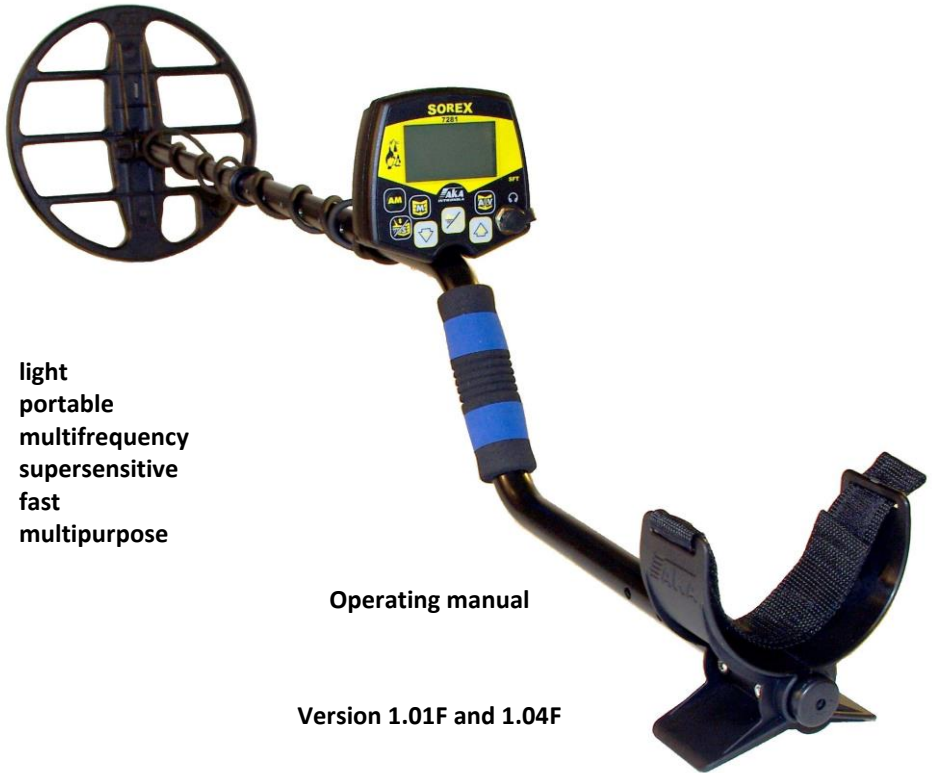


Selective
Metal Detector

SOREX 7281



- light
- portable
- multifrequency
- supersensitive
- fast
- multipurpose

Operating manual

Version 1.01F and 1.04F

Warning!
Read carefully
before use.

For
Sorex 7281 product support and discussions visit <http://www.reviewdetector.ru>
AKA LLC Moscow

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General Guidelines

Sorex 7281 Metal Detector is designed to search for and identify metal objects in dielectric (dry sand, wood etc) and low-conductivity environment (soil, brick walls etc). The device can be used in the following areas:

- criminalistics;
- engineering corps;
- housing and utilities infrastructure, civil construction and firefighting, detection of buried utilities, pipelines, cables, manhole hatches, waterposts, valve caps etc;
- archeology and search for buried treasure

The device is designed to work in the following conditions:

- ambient temperature from -5 to +50°C;
- relative humidity up to 98% at a temperature of 25°C;
- atmospheric pressure from 630 to 800 mm Hg

Product features.

Sorex 7281 is a selective eddy current metal detector working on the induction balance.

The device is produced in two versions:

- version 1.01 powered by one Li battery (type 14500 3,7V);
- version 1.04 powered by 4 AA batteries.

The key feature of this device is that it is one of our lightest models. Its weight in basic configuration (search coil 6x10"DD-14) is approximately 1 kg (version 1.01).

Another Sorex 7281 key feature is an on-board hardware/software automatic customization adaptor for any search coil we produce regardless of operating frequency or search coil size.

The distinctive feature of the model is the original spatial filtering technology (SFT) that allows minimizing interference of soil Ferro-oxides (mineralization) and therefore improving identification of deep and small-scale objects.

Dynamic mode is the main search mode of the device, i.e. object detection with the constant search coil motion.

The device also has a static mode allowing to detection of the exact location of the object (Pin-Point).

The device has two types of object detection indicators:

- multimode programmable sound,
- visual (hodograph, VDI (Visual Digital Index), signal rating (level).

