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1. Instrument overview

GOLDEN ROD is a new generation intelligent prospecting instruments designed by shanghai weiqi and shanghai aidu. Based on more than 5 decades R&D experiences, we use mobile phone or tablet PC to run the complicated data calculation to realize the quickly calculation inversion and rapid graph drawing. Then we can quickly draw 2D/3D profile maps, contour maps and curve diagrams by an APP. This is a leap in technology because it makes the complicated geophysical survey become easier and simpler. With the APP you could use many intelligent functions such as field measurement control, instantly data process, data cloud backup, online expert analysis and Buletooth/WIFI data transaction etc.

The instrument is connected to the APP through the built-in Bluetooth or WIFI, So you can use the APP to realize all the operations of the instrument such as measurement signal input, data checking and processing. Using wireless sensor probe, you can complete all the measurements just by walking and stopping. No need long cable, Saving time and manpower.

Many innovative designs make the instruments become more intelligent, efficient and accurate and obtained dozens invention patents(Patent No: 201320054153.5 、201120214308.8、201120567915.2、201320303919.9).

2. Main features

2.1 Totally Wireless:The Rod integrates MN and TT signal inputs (300H no TT), and the data sampling work has realized without pulling wires; built-in high-performance lithium battery, Bluetooth or WiFi communication for the device, the man-machine interface is completely wireless.

2.2 Freedom Combination:It can be used for single-channel data acquisition or 2-251 channels to form matrix multi-channel data acquisition, which greatly improves the accuracy and efficiency of field data acquisition, and can meet the accuracy requirements of data acquisition in different application scenarios.

2.3 Accurate and stable:The data acquisition circuit and algorithm have been iteratively upgraded for nearly 50 years, which can remove most of the environmental interference factors, and can also switch between MN (electrode) and TT (electromagnetic probe) measurement modes to the greatest extent Solve the problem of field data collection interference.

2.4 Smart and Simple:It is completely wireless to omit various connector wiring in the field, and the Android system man-machine interface is easy to operate, and fast data processing, inversion, 2D/3D drawing analysis, etc. through mobile phones, tablets, professional hosts and PC terminals.

3. Introduction of the working principle of the instrument

The AIDU series instruments use natural electromagnetic field of the earth as the working field source to study the electrical structure inside the earth. According to the principle that different frequencies of electromagnetic waves have different skin depths in the conductive coal, the surface is measured from high frequency to The low-frequency Earth electromagnetic response sequence studies the difference in electrical variation of geological bodies at different depths in the subsurface and determines the occurrence of underground geological bodies.

3.1 Electromagnetic wave propagation theory, Helmholtz equation

Ground electromagnetic waves are sent to the ground, and the propagation of electromagnetic waves in the earth and soil follows the Maxwell equation. If it is assumed that most of the subterranean geotechnical soil is non-magnetic and is uniformly conductive macroscopically, there is no charge accumulation, then the Maxwell equation can be simplified to:

$$\left.\begin{aligned}\nabla^2 \mathrm{H} + \mathrm{k}^2 \mathrm{H} = 0 \\ \nabla^2 \mathrm{E} + \mathrm{k}^2 \mathrm{E} = 0\end{aligned}\right\} \qquad (1)$$

（1）where k is called the wave number (or propagation coefficient)

$$k = [\omega^2 \mu\varepsilon - i\omega\sigma\mu]^{\frac{1}{2}} \qquad (2)$$

Considering that the propagation coefficient k is a complex number, let k = b + ia, where: a is called the phase coefficient and b is called the absorption coefficient.

In the electromagnetic frequency range measured by the ADMT series of natural electric field geophysical instruments (0.1Hz to 8KHz), the displacement current can usually be ignored, and K is further simplified as:

$$k = -i\omega\mu\sigma \qquad (3)$$

3.2 Wave group resistance and resistivity

A magnetic field with a change in the Helmholtz equation induces a changing electric field, and we have a magnetoelectric relationship:

$$\frac{E}{H} = -\frac{i\omega\rho}{k} \qquad (4)$$

The surface impedance Z is defined as the ratio of the surface electric field and the horizontal component of the magnetic field. In the case of uniform earth, this impedance is independent of the polarization of the incident field and is related to the earth resistivity and the frequency of the electromagnetic field:

$$Z = \frac{E}{H} = \sqrt{\omega\mu\rho}e^{i\pi/4} \qquad (5)$$

（5）The formula can be used to determine the resistivity of the earth:

$$\rho = \frac{1}{5f}\left|\frac{E}{H}\right|^2 \qquad (6)$$

3.3 Skin depth

In non-magnetic media, the skin depth formula is:

$$\delta \approx 503\sqrt{\rho/f} \qquad (7)$$

It can be seen from the above equation that the penetration depth of electromagnetic waves is related to frequency and resistivity. The frequency is certain, the higher the resistivity, the greater the penetration depth, the higher the resistivity, and the lower the frequency, the greater the penetration depth.

4. Instrument instruction

It is highly integrated with acquisition circuit, MN electrode, TT sensor,high-performance lithium battery, switch button, charging port (Figure 2)

Generally speaking, the longer the core length of the Rod sensor, the higher the measurement accuracy and the more stable the performance. Especially in the low frequency band, the measurement effect is better, and the measurement depth will be deeper. Several commonly used models have lengths of 46cm, 86cm, 100cm, 115cm, 130cm (Figure 3), and different lengths have different weights.

