TFN A1200 Underground Pipeline Detector

USER MANUAL

Catalogue

Chapter 1 Preface

1.1 Research and Development Significance

The research and development of underground pipeline detectors has a history of more than 30 years in China. From the early electric bridge to the recent time domain, it has now developed to secondary pulse (multiple pulses) and triple pulses. These changes are all to solve the problem of distance measurement, but there has been no breakthrough in the path and fixed point. While developing and producing underground pipeline detectors, our company has long been committed to the service and research of cable fault testing technology, solving many difficult problems for customers and gaining the trust and support of the majority of users. At the same time, we brought back the problems on site and conducted targeted research, and finally gave birth to the user-expected and unique underground pipeline detector in China. It has path finding and buried depth testing in one, one person can operate it and complete it in one go.The successful development of this product has solved the problems of live routing and live identification that have plagued power supply and power consumption departments for many years; solved the problem of accurate path finding of faulty cables; solved the problem of the inability to locate dead cables and short circuits; opened up new areas of cable routing and fault location, breaking the monopoly of foreign products in China.

1.2 Scope of application

Since the product was launched on the market, it has been widely used in urban power supply bureaus, county power bureaus, railway power supply sections, large and medium-sized enterprises (petroleum, chemical, coal mines, power plants, steel mills), colleges and universities, property communities, urban street lamps, highways, China Railway, China Construction and other departments due to its powerful functions and superior performance. With our strong technical support, it plays a due role in the rapid repair and elimination of cable faults for power supply and power consumption departments.

1.3 Tips

Although the instrument is powerful and has excellent performance, it is always a tool to assist people in solving problems. It cannot directly tell people the specific location of the line and fault, but the operator can easily make judgments and conclusions based on the various information reflected by the instrument.

The company will make unremitting efforts to improve and enhance the products and continuously launch new products with more advanced technology, better performance and more complete functions, providing you with a solid material foundation and strong technical support in the field of cable monitoring and testing. At the same time, we hope

that users will give us more valuable suggestions.

In order to ensure the safe and smooth use of this instrument and to maximize the function of the instrument, please read the user manual carefully before using the instrument.

Chapter 2 Instrument Introduction

2.1 Instrument features

1) Portable and lightweight, easy to use, powered by rechargeable batteries, can be operated by one person, and four tests can be completed at one time.

2) Digital design, software control, stable and reliable performance.

3) Large color LCD interface, English display, easy to understand at a glance, easy to learn and easy to master.

4) The measured information is provided to the operator in three ways: digital size, grating length, and sound speed, making the test process easy and comfortable.

5) The transmitter has constant power output and automatic matching to ensure that the machine works in the best state. Built-in ohmmeter function, automatically measures the loop impedance of the cable to the ground and between phases, which can help determine the nature of the fault.

6) It has a backlight function and is suitable for night operation.

2.2 Instrument composition

2.2.1 Standard configuration: transmitter, receiver, charger, direct connection line, ground rod

2.2.2 Optional: A-frame, large coupling clamp, small coupling clamp, damage detection rod

2.3 Instrument parameters

2.3.1 Transmitter

1) Output signal: Output four frequencies of sinusoidal AC signal, namely low frequency, medium frequency, high frequency, and radio frequency.

2) Output power: Constant power output, low, medium, and high (maximum not less than 6 watts).

3) Output mode: direct connection method, coupling method, induction method.

4) Impedance display: within 99999 ohms.

5) Load matching: 1-10000 ohms.

6) Display interface: Large screen color LCD English, graphic display, with backlight.

7) Power supply: 6 standard No. 1 1.2V rechargeable batteries, charge and discharge 500 times.

8) Standby time: more than 8 hours, power prompt.

9) Overheat and overcurrent: automatic protection.

10) Working temperature: -20℃—50℃

11) Volume: 400mm × 160mm × 140 mm

12) Weight: 3.6 kg

2.3.2Receiver

1) Receiving frequency: Receive sinusoidal AC signals of five different frequencies, namely low frequency, medium frequency, high frequency, radio frequency, and 50HZ.

2) Receiving mode: peak method (horizontal coil), trough method (vertical coil), external device method (A-frame, coupling clamp).

3) Signal interface: Three interfaces, namely digital size, grating length, and sound speed, simultaneously indicate signal strength

4) Display interface: Large screen color LCD English, graphic display, with built-in backlight.

5) Gain control: manual adjustment, dynamic range 000-100db.

6) Detection length: When directly connected to the cable, the maximum is 15KM. .

When coupling the cable, one coupling can measure 3Km, and multiple couplings are infinite.

When inductive cable, one induction can measure 300m, and multiple inductions are infinite.

7) Depth measurement: direct reading detection depth, range 000-250cm.

80% method for depth measurement, range 000-250cm (induction)\500cm (direct connection)

8) Current measurement: direct reading current, range 000-999mA.

9) Detection accuracy: 5% of burial depth

10) Power supply: 6 standard No. 5 1.2V rechargeable batteries, charge and discharge 500 times.

11) Standby time: more than 12 hours, power prompt.

12) Overheat and overcurrent: automatic protection.

13) Working temperature: -10℃-40℃.

14) Volume: 650mm × 110mm × 230mm

15) Weight: 2.3Kg

2.4 Working Principle

This instrument is a high-tech product designed based on the principle of electromagnetic induction, step voltage theory, digital filtering, wireless reception, and software control.

Electromagnetic induction: Its basic working principle is: the transmitter generates electric and magnetic waves and transmits the transmission signal to the underground metal pipeline to be detected through different transmission connection methods. After the underground metal pipeline senses the electromagnetic wave, an induced current is generated on the surface of the underground metal pipeline. The induced current will propagate far away along the metal pipeline. During the propagation of the current, it will radiate electromagnetic waves to the ground through the underground metal pipeline. In this way, when the underground pipeline detector receiver detects on the ground, it will

receive electromagnetic wave signals on the ground directly above the underground metal pipeline. The position and direction of the underground metal pipeline can be determined by the changes in the strength of the received signal.

