# T-H200

## DC Resistance Cable Sheath Fault Locator

## User Manual

## Version 1.2

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## Legal Notices



This product complies with the design requirements for environmental protection and personal safety.

This product is a professional instrument specially designed for power cable faults. Please do not use it for any other purpose. The company assumes no responsibility or loss if it is used for other purposes.

The safety regulations in this user manual should be strictly adhered to.

The storage, use and disposal of the product should be in accordance with the product manual, relevant contracts or relevant laws and regulations.

As part of Kehui's continual product development this product is subject to design or technical changes without prior notice. When product improvement or technical changes occur, you can check the information through Kehui International Ltd. website https://www.kehui.com.

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Revision history:

| Data version | Revision date | Revision reason | Person |
|---|---|---|---|
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| | | | |

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# 1. Safety Instructions

**Safety Note:** This user manual is the basic commissioning and on-site operation guide for the T-H200. Users should read the entire contents of this manual before operating the device. The manufacturer of this product is not responsible for any loss caused by the operator's failure to comply with the operating procedures described in this manual or for any contravention of safe working procedures.

**Meaning of the manual symbols** Important instructions concerning personal safety, operating procedures, technical safety etc., are marked with the following symbols:

| Symbol | Meaning |
|---|---|
|  | Indicates the presence of high voltage which presents a potential hazard that could result in fatal or serious injury |
|  | Indicates a potential hazard which could result in personal injury or damage to equipment |
|  | Indicates that it contains important information and useful guidance for using this product. Failure to heed this information will result in the test not functioning properly. |
|  | Indicates that this is a useful guideline based on field practice. |

**Use of accessories**: To ensure the safe and reliable use of this instrument, only use spare parts approved by Kehui. The use of items from other sources may invalidate the warranty.

**Repair and maintenance**: This instrument must be repaired and maintained by Kehui or its authorised agents. If there are any questions relating to maintenance, contact info@kehui.com

## 2. Introduction

The T-H200 DC Resistance Cable Fault Locator, uses the advanced DC resistance method to locate external protective sheath faults and main insulation faults on power cables. It is designed for use with a high voltage generator and comprises a signal acquisition unit and an Android smart tablet, which acts as the user interface. The tablet is connected to the main unit using a low-powered Bluetooth™ signal. The associated tablet APP guides the user through on-site safety, correct wiring and step-by-step operation, to ensure the accuracy of the result. After the test, a summary report is produced to simplify user documentation.

Figure 2.1 – T-H200 unit and tablet controller

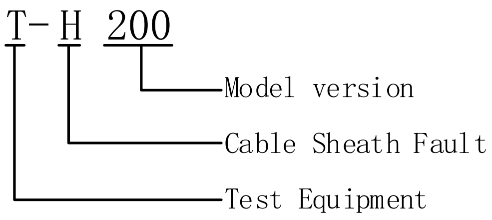
### 2.1 Product features

This product has the following features:

- Through an advanced DC resistance method, the equipment can locate low and high resistance external sheath faults for single core power cables, and main insulation failures for 3-core cables.
- The intelligent tablet APP guides the user through the wiring connection, testing and report generation.
- The test leads use different coloured wire clamps and terminals which, together with the APP's wiring diagram, help to ensure correct wiring.
- The acquisition unit's voltage withstand is up to 45kV DC, helping to ensuring operational reliability.
- An undervoltage alarm function is available to provide a low battery-charge warning.
- The unit is compact and light weight, making it easy to carry.
- Communication between the acquisition unit and the tablet is through a safe and reliable Bluetooth™ connection.

