T-710 Intelligent Cable Identifier

User Manual

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Legal Notices

This product complies with the design requirements for environmental protection and personal safety. It is a professional instrument specially designed for power cable identification and should not be used for any other purpose. The company assumes no responsibility or loss if it is used incorrectly.

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.

Revision history

Data version	Revision date	Revision reason	Person
Version 1.0	December 2020	First issue	D Kibart / W Kibart

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Foreword

Thank you for purchasing the T-710 intelligent cable identification device.

The T-710 is a light-weight, high power device for accurately identifying a specific cable from a group of adjacent cables and is a complementary product to the Kehui range of cable fault location equipment.

In order to ensure that you use the instrument to full advantage, always read the instructions carefully before using.

Kehui is constantly improving its products, and the individual instruments provided may differ from the instructions in this manual without prior notice. We are always at your service if you have any queries or should you require further information.

Please do not attempt to repair or adapt the device, as this will invalidate the warranty. If you encounter any problem with it contact us on: info@kehui.com

Table of Contents

1. Safety Instructions

Safety Note: This user manual is the basic commissioning and on-site operation guide for the T-710 Intelligent Cable Identifier. Any operator who uses the T-710 should read the entire contents of this manual in advance. The manufacturer of this product is not responsible for the loss caused by the operator's failure to comply with the operating procedures of this manual or for violation of the safe working procedures of the operator.

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

Symbol	Meaning
	Indicates a potential hazard that could result in fatal or serious injury
	Indicates a potential hazard which, if not avoided, may result in minor personal injury or property damage.
	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: Kehui's spare parts must always be used to ensure the safe and reliable use of this instrument. Using accessories made by other companies will make any warranty null and void.

Repair and maintenance: This instrument must be repaired and maintained by Kehui or an agent authorised by Kehui. If you have any questions such as maintenance, cable fault detection, on-site test consultation, etc., please contact; info@kehui.com

Earthing / grounding: In English speaking markets the words earthing and grounding are synonymous for an electrical connection to the mass of earth. For simplicity, this manual uses the term earthing throughout.

2. General Description

2.1 General

T-710 is a high-performance cable identification system, composed of a signal transmitter T-710T and receiver T-710R. It is used to accurately identify the target cable among multiple cables. It is suitable for live and uncharged cables, including three-core cables with armour.

2.1 device appearance

2.2 Features

- High-power, multi-level, adjustable output
- The unique identification of the cable, the result is accurate and reliable
- Automatic impedance matching, and protection
- Two signal output modes: direct output and clamp coupling
- Digital, high-precision sampling and processing, extremely narrow receiving frequency band and strong anti-interference ability
- Built-in large-capacity lithium-ion battery pack, automatic shutdown on under-voltage and after long periods on non-operation
- Clear identification of cable
- Lightweight, sturdy housing
- Suppression of power frequency and harmonic interference from adjacent cables and pipelines.

2.3 Specification

2.3.1 Transmitter

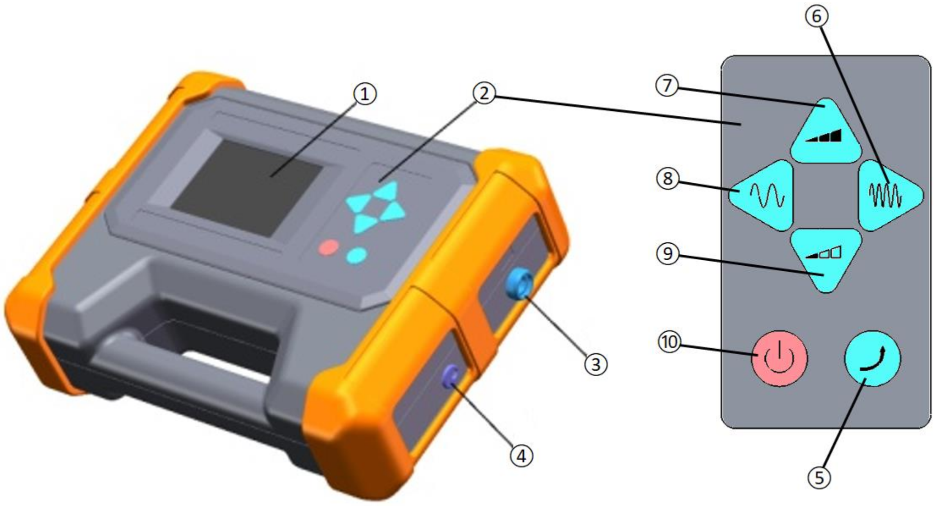
- Output frequency: 640Hz or 1280Hz (Composite frequencies)
- Output power: max 10W in 10 steps with automatic impedance matching
- Output voltage: maximum 150V (peak to peak)
- Overload/short circuit protection
- User interface: 320 x 240 pixels LCD
- Internal battery: Four 18650, 7.4V, 6.8 Ah
- Dimensions 280 x 220 x 90mm
- Weight 2.3Kg
- Operating temperature: -10^{o}C to +40^{o}C
- Relative humidity: 5 – 90%

2.3.2 Receiver

- Input mode: Flexible sensor
- Active detection frequency 640Hz, 1280Hz
- Passive detection system frequency 50/60Hz (configurable)
- Current measurement: 1 – 1000A ±3% AC
- HMI: 800 x 480 pixels LCD
- Battery: Two 18650, 3.7V 6.8Ah
- Dimensions: 220 x 125 x 55mm
- Weight 0.9kg
- Operating temperature: -10^{o}C to +40^{o}C
- Relative humidity: 5 – 90%

2.4 Device composition and Accessories

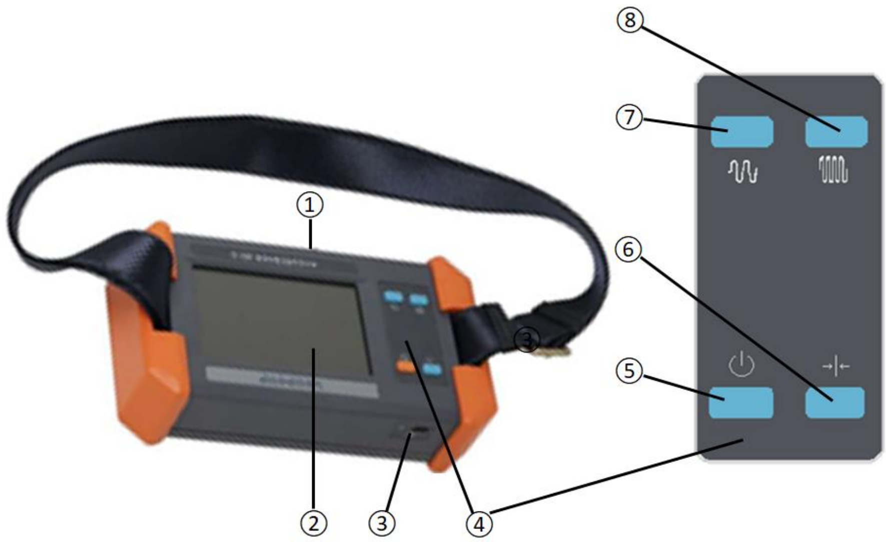
2.4.1 Transmitter



① LCD Display
② Keypad
③ Output port
④ Charging socket
⑤ Reset output
⑥ Output frequency increase
⑦ Output power increase
⑧ Output frequency decrease
⑨ Output power decrease
⑩ Power on/off

Figure 2.2 Transmitter overview

2.4.2 Receiver



① Output port
② LCD display
③ Charging port
④ Charging socket
⑤ Power on/off
⑥ Calibration key
⑦ Output frequency decrease
⑧ Output frequency increase