The conditions for the realization of this principle: First, there must be a signal source that can generate enough electrical energy to form a current in the line that can transmit electrical energy, and the current will generate a magnetic field around the line during the flow; second, there must be a circuit that can receive this specific magnetic field and display the change process of the magnetic field in the form of an electrical signal.

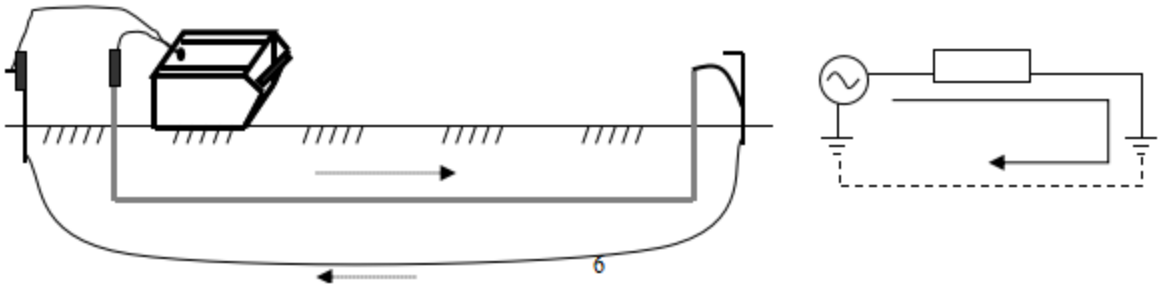
Step voltage: First, it is necessary to ensure that the electric energy in the circuit flows to the ground (leakage point). An electric field will be formed around this point. It diffuses outward in the form of electric potential with the leakage point as the center, and the electric potential is equal in the same circle. Secondly, there must be a circuit that can detect the potential difference, measure the equipotential circle, and the center of the circle is the leakage point (cable fault point). This is the theoretical basis for the step voltage setting point of this instrument.

2.5 Signal output mode - Transmitter working mode

The transmitter can output four different frequency AC signals (low frequency, medium frequency, high frequency, radio frequency), which can be applied to the target cable in three ways (direct connection, coupling, induction). To ensure reliable transmission of the signal on the target cable, there must be a reliable loop in the line. It can be an indirect loop formed by the earth, a capacitive loop formed by the distributed capacitance formed between a sufficiently long cable and the earth, or a direct loop formed by the line short circuit fault point. Different loops meet different tests, such as: direct loops can only be used for tests of line short circuits and fault area judgment. Direct loops must be avoided in other tests.

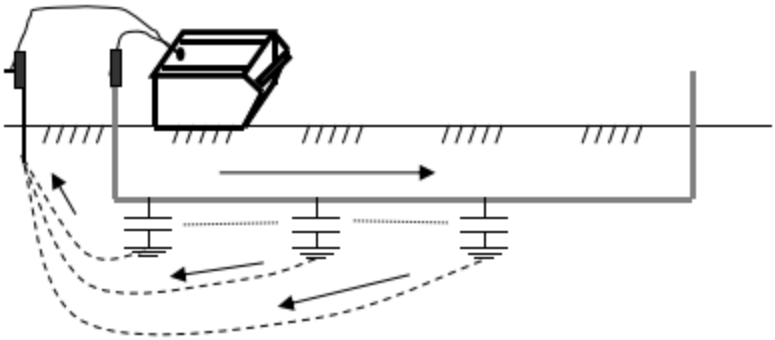
2.5.1 Direct connection method

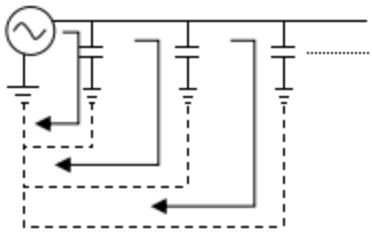
The signal of the transmitter is directly applied to the target cable (power-off cable) with a direct connection line. The direct connection line is divided into red and black wires. The red wire is connected to one of the wires of the cable. The black wire is the instrument working ground wire and should be reliably grounded separately. In order to ensure the reliable one-way transmission of the signal in the line, it is required to disconnect at least one end of the ground wire of the target cable so that the signal can flow back through the earth in an indirect loop or a capacitive loop. As shown in the figure:



Direct connection method indirect circuit (terminal grounding) - schematic diagram

Direct connection method indirect circuit - schematic diagram





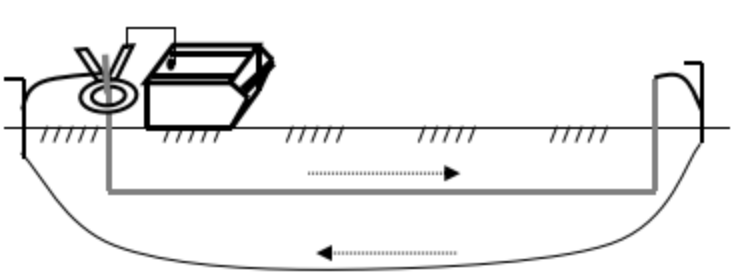
Direct-connect capacitive loop (terminal not grounded) - schematic diagram

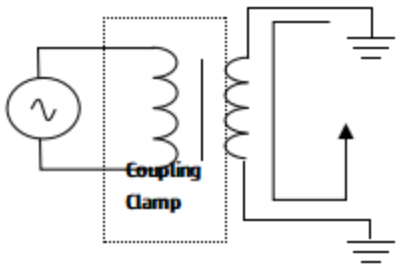
Direct-connect capacitive loop - schematic diagram

The direct connection method uses cables to directly transmit signals. The transmission process has low attenuation, strong signals, and long transmission distances. It is the best method for signal application and is suitable for the transmission of any type of signal. It is the preferred method for testing.