## 2.2 Model number nomenclature

The model number nomenclature is as follows;




## 2.3 Technical data

- Working mode： cable sheath fault location, cable insulation fault location
- Current measuring range： 0 to 150mA
- Current resolution： 10μA
- Current accuracy： 1%
- Voltage measuring range： 0 to 50mV
- Voltage resolution： 10μV
- Voltage accuracy： (U±20%) μV
- Bluetooth range：10m
- Power source：Polymer Lithium Ion battery pack，nominal voltage 7.4V。
- Charger：Input AC 220V，50Hz，Voltage 8.4V, Charging current 2A，Charging time 8 hours。
- Size：216mm×152mm×95mm
- Weight：2kg

## 2.4 Working conditions

- Working temperature -10℃ to +50℃
- Relative humidity 25℃ (20 - 90)%RH
- Atmospheric pressure 86 - 106kPa

# 3. Working Principles

Most cables above 35kV have a single-core. When load current passes through the cable, an inductive voltage appears at both ends of the protective layer (aluminium or other types of metallic shield). In order to avoid circulating current, which results in heat loss and accelerated aging of the cable, multi-point grounding (or earthing – subsequently referred to as grounding) of the metallic shield is not allowed and only one end of the shield is grounded.

The outer insulation of the protective layer (the sheath) is made of plastic, paper or other insulating materials, which is susceptible to external damage causing ground faults involving the protective layer. Therefore, failure of the protective layer of a high voltage single-core cable, known as a sheath fault, is a common fault phenomenon.

Power cables at 35kV and below usually have three-cores, the insulating layers are relatively thick and most of the insulation faults are either high resistance or flashover faults.

In both cases, the only available return path from the fault position is through the ground surrounding the cable, which does not provide a return path suitable for using conventional fault-finding equipment such as surge generators or TDR units. Hence alternatives have to be found to measure the distance to the fault.

Traditionally, the DC bridge method has been used for sheath fault location which is simple in operation, however, the accuracy is affected by the resistance of the fault and the connecting wire, which may lead to significant errors.

## 3.1 DC resistance method

The DC resistance method calculates the fault distance by measuring the DC resistance from the measuring point to the fault point. Unlike the traditional DC bridge method, this is not affected by the resistance of the fault or the connection leads, hence the accuracy is higher. The DC resistance method can be used to test the resistance of the main insulation and the protection layer. The T-H200 uses this principle to find faults on high-voltage cable sheaths and the main insulation which exhibit low grounding resistance, and joint failure.

The principle of the DC resistance test is shown in Figure 3.1. The faulty cable shield is connected to a healthy core or to another healthy shield at the remote end. Using the negative terminal of the DC power supply E, the current $i$ is injected into the cable shield and the DC voltage U1 is measured across the two line terminals. There is no current flow from the fault point to the near end of the healthy shield where the voltage is measured, therefore, they are of equal potential. The measured voltage U1 is effectively the voltage drop across the faulty section of the shield. The DC resistance between the measurement point and the fault point can thus be calculated as: R1 = U1/$i$.

Assuming the resistance per unit length is ρ0（Ω/km), the distance can be calculated as：

$$L = R_1 / \rho_0$$

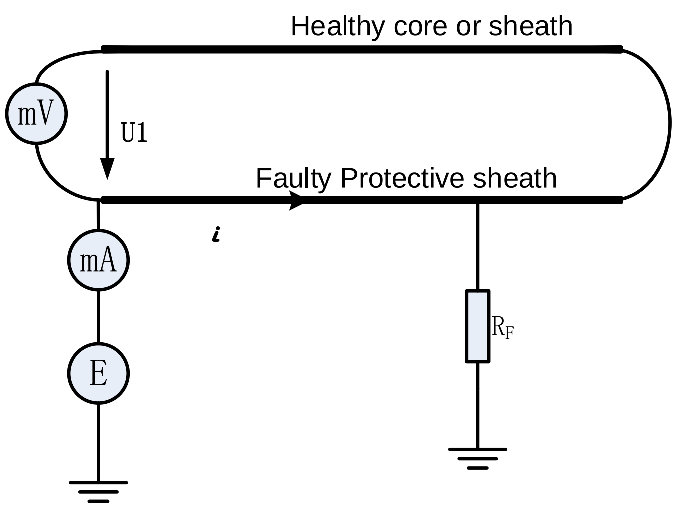



Figure 3.1 - DC Resistance method for sheath fault

# 4. Composition and Applications

## 4.1 Data acquisition unit

The unit is shown below, with the lid removed for clarity:

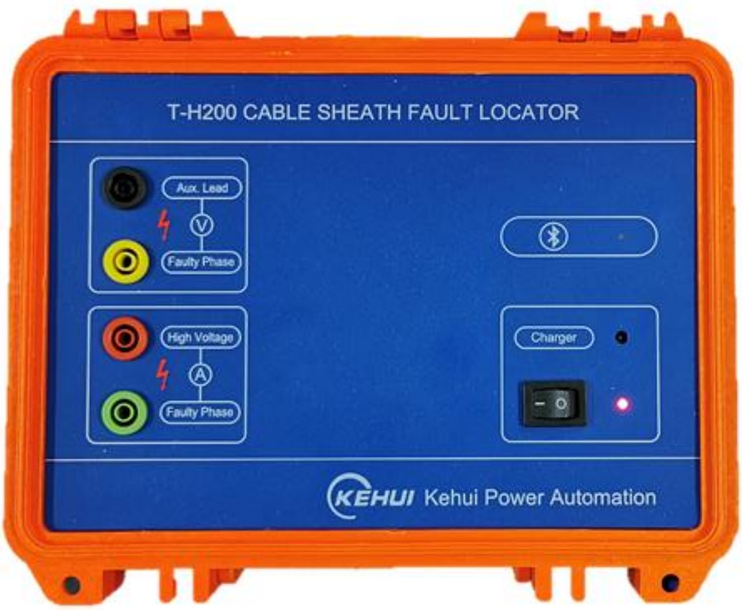



Figure 4.1 – T-H200 Front Panel

The front panel comprises the following elements:

- The <On/Off> switch controls the power supply. When the switch is on, the “Power indication” will be lit.
- Charger terminal – for connection to the output of the charger. The <red> indication shows that charging is in progress, the <green> indication shows that charging is complete.
- Bluetooth indication : When the instrument is switched on, the Bluetooth light is flashing. After the connection with the tablet is established, the light will remain steady.
- 4 coloured sockets – Each wiring socket has a different colour, related to the colour scheme of the wiring diagram shown in the display unit (see figure 3 and 5).Theyare labelled:
  - Auxiliary wire (black), connected to the healthy cable
  - Faulty shield (yellow), connected to the faulty cable shield
  - High voltage (red) connected to the high-voltage generator (e.g. Kehui T-100C)
  - Faulty shield (green). connected to the faulty cable shield (together with the yellow lead).

Note: The HV generator output is normally negative, the connection should be in accordance with the colour scheme shown in the wiring diagram.

## 4.2 Display unit

The display unit is an Android tablet. A specially designed APP operates as the background software, which receives test signals transmitted through Bluetooth. Its main functions are:

- Receiving test signals
- Operational step-by-step guidance
- Data storage
- Results display
- Test report production


Figure 4.2 – Tablet Controller

### 4.2.1 Tablet Preparation

Fully charge the tablet using the charger supplied (do not use any other charger for this purpose).

### 4.2.2 Turning on the tablet PC

- Turn on the unit by pressing the “on” button for several seconds (below (i)).


Figure 4.3 – Tablet “On” button

- This should result in the screen shown in (ii). Do not touch the screen until advised below (i)


Figure 4.4 – Tablet boot-up - i

- This screen will remain for about 30s while the unit boots-up.

- It will then automatically change to (ii) with the “Handheld” logo swiping across the screen.
- 


Figure 4.5 – Tablet boot-up -ii

- After a few seconds it will stabilise and then change to the screen shown below (iii):
- 


Figure 4.6 – Tablet boot-up -iii

- When this screen appears, put your finger at the bottom of the screen and swipe upwards, the screen should change to (iv)


Figure 4.7 – Tablet boot-up -iv PIN Code

- Put in the PIN number (initially 1234) using the touch screen and press ✓ , the screen changes to (v), with the Kehui T-H200 APP highlighted.


Figure 4.8 – Tablet boot-up – v APP Icon

- Touch the Kehui symbol and the APP will open (vi). If the Kehui symbol is not there, swipe the screen left or right, as it may be on a different page.

