable core. Otherwise will bring equipment damage and safe accident.
- The straighter the test ground to which the filter is attached, the better (especially near the filter).
- The protected ground and test ground are different ground points. Do not combine them.

Slightly different from the low-voltage pulse method, the pulse current locates the fault by detecting the pulse reflected back and forth between the fault point and the test end of the discharge pulse. So the range is generally 3 to 5 times the test

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distance, making sure there are multiple back and forth reflected pulses.

If observations of high voltage generator of high pressure table, found that the discharge voltage drop significantly, fault point has discharge, but still didn't get the discharge waveform, suggests that fault point breakdown time delay may be longer, can be appropriate to increase scope to test again, if still not discharge waveform, need to adjust the breakdown time delay setting, see this section of [article 7 - set of breakdown time delay](#).

### 5.3.3 Set VOP

Set appropriate wave speed according to cable type.

### 5.3.4 Test and adjust the gain

Press the **Test** key and the instrument enters the waiting state. When the high-voltage generator discharges the cable, the instrument triggers, collects and displays the waveform. If the waveform is too small, increase the gain, otherwise lower it, and repeat the test until a satisfactory pulse current waveform is obtained.

Note: In the waiting trigger state, press the **Test** key again to exit the waiting trigger state. The on-screen menu disables operations in the waiting state.

### 5.3.5 Fault point location

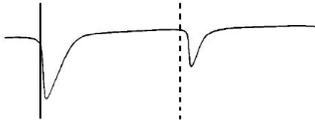
Move the cursor to position the real cursor at the starting point of the first discharge pulse, and move the virtual cursor to the starting point of the second pulse. The relative distance is the distance between the fault point and the test end. Figure27 shows a group of typical direct flash waveform and Figure 28 typical flash waveform .

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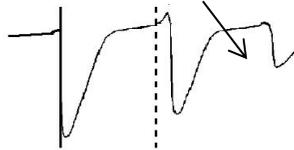
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Power effect and it causes the reflected waveform front upward.

The cursor should be set in the beginning of the upward.



A. Perfect Direct flashover



B. Typical Direct flashover



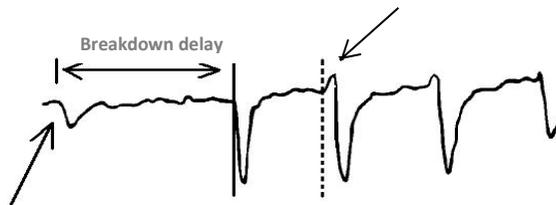
C. Near Direct flashover waveform



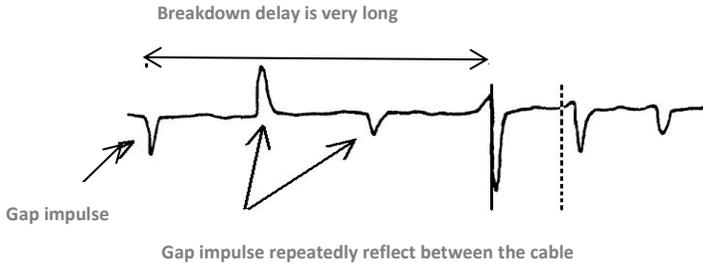
D. Very near terminal Direct flashover

Power effect and it causes the reflected waveform front upward.

The cursor should be set in the beginning of the upward.



A. Perfect Impact flash waveform



**B. Longer delay Impact flash waveform**



**C. Near distance Impact flash waveform**



**D. Very near distance terminal Impact flash waveform**

### 5.3.6 Cursor location attention

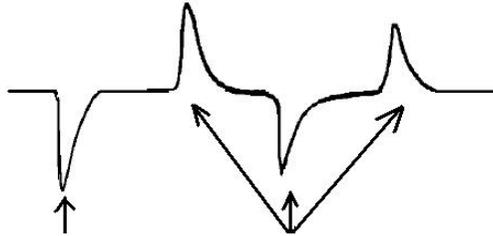
- Difference between the two methods is impulse from gap discharge for the typical impulse voltage breakdown will cause time delay
- Because the stray inductance, the reflection impulse often has upward crest. Pls locate the dotted cursor
- Use the zoom in function for accurately location
- Common the distance value is a little longer than actual distance.
- The point must be breakdown before testing. We can say it's breakdown

when:

-Sphere gap discharge with clear crackle and stronger spark; Otherwise the discharge with hoarse sound and weak spark.

-Voltage indicator will have a wide Otherwise swing is light.

-distinguish by the waveform. Below is the typical waveform of no breakdown.



Sphere gap discharge impulse

Gap impulse repeatedly reflect between the cable

### 5.3.7 Breakdown time delay setting

Sometimes the fault point exceed the range that device could record.Then we'll manually set the delay time.

Choose **Operate** - **System setting** ,to enter the delay discharge adjusting interface.