The device has two independent search channels: RT and ST

RT channel (real-time) is a detection channel **and** it works on a real time basis, i.e. sound indication is synced with the search coil sweep above the object. In this channel sound indication is a single-tone signal and its volume and frequency may change when the search coil is near the object, and highest values appear above the center of an object. The size of the object may also be estimated by the sound time value from the object.

When the object signal in the RT channel exceeds the set-up threshold, the ST channel turns on.

The ST channel (short tone) is the object type identification channel. Once the threshold of the object signal level is exceeded, it is identified in the ST channel and followed by the appropriate tone signal, and the display shows the hodograph.

Short tone frequency identifies object type (high tones - nonferrous metal, low tone - ferrous metal, default - 5 tones).

Each channel has its own independent sensitivity control - ST Sensitivity and Threshold volume tone.

Delivery set

• Electronic module	1 item.
• Search coil DD 6X10" with rod	1 item.
• Shaft*	1 item.
• Arm rest	1 item.
• Battery (Li-Ion, 3.7V)**	2 items.
• Charger**	1 item.
• Bracket***	1 item.
• Headphone**	1 item
• Carrying bag**	1 item
• Search coil protector****	1 item

*) the device may be equipped with extendable arm providing "no-disassemble portability" option

**) only for version 1.01

***) electronic module bracket hanger in the arm rest zone for better mechanic balancing of the device (sold by supplementary order)

****) sold separately or in supplementary order.

Warning! For additional accessories and search coils visit our website

www.aka.2000.ru

Specifications

Maximum detection range of metal objects

(in the air, search coil 6X10"DD - 14 kHz) ST channel:

- coin Ø25 mm (brass), without electromagnetic interference - 38 cm;

Operating frequency range (version 1.01F), kHz - 2...20;

Operating frequency range (version 1.04F), kHz - 1...22;

Power supply (number of batteries, type, voltage):

Version 1.01 - 1, type Li-Ion, 3.7V;

Version 1.04 - 4, type AA, 4.8-6V

Runtime:

- Li battery 3.7V 900 mAh (version 1.01) - 7-8 hours;

- 4 batteries 2800 mAh type AA (1.2V) - 20-40 hours;

- 4 batteries type AA (1.5 V) - 10-20 hours.

Dimensions, (package) mm: - 520x170x85;

Weight (without batteries): - 950 ±5% g.

Getting started

Assemble metal detector. To assemble:

- attach arm rest to metal shaft with two screws.
- attach search coil to the internal (plastic) rod;
- insert rod with the attached search coil into the metal shaft for the required length using latches and holes in the shaft;
- tighten collect clamp;
- wrap the search coil cable around the shaft evenly and tightly (loose cable may cause false signals);
- attach electronic module to shaft skids.
- connect search coil slot to the electronic module

WARNING! Do not overtighten attachment and mounting fittings of the telescopic shaft. This applies especially to the plastic screw of the search coil and collet

Power Supply

Depending on the hardware version the device may have either Li type 14500 (version 1.01) or 4 AA batteries (version 1.04).

Battery discharge control system automatically switches the device into power saving mode when voltage is less than 3.1V (1 Li power supply variant) and 4.2V (4 AA batteries variant).

WARNING! Please insure that the battery (batteries) is properly installed (installation polarity is shown on the battery compartment). The device can be damaged in case of wrong polarity or power supply voltage.

Controls and connections.



LCD graphic display, headphone jack and 7 detector control buttons are located on the front panel of the device (see picture). Search coil slot, on/off switch and battery compartment is located on the rear panel of the unit.

Control buttons.



«all metals». Switch between "discrimination" and "all metals" modes



«balance – S menu». Automatic ground balancing On. Switch device to manual ground balancing mode pressing one more time. Switch to S menu holding the button.



«M menu». Pressing this button enter the main settings menu.



«plus». Change values in settings mode. **Warning! In search mode is used for on the fly change of sound indication type RT-ST / RTT-ST (PB-KT / PBП-KT).**



"minus" Change values in settings mode. **Warning! In search mode is used for the on the fly switch between "norm 1" and "met. trash" modes.**






«search – static» . Used to turn on/off of the static search mode (pinpoint). Also exits settings modes (menu, ground balancing) in the search mode.







«audio – video menu». Enter audio and video settings of the device.

Device Settings

Warning! All changed settings remain in the device memory after the switch-off; the device switches-on with latest settings.