Figure 1：The overall appearance of the golden rod

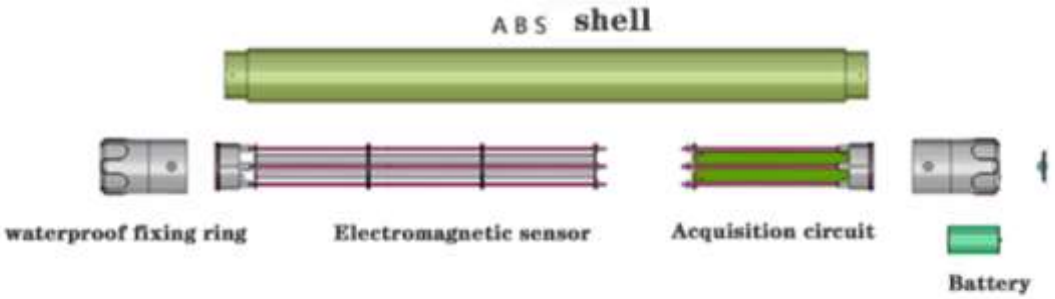

Figure 2：Inside structure of golden rod

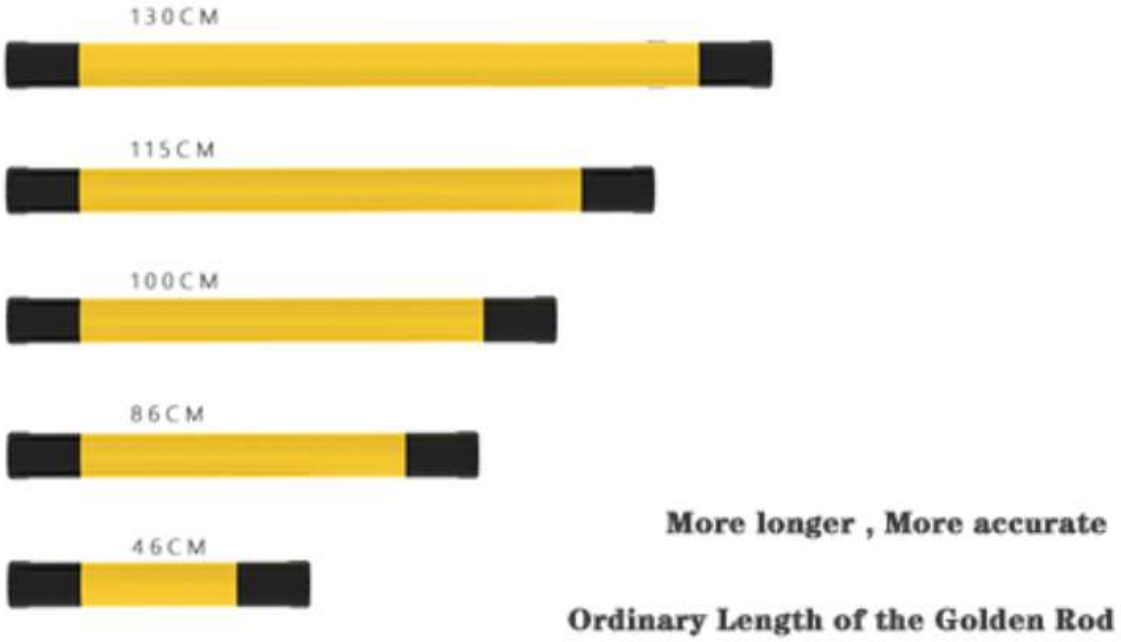

Figure 3：Ordinary length instruction

Main Parameters of Golden Rod Water Detector

	ADMT-300H	ADMT-300HT2	ADMT-300HT3	ADMT-800H	ADMT-800HT2	ADMT-800HT3	ADMT-3000HT3
Adjustable depth(m)	Optional 0~100/200/300			Optional 0~100/200/300/500/800			100-3000
battery	8.4V2600mAH lithium battery						
Connection	Bluetooth 4.0						
MN Electrodes	Copper 12mmΦ10						
Display	Mobile phone						
Main Update	Adjustable detection depth;2D/3D automatically Mapping; Total Wireless;						
Work Place	Soft Ground	No limitation		Soft Ground	No limitation		
Frequency range(HZ)	10-8K			0.01—8K			
Measurement Model	MN	MN/TT		MN	MN/TT		
Resolution	0.1mV±5%			0.01mV±2%			0.01mV±1%
Sampling time (s)	40-80			40-200			40-350
Depth Division	10-60m			10-60m			
Size/Weight cm/kg	46/1.1	86/2.9	100/3.6	46/1.1	86/2.9	100/3.5	100/4

4.1 Main parameters of basic type

The basic Golden Rod balances product performance, accuracy and product materials, and realizes complete wireless and free combination, which can meet the exploration of some larger targets, such as groundwater, shallow geothermal hot springs and basic geological disasters. The product is basically dustproof and free fall 50-100cm.

4.2 Main technical parameters of professional version

	ADMT-100G	ADMT-100GT2	ADMT-100GT3	ADMT-3KHT4	ADMT-3KHT5
Adjustable depth(m)	5/10/20/40/80/100			100/200/300/500/800/1200/2000/3000	
Battery	8.4V2600mAH Lithium battery, Power consumption is around 130mA				
Connection	Bluetooth 4.0（WIFI optional）				
MN Electrodes	Copper 12mmΦ12 or self-made electrode				
Display	（5-10.1）inch Android Touch screen (Optional)WIFI or 4G network				
Main function	Adjustable detection depth; 2D/3D automatically mapping, total wireless, automatical adaptation				
TT Electromagnetic induction coil （mm/w）	——	300/0.2	450/0.3	450/8	450/12
TTTT Electromagnetic induction core （KmH/m）	——	120	200	300	400
Work Place	Ground	Any ground			
Frequency range(HZ）	100-10K			0.0001-6K	
Measurement Model	MN	MN/TT			
Resolution	0.01mV±2%			0.001mV±1%	
Sampling time （S）	20-80			120-480″	
Depth Division	10-40			10-160	
Size/Weight cm/kg	46/1.1	86/2.2	100/2.8	115/4.8	130/5.8

5. Basic usage

5.1 Introduction of two measurement modes

In the field use, there are two modes switchable between TT and MN (as shown in Figure 4, 5, and 6). You can either use the MN electrode to insert into the ground for direct measurement, or directly place it on the ground for measurement, or even carry it in the air. There is no need to pull wires for data signal realization; built-in high-performance lithium

battery, Bluetooth or WiFi communication, and the man-machine interface is completely wireless. Note: If the lowest configuration model does not have a TT sensor, you can only use the MN electrode to insert into the ground for direct measurement.