Figure 2.3 Receiver overview

2.4.3 Receiver LCD display

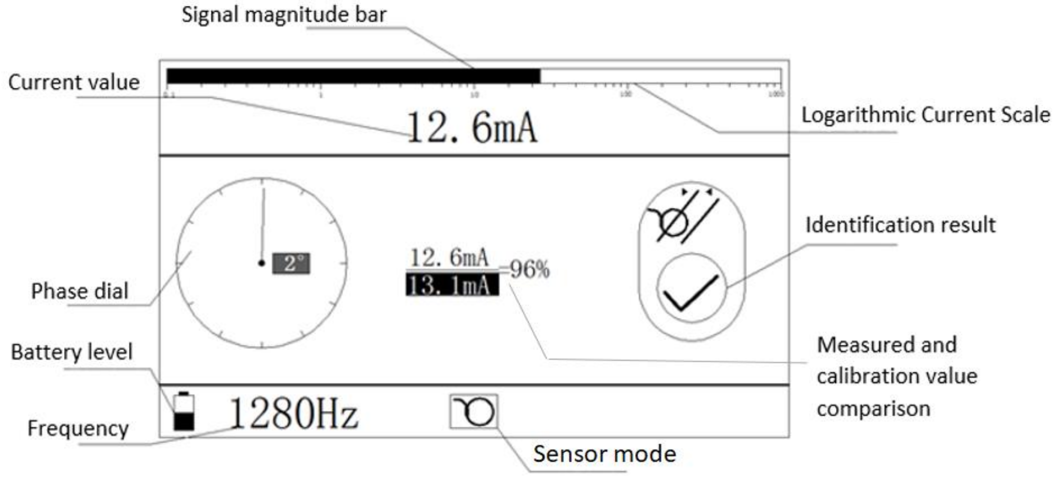


Figure 2.3 Receiver display

3. Signal Transmission Methods

Before making any contact with electrical cables, ensure that the supply is switched off and the cable is discharged.

There are two methods for the transmitter to transmit signals to the cable: direct connection and clamp coupling.

3.1 Introduction to the two operating methods

3.1.1 Direct connection method

Using the direct connection method, the output line of the transmitter is directly connected to the metal cable, in order to inject the signal.

Compared with other methods, the direct connection method produces the largest current output and so, if conditions permit, it should be used wherever possible.

3.1.2 Clamp coupling

The clamp coupling method is suitable where the cable is exposed, but the conductor cannot (or is not allowed to) be touched, and both ends of the cable are earthed.

The advantage of the clamp coupling method for transmitting signals is that it is easy to use, requires no electrical connection to the cable, does not have any impact on its normal operation and can reduce induction to other cables; the disadvantage is that the coupled current is less than in the direct connection method and it requires both ends of the cable to be well earthed.

3.2 Wiring and operation for direct connection

Step 1: Insert the 5-pin red plug on the output cable directly into the output socket of the transmitter.

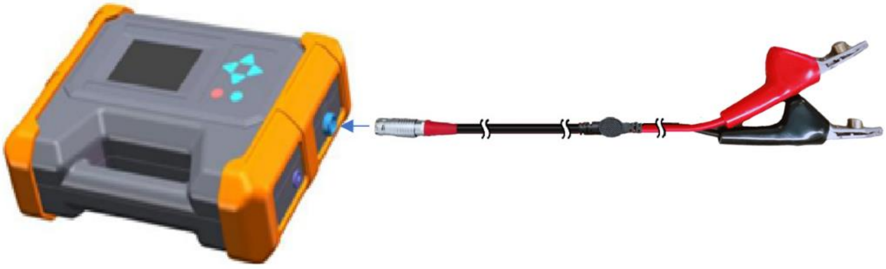


Figure 3.1 Direct connection cable

Step 2: Disconnect the sheath at both ends of the cable, remove the sheath and neutral earthing.

Step 3: Attach the red clip to a healthy conductor, and the black clip to the earth through the earthing rod. At the opposite end of the cable, connect the other end of the connected conductor with the earthing rod inserted in to the ground.

For the near end it is preferable to use the earthing rod rather than the earth grid network. At the far end, the earthing rod must be used and should be away from the earthing network. Otherwise, the flow of current through the earth grid will affect the results.

Connect the red crocodile clip to the exposed core conductor or sheath of the cable; the black crocodile clip is connected to the earthing pin that is driven into the ground (soil). If the cable is not long enough, an extension cable can be used.

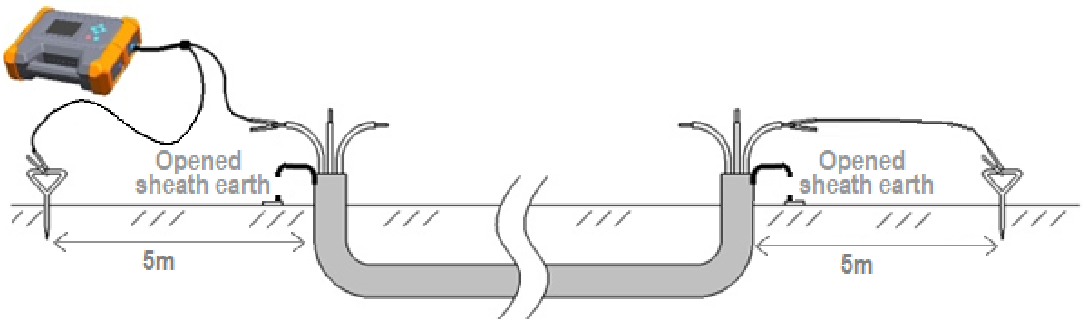


Figure 3.2 Directly connected to the cable core

Observe the following points:

- Make sure that all connections are solidly made. If there is any insulating coating or rust on the joint, clean it before connecting the red crocodile clip.
- In order to ensure the detection effect, the earthing pin should be at least 5m away from the cable, and the black earthing wire should be as perpendicular to the pipeline as possible.
- Do not connect the black earth wire to a pipe, or there will be transmission signals induced in it, which will interfere with the normal detection of the target cable.
- There should be no other cables or pipelines between the earthing pin and the target cable, otherwise the transmission signal will be induced on them, which will cause interference.

- The maximum output voltage of the transmitter is 150V. To prevent electric shock, do not directly touch the output clamp or target cable when working.

The current flows from the transmitter, through the conductor and the earth at the far end, then travels back to the transmitter. This connection method induces a strong signal in the receiver.

A strong signal will flow through a well-isolated conductor, it will not flow in nearby cables, including those crossing the cable path. It is especially suitable for route tracing in complex environments. In addition, as the cable is earthed, the signal voltage flow through it is low and does not interfere with other instruments.

Because there is distributed capacitance between the conductor and earth, the current will attenuate when it flows from one end to the other, but if it is well earthed, the leakage current will be very low and can be ignored.

Step 3: After completing the wiring, press and hold the power button (Figure 2.2 ⑩) to turn on the transmitter. The transmitter automatically detects the cable and confirms the direct connection mode. In this mode, the voltage of the cable will be measured first - the screen is shown in Figure 3.3a. If the output cable is not detected, the screen appears as Figure 3.3b.

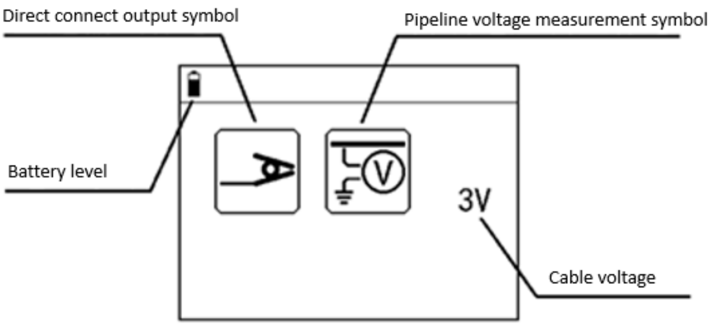


Figure 3.3a Direct connection mode cable voltage measurement

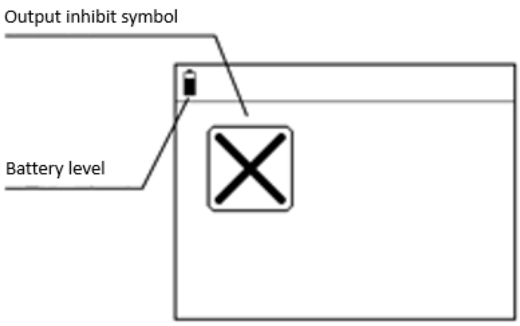


Figure 3.3b Direct connection mode no cable detected

If the voltage on the cable exceeds the limit (50V), the voltage detection interface will display a warning sign (Figure 3.3c), and there will be no output thus protecting the instrument from damage.