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## 6. MULTIPLE IMPULSE MODE

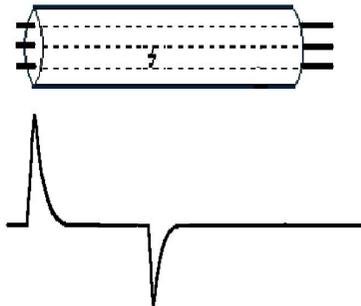
### 6.1 GENERAL :

This method is more suitable and flashover fault. To use this method, a high voltage generator(both our device and other brands are ok) and our PCLC-900C multiple impulse filter is needed.

### 6.2 PRINCIPLE :

Secondary impulse method principle:

High voltage is applied to the cable so that the fault clicks through and produces an arc. The AC resistance of the arc is very low, which can be considered as a low-resistance short-circuit fault. Using certain technical means, the arc duration can be greatly prolonged and stable. During the arc duration, low-voltage pulse is sent to the cable, and the arc at the fault point will reflect the pulse back to the measuring end. The waveform is similar to the low-resistance fault waveform of the low-voltage pulse method, as shown in Figure 29



After the arc is extinguished, the fault point will return to the high-resistance state, and then a low-voltage pulse will be sent to the cable, as shown in Figure 30, a reflection waveform with the cable end open will be obtained, as shown in Figure 30

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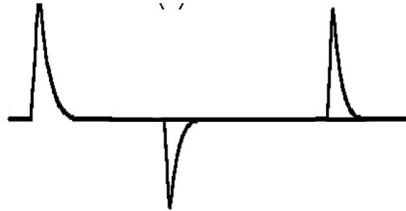
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When the two waveform are displayed at the same time, obvious differences will appear at the fault point, and the fault distance can be easily judged and measured, as shown in Figure 31.



The multiple pulse method is an improvement of the secondary pulse method, in which multiple low-voltage pulses are emitted during the arc duration and the optimal fault waveform is selected manually or automatically, which will make the judgment and measurement easier.

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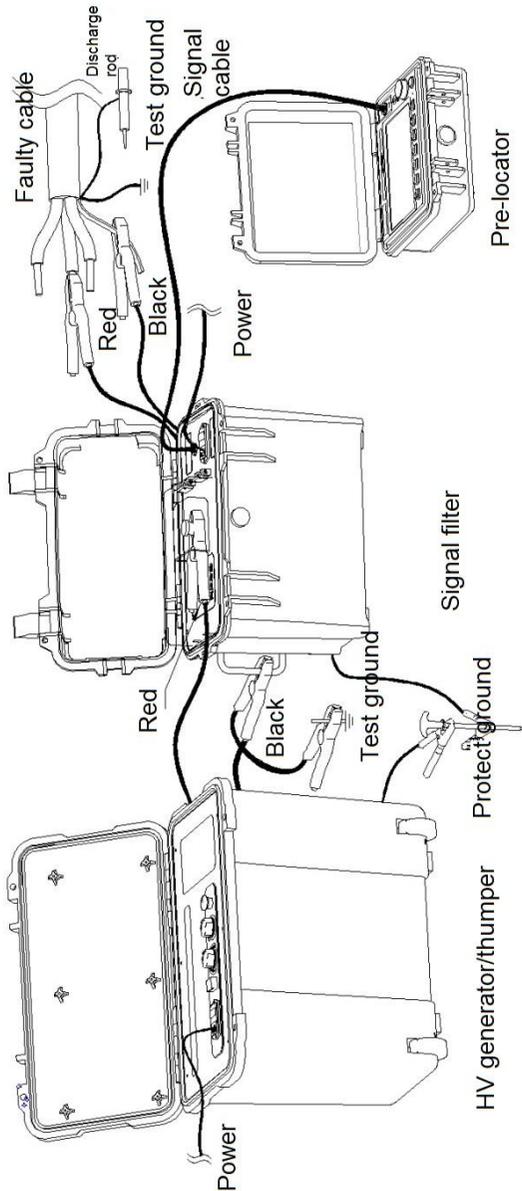


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### 6.3 TESTING STEP:



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The MIM method should be used matched with the signal filter.

- Connect the high voltage output clip(the red one) of generator with the input of the filter(PCLC-900C).
- Connect the PCLC-900C filter HV clip (red clip) with the cable fault phase.
- Connect the HVSG-500GN HV generator unit and PCLC-900C filter testing ground clip(black) with the cable testing grounding.
- Connect the multiple impulse testing cable PCLC-900C Locating port and CD-7X pre-locator Signal port
- Switch the discharge way of generator to PERIOD or HAND OPERATION

### Attention!!

- Completely discharge before wiring
- Connect with protective ground line of don't connect the ground directly
- When phase-grounding fault, the black clip of generator must be connected with the testing ground. When phase-phase fault, pls grounding with the connection of the cable core. Otherwise will bring equipment damage and safe accident.

#### 6.3.1 Choose the testing range

The range chosen during the initial test should be greater than or equal to the full length of the cable. If the suspect is found close, in order to get a higher ranging resolution, the range can be reduced appropriately.