2.5.2 Coupling method

The signal from the transmitter is inductively applied to the target cable using a coupling clamp, which is called the coupling method. To ensure that the coupled signal can be reliably transmitted in the line, the jaws must be completely closed and there must be ground-related contact points at both ends of the cable. As shown in the figure:





Coupling method wiring - schematic diagram

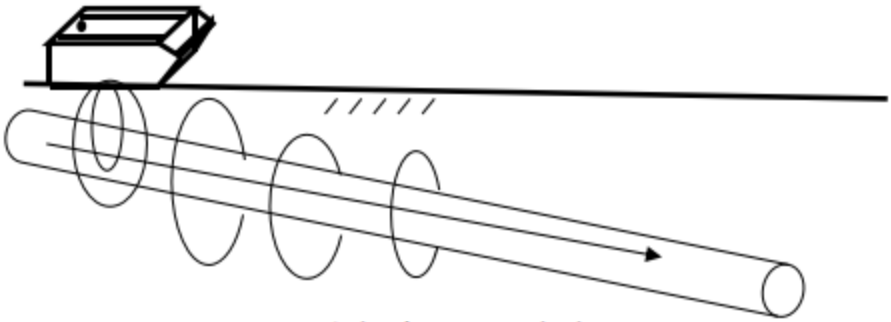
Coupling method schematic diagram

The strength of cable coupling to the signal is directly related to the frequency of the signal.Low frequency means weak coupling, high frequency means strong coupling. Sometimes it is also related to whether the line is running. Under the same frequency, the signal coupled to the running cable is stronger than that to the non-running cable. Therefore, the coupling method is particularly suitable for live line measurement and live line

identification.

2.5.3 Induction method

The transmitter uses the built-in antenna to emit electromagnetic waves with a certain direction, frequency and range. When the mobile transmitter is aimed at the cable, the electromagnetic waves will be induced to the cable and transmitted along the cable, which is the induction method. To ensure that the signal can be reliably sensed and transmitted, it is required that both ends of the cable must have contact points related to the ground, the induction indicator line of the transmitter must be consistent with the direction of the cable, the signal frequency must be high frequency or radio frequency, and the power should be as high as possible. As shown in the figure:



Inductive test method

Induction is a process in which there is no contact between the transmitter and the target cable, and the electromagnetic wave is radiated to the carrier that can generate the induced potential, and the induced current is generated and transmitted. Because of the induction process, the induction method is a passive signal application. Whether the signal is applied, the strength and the speed of attenuation are not only determined by the instrument, but also have a lot to do with the structure, laying and operator of the cable. In the case of multiple cables, it is impossible to accurately locate a certain cable and cannot be used to locate the fault point.

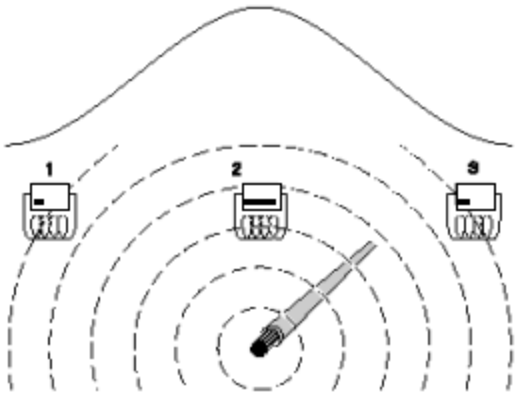
Induction can be divided into two types: target induction and non-target induction; target induction means: it is known that the cable is buried at a certain point, and induction is performed at the known point. Non-target induction means: it is unknown whether there is a cable in a certain area, and blind induction is performed by mobile transmitters. Therefore, the induction method is particularly suitable for detecting whether there are cables in a certain area.

2.6 Signal Receiving Method – Receiver Working Mode

When a signal is applied to the cable, there is a current on the cable, and the current generates a magnetic field that radiates around the cable. The frequency of the magnetic field is consistent with the frequency of the applied signal, and the strength decreases from

the cable as the center and radiates outward, and the direction is the tangent direction of a certain point on the circumference of the radiation circle.

The receiver receives the magnetic field signal or the leaked electric field signal radiated by the cable through the internal antenna or external input device, and can be processed in three different working modes to prompt the operator of the change in signal strength.



Peak Method

2.6.1 Peak Method

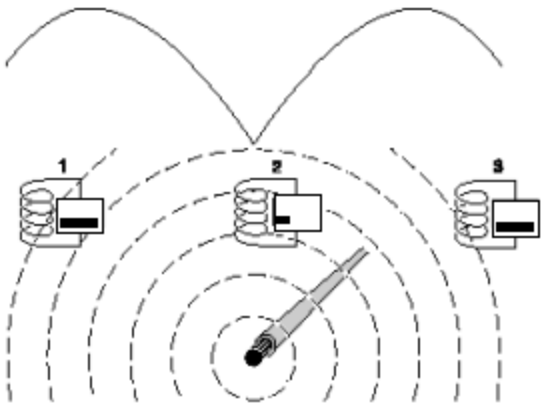
The signal measured by the receiver is the strongest when it is directly above the cable transmitting a specific signal; the signal measured by the receiver will decay immediately when it moves left and right on the same plane, so it is named the peak method. In fact, it uses the horizontal antenna in the receiver to sense the magnetic field signal.

When the horizontal magnetic field passes through the horizontal antenna, an induced current is generated in the coil. The magnitude of the induced current varies with the amount of magnetic field passing through the horizontal antenna (magnetic flux). Only when the magnetic field passing through the horizontal antenna is the largest (magnetic flux is the largest) when it is directly above the cable, the signal measured by the receiver is the strongest. As shown in the figure:

The peak method is suitable for path detection, depth testing, fault prediction, short-circuit point location, etc.