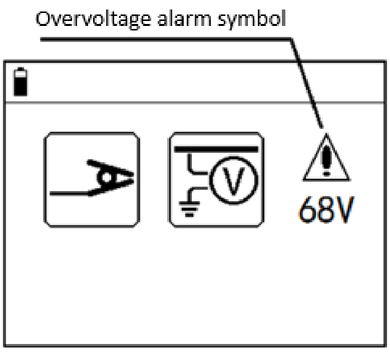


Figure 3.3c Overvoltage warning

If the voltage is normal, the signal will be output automatically after a few seconds, and the screen in Figure 3.4 will appear:

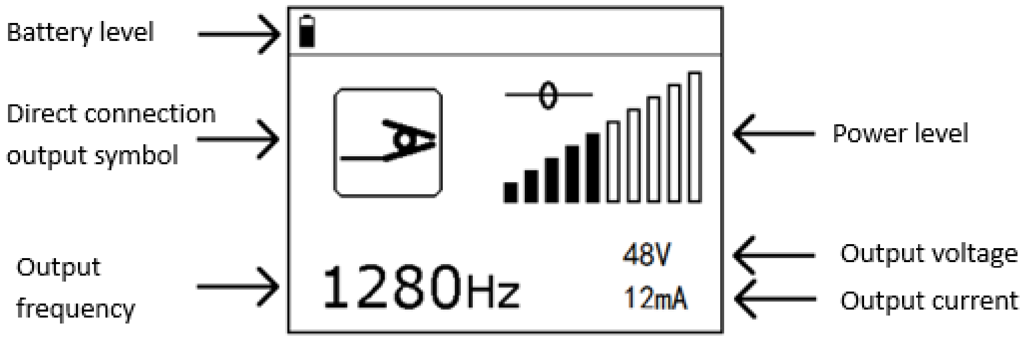


Figure 3.4 Direct connection output interface

Step 4: Pressing the frequency decrease and increase keys selects the transmission frequency. At power-on, the default frequency is 1280Hz, but 640Hz can also be chosen, both are composite frequency signals, which the receiver can track as right or wrong.

There is no uniform standard for which frequency to choose. It can be selected based on the following principles and actual detection results.

- Generally, for cables with good earthing, most of the tests can be completed by using the default value of 1280Hz.
- The lower frequencies (640Hz) can be chosen for long cable tracking. The low-frequency signal has a long propagation distance and will not easily be induced on to other cables.

Step 5: Press the output decrease and increase keys to adjust the output signal level (magnitude), which is divided into 10 levels. The output voltage and current are displayed in the lower right corner of the screen (Figure 3.4).

The default output power is set to half the maximum power. If the receiver signal is too weak, increasing the power may help to stabilise the reading. Alternatively, if the receiver displays excessive signal distortion, the output power needs to be reduced.

If the receiver signal continues to be unstable, the reset output button (Figure 2.2 item ⑤) can be used to reset the device and re-apply the signal.

The disadvantage of this connection method is that it requires the disconnection of the earthing at both ends of the cable which is complicated, care must be taken to reinstate them correctly.

3.3 Wiring and operation of clamp coupling method

This is an ideal detection method for the live cables as there is no need to reconnect the cable, making it very safe for the operator. There is a signal throughout the entire length of the cable, and no distance limitation.

Both ends of the cable sheath should be earthed as the coupling current will decrease as earthing resistance increases.

The clamp coupling method can only be used where both ends are earthed and the sheath is unbroken.

Step 1: Insert one end of the transmitter accessory connection cable (red 5-pin plugs at both ends) into the transmitter clamp socket, and the other end into the transmitter output socket.

Figure 3.5 Clamp cable connection

Step 2: Attach the clamp around an exposed part of the cable, as shown in the following figure:

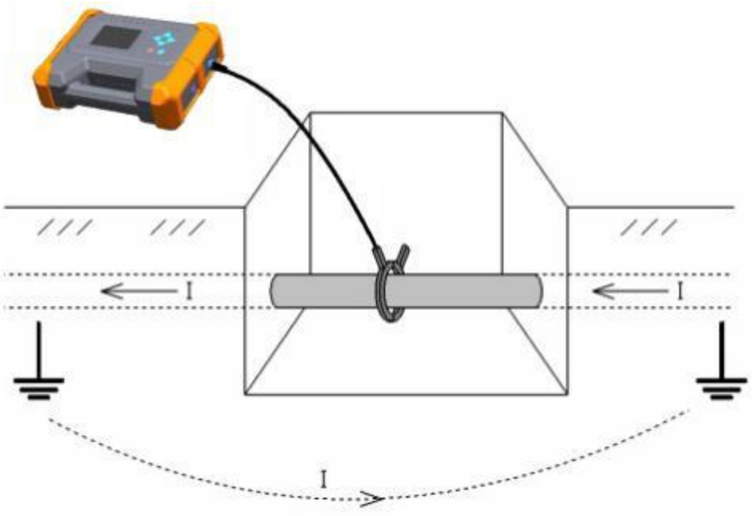


Figure 3 6 The clamp method is connected to the pipeline

- Both ends of the cable must be earthed to induce a signal.
- When putting the clamp around the cable, make sure that the jaws are completely closed, and that there is no foreign matter or rust on the jaws.

  Step 3: After completing the wiring, when the transmitter is turned on, it will automatically detect the connected test line and lock it in the clamp output mode.

The screen displays as follows:

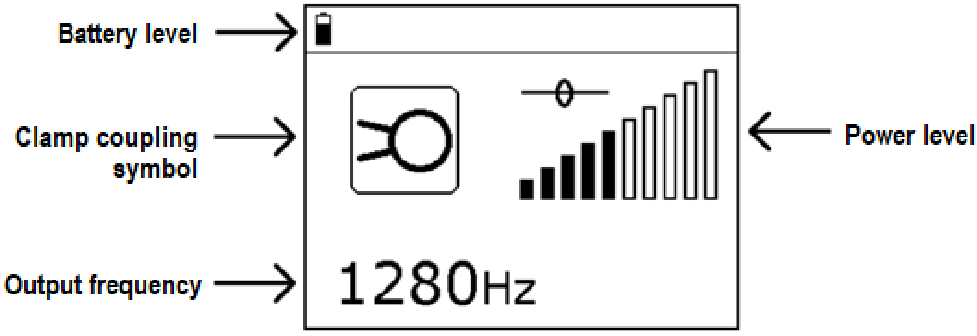


Figure 3.7 Clamp connection output interface

Step 4: Press the frequency increase and decrease keys to select the transmit frequency. There are two frequencies to choose from: 1280Hz (The default when the unit is energised) and 640Hz.

Frequency selection in the clamp coupling method is the same as in the direct connection method, repeated here for clarity:

There is no uniform standard for which frequency to choose. It can be selected based on the following principles and actual detection results.

- Generally, for cables with good earthing, most of the tests can be completed by using the default value of 1280Hz.
- The lower frequencies (640Hz) can be chosen for long cables. The low-frequency signal has a long propagation distance and will not easily be induced on to other cables.

Step 5: Press the output increase and decrease keys to adjust the output, which is divided into 10 levels.