Figure 4：Wireless and electrodes Survey Mode Figure

Figure 5：MN Electrode Connection Diagram

Figure 6：Wireless sensor Survey Diagram

5.2 Device connection

Before the device is connected, first download the Aidu Exploration APP, and open the APP to register. The first connection to the device requires network signal support. After the APP is registered and connected to the device, as long as you do not exit the APP, you generally do not need to use the network, and only use the device's own Bluetooth and Can be operated wirelessly.

Press the device switch key, the indicator light flashes. Open Aidu Exploration APP and click "Bluetooth Connection" (Figure 7) to pop up the "APP Connection" and "System Connection" interfaces (Figure 8). First, click "System Connection" to enter the Bluetooth search interface of the phone or tablet itself to search for Bluetooth devices. During the search process, a Bluetooth name starting with "98", "20" or "AIDU" will appear. After clicking connect, you may be prompted to input PIN code, PIN code is uniformly "6666".

After the system is connected, return to the "APP connection" to search for the Bluetooth name starting with "98", "20" or "AIDU", click the Bluetooth name that appears, and the device model will be displayed on the top of the APP after the connection is successful.

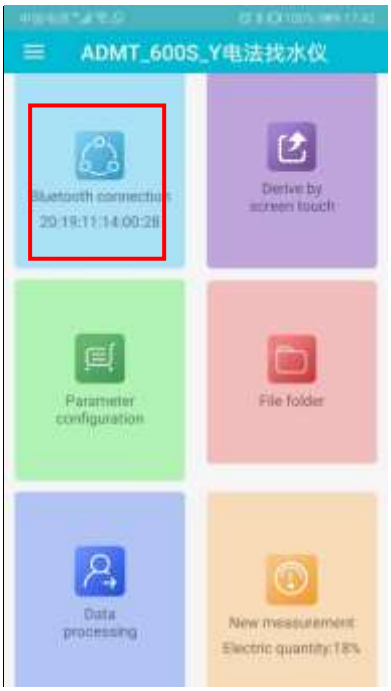

Figure 7

Figure 8

5.3 New Measurement

After the connection between the APP and the device is completed, click "New Measurement" to enter the measurement interface (as shown in Figure 9), enter the name of the measurement line (input in Chinese, numbers, and English), and the default X coordinate of the drawing is 10. Generally, there is no need to change it. The larger the value is , The wider the X coordinate display of the drawing, the later the drawing can be modified after APP2.0. Click OK to enter the measurement setting interface, and then the parameter measurement interface will pop up to set the relevant parameters as shown in Figure 10.

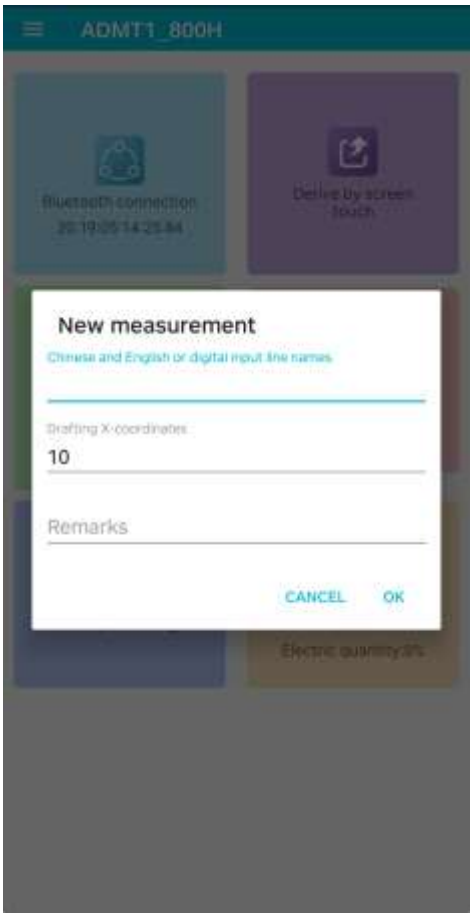

Figure 9

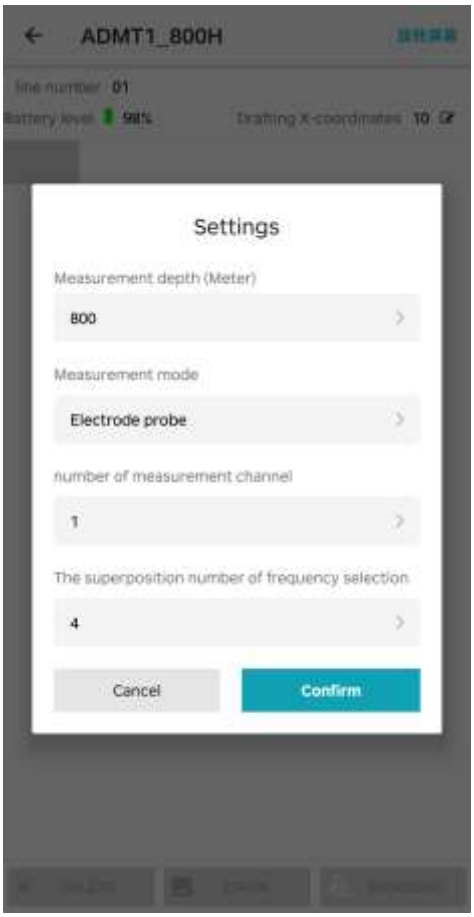

Figure 10

Choose the measurement depth (meters), the optional depth range of different models and specifications of equipment will be different, you can choose TT (Porcelain probe) or MN

(Electrode probe) two measurement modes, when you select MN (Electrode probe) measurement mode, you need to connect two A MN electrode (as shown in Figure 4) can be directly measured when the TT (Porcelain probe) measurement mode is selected (some low-profile models are not equipped with a wireless probe).

The default number of measurement channels is "1" and cannot be changed. The frequency selection and superposition times can be 4-6 times, 4-10 times, 4-16 times, and the number of options for different models and specifications is different. The more times of stacking, the longer the measurement time and the more stable and reliable data. Click "Confirm" to enter the measurement interface.