#### 6.3.2 Setting the waveform velocity

Set suitable velocity according different cables.

#### 6.3.3 Test and adjust the gain

Press **Test** button to enter the waiting condition. When the high voltage generator discharge to transmit multiple low voltage impulse, and when the arc extinguishing it will transmit again, and to display these waveform in different colors. If the waveform we need to turn up the gain, otherwise to turn the gain until to get a suitable waveform.

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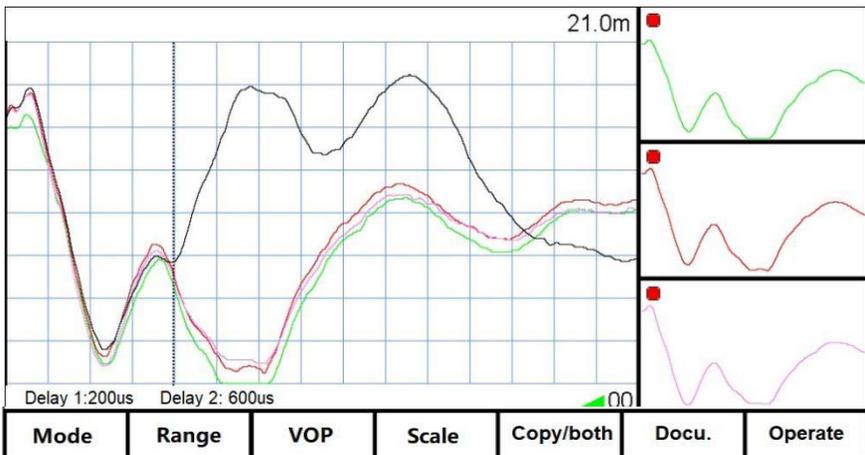
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\*when in the again to exit the WAITING condition. The screen menu is forbidden to operate.

## 6.3.4 Choose the most suitable waveform

After one time test, the device will display the waveform in different color and display them in the temporary storage) windows,Copy 1,Copy 2,Copy 3.

Under the both/copy menu, Menu allows you to close or open the waveform of the specified staging area.Double-click the corresponding staging area to turn on or off the comparison waveform..



## 6.3.5 Fault point locating

Move cursor 1 to the left of the screen, and move the virtual cursor to the starting point of the fault reflection pulse. The value displayed in the upper right corner of the screen is the distance between the fault point and the test end.

It can make full use of the proportional magnification function for accurate calibration.

## 6.3.6 Testing delay adjustment

If test didn't get the useful waveform, we could try to adjust the TESTING DELAY then test again.There are two time delay for the multiple impulse method.

Delay 1:The time interval between the fault ignition arc and the second measurement.

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Delay 2:time period of secondary testing and third testing, and the time period of third testing and the fourth testing.

Is the time interval from the second measurement to the third measurement, and the time interval from the third measurement to the fourth measurement. Note: The first measurement is a low-pressure pulse test waveform.

## **7. COMPUTER ONLINE**

### **7.1 COMPUTER ONLINE**

The instrument can communicate with the computer online, after which the computer can control all functions of the instrument, carry out more advanced and complex waveform analysis, and dump the waveform stored in the instrument to the computer for archiving, classification and management.

The instrument uses wireless Bluetooth to communicate with the computer, so the computer is required to have a Bluetooth interface. Start the online management software, when the computer issued the online command, the instrument will automatically enter the remote control state.

For details about how to install and use the online management software, see the help file delivered with the software.

Note: This function is optional.

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## **8. CHARGE AND MAINTAIN**

### **8.1 CHARGE**

After each use, the lithium battery should be charged as soon as possible with the special charger provided by the manufacturer; If not used for a long time, charge the host once every six months; Before use, please turn on the battery and check the battery voltage. When the battery energy is less than 30%, charge it before use. When charging, there must be special care, fully charged to unplug the charger power in time, continuous charging not more than 8 hours; Do not charge in sub-zero temperatures.

The output plug of the charger is inserted into the charging jack of the instrument, and the power plug of the charger is inserted into the 220V socket of the mains. The instrument begins to charge, and the indicator light of the charger indicates the charging state. The red light indicates that the charger is charging, and the green light indicates that the charging is complete.

### **8.2 WARRANTY**

If it is a product quality problem, the instrument host, accessories and charger three years warranty, battery one year warranty.

If the use of improper damage or beyond the warranty (warranty) period of product quality problems, our company is responsible for maintenance, maintenance only charge the cost of replacement components.

The user can try to solve the following problems:

No power on: The battery may be exhausted, please charge the battery before use.

Automatic shutdown of the instrument: It may be due to battery undervoltage or automatic shutdown without any operation for a long time (30 minutes), please try to start the machine again.

Power off immediately after starting: the reason is the battery undervoltage, please charge the battery before using.

If there is any other problem, please do not attempt to repair it by yourself, so as not to expand the fault, please contact our company immediately for repair.

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