- The App start page (vi) will appear.


Figure 4.9 – Tablet boot-up vi App Start

### 4.2.3 Turning on the T-H200

The T-H200 unit can be turned on or off by pressing the power on/off switch on the front panel. The detector power indicator lights up when the detector is turned on.

[**Warning**] The battery must be charged using the dedicated charger. Using other chargers that do not meet the exact parameters, may cause damage to the instrument.

### 4.2.4 Bluetooth Connection

With the detector and tablet PC powered on, click the device name T-H200 in the pop-up pairing dialogue box, enter the T-H200 detector default PIN code 1234, then click the tick ✓ to complete the Bluetooth pairing and connection of the tablet and detector. Once the Bluetooth connection is successful, you should exit to the tablet desktop interface. The operation interface is as follows:


[**Note**]

Figure 4.10 – Tablet boot-up vi App Start page

This step only needs to be performed once. After the device is successfully paired, it is not necessary to repeat this operation. However, the pin number will be required to access the tablet after a period of inactivity.

### 4.2.5 Launch APP

After clicking the T-506 APP icon on the desktop, the user will see the APP start-up screen as shown in the figure below.


Figure 4.11 – Tablet boot-up vi App Start

To connect the unit, enter the settings menu of the Android device on which the App is loaded. Select the Bluetooth settings (usually in “Device Connectivity”), ensure Bluetooth is activated and that the device is visible. If the T-H200 is switched on, it should appear as an available device and tapping on the T-H200 device name will bring up a password request. The password is “1234”, entering this will connect the device and allow it to be used as the T-H200 control panel.

The home page of the APP (Figure 4.14) shows two functional selections: cable sheath fault test and cable main insulation fault test. The user can select and open the corresponding page according to the different cable fault types.

## 4.3 Cable sheath fault test

After confirming that the fault is a cable sheath fault, select the “Cable sheath fault test” mode and follow the instructions below.

### 4.3.1 Cable shield resistivity test

<u>First Step: Resistivity test Connections</u>

The operator interface shows the connection diagram for the resistivity test. The colour scheme of the diagram should be followed precisely, using the different coloured connectors provided. Note that “HV” shown on the APP circuit diagram, refers to a High Voltage generator, such as the Kehui T-100C or Kehui T-305E (in DC mode).

i. Before connection, make sure the cable is completely disconnected and is fully discharged. Residual charge on the cable can make it extremely dangerous.

ii. Ensure that the battery charger <u>is not</u> connected to the T-H200 (n.b. if the battery completely discharges during testing, the T-H200 should be completely disconnected before recharging)

iii. Connect the auxiliary line (the cable core) and the healthy shield together at the remote end with a wire.

iv. Connect the current measurement faulty shield terminal (green connector) to the healthy shield.