The default output power is set to half the maximum power. If the receiver signal is too weak, increasing the power may help to stabilise the reading. Alternatively, if the receiver displays excessive signal distortion, the output power needs to be reduced. However, the current coupled to the cable through the clamp is much smaller than the direct connection method and the maximum output level should be used wherever possible.

If the receiver signal continues to be unstable, the reset output button (Figure 2.2 item ⑤) can be used to reset the device and re-apply the signal.

The clamp coupling method cannot display the voltage and current coupled to the cable.

4. Connection modes for cable identification

The ability to identify a particular cable is an important aspect of cable maintenance. Cables are often composed of several core conductors with metal armour. Different wiring methods produce different electromagnetic fields and require detection approaches described in the following section.

4.1 Out of service cable wiring method

For the detection of outage cables, the direct signal transmission method is mainly used to generate the maximum transmission current.

4.1.1 Core conductor-earth connection

The core conductor-earth connection method is the best wiring method to identify the out-of-service cable (the uncharged cable that is out of service), which can give full play to the performance of the instrument and shield interference to the greatest extent. The specific wiring is shown in the figure below:

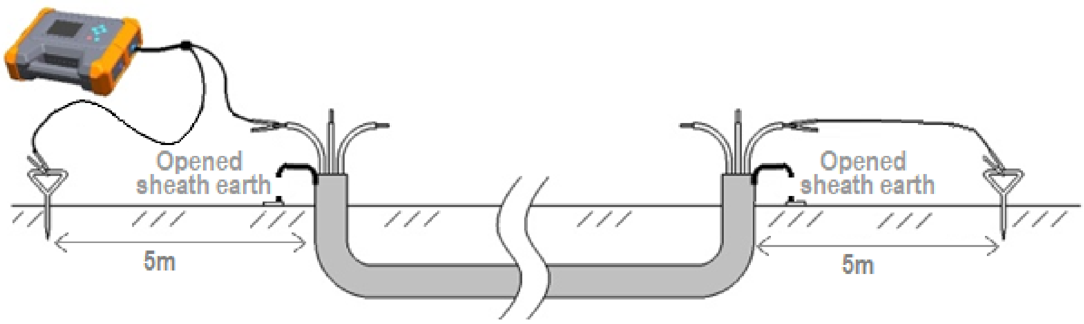


Figure 4.1 Core conductor-earth method, wiring diagram

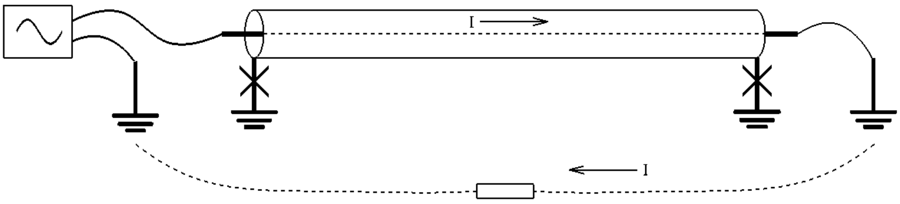


Figure 4.2 Core conductor-earth method principal diagram

Before making any contact with the cable, ensure that it is switched off and fully discharged.

For this method it is important that the return path, through the connected conductor and its earth connection, is the only available path for the signal. Hence, it is necessary to disconnect the earth wires at both ends of the cable's metal sheath. For low-voltage cable it will also be necessary to disconnect the neutral wire, if it is earthed, and the earth wire.

Attach the red crocodile clip of the transmitter to one of the cores, and the black crocodile clip to an earthing pin driven into the ground. At the opposite end of the cable, the corresponding core conductor is connected to another earthing pin.

Due to the anti-error tracking function of the instrument; the signal flows through the well-insulated core conductor and will not flow in adjacent cores. In addition, because the cable is earthed, the signal voltage is very low, preventing capacitive coupling to adjacent lines, reducing interference.

Earthing pins should be used as much as possible, rather than using the earth grid. The remote end must always be earthed using an earthing pin which should be inserted into the ground as far as possible from the earth grid, otherwise earth current return may flow on other cables, adversely affecting the measurement.

The current is injected into the core conductor from the transmitter, enters the earth at the opposite end of the cable, and finally returns to the transmitter through the ground. The receiver will sense a strong signal, with clear signal characteristics. The signal flows through a well-insulated core conductor and will not flow in adjacent pipes or cables. In addition, because the cable is earthed, the signal voltage is very low, and making capacitive coupling to adjacent lines unlikely, hence reducing interference.

Due to the distributed capacitance between the core conductor and the ground, the current will gradually decrease as the distance increases. However, if the earthing is good, the capacitive current is very small and can be ignored.

The disadvantage of this method is the need to disconnect the earthing wires at both ends of the cable, which can be inconvenient.

4.1.2 Sheath-earth connection

The protective layer-earth wiring diagram and principle are as follows.

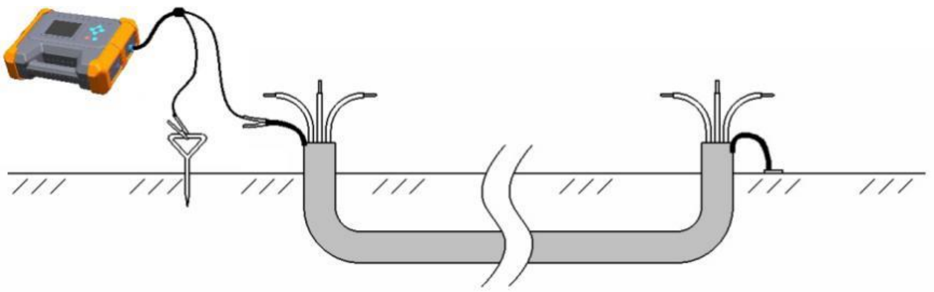


Figure 4.3 Connection diagram of sheath-earth method

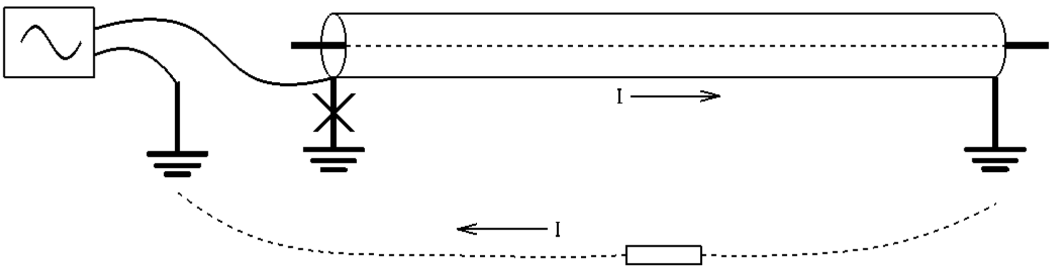


Figure 4.4 Schematic diagram of sheath-earth method

As shown in the figure above, the earth wire to the sheath must be disconnected at the near end of the cable. For this method it is important that the return path through the sheath and its remote earth connection is the only available path for the signal. Hence, for low-voltage cables, it will also be necessary to disconnect the neutral wire, if it is earthed, and the earth wire.

With this method, the cable sheath at the far end remains earthed. A signal is then applied between the sheath and an earthing pin inserted in to the ground (Do not use the earth grid). No connection is made to the cable core. Current is injected into the sheath from the transmitter, it is conducted along the sheath and enters the earth at the opposite end of the cable, returning to the transmitter through the ground. There is no shielding in this connection, so the signal generated in the ground is strong and the signal characteristics are relatively clear.

Similarly, due to the existence of distributed capacitance between the sheath and earth, the signal will gradually attenuate along the cable.

If the insulating layer outside the protective layer is damaged, part of the current will flow into the ground from this point, causing the current flowing beyond it to suddenly decrease. The reduction in the current is proportional to the earth resistance at the fault point. This may affect the use of the current intensity criterion, which is why this method is not preferred.