2.6.2 Trough Method

The signal measured by the receiver is the weakest just above the cable transmitting a certain signal. The signal measured by the receiver will increase immediately when the receiver moves left and right on the same plane, which is opposite to the peak, so it is named the trough method. In fact, it uses the vertical antenna in the receiver to induce the magnetic field signal.



Trough Method

When the vertical magnetic field passes through the vertical antenna, an induced current is generated in the coil. The magnitude of the induced current varies with the amount of magnetic field (magnetic flux) passing through the

vertical antenna. Only when the magnetic field is just above the cable or far away from the cable, the magnetic field passing through the vertical antenna is the least (magnetic flux is the smallest), that is, the signal measured by the receiver is the weakest.

Because the signals above the cable and far away from the cable are weak, the trough method is designed with an azimuth indication on the display; it is suitable for path verification and 45° depth measurement.

2.6.3 External connection method

The receiver can collect signals and expand functions by connecting an external A-frame, a damage detection rod and a coupling clamp.

In this mode, an external A-frame or a damage detection rod is connected, and the two ground pins of the A-frame or the damage detection rod are used to measure the potential of the earth leakage cable, and transmit it to the receiver for comparison and processing, and provide it to the operator in the form of signal strength, and then make a judgment based on the step voltage theory to accurately locate the earth leakage fault.

In this mode, an external coupling clamp is directly clamped on the cable to which the signal is applied, and the induction signal is directly transmitted to the receiver. According to the strength and presence of the signal, the cable can be identified or the fault area can be judged.

Chapter 3 Operation Instructions

3.1 Transmitter Operation

The transmitter is a signal source that can generate enough electrical energy and is one of the cores of this set of instruments. It has complete functions, high intelligence and simple operation.

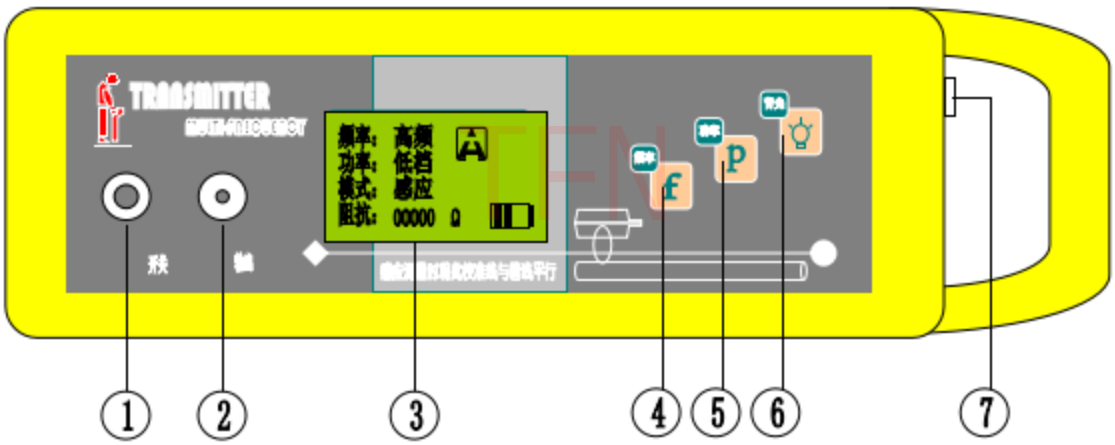
3.1.1 Panel Introduction

① Power button ② Output port ③ LCD display area ④ Frequency button ⑤ Power button ⑥ Backlight button ⑦ Charging port

See the figure below

3.1.2 Function Introduction

① Power button: This switch is a self-locking switch; press it to turn on the power, and the transmitter is in working state; pop it up to disconnect the power, and the transmitter is in shutdown state.



Transmitter panel diagram

②Output port: This interface is a multi-core dedicated aviation socket; it is used to change the output mode of the signal. Connecting a direct line is the direct connection mode; connecting a coupling clamp connection is the coupling mode; not connecting is the induction mode.

③LCD display area

Frequency: Displays the current output frequency; can display low frequency, medium frequency, high frequency, and radio frequency respectively. In the induction mode, only high frequency or radio frequency is displayed.

Power: Displays the current output power; can display low, medium, and high range respectively.

Mode: Displays the current working mode; can display direct connection, coupling, and

induction respectively.

Impedance: Displays the current loop impedance value; the effective display is 00001-99999 ohms.

Power: Prompts the current battery power; represented by a battery symbol, full black means full power.

Matching prompt: The icon rotates to indicate that the transmitter has been working stably.

④ Frequency key: This key is a momentary soft switch; each press can change the frequency of the output signal once, from low frequency, medium frequency, high frequency, radio frequency, and cycle selection; the initial power-on is low frequency. In the induction mode, only high frequency or radio frequency can be selected, and the initial setting is high frequency.

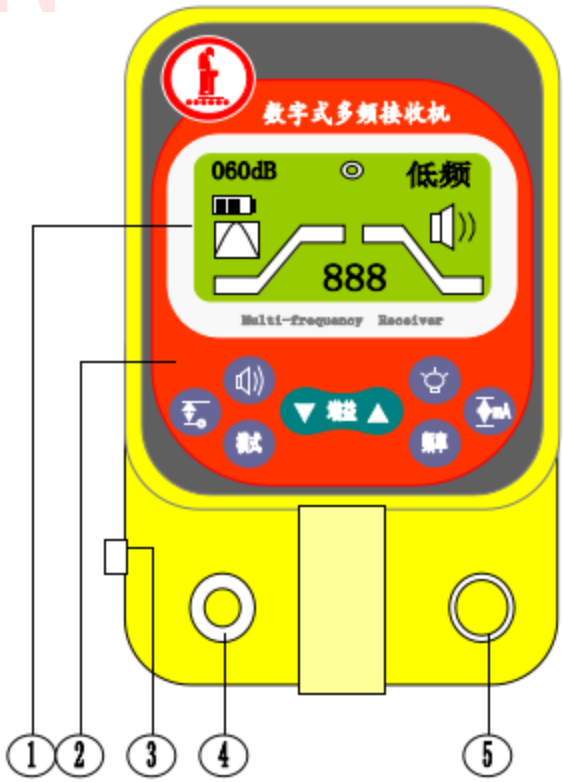
⑤ Power key: This key is a momentary soft switch; each press can change the output power once, and it can be selected from low, medium, high, and cycle; the initial setting is low when the power is turned on.