5.4 Measure

After entering the measurement interface, click the "Measure" button in the lower right corner to collect data. The measurement progress bar reaches 100% to complete the data collection of the current measurement point (Figure 11). Click "Confirm" to save the data, and click "Measure again" to do this point. Perform re-measurement (Figure 12).

If the MN measurement mode is selected, the M N electrodes must be inserted into the ground (Figure 5). If the TT measurement mode is selected, it can be measured directly on the ground (Figure 6).

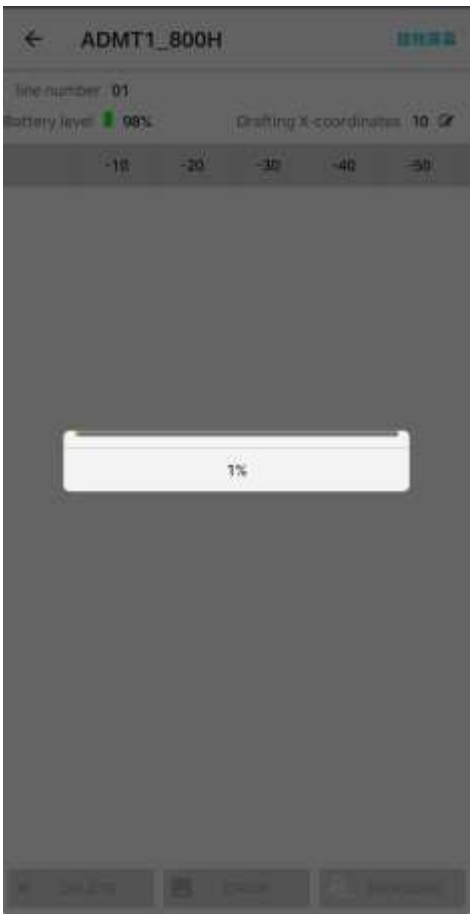

Figure 11

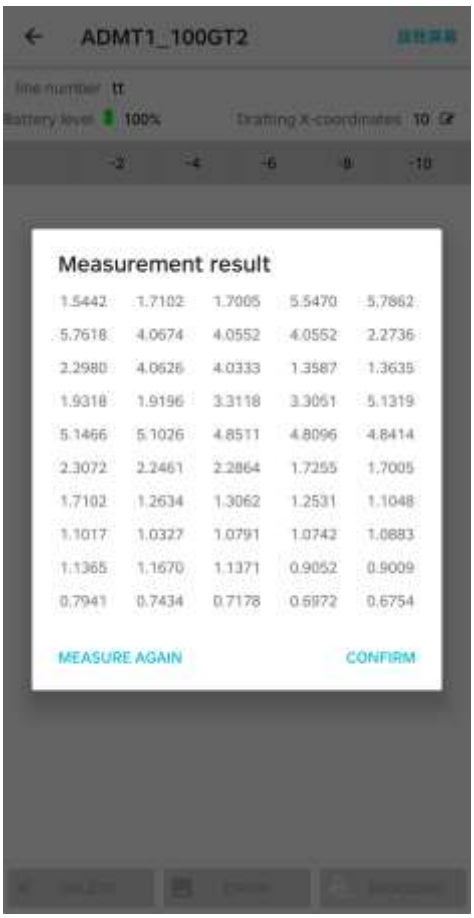

Figure 12

Select "Delete" to delete the last measurement data. After moving the device to the next measurement point, click "Measure" to measure the next measurement point data, and so on to complete the measurement collection of the entire profile (Figure 13).

Do not click "Draw" during the process of completing the entire profile data measurement, because the data processing after selecting the drawing may affect the data accuracy.

There is an error message during the measurement (Figure 14). Please check whether the MN is normally connected to the ground, whether the device is equipped with an electromagnetic probe, and the connection signal input is normal for normal measurement. If you can't solve it, please contact the manufacturer or distributor.

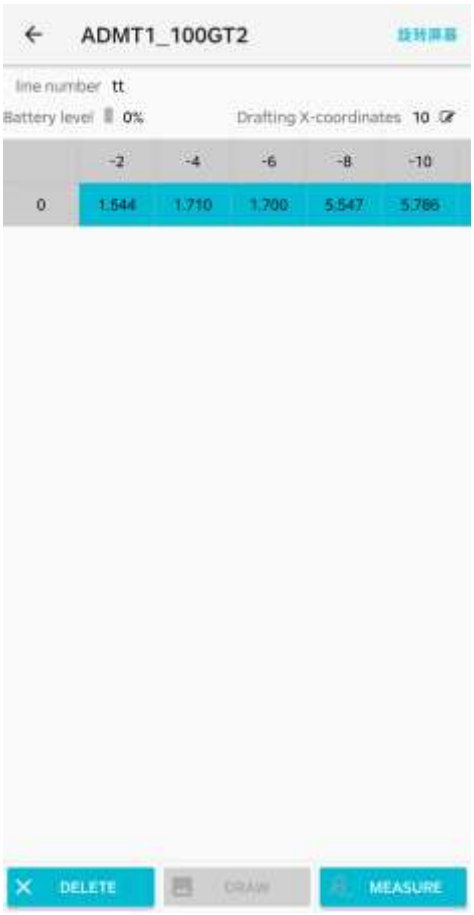

Figure 13

Figure 14

6. Draw

Click the "Drawing" function to enter mapping APP to draw 2D, 3D contour maps and curve diagrams for the majority of users.

6.1 Data viewing and drawing

When the number of measurement points exceeds 6 points, the "Draw" button will turn blue. For the detailed and clear profile data, it is recommended to measure more than 14 points. Click the drawing to appear (as shown in Figure 15) to select the drawing method, select "Isoline graph" and "Graph" (as shown in Figure 16).

Do not click "Draw" during the process of completing the entire profile data measurement.