4.1.3 Core conductor (phase conductor)-sheath connection

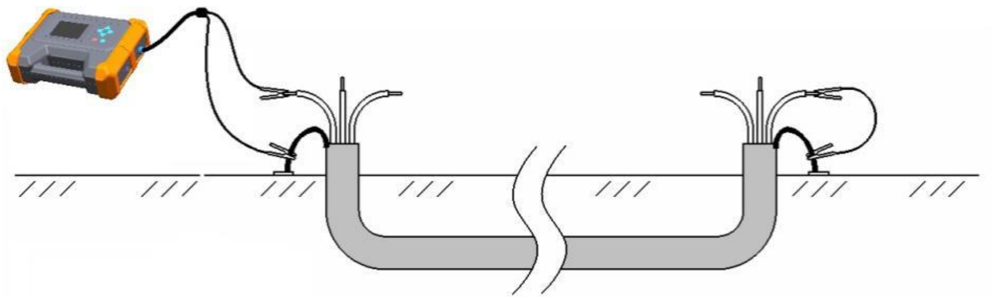


Figure 4.5 Wiring diagram of core conductor-sheath method

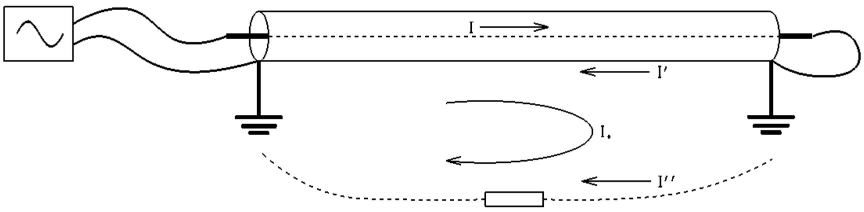


Figure 4.6 Schematic diagram of core conductor-sheath method

As shown in Figure 4.5 above, the transmitted signal is connected between one of the phase cores of the cable and the sheath. The connected core and the sheath at the far end are short-circuited, with both ends of the sheath earthed.

The signal is injected into the core from the transmitter and returns through both the shield and the earth. As the shield is composed of continuous metal, the resistance is very small, however, the earth loop has a large resistance value due to the earthing resistance at both ends and the earth resistance. As a result, most of the current will return through the protective layer, with only a small portion of the current returns through the earth.

Since the core conductor current and the sheath current are flowing in reverse directions, the effective current which will generate a magnetic field signal is the difference between the two, with the value being equal to the resistance current returning through the earth. In addition, due to the mutual inductance between the core conductor-sheath loop and the sheath-earth loop, electromagnetic induction can also induce current in the sheath-earth loop.

Therefore, the total effective current is equal to the vector sum of the resistance current and the induced current of the earth loop (there is a phase difference between the two). Depending on site conditions, the total effective current may account for up to ten percent of the total injected current.

If there are other cables laid in the same path (with their ends in the same place), the return current will be mainly divided between the sheaths of several cables. For example, if three cables have the same path, the sheath return current of the three cables will each account for 1/3 of the total. The effective current in the cable under test, is in the forward direction, accounting for 2/3 of the injected value. In the adjacent lines, the current is in the reverse direction, accounting for 1/3 of the injected value. As shown in Figure 4.7.

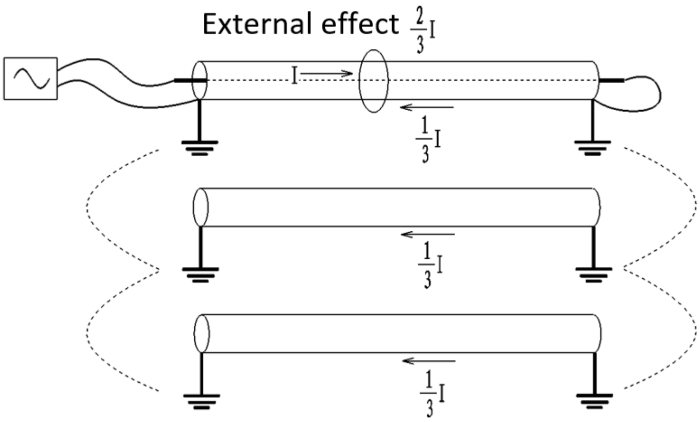


Figure 4.7 Diagram showing the effect of the core conductor-sheath method on parallel cables

The core conductor-sheath method has the advantage of simple wiring and no need to disconnect the earth wire. The disadvantage is that when multiple cables are laid in the same path, the signal of each cable is not much different, and it is sometimes difficult to distinguish only by the signal amplitude; when single-conductor laying, the effective current is greatly reduced, the signal is weak, and the effective current contains induced current components, the phase of the induction signal of the target cable and the adjacent pipeline is the same. When using composite frequency detection, it may not be possible to exclude adjacent line interference according to the current direction.

4.2 Live cable wring method

4.2.1 Clamp coupling method

The clamp coupling method provides an effective way of identifying live cables. It allows safe testing without the need to directly access the live cable. The method relies on the voltage signal which is present over the entire length of the cable, such that there is no distance limit.

When applying the clamp coupling method, both ends of the cable sheath must be properly earthed, otherwise the coupling current will decrease with the increase of earth resistance. If the two ends are not earthed, or the cable sheath is disconnected, this method cannot be used.

The clamp coupling method requires the sensor to be clamped around the cable body. It is suitable for the identification of ordinary three-phase cables. The transmitter output is connected to the clamp, which is then attached to the cable body (noting that it should not be attached to the portion of the cable beyond the earth wire). The clamp is equivalent to a primary winding of a transformer, and the cable sheath to earth loop is equivalent to a single-turn secondary of the transformer.

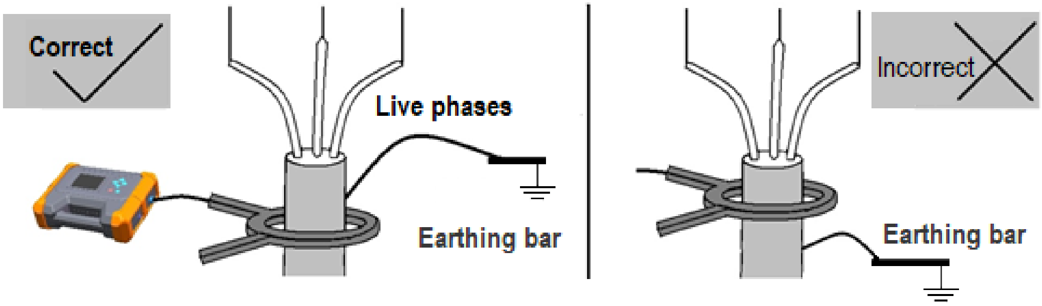


Figure 4.7 Correct, and incorrect, methods of cable clamping

The magnitude of the secondary coupling current is inversely proportional to the loop resistance, which mainly consists of the earthing resistance at both ends. The two ends of the cable must be well earthed to facilitate a high coupling current. If the current is small and it is confirmed that the measurement is being taken from the target cable, the quality of the earth bond should be checked.

The current induced in the cable through the clamp is relatively small. In order to improve detection, a larger output level may need to be selected.

The clamp method is not suitable for identifying live, very high voltage single-core cables. In this case, the power frequency current flowing through the core of the cable is very high, and the other phases are separate. Hence, there is no three-phase cancellation effect, as with a three-core cable. The high current in the cable may cause magnetic saturation of the sensor, so that it fails to measure high-frequency signals correctly.

4.3 Transmission frequency selection in cable detection

For general cable detection, unless the phase indirect method is adopted, it is recommended to use the default frequency of 1280 Hz which is selected when the power is turned on. This relatively low frequency gives a long propagation distance and it is not easily induced into adjacent cables or pipelines; in addition, the reception of the receiver at 1280Hz signal is stronger than at 640Hz and it has a stronger resistance to interference making it easier to distinguish.

If a 1280Hz signal is used for cables longer than 2-3km, there will be greater attenuation making the signal reception poorer and the phase may also shift. Therefore, it is recommended to use 640Hz when transmitting signals for the detection of long-distance cables.