⑥ Backlight key: This key is a momentary soft switch; pressing it can light up or turn off the LCD backlight; the LCD backlight is turned off when the power is turned on.

⑦ Charging port: This interface is a Φ2.5 charging seat; it is used to connect a dedicated charger to charge the battery.

3.2 Receiver Operation

The receiver is a system circuit that can receive a specific magnetic field and convert it into an electrical signal to display it to the operator. It is the second core of this set of instruments. It is fully functional, highly intelligent, portable and easy to operate. Optional external devices can be used to expand its functions.



3.2.1 Panel Introduction

① LCD display area, ② key area, ③ charging port, ④ switch, ⑤ external device port

3.2.2 Functional Introduction

① LCD display area

Frequency: Displays the current receiving frequency; displays low frequency, medium frequency, high frequency, radio frequency, and 50Hz respectively; the initial setting is low frequency when powered on.

Left and right gratings: An interface indicating the strength of the received signal, with the length of the grating indicating the strength of the signal; the left and right gratings move relative to each other, and when combined together, the signal is too strong or out of range.

Three-digit numbers: An interface indicating the strength of the received signal, with the size of the number indicating the strength of the signal; the effective digits are 000-999, and when 999 is displayed, the signal is too strong or out of range. It can also instantly display the direct measurement depth value, with a dynamic range of 000-250cm; it can also instantly display the direct measurement current value, with a dynamic range of 000-500mA;

Gain: Indicates the amplification factor of the current signal processed by the receiver, with a dynamic range of 000-100db; the initial setting is 060db when powered on.

Mode: Indicates the way the receiver receives signals, showing peak  , trough  and external device  . The initial display is peak when the receiver is turned on.

Battery level: indicates the current battery level; it is indicated by a battery symbol, and full black means full battery

Volume: indicates the current working status of the buzzer, indicated by a speaker symbol plus a line, one line means low volume, two lines means medium volume, three lines means high volume, and a cross means turning off the buzzer. The initial volume is medium when the device is turned on.

Target direction: In trough mode, an arrow (←) will automatically appear pointing to this mark (direction indicator) when the cable deviates; the arrow will automatically disappear above the cable.

②Key area

Frequency key:  This key is a momentary soft switch; each press can change the frequency of the received signal, from low frequency, medium frequency, high frequency, radio frequency, 50Hz, cycle selection; the initial power-on is low frequency.

Mode key:  This key is a momentary soft switch; each press can change the mode of receiving the signal, from peak  , trough  , external device  ; cycle selection; the initial power-on is peak.

Gain key:  This key is two momentary soft switches, the arrow up means that the gain can be increased, and the arrow down means that the gain can be reduced; each press changes a number, and holding it down changes continuously;

Depth key:  This key is a momentary soft switch, each press can directly measure the depth value, and it is instantly displayed in the three-digit area.

Current key:  This key is a momentary soft switch, each press can directly measure the current value, and it is instantly displayed in the three-digit area.

Backlight key:  This key is a momentary soft switch. Each press can light up or turn off the LCD backlight. The backlight is turned off at the beginning of the power-on.

Volume key: This key is a momentary soft switch. Each press can change the buzzer volume once. It can be selected from medium loudness, high loudness, beep off, low loudness, and cycle. The initial volume is medium when the power is turned on.

③ Charging port: This interface is a Φ2.5 charging seat; it is used to connect a special charger to charge the battery.

④ Switch key: This switch is a self-locking switch; press it to turn on the power, and the receiver is in working state; pop up to disconnect the power, and the receiver is in the off state.

⑤ External device port: This interface is a multi-core special aviation socket, which is used to connect external devices such as large and small coupling clamps. Expand the way of receiver signal intervention.

3.3 Operation of Accessories

3.3.1 Charger:

The charger is a DC9V, 1.2A intelligent charger with current limiting charging and overcurrent and overheating protection functions. When the charger is connected to AC220V mains power, the indicator light turns green. After the charging head is inserted into the charging seat of the host, the indicator light turns red, indicating that the battery is being charged; when the indicator light turns green again, it indicates that the charger enters a low-current slow charging state, and the charging time is generally required to reach 8-12 hours.

3.3.2 Direct connection line:

Insert the aviation plug of the direct connection line into the output port of the transmitter, and the red and black clips are connected to the cable and the ground respectively.

3.3.3 Ground rod: Insert into moist soil as a grounding electrode.

3.4 Operation of Options

Coupling clamp:

Large coupling clamp: a special clamp with a wide band and large opening (125mm). The clamp handle is equipped with a four-core aviation socket, which is connected to the transmitter for coupling output; connected to the receiver for cable identification.