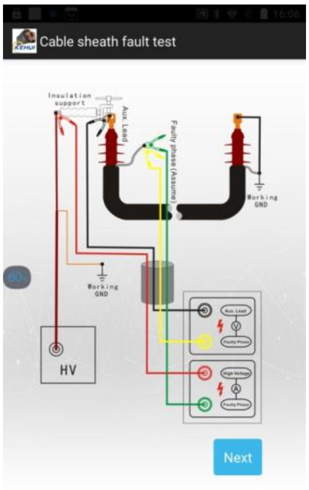



Figure 4.12 – Cable sheath fault test

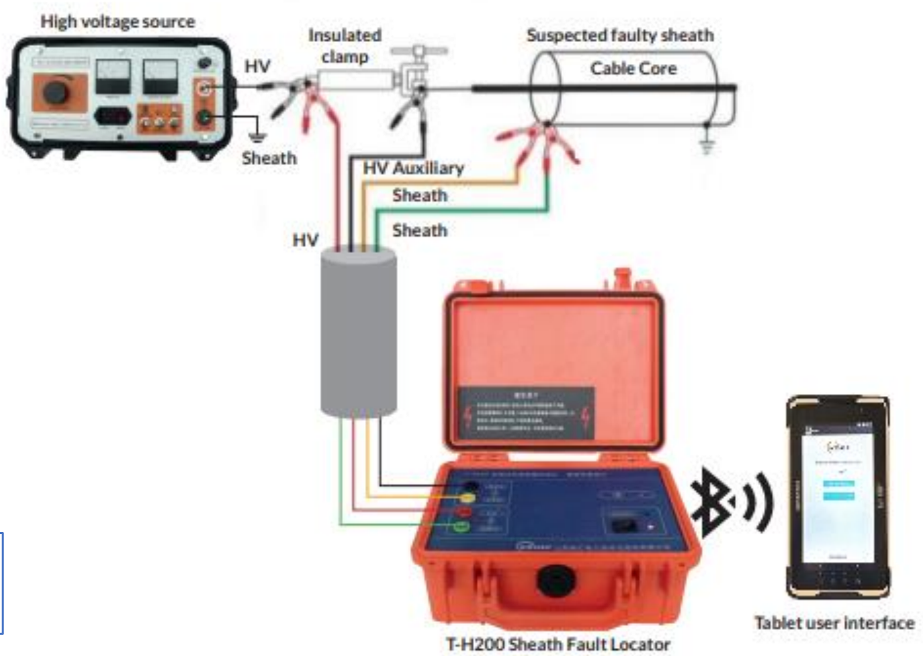



Figure 4.13 – Cable sheath fault test showing actual equipment

v. Connect the current measurement HV terminal (red connector) to the HV generator’s HV capacitor output terminal.

vi. Connect the current measurement faulty shield terminal (green connector) to the healthy shield.

vii. Connect the voltage measurement auxiliary wire terminal (black connector) to the auxiliary line (cable core).

viii. Connect the voltage measurement faulty shield terminal (yellow connector) to the healthy shield.

ix. Ground the HV generator’s grounding terminal to the working ground (or the auxiliary ground).

x. Ground the protective ground of the HV generator.

xi. The protective ground and the working ground must be separated.

Second Step：Resistivity measurements

After entering the screen shown in Figure 4.18, the interface will show the precautions for HV operation. It will display the "Test current" and "Test voltage" values in real time, and the instrument will automatically calculate the "full length resistance".

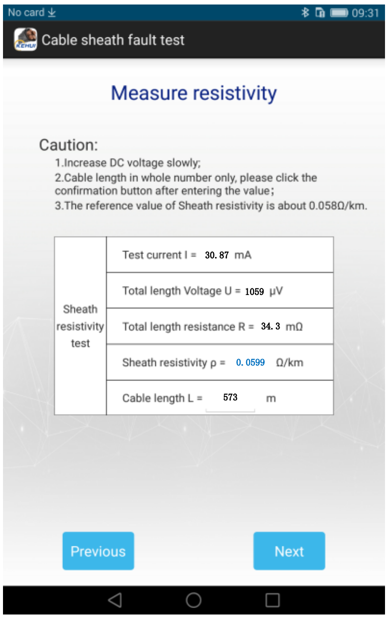



Figure 4.14 – Resistivity measurement screenshot

Operation of the HV generator when using the Kehui T-100C (refer to the T-100C manual for full instructions):


Figure 4.15 – T-100C front panel

i. For the “mode of operation” select “DC” by pressing the CYCLIC/DC button.
ii. Reduce the HV output (OUTPUT ADJUST) to zero by turning it fully anti-clockwise.
iii. Switch on the power supply.
iv. Press the “START” button to engage the HV output. The indication light will be on, and there is a hissing sound.
v. Slowly rotate the Output Adjust knob to increase the output HV voltage, observing both the voltmeter and the ammeter. When the current reaches 50-100mA, stop raising the HV voltage.
vi. On the tablet APP, select “cable length” and enter the exact length of the cable, the APP will calculate the “resistivity” automatically, and store the value for the next stage of operation.

Note that the T-100C is the preferred power source for the T-H200, however it will also work with other suitable high voltage sources and can be powered from the Kehui T-305E surge generator, used in DC mode. Note that the output must be negative.