640Hz and 1280Hz are composite frequency signals, allowing the receiver to readily identify them.

5. Intelligent Cable Identification

When laying cables for an electric power system, their unique identification is vital to ensure the safety of personnel and to prevent damage to equipment and plant.

Intelligent recognition using the flexible sensor facilitates clear results with immunity to interference.

5.1 Selection of signal transmission method

The transmitter must be set to 1280Hz or 640Hz frequency. Generally, using the default value of 1280Hz will meet most test requirements, with 640Hz being used for extra-long cables.

For non-operating cables with no voltage present, use the direct connection method, with the core conductor-earth connection method being preferred; if this method is not convenient, use the phase conductor-sheath connection method. The sheath-earth connection method is not recommended.

The clamp coupling method must be used for live cables.

5.2 Receiver flexible sensor connection

Insert the lead of the flexible sensor into the accessory input socket on the receiver, as shown in the figure below.

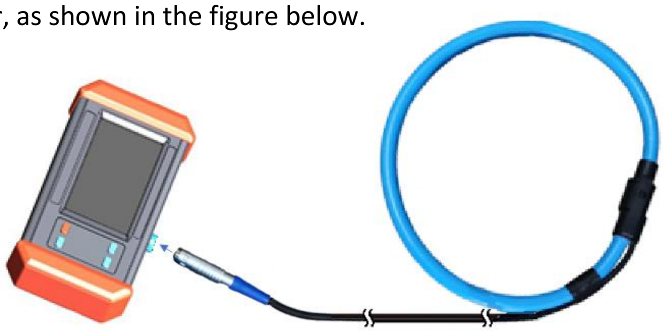


Figure 5.1 Flexible sensor connection

5.3 Introduction to the receiver interface

After power on, the receiver automatically recognises the connected accessories and sets it to sensor receiving mode. The interface is as follows:

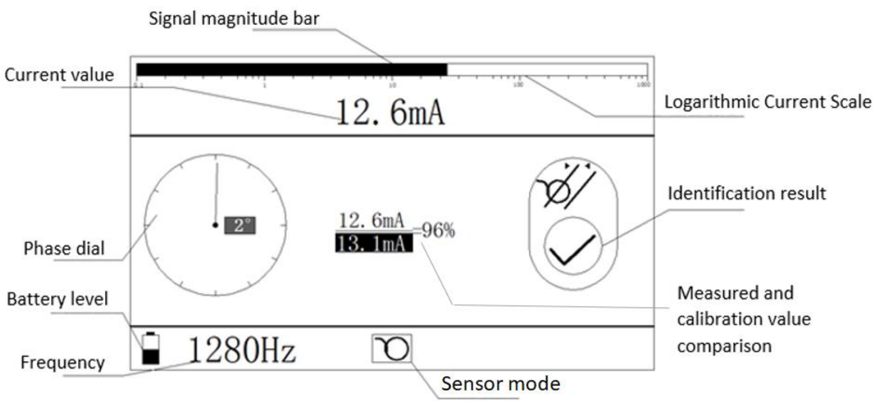


Figure 5.2 Receiver interface

The receiver selects 1280Hz by default when it is turned on, and the frequency is set to be consistent with the transmitter. In the sensor mode, there is no need to adjust the gain. The current value is directly displayed and compared with the calibrated current, the percentage is displayed. The phase dial displays the current phase and the recognition result will either show that the correct cable has been chosen with a tick icon or the cable is incorrect with a cross icon.

5.4 Calibration

The intelligent identification by the flexible sensor requires the receiver to measure the current intensity and the phase of the target cable at a known position, this is used as a benchmark for comparison. The measurement result at an unknown point can then be compared with the benchmark, to make a judgment as to whether or not it is the correct cable.

Calibration is the process of measuring and recording the reference current and phase as the benchmark. It should be carried out at a location close to the transmitter, at a point where the measurement will not be affected by interference.

The sensor should be at least 2m away from the transmitter and must be attached to the target cable.

Note that the arrow on the sensor must point to the remote end of the cable.

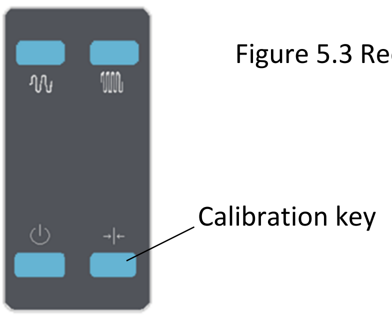


Figure 5.3 Receiver keypad

To operate the device, Press the “Calibration” button on the receiver, the lower right of the screen will display: to prompt whether a sensor Set reference is required. If it is not, then pressing another button will cancel it. If the reference setting is wanted, pressing the calibration button again will complete the setting.

Now the screen will display and the current phase is reset. The pointer of the phase dial points upward and the angle below the dial will be 0°. The current value will be used as the denominator of the comparison calculation. The cable recognition result will then be shown as correct .

This will be the reference for following measurement. After setting the reference, the data should be saved. If the instrument is switched off, the data will be saved. When identifying other cables, the reference must be reset for the new target cable.

All subsequent identification measurements are based on this. Data will not be lost after the calibration is completed. However, when identifying another cable, it must be re-calibrated for the new target cable.

When the clamp method is used to transmit signals to a live cable, the transmitter clamp will radiate signals in to the air which may cause interference to the reception. To avoid this, the distance between the transmitting and the receiving sensor must be 2 - 5m during calibration. To identify if there is interference, the receiver should be calibrated and without changing position, the clamp should be moved away from the cable and closed in the air. The observed measured current value on the receiver should be far less than the original current, ideally close to 0, indicating the separation is sufficient. If the measured current is too high, the distance between the transmitter and receiver should be increased.

5.5 Cable identification

With the calibration complete, the instrument is repositioned at the point at which the cable requires identification and is attached using the flexible sensor, ensuring that the direction arrow still points towards the end of the cable.

If it is the target cable (the one on which the calibration was made), its current value and phase should be similar to the measurement result at the calibration point. The specific criteria are as follows:

The current value is greater than 75% of the calibration value and less than 120%.

The current phase difference does not exceed 45°.

If it matches, the recognition reference result is displayed as correct✔. If it does not meet the criteria, it is not the correct cable and the recognition reference result is displayed as incorrect✖.

Core conductor-earth connection method basic operation

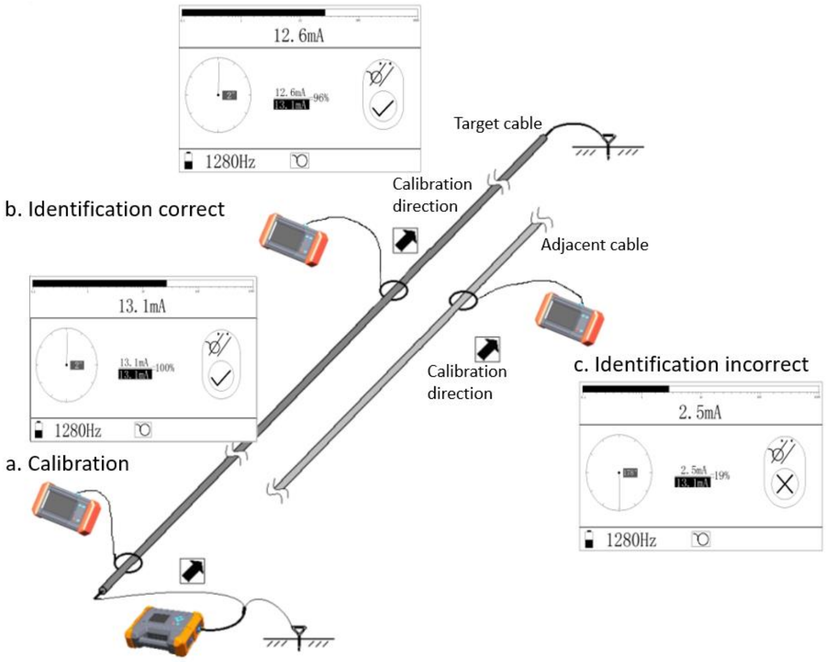


Figure 5.4 Intelligent sensor recognition process using the core conductor – earth connection

During the calibration process and when the identification procedure is being carried out, the direction arrow on the sensor must point to the far end of the cable, and it must be properly closed.