Chapter 4 User Guide

4.1 Introduction

The first three chapters introduce the instrument and its operation, achieving the purpose of understanding the instrument's functions and performance and mastering the functions of each key and interface content. There is no problem in operating the instrument alone. However, actual testing and operating the instrument alone are two different concepts. Actual testing is a system testing process in which the operator (person) combines the transmitter, receiver, optional accessories and cable (target under test) in a certain environment (site) according to certain principles and theories, using specific methods to send signals, detect signals and then draw conclusions. In this process, any improper use of any link may cause the failure of the test. In other words, (actual testing is) in the test system of personnel + instrument + target under test + field factors under test, operating the instrument is only an important link, and understanding of factors such as cable structure, power supply mode, wiring conditions and laying environment is equally important. The more you understand, the more conducive it is to the test results. This chapter concludes with the general routine field introduction of the various test processes of this set of instruments: (4.2 Path detection 4.3 Buried depth test 4.4 Fault point location 4.5 Cable identification and fault area judgment)

4.2 Path detection

Path detection is one of the main functions of this instrument. Different signal application methods can be selected for different sites. The priority of selection is: direct connection, coupling, and induction. The reception and detection of the signal is not affected by the signal application method, and the operation is the same.

4.2.1 Direct connection method to detect the path:

1. Direct connection conditions:

1) It must be a power-off cable.

2) At least one end of the cable is known, and the known end is separated from the system, including the neutral line and the ground line.

2. Signal application: (transmitter)

1) The multi-core aviation head of the direct connection line is connected to the multi-core aviation socket (output port) of the transmitter.

2) The red clip is connected to a phase of the cable under test; if conditions permit, the other end of this phase can be grounded. (Forming an indirect loop) The effect is better.

3) The black clip is the working place of the transmitter. The principle of selecting the

grounding point is that the return signal cannot flow back from this cable, and the impact of the return signal on the test is minimized. Generally, it is required to make a separate grounding electrode. The method is to insert the grounding rod away from the cable into the moist soil. When the cable is completely separated from the system, the grounding point can be selected as the system ground.

4) After connecting the wires, press the power switch, the transmitter starts to work, automatically detects the loop impedance, and ensures that it works in the best matching output state. When the icon in the upper right corner of the LCD starts to move, it indicates that the transmitter is working stably. At this time, observe the loop impedance value. Generally, 00001-03000 Ω is appropriate. If it exceeds 03000 Ω , it means that the impedance is too large and the signal in the line is very weak. It should be adjusted and improved from the following three aspects.

First, improve the grounding conditions of the grounding electrode, humidify or change the system ground.

Second, ground the phase of the signal applied by the cable at the other end.

Third, adjust the frequency, change the low frequency at startup to the medium frequency (Note: the medium frequency is sufficient to meet the test when the direct connection method measures the cable)

5) The power is low when it is turned on, and the direct connection detection low power is fully satisfied.

3. Signal search and tracking. (Receiver)

1) Hold the receiver handle, relax your wrist and arm, let the receiver hang naturally, operate the button with your thumb, and keep a certain distance from the signal application point. The purpose is to avoid the grounding electrode and ground wire, and avoid obstacles such as distribution cabinets and buildings.

2) Press the power switch, select the peak mode  (the initial peak is when the power is turned on, and you don’ t need to select it again) and the frequency corresponds to the transmitter. Face the signal application point and point the head of the receiver to the beginning of the cable. And search for signals around the beginning. The initial gain of the power on is 60db. At this gain, if the three-digit number of the signal is displayed as 999 and the two gratings have crossed, then reduce the gain so that the number is displayed at around 800. There is an opening in the two gratings. At this time, keep the gain unchanged and continue searching. If the three-digit number shows 999 again, it means that the signal here is stronger than the last search. Reduce the gain again so that the digital display is around 800 again. Search in this way for a circle, and finally determine the minimum gain. The point below the strongest signal is the location of the cable. This process is to search for the secondary magnetic field radiated by the cable that transmits the applied signal, and exclude the secondary magnetic field of the non-target cable caused by the interference of

the ground wire string.

3) Keep the current gain unchanged, use the current received signal strength as the reference (three-digit value) and rotate the receiver with the axis of the point. The received signal will weaken with the rotation. When it is weakened to the weakest, the direction of the head is 90° with the direction of the cable at this point. Continue to rotate the receiver, and the received signal will increase with the rotation. When it is increased to the same as the reference value, the direction of the head is the path direction of the cable. Follow the direction of the head and follow the strongest signal forward to detect the exact path of the cable. This process is signal tracking, and the path is also detected.

4.2.2 Coupling method detection path

1. Coupling conditions

1) The cable must have a known exposure point.

2) Both ends of the cable must have a grounding point or a point related to the ground.

3) The coupling position should be as far away from the end as possible, and the ground wire should not be clamped into the clamp.

4) The coupling effect of the running cable is better than that of the non-running cable, and the running cable can clamp the phase line coupling and signal.

2. Coupling signal application (transmitter)

1) The four-core aviation head of the coupling clamp connection is connected to the four-core aviation socket on the clamp body, and the multi-core aviation head is connected to the multi-core aviation socket of the transmitter to complete the connection between the coupling clamp and the transmitter.

2) Put the coupling clamp on the exposed point of the cable under test, which is the signal application point. Note that the jaws must be closed.

3) Press the power switch and select the appropriate frequency and power. It is recommended to select medium or high frequency for frequency and select the gear for power. When the icon in the upper right corner of the LCD starts to move, it means that the transmitter is working stably.

3. Signal search and tracking (receiver)

It is exactly the same as 3. Signal search and tracking in 4.2.1.

4.2.3 Detection path by induction method. (It is known that the cable is buried at a certain point and the direction of this point is known)

1. Induction conditions

1) There must be a grounding point or a point related to the ground at both ends of the cable.

2) The placement of the transmitter requires that the induction test line must be consistent with the direction of the cable.

3) The burial depth cannot exceed 3 meters.

2. Application of induction signal

Press the power switch of the transmitter, select high frequency for frequency or high frequency for RF power. When the icon in the upper right corner of the LCD starts to move, it means that the transmitter is working normally.