### 4.3.2 Cable sheath fault distance measurement

<u>First Step： Connection</u>

The display in Figure 4.20 shows the connection diagram. The connection needs to be exactly as shown in the diagram.

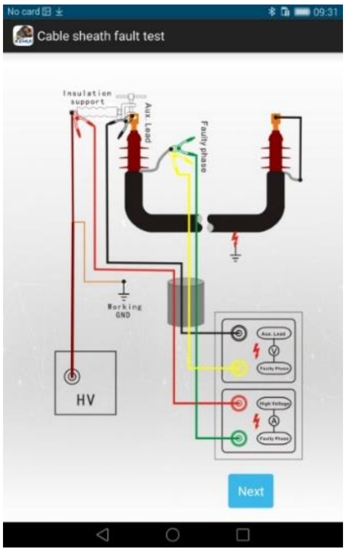



Figure 4.16 – Cable sheath fault location connection

Before connection, make sure that the cable is completely disconnected and is fully discharged. Residual charge on the cable can make it extremely dangerous.

i. Connect the auxiliary line (either the cable core or the healthy shield of another cable) with the faulty shield.
ii. Connect the rest of the set-up following the colour scheme of the connection diagram.

<u>Second Step: fault distance measurement</u>

Slowly increase the DC HV voltage on the HV generator (e.g. Kehui T-100C) until the test current is approximately 50 - 80mA. In the screenshot shown in Figure 4.21, the "Test current" and "Test voltage" are displayed in real time and the instrument automatically calculates the "faulty section resistance". The cable resistivity obtained previously will be used to calculate the "fault distance” automatically.

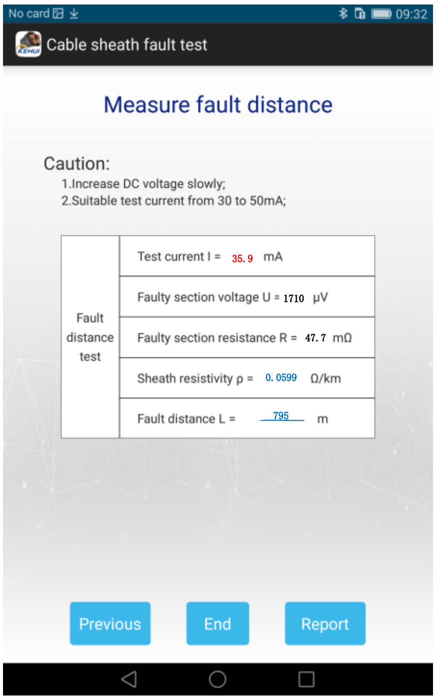



Figure 4.17 - Fault distance measurement

## 4.4 Cable main insulation fault test

After confirming that the fault is in the cable's main insulation, select the "Cable main insulation fault test" mode and follow the instructions provided.

### 4.4.1 Cable resistivity test

<u>First Step: Resistivity test Connections</u>

The operator interface shows the connection diagram for the resistivity test (Figure 4.22). The colour scheme of the diagram should be followed precisely using the different coloured connectors provided.

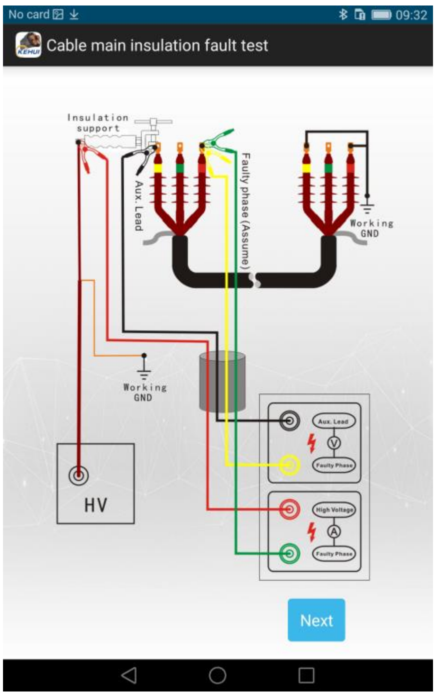



Figure 4.18 - Main insulation resistivity test connection diagram

The following procedure should be followed:

i. Before connection, make sure the cable is completely disconnected and is fully discharged. Residual charge on the cable can make it extremely dangerous.