All device settings are changed pressing  and . Exit settings mode pressing .

«M» menu.

Enter "M" menu and browse its entries pressing  several times on the device panel. Set up parameters - pressing  and . Press for exit  or automatic exit 7 seconds after the end of the setting.

Menu entries.

1. Sensitivity
2. Threshold tone.
3. Search conditions.
4. Left discriminator border.
5. Right discriminator border.

Sensitivity.



This option allows adjusting sensitivity of your device. You may change its value from 0 to 21. Remember, increasing device sensitivity you get search depth increase but it comes along with possible interference from power lines and false responses from the search coil bumping obstacles.

Choose appropriate sensitivity at the search area taking into account the formula "highest value appropriate for stable device operation in this area".

It is recommended to reduce device sensitivity in the areas with a lot of metal trash. Due to strong random noise from a large quantity of surface iron the device is unlikely to detect a coin located lower than this iron; while the depth is tolerable in the clear area (it could be even deeper). At the same time the device may not distinguish small nonferrous object (for instance, a "flake" [small odd-shaped coin]) located on the same level as the iron or a bit higher, from the total search coil "snap" including the deep iron. While the device with reduced sensitivity will see this coin because it is not dazzled by the iron below the coin.

To sum up all the abovementioned: high sensitivity does not guarantee high search performance. Use this setting as the condition may demand and in accordance with the search target.

WARNING! The "Metal Trash" mode has its own sensitivity tuning (see below).

Threshold tone.



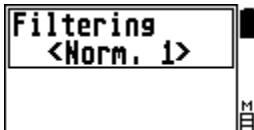
This option allows adjusting sensitivity (detection depth) of the threshold tone of your device. The threshold tone is a detection channel signal informing you of the metal object detected by the device. After detection and during search coil motion the sound volume of the threshold tone

increases, the highest value is above the center of the target.

Over device operation and acoustic experience gained, the combination of threshold tone and identification signal tone, duration and loudness of threshold tone would give you the full information on the size and relative target depth. Even two-target detection with one identification signal would be possible, but this is an exigent stunt. We recommend setting the threshold tone sensitivity to 16-17 in clear areas and reducing it to the comfortable level in trashy areas.

Maximum values of threshold tone sensitivity exceed device ability to identify target metal. That is why it may be applied for the search of metal objects at depths impenetrable for the identification, when any metal object detection is essential.

Search conditions.



Search conditions imply presence or absence of such influencing factors as metal trash, rough plants, rugged ground surface (plowland). Selection of "Met. Trash" mode increases device operating speed as well as its ability to distinguish

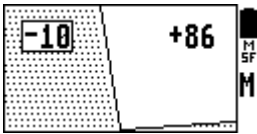
metal objects earthed close to each other. At the same time the sensitivity and identification reliability for deep targets with weak response, which in any case could not be fully implemented in the trash, are slightly reduced (up to 20% from the maximum).



In case of area with rough plants or rough and rugged ground surface (plowland), the search coil will suffer from shock impacts leading to frequent false responses. The "Norm FA" mode is recommended in this case. FA means additional filtering algorithm in the signal processing system. This mode may also be useful when there is a high level of electromagnetic interference (power lines). But it should be noted that such mode slows down device operation to some extent. In case of absence of aforementioned interference factors we recommend to use the "Norm. 1" search mode.

Please note! In the search mode switch from "Met. Trash" to "Norm." or

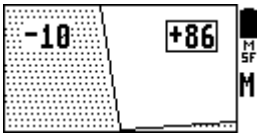
"Norm FA" pressing .



Left discriminator border.



Use buttons  and  to set up left discrimination sector border. All targets with VDI, as well as hodographs, located to the right of this border, will give the sound signal when they are detected by the device. Targets with VDI located to the left of this border do not give sound response. VDI by regulated border is shown in the frame.





Right discriminator border.



Use buttons  and  to set up right discrimination sector border. All targets with VDI, as well as hodographs, located to the left of this border, will give the sound signal when they are detected by the device. Targets with VDI located to the right of this border do not give sound response.

Hodograph of the objects cut by the discriminator will be shaded VDI by regulated border is shown in the frame.

«A/V» menu

To enter «A/V»menu (audio-video menu) and browse its entries press  several times on the device panel. To set up parameters press  and . Press for exit  or automatic exit 7 seconds after the end of the setting.