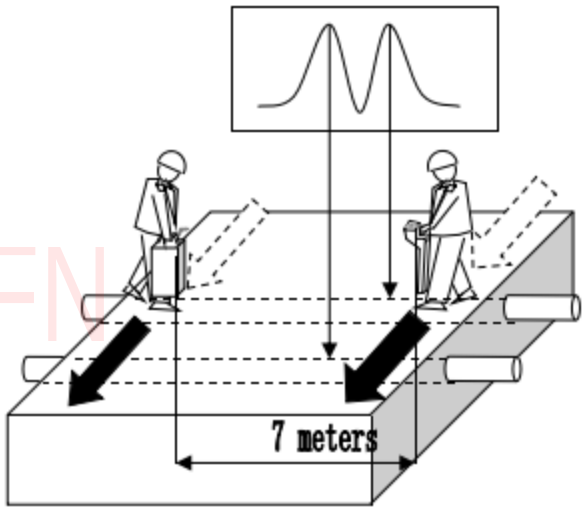
The transmitter is placed above the known point of the cable, and the induction test line is consistent with the direction of the cable at this point.

3. Signal search and tracking, the same as 3 in 4.2.1

4.2.4 Extension of induction detection - blind test

1. Principle of blind test

Blind test is a test method that uses the induction mode of the instrument to detect unknown metal pipelines and various cables. It uses the built-in antenna of the transmitter to transmit high-frequency or radio frequency electromagnetic signals underground (and also to the air) in a certain direction. When the electromagnetic signal hits the underground metal pipeline, the signal will be transmitted by the metal pipeline in the form of current. At the same time, the pipeline radiates a secondary magnetic field The receiver can receive this secondary magnetic field signal above the pipeline, which not only locates a point of the pipeline position, but also connects the measured pipeline position points to the specific position and direction of the pipeline. This is the principle of blind test.



Blind Test

Blind test using instrument induction method is an effective method for detecting pipelines, but it is also affected and restricted by factors such as the site environment, the material of the pipeline, and the burial depth. Therefore, the surveying and mapping of an area must be combined with the surrounding area of the site and the existing drawings and materials, and the investigation and field observation of local users.

2. Blind test method:

1) Preparation before the test: Before the blind test, the receiver must be placed within a certain distance from the transmitter, generally between 5-10 meters, preferably about 7 meters. One person holds the transmitter as close to the ground as possible (try to keep it as close to the ground as possible). Without connecting any wires, turn on the transmitter, select high frequency or radio frequency (it is recommended to select radio frequency), and select high power. Another person holds the receiver with the head pointing to the transmitter panel (front), and the two machines are about 7 meters apart. At this time, turn

on the receiver, select the frequency corresponding to the transmitter, and then adjust the gain to make the receiver as unaffected as possible by the magnetic field signal radiated from the transmitter in the air. Generally, the gain is reduced (about 50DB) to make the receiver signal strength display at about 500. With this signal strength as the base, keep the gain unchanged, maintain this distance, and then carry out the blind test. (Note: The two machines are close to each other. The receiver gain drops very low, which loses the detection depth and reduces the test blind area. The two machines are far away, the receiver is far away, and the receiver gain drops less, which can ensure the test depth, but the radiated secondary signal is relatively weaker than the close point, and the blind area increases.)

a) Blind test method 1: surface test

(1) Operation: Based on the preparation before the test, the two machines face each other and move in parallel. The moving speed should not be fast, but should be slow to allow the instrument to have enough time to react to the test. The transmitter is active and the receiver is passive. The receiver head should always be pointed to the front of the transmitter and the two machines should be consistent. When the receiver signal strength suddenly increases (the gain remains unchanged and is greater than the base number set before the test), it means that there is a metal pipeline between the transmitter and the receiver. At this time, you can lift the receiver up a little to see if the signal strength decreases, and then stick it down to the ground to see if the signal strength increases. If so, it is certain that there is a pipeline below. In this way, all metal pipelines within a depth of 2.5 meters perpendicular to the moving direction (deviation angle is ± 10°) can be measured. After measuring the known points, the path of the metal pipeline can be measured by induction method. Then, change the moving direction and find the pipeline perpendicular to the moving direction. In this way, the pipelines in this working surface can be found.

(2) Advantages: Fast test speed

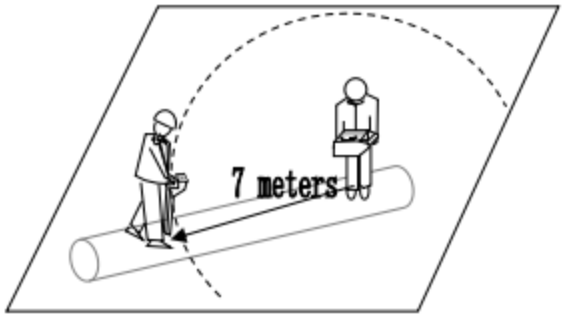
(3) Disadvantages: There is a blind spot on a test surface because parallel movement cannot be divided into too fine angles, and there are pipelines that suddenly turn.

(4) Features: This method is the fastest, most effective, and most suitable for finding pipelines whose directions are clear but whose specific locations are unknown.

b) Blind test method 2: point test

(1) Operation: Based on the preparation before the test, the two machines face each other and keep a distance. One machine (transmitter) rotates on the measured point with the human as the axis (center of the circle), and the other machine (receiver) rotates synchronously on the circumference with a radius of about 7 meters between the two machines (Note: the two machines must rotate face to face, that is, the head of the receiver points to the front of the transmitter.). The rotation must be as slow as possible to allow the

instrument to have enough reaction time. When it turns to a certain position, the receiver signal strength suddenly increases (the gain remains unchanged and is greater than the base number determined before the test), indicating that there is a metal pipeline between this point on the circumference and the center of the circle. At this time, you can lift the receiver up a little to see if the signal is weakened, and then stick it down to the ground to see if the signal is strengthened. If so, it is certain that there is a pipeline below. After rotating one circle in this way, the pipeline passing through the measured point (R ≤ 0.5 meters) with a buried depth of less than 2.5 meters can be measured. (Suggestion: During the rotation process, the instrument on the circumference is active, and the instrument on the center of the measured point is passive, and they rotate synchronously face to face. Because the rotation on the circumference is large, the rotation at the center is small, and the person is the axis of rotation). After measuring the two known points of the pipeline, the path of the pipeline can be measured by induction method.