ii. Connect the auxiliary line (a healthy cable core, e.g. the first core) to another healthy cable core (e.g. the second core) at the remote end.

iii. Connect the current measurement HV terminal (red connector) to the HV generator's (e.g. Kehui T-100C) HV capacitor output terminal.

iv. Connect the current measurement faulty shield terminal (green connector) to the second core.

v. Connect the Voltage measurement auxiliary wire terminal (black connector) to the auxiliary line (first core).

vi. Connect the voltage measurement faulty shield terminal (yellow connector) to the second core.

vii. Ground the HV generator's earthing terminal to the working ground (or the auxiliary ground).

viii. Ground the protective ground of the HV generator.

ix. The protective ground and the working ground <u>must be</u> separately earthed.

<u>Second Step： Resistivity measurements</u>

After entering the APP page shown in Figure 4.23, the interface will show the precautions for the HV operation. It will display the "Test current" and "Test voltage" values in real time, and the instrument will automatically calculate the "full length resistance".

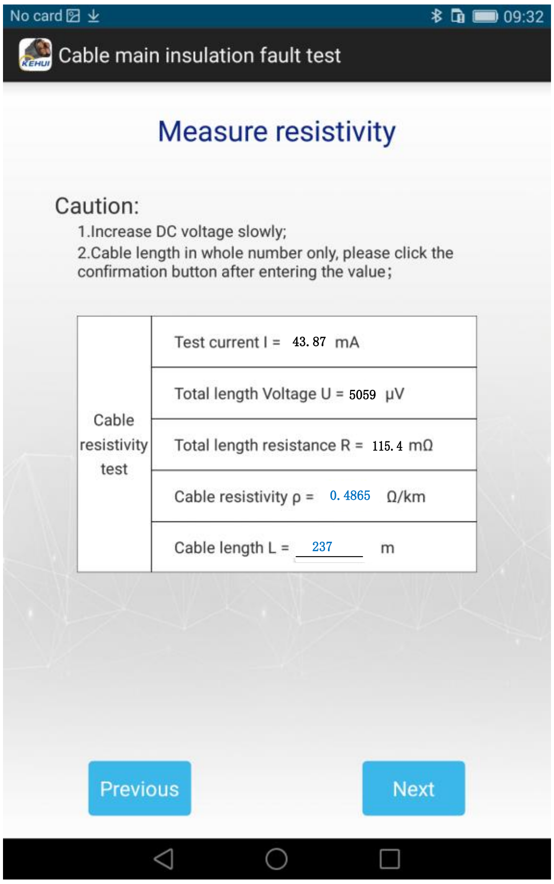



Figure 4.19 - Resistivity measurements

Operation of the HV generator：

i. For the “mode of operation” Select “DC”.

ii. Reduce the HV output to zero.

iii. Switch on the power supply.

iv. Press the “HV output” button to engage the HV output. The indication light will be on, and there is a hissing sound.

v. Slowly rotate the “HV adjust” knob to increase the output voltage, observing both the voltmeter and the ammeter. When the current reaches 50-100mA, stop raising the HV voltage.

vi. Select “cable length” and enter the exact length of the cable, the APP will calculate the “resistivity” automatically, and store the value for the next stage of operation.

### 4.4.2 Cable main insulation fault distance test

<u>First Step: Connection</u>

The display shows the connection diagram. The connection needs to be exactly the same as in the diagram.