Menu entries

1. Sound Volume
2. Fe
3. Type of video indication
4. Low tone border
5. Weak signal scaling
6. Type of sound indication.

Sound Volume.



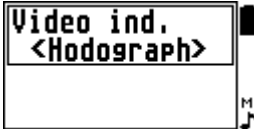
This option allows adjusting device sound volume to your own preference. External speaker turns off when the headphone jack is inserted into the slot on the front panel and this option allows adjusting headphone sound volume.

Sound Volume Fe.



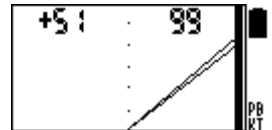
This option allows making separate adjustment of sound volume for iron only in order to increase comfort and reduce sound overflow in the "all metals" mode. But this may cause some reduction in sound descriptiveness. Adjust this setting for the sake of your convenience.

Type of video indication.



This option allows switching between types of data display on the main operating screen.

1. Hodograph, small numbers VDI and target rating (top picture)



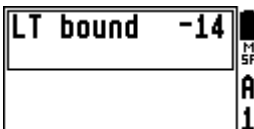
2. Large numbers VDI and target rating + vectograph. (bottom picture.)

VDI (Visual Digital Index) - a digital index with angle size that allows to associate the number with the type of the metal object.

Hodographic display of the target signal is the most informative and it becomes very powerful "visual identification" after some time. We strongly recommend you this particular graphic mode. It has been checked and appreciated by thousands of your colleagues over the last years. But if it is too complicated for you or you got used to the digital display of other devices, you can always switch to the second mode "Large VDI".



LT (low tone) border.

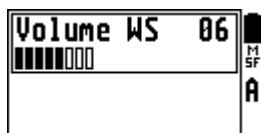


This option allows moving the sound border of **nonferrous** low tone (LT) to the iron sector by the required value.

It's well-known that small objects, especially pieces

of golden jewelry, as well as nonferrous targets "wiped out" by the ground mineralization or slightly covered by the iron, quite often may give the "iron" signal in the minus sector of VDI. But usually they give signal between medium - large iron and foil, and that allows identifying them with no iron catch. Medium-large wrought iron (wrought nails) is located approximately at -45 - 40 sectors of the VDI scale. The foil would be in sectors close to 0, respectively, i.e. sectors 0 to -35 are "suspicious" and subject to exploration in terms of beach jewel search, search for small medieval crosses or coins on the trash. Having moved the LT border to the required sector you would not miss those targets on the iron signal working in the «all metals» mode. It would give the nonferrous tone despite the minus signal VDI. Pay special attention to the "coin" arrow or narrow hodograph loop of the signal in this sector. There is 95% probability that this is a nonferrous target. Together with the speed of target distinguish in the "trash" mode this setting will increase your chance not to miss nonferrous targets surrounded by the iron. Select value of the low tone shift taking into account a specific search area, trying to hold it on the edge of the iron common to the area. If you dig the area with an interesting medium-large iron (arrow heads, medieval knives, locks, splinter holders, etc) you may shift nonferrous tone to the medium-large iron sector -45 (maximum possible -50).

Weak signal scaling (W.S. Scaling) (Macш. C.C.)



This option was brought to increase capabilities of visual hodographic identification. It allows to increase sizes of weak signal hodographs as well as to evaluate the signal level by the size of the hodographic picture. For instance, setting up 1:2 scales you can increase and thoroughly examine a low-signal

hodograph. Scaling 1:7 you can evaluate signal levels in a wider range by the size of the picture respectively.

Type of sound indication



This option allows changing type of sound indication between RT-ST and RTT-ST.


RT-ST is the most informative type of sound indication for the «all metals» operation mode. Threshold detection tone and target identification tone work independently of one another and give total sound information on the nature, size and depth of the target, but they are notable for high sound overflow that may cause discomfort in trashy areas.




In sound indication **RTT-ST** the threshold tone increases till the moment the device is able to detect the metal the target is made of. Once it is done, the threshold tone cuts down and the separate identification signal sounds. This mode is less informative, but it is more comfortable and has no sound overflow. In this mode the threshold tone may be turned off completely by decreasing its sensitivity to 0 in the "M" menu when needed.

Please note! In the search mode you can switch type of sound indication on

the fly pressing .

«S» menu.