Point Test

(2) Advantages: For a certain point, the test speed is fast and accurate, and there is no blind spot.

(3) Disadvantages: The test area is small at one time, less than R = 0.5 meters.

(4) Features: Most suitable for testing point-shaped working surfaces.

4.3 Depth Test

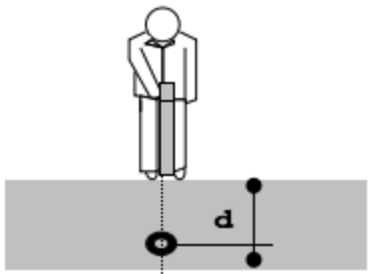
The depth test is completed synchronously in the path detection state. The specific operations are as follows:

4.3.1 Direct reading depth

1) Place the receiver directly above the cable, with the head pointing in the direction of the cable path, and keep the machine stable;

2) Adjust the gain so that the three-digit value is displayed between 700 and 900

3) Press a certain depth key I and release it immediately. After a few seconds, the depth value unit cm is displayed in the three-digit area, and after a few seconds it returns to the three-digit value (indicating signal strength)



Direct Reading Depth

4) If you can't see the depth value clearly, you can repeat 3) again

5) After pressing the depth key, sometimes -cm is displayed, indicating that the burial depth

exceeds 250cm and exceeds the direct reading range.

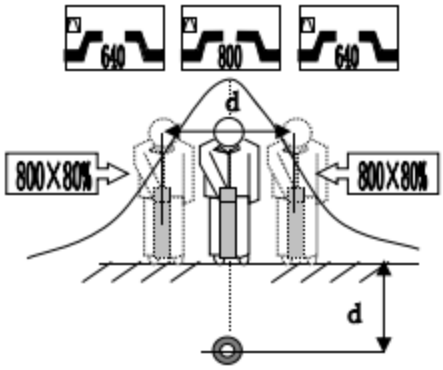
6) When measuring depth, do not test at turns, ups and downs, and fault points, as this will cause excessive depth measurement errors or test failures.

4.3.2 80% method for depth measurement

1) The receiver is placed directly above the cable, with the head pointing to the same path as the cable, and the machine is kept stable and motionless;

2) Adjust the gain so that the three-digit value is displayed between 700 and 900, for example, the current display is 850.

3) Take the current displayed value as the base, multiply by 0.8 to get a new value, such as 850 × 0.8=680. This value is not displayed on the LCD, but remembered in the author's mind.



80% method of depth measurement

4) At this time, the receiver moves left and right once in a direction perpendicular to the path, maintaining the same horizontal position. Each time it moves to the three-digit value of the LCD, the value in mind, such as 680, it stops moving and records the position points of these two moves.

5) Use a ruler or visually measure the distance between the two points, which is the buried depth of the cable.

Chapter 5 Analysis of Common Problems

5.1 Daily Maintenance

The equipment should be stored in a dry and room temperature environment and charged regularly, usually once every three months, with a charging time of 8-12 hours.

The equipment should avoid long-term exposure to sunlight and long-term use at low temperatures (below -10° C). Otherwise, the LCD will be damaged and the casing will age.

Try to avoid using it on rainy days. If it cannot be avoided, please make rain and moisture-proof preparations. Once the instrument is exposed to rain and moisture, it should be drained in the shortest time, otherwise it will cause damage to the instrument.

If you find any abnormality in the instrument during use, please contact the manufacturer in time to avoid affecting the use and delaying work.

5.2 Correct Charging

The charger is connected to AC 220 V 50HZ mains power, the charger indicator light is on (green), and then the charging head is inserted into the host charging seat (the host being charged is in the off state). At this time, the charger indicator turns red, indicating that the system is charging normally. After a period of time, the charging indicator turns from red to green. At this time, it does not mean that the battery is fully charged, but it only means that the charger has changed from a high-current fast charging state to a low-current slow charging state. As long as the charging time is guaranteed to reach 8-12 hours, it will be fine.

If the charger indicator does not turn red after the charging head is inserted into the charging dock of the host (the host is turned off), and there is no display when the host is turned on, it means that the battery in the machine is loose or has poor contact. At this time, open the battery cover and install the battery.

5.3 Instrument Self-test

5.3.1 Panel button check

1. Transmitter: Operate each button according to 3.1.2 Function Introduction to see if it is normal.

2. Receiver: Operate each button according to 3.2.2 Function Introduction to see if it is normal.

5.3.2 Working status check

1. Signal output and reception mutual check

Insert the five-core aviation head of the direct-connection line into the five-core aviation socket of the transmitter, separate the line and straighten it and short-circuit the two clips, press the transmitter power switch, and the impedance display will be 00001 Ω . The icon

rotates.

The handheld receiver is located near the direct-connection line, press the receiver power switch, and after a few seconds, the receiver works stably and receives the signal on the direct-connection line and displays it. The signal display of the mobile receiver will change. It means that the transmitter and receiver are working normally.

When the transmitter is in the induction state, turn on the transmitter, adjust the receiving frequency of the receiver to the same frequency as the transmitter, and see if the receiver can receive the signal. Move the receiver to see if the data of the receiver changes;

2. Check the coupling clamp

Connect the coupling clamp to the transmitter, press the transmitter power switch, the impedance display is about 10 Ω , and the coupling clamp makes a sound (low frequency). This means that the coupling clamp is working properly.