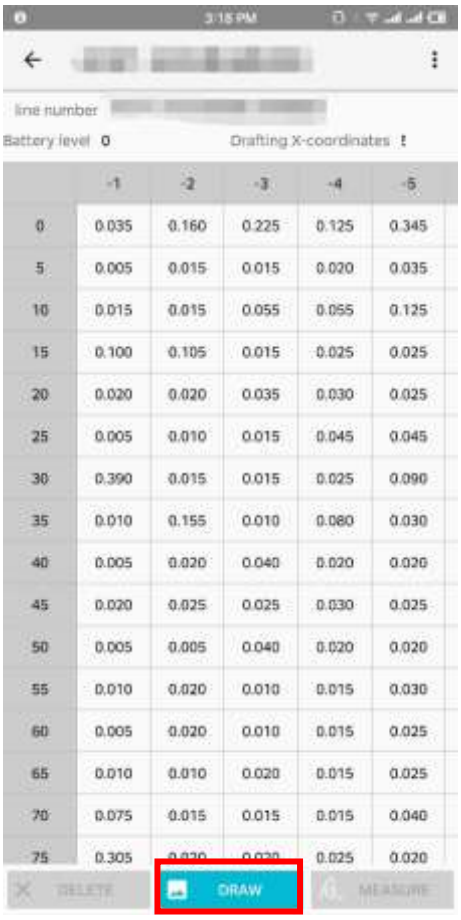

Figure 15

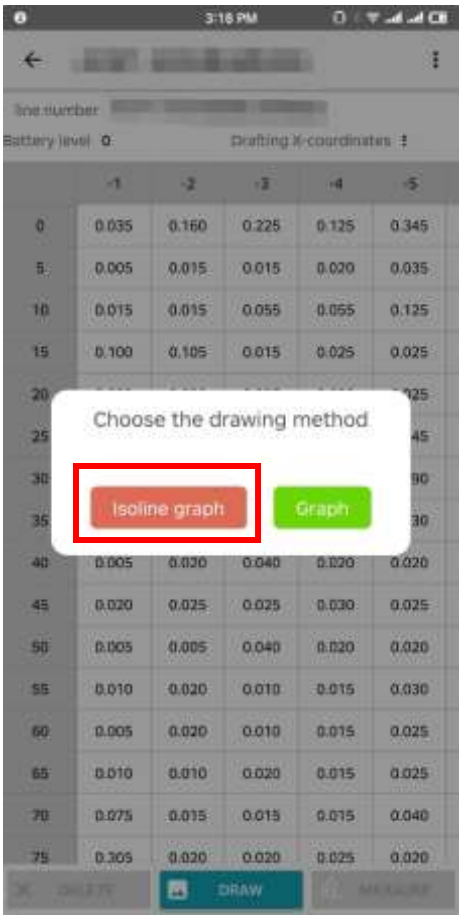

Figure 16

6.2 Draw contour maps

In the selection interface of Figure 16, select "Contour Map" APP to automatically process the data and invert it into apparent resistivity, and directly generate the contour map (Figure 17). The value on the left (Y axis) is the measuring depth, and the value on the bottom (X axis) represents the set measuring point.

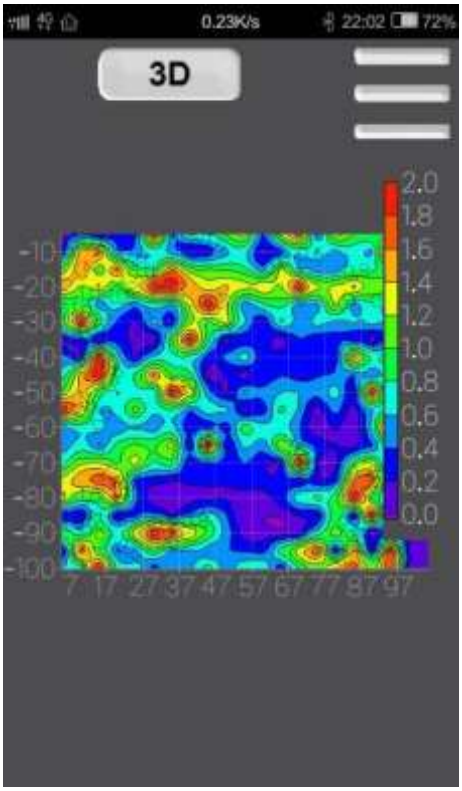

Figure 17

Lightly touch the "3D" or "2D" icon in the upper left corner of the drawing interface, select to switch between 2D or 3D, (as shown in Figure 18), click the icon in the upper right corner of the drawing interface to set the color scale, generally the default is 5 Change the settings (Figure 19). Click "Save Picture" and confirm to save the effect picture directly to the APP file for easy reference and expert analysis. Click "Exit" to return to the measurement data interface.

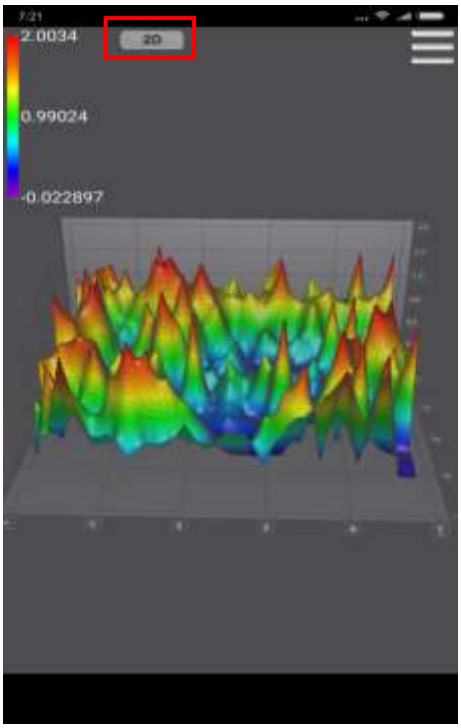

Figure 18

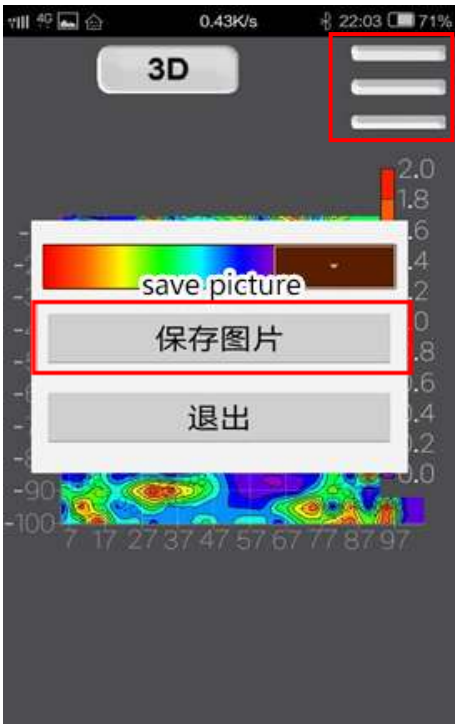

Figure 19

6.3 Drawing curve map

Select "Graph" in the selection interface of Figure 16, the system will automatically process the data and invert it into apparent resistivity, and directly generate a graph (Figure 20).