Although the core conductor-earth connection method is cumbersome to use, it is preferred as it produces the largest effective current on the target cable and it minimises interference from adjacent cables, so it should be used first.

In the example shown in Figure 5.4, the target cable current is 96% of the calibration figure, and the phase is near 0°, indicating that the identification is correct; the adjacent line current is only 19% and the phase is close to 180°, indicating this is not the correct cable.

5.5.1 Core conductor-earth connection method examples

When using the core conductor-sheath connection method to transmit signals, if there is no parallel cable laid along the same path with the same start and end points, the effective current will be relatively small. If there are cables with the same path, the current of the target cable is approximately equal to the sum of other cable currents.

- The first example (Figure 5.5) shows three cables, including the target cable, are in the same path. The measurement result will show the target cable current is I, and the phase is near 0°, indicating that the identification is correct; the current of the two adjacent lines will be half the value of I, with the phase near 180°, leading to recognition of incorrect cables.

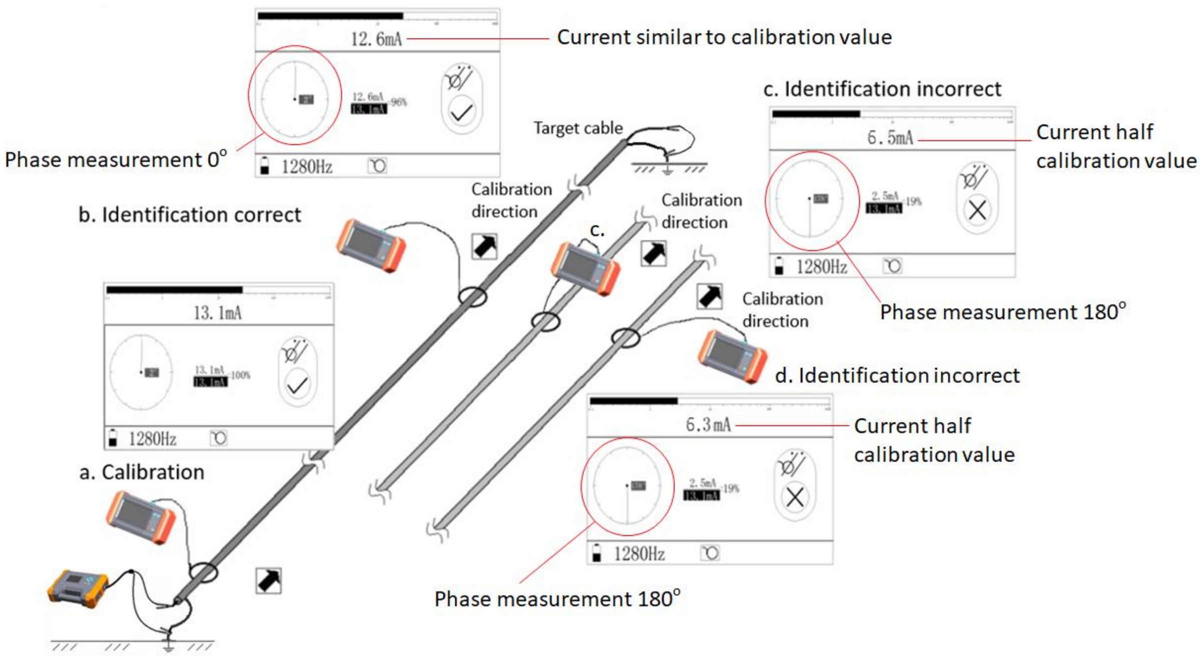


Figure 5.5: Results for three parallel cables with core conductor earth connection

- The second example (Figure 5.6) shows two cables which are in the same path (including the target cable). The measurement result shows the target cable current is I (in this example 12.6mA) and the phase is near 0°, indicating that the identification is correct. The other adjacent line current is also I, but this time the phase is near 180° which indicates it is not the target cable. In this case, because the current value is almost the same, it can only be distinguished by the phase, and special attention should be paid to the sensor arrow direction.

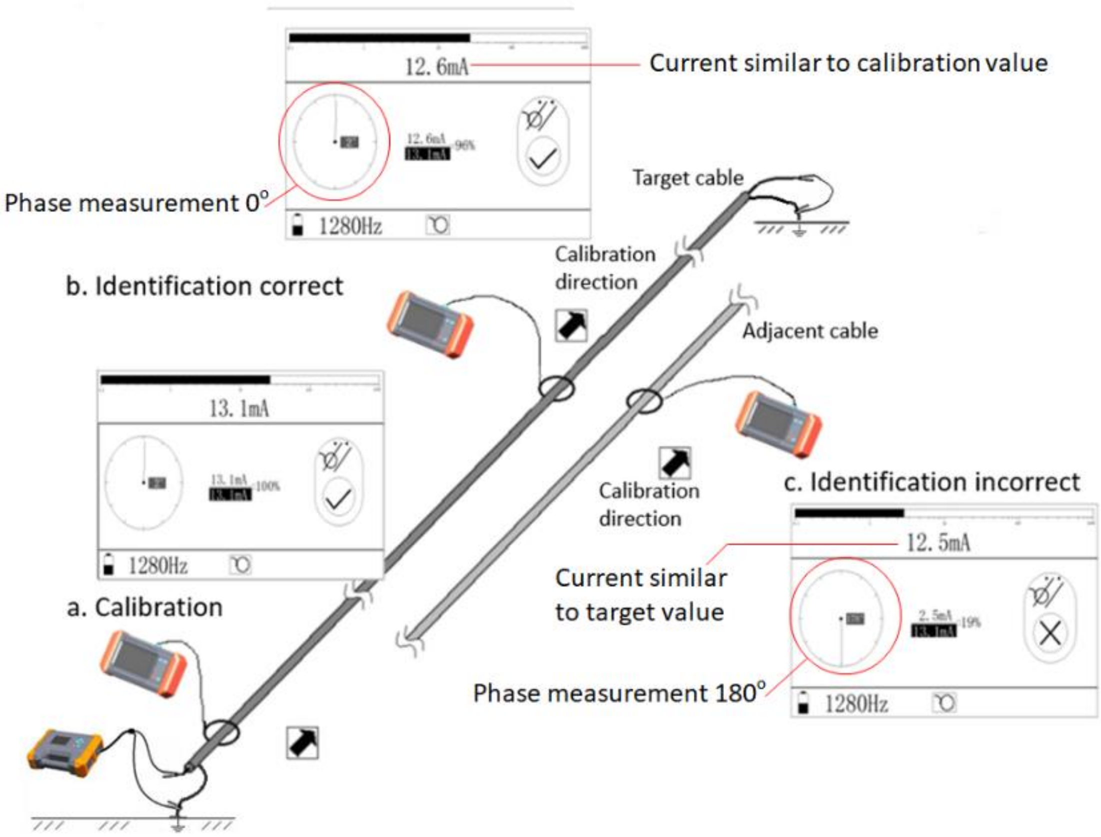


Figure 5.6: Results for three parallel cables with core conductor earth connection

➢ The third example (Figure 5.7): The paths of other parallel cables and the target cable are different (generally the ends are at different positions). The measurement result is: the target cable current is I, but the value is much smaller than the transmitter injection value, and the phase is near 0°, prompting identification Correct. The adjacent line current is close to 0, and the phase is close to 180° or unstable, indicating a recognition error.