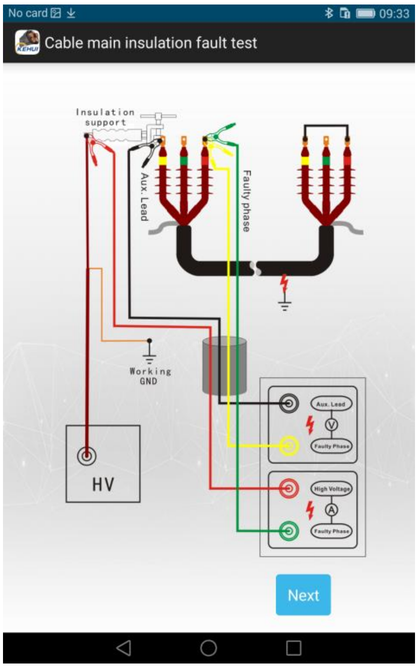



Figure 4.20 - Main insulation failure test connection diagram

i. Before connection, make sure that the cable is completely disconnected and is fully discharged. Residual charge on the cable can make it extremely dangerous.

ii. Connect the auxiliary line (a healthy cable core) and the faulty core at the remote end together.

iii. Connect the rest of the set-up according to the colour scheme of the connection diagram

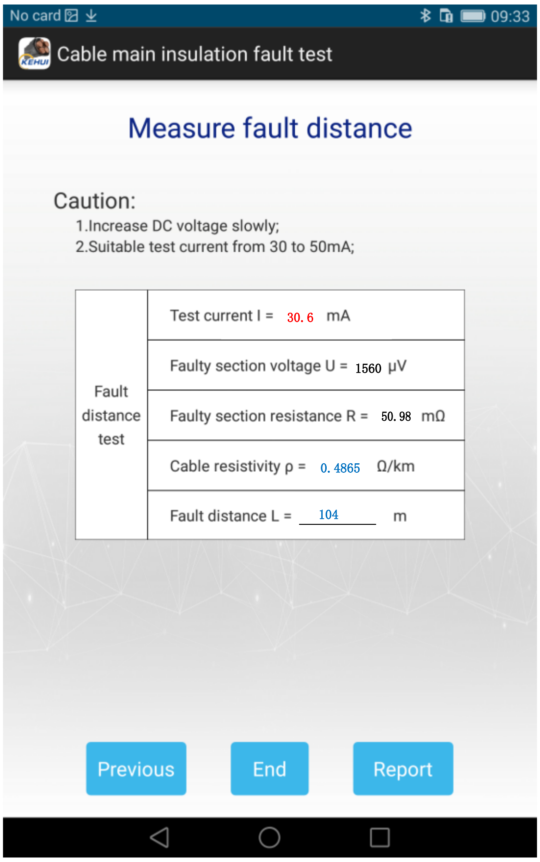



Figure 4.21 - Main insulation fault distance calculations

<u>Second Step: fault distance measurement</u>

Using the output control, slowly increase the DC voltage on the HV generator until the test current is approximately 50 - 80mA. In the screenshot shown in Figure 4.24, the "Test current" and "Test voltage" are displayed in real time, and the instrument automatically calculates the "faulty section resistance"; the Cable resistivity result obtained previously will be used to calculate the" fault distance automatically."

## 4.5 Battery charging

The data acquisition unit is powered by a rechargeable lithium battery, which provides 5 hours of continuous operation. When the battery voltage is lower than the nominal working voltage, an alarm will notify the user to charge the battery. If the battery is not recharged, further usage will eventually cause shut-down of the instrument.

Always ensure that the charger supplied by Kehui for this device is used to charge the battery

Due to airline regulations, the unit may be shipped with the battery disconnected. When the unit is first unpacked, plug the charger into a suitable power outlet and insert it in to the charger socket on the detector and press the on/off switch. If the unit’s Power light does not illuminate, it is probable that the battery is disconnected. If this happens, it will be necessary to remove the unit from its case and reconnect the battery jumper.

# 5. Packing list - T-H200

| No. | Materials | Quantity |
|---|---|---|
| 1 | T-H200 Sheath Fault Locator (data acquisition unit)  | 1 |
| 2 | Tablet with charger  | 1 |
| 3 | Grounding Clamp  | 1 |
| 4 | 8.4V 2A Charger  | 1 |
| 5 | Test Lead  | 1 |
| 6 | Manual  | 1 |