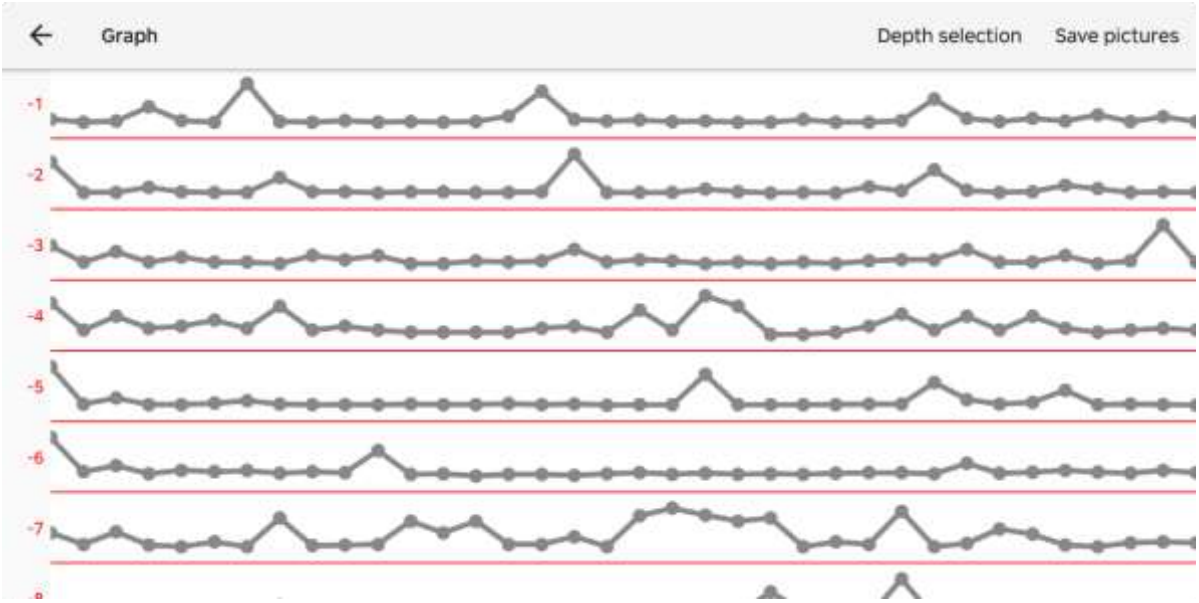

Figure 20

By clicking "Depth Selection"- " √ " you can view the corresponding depth curve independently (Figure 21).

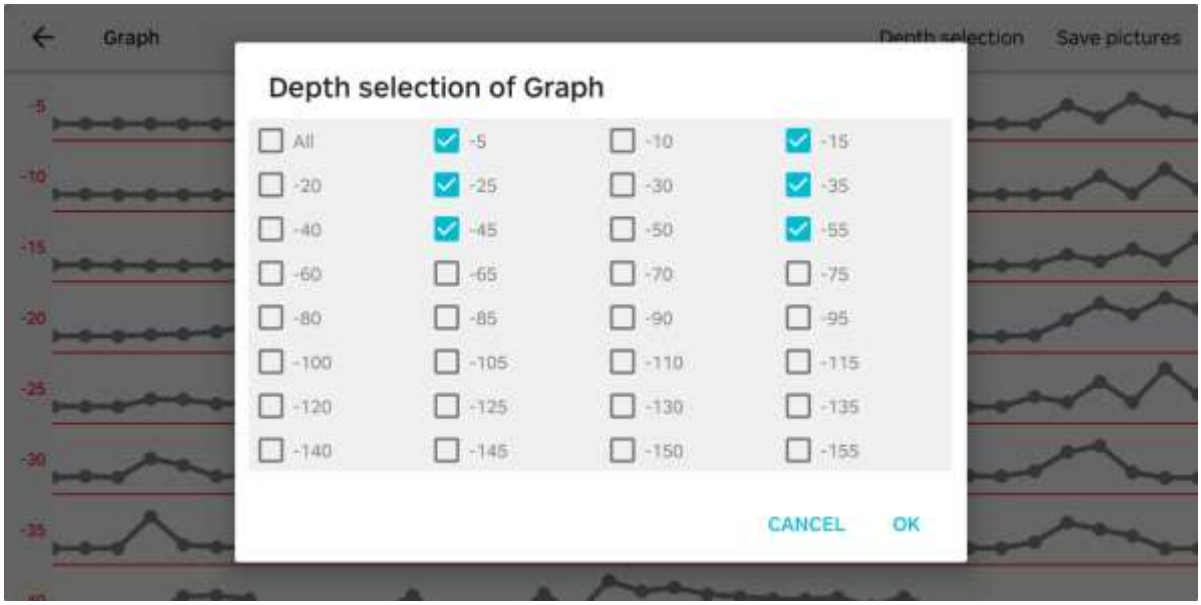

Figure 21

Select Save Pictures to save the graph to the APP line folder (Figure 22).

Figure 22

For more APP operations, please refer to "Operation Instructions of Aidu Exploration APP" and timely update content. Aidu Exploration APP provides free online upgrade. In order to keep data in the cloud, you need to register with your mobile phone number for the first time.