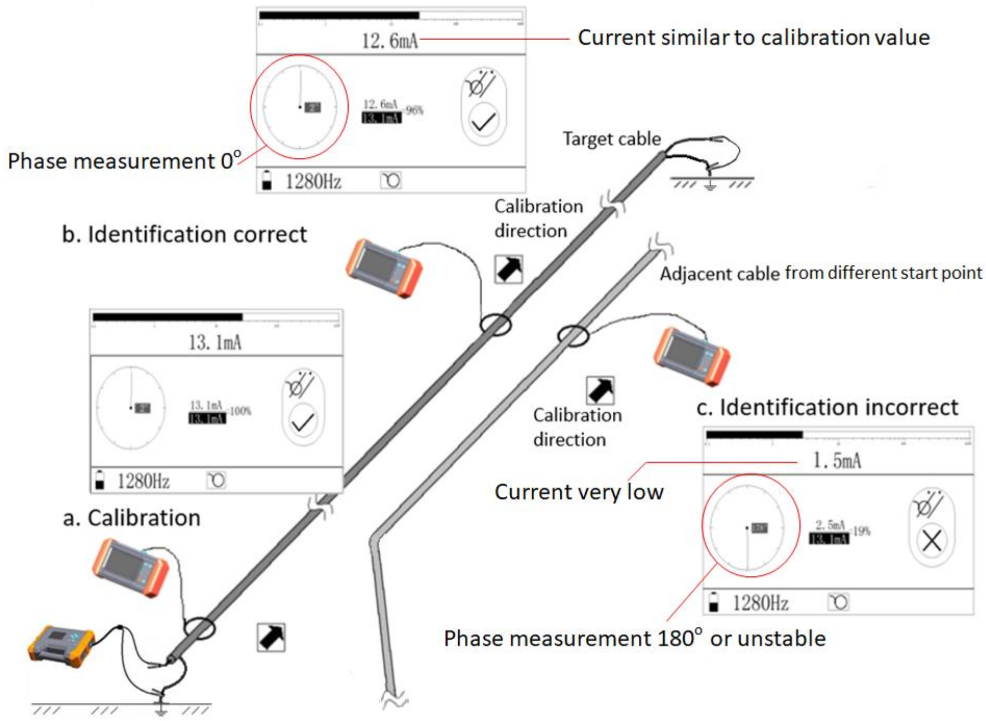


Figure 5.7 Results for adjacent cables from different start points with core conductor earth connection

5.5.2 Analysis of results

The results of the cable identification process have implications for the safety of both personnel and the risk of damage to facilities, hence care is required to ensure the results are correct. The user should always confirm its validity by considering on-site information such as the cable diameter etc. Even if the initial result appears to confirm that the target cable has been identified, other adjacent cables should also be checked for their current magnitude and phase to confirm that they deliver negative results which affirm the initial indication.

If it is certain that the target cable is amongst those being checked but two, or more, cables appear to show correct identification; or, if all show identification errors, and the observed current value and phase are similar, further investigation is required:

- Recheck the wiring
- Repeat the calibration process
- Ensure that the sensor is connected with its arrow in the right direction

- Confirm that the correct transmitter is indicating the correct transmission method
- Clean the jaws of the clamp, ensuring they are not contaminated and are closing properly, then repeat the identification process

If the result is still unclear, a different method should be attempted if possible.

6. Power Frequency Current Measurement

Power frequency current measurement is useful wherever AC power is used. The main function is for the on-site measurement of AC supply and leakage current, etc.

The flexible sensor coil on the T-710 allows non-contact measurement of the current and has no exposed metal parts. It is safe, fast and convenient due to its small size, light weight, reliability, high measurement accuracy and bandwidth response frequency. It is especially suitable for use in narrow, inaccessible environments and places with dense wiring such as transformers positioned against walls. It can also be used in industrial environments in the presence of interference.

6.1 Interface introduction

In the power-on state, the receiver automatically recognises the connected accessory and sets the sensor receiving mode. Pressing the frequency increase or decrease key accesses the power frequency current measurement interface. Once the flexible sensor is correctly connected, the current measurement can be performed.

6.2 Position error

The cable to be tested should be placed as close to the centre of the flexible sensor as possible. It should also not be next to the sensor fastening, as this will lead to the test error approximately doubling.

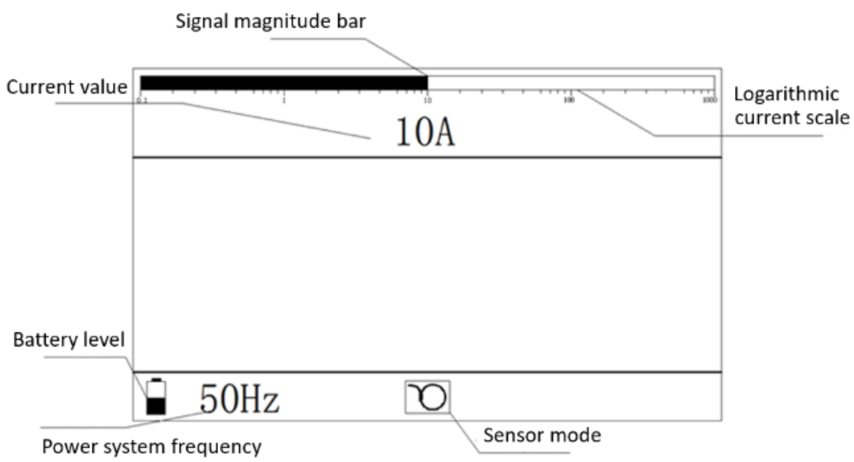


Figure 6.1 Power frequency current measurement interface

7. Transportation and Storage

7.1 Transportation considerations

The instrument has been subjected to environmental testing covering; temperature, humidity, vibration, impact and other tests in accordance with appropriate specifications. However, the instruments should be handled with care during transportation.

7.2 Storage conditions and precautions

To ensure good maintenance and correct use of the instrument, the following environmental requirements should be adhered to:

- Storage temperature: -40℃ to +50℃
- Relative humidity: 40℃ 20% to 90% RH
- Atmospheric pressure: 86 to 106 kPa

When the instrument is not in regular use, it should be stored indoors using the original packaging and not exposed to direct sunlight or moisture. The storage room should be ventilated, dry and free from corrosive gasses. The instrument should not be exposed to severe mechanical vibration and shock and should not be subjected to strong electromagnetic fields.

8. Unpacking Inspection, Maintenance and Warranty

8.1 Initial checks

Before unpacking for the first time, please follow the steps below for unpacking inspection.

- Open the box and remove the document bag containing the packing list.
- Check the packing list to confirm the instruments and accessories are included and intact.
- Check that the serial number on the warranty documentation matches the actual serial number on the nameplate of the instrument and the card.
- Check whether the instrument batteries are charged, if not charge them.
- Press the Power-on button and check that the device turns on correctly.

8.2 Maintenance

As long as they are used properly, the instruments do not have any parts that require maintenance or calibration under normal conditions. If the surface of any of the instruments becomes contaminated with dirt, wipe it off with a soft, dry cloth or a soft cloth slightly dampened with a soft (non-bleach) household cleaner. As a basic principle, do not let moisture into the Receiver charging port; if the surface of any of the instruments becomes wet, dry it with a soft cloth.

8.3 Warranty

The instrument is guaranteed for one year from delivery for any problems arising from product quality issues. If problems occur due to improper use or are beyond the warranty period, contact Kehui International or one of its approved distributors for assistance. (info@kehui.com)

Repairs attempted without the express permission of Kehui will invalidate the warranty and may lead to further damage to the equipment.

9. Packing list:

No.	Description	Appearance	Quantity.
1	T-710 Transmitter		1
2	T-710 Receiver		1
3	Transmitter direct connection cable		1
4	Transmitter accessory cable		
5	Transmitter clamp coupler		1
6	Receiver sensor		1
7	Earthing rod		2
8	Transmitter power cable		1
9	Receiver charger		1
10	Carry case		1
11	Manual		1