7. MN and TT are two methods of using measurement modes

7.1 MN electrode mode measurement method

After the device is switched on, the MN metal electrode is connected, the host connects the Aidu Exploration APP, and selects the measurement depth and measurement mode to select the MN electrode. Install the M, N electrode and insert the earth, start measuring, the point recording point is the center O of the M and N electrodes, after the completion of the first measurement O_1 move to the second measurement O_2, and so on to complete the third measurement O_3,O_4,O_5,O_6、... until the entire section is completed.

The distance between O_1 and O_2, O_2 and O_3 is called point distance, which is generally ≤ the size of the exploration target, and the unit is meters.(Figure 23).

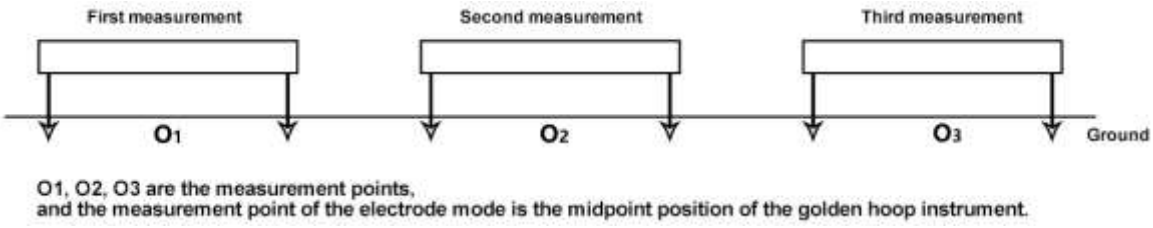

Figure 23

7.2 TT electromagnetic probe measurement mode

After the device is started up, connect to the host of The Aidu Exploration APP and select the measurement depth and measurement mode and select the TT probe. Put the equipment flat on the ground and start measuring. Record the center position O of the equipment at the point. After the first measurement of O_1, move to the second measurement of O_2, and …… Until the whole section is measured. Where, the distance between O_1 and O_2, O_2 and O_3 is called point distance. Generally, the point distance is ≤ the size of the exploration target, and the unit is meters (See Figure 24).

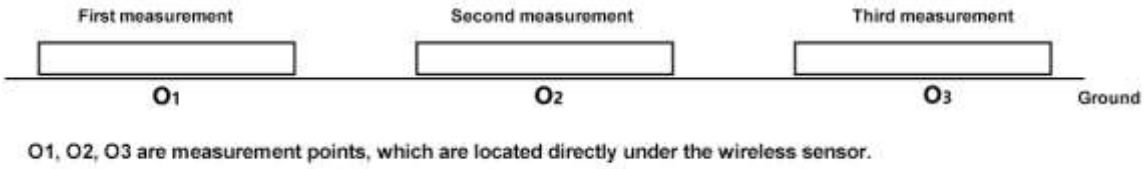

Figure 24

8. Field line layout method

The layout of survey lines is a very important part in exploration. The layout of survey lines will directly affect the measurement accuracy and improve the anti-interference ability. The basic principle is that the direction of survey lines should be able to explore the target vertically, the straight section should be as straight as possible, the circular section should be as round as possible, and the ground should be as flat as possible. According to the actual landform, different methods of line layout are selected.

8.1 A parallel laying method for a straight-line section

The linear section is the most commonly used layout method, and multiple linear sections are formed in parallel by multiple linear sections, which can quickly judge the direction of the prospecting target. First assumptions, and judge the exploration targets, the direction of the vertical direction of exploration target will decorate line (as shown in figure 25) straight line profile can deploy one or more, the general layout of 2-3 can quickly judge the abnormal body, according to the length of the exploration target setting multiple linear profile, the distance between each line section is called line spacing, the length of the line is apart from the general exploration target or less, the unit is meters.

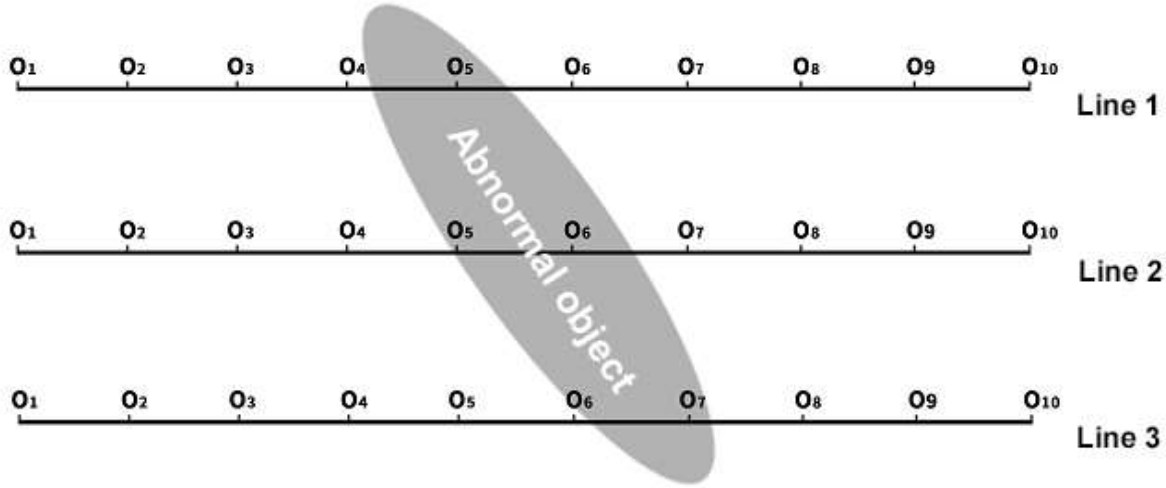

Figure 25

8.2 A cross or slash intersection method for a straight-line section

After measuring a straight-line section, when it is found that there are anomalies or site is relatively limited difficult to lay more than one straight section, you can use cross -crossing (Figure 26) or slash cross (Figure 27) to lay a second straight-line section, combined with two straight-line section anomalies can be repeatedly confirmed the existence of exploration targets, can also assist in the determination of the approximate direction of exploration targets.

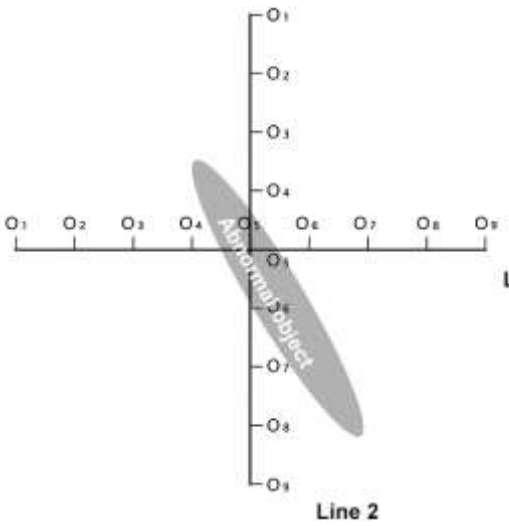

Figure 26

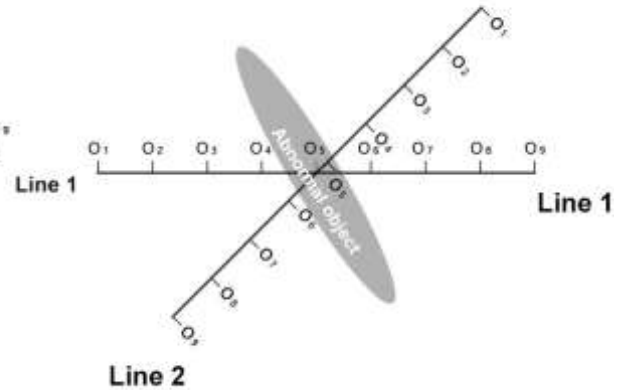

Figure 27

8.3 Round section laying method

When some regional survey sites are indeed narrow or there are point-like interferers such as transformers and signal transmitter towers nearby, a section (Figure 28) or a semicircle (Figure 29) is arranged with the site or interferers as the center for measurement, and the trend and position of the target objects (water veins and ore veins, etc.) can also be quickly traced.

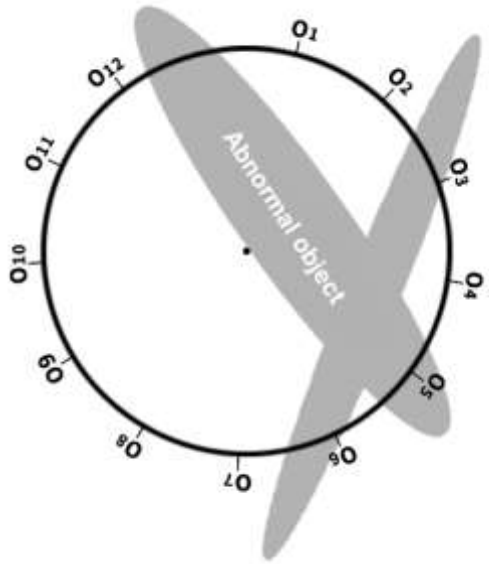

Figure 28

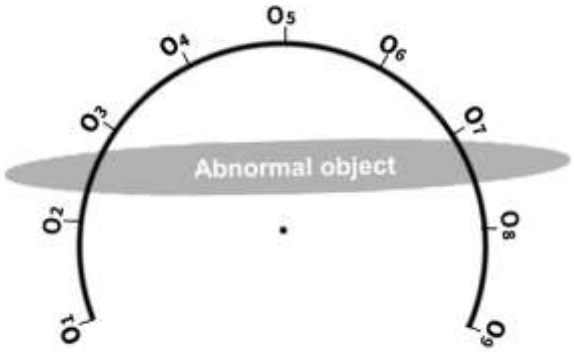

Figure 29

8.4 The matrix electromagnetic line-laying method

In addition to the single Bluetooth wireless link above, there are 2-251 Magic cudglets that can be freely combined into matrix MT electromagnetic method. Using the powerful WiFi LAN and a host machine, multiple magic cudglets can be controlled for data collection, and electric and electromagnetic fields can be measured at the same time to form the MT electromagnetic method (As shown in Figure 30). According to the needs, it can realize the simultaneous measurement of single point or multiple points and multiple sections, and can complete the linear section, multi-line section, circular section, cross section and so on at one time.Greatly improve the measurement accuracy, stability, higher requirements for measuring accuracy of exploration, such as geothermal hot springs and engineering

exploration, mineral resources, such as scenario, the multiple channel matrix measurement, repeated analysis, vertical and plane profile form true three-dimensional exploration graphics multiple explanation, need to buy more products, please contact the manufacturer and dealer.

Figure 30

8.5 Several principles of field line layout

The line should be laid as far as possible vertical abnormal body direction, straight section as straight as possible, circular section as round as possible, the ground as flat as possible. You can use the compass or benchmark three-point line method to determine the line as straight as possible.

When measuring on the hillside, try to choose the same altitude of the laying, encounter can not wait for high laying, try to choose the slope is consistent or slope is more gentle direction of the laying, the height difference between adjacent points is best not more than 2 meters.

The lines should be kept as far away from high-voltage transmission lines and telephone lines as possible, and when they cannot be far away, the wiring direction should be as parallel as possible.

When measuring, make sure that the M and N electrodes are in the same plane, and that the recording point is M, N electrode center point or below the device sensor.

The point distance in the same test area is kept as much as possible, the line distance is the same, and it is easy to record and analyze.

MN electrode mode measurement as far as possible to maintain the M, N electrode ground consistency.

9. Precautions for using the instrument

Check your device's battery level regularly and charge it regularly. Keep the power full during business hours and turn off the power when the work is over.

Equipment should be kept in the course of transportation or use to avoid severe vibration, impact and moisture in the water.

After each work, keep the equipment and MN electrode clean and place them in a ventilated and dry place.

The MN electrode or electromagnetic sensor is not connected or disconnected will indicate a measurement failure, so check that the line is connected.

When the measurement data for each point encountered in the equipment measurement is small and the values are basically the same, it may be an instrument failure, please contact the after-sales confirmation.

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