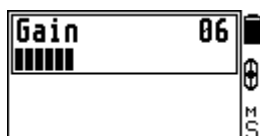
To enter the «S» menu press and hold  on the device panel. To browse its entries press the same button several times.

To adjust parameters use buttons  and . Press for exit  or automatic exit 7 seconds after the end of the adjustment

Menu entries.

1. General Boost
2. FGR Filter (false ground response)
3. HRN (hot rock neutralization) on/off
4. Storage off/auto/«3»
5. Short tone modulation (ST) on/off
6. Rate of AGBT
7. "Economy" mode (only for version 1.04)

General Boost (Gen. Boost) of search coil signal.

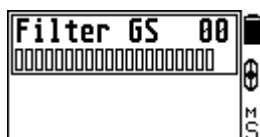


Option allows regulating search coil signal boost for the detection channel (Threshold tone) and identification channel (ST Sensitivity) simultaneously. Such setting may be used in extremely trashy areas, beaches etc, when there is no need in a great search depth, and distinction of objects located close to each other is more important.

In most cases we recommend to set the boost value at 6.

WARNING! The "Metal Trash" mode has its own separate General boost tuning.

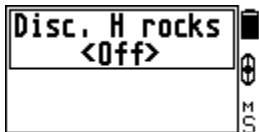
FGR Filter



Option allows selecting false signal block-out level, signals caused by high conductivity of the ground (salty soil, sea beach etc).

It is particularly important when using large-size (10' and 12,5'x9,5') search coil operating at high frequencies (14-20 kHz), that comes from the specific character of the interaction of those search coils with the high-conductivity soils.

it should be noted that the increase of filtering level results in search comfort increase, but it can also lead to missing of large and high-conductivity targets made of nonferrous metals. Filtering values should be selected empirically for specific search conditions, for this purpose it is desirable that they are kept to the minimum search comfort.

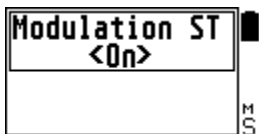
HRN (Hot rock neutralization) on/off.

This option allows turning on/off non-discrimination algorithm of hot rock signal neutralization. When it is turned on, most of the round-shaped rocks do not give identification signal, only the threshold tone with a light sound increase appears. The search becomes more comfortable in the area containing large quantities of such rocks, but it should be noted that in the uneven and broken ground, for instance in the rough plowland, this algorithm may detect some small targets in soil clods incorrectly and clip them out. In such case they would give the threshold tone signal only, sharper and shorter than rocks would. That is why in such places we recommend you to turn this algorithm off.

Storage

When the storage mode is "off" the display will show only the hodograph of the latest target identified by the device. Once the next target is identified, the previous hodograph is deleted. In the "auto" mode the display saves hodographs of the last three targets identified consequently.

Whereby the hodograph of the last target is marked with the cut-in of two previous ones. And in the "3" mode the display also saves hodographs of last three targets identified by the device, but first and second hodograph do not cut-in with the hodograph of the last one. The "auto" or "3" storage mode is more informative than the "off" mode, and it allows to identify the target more accurately by means of several hodographs resulted from target scanning from different angles.

Short tone modulation (ST) on/off.

This option allows increasing sound indication capabilities, making the ST more informative in weak signal zones.

Tone modulation is made by the width of tone burst depending on the object signal length and size of the object itself.

The option contributes greatly to the distinctions between false responses of signal indication in the identification channel and signals from the objects.

Rate AGBT [Off./1/2]

With this setting you can turn on/off automatic tracing of ground balancing change and its correction by the device during operation. When this function is turned on, the device traces soil mineralization, search coil heating and cooling and other factors, influencing the accuracy of the device ground balancing, and it makes a correction allowing operator not to mind changes himself and perform the ground balancing procedure less frequently. This option is not recommended for use in trashy areas.

"Economy" mode (only for version 1.04)

The key feature of this mode is a shift to a low power consumption resulted from the reduction of ECC excitation current. Upon that, detector's runtime may reach 40 hours (with 2800 mAh battery). Besides, this mode allows performing ground balancing more accurately when working at the highly mineralized sea beaches. This mode is recommended for trashy areas where high sensitivity is not required.

Warning! To turn the "Economy" mode on/off the fly during the search hold



(for 1-2 seconds). The appropriate symbol is shown in the top right corner of the display when the "Economy" mode is on.

Ground balancing

Device ground balancing is the most important aspect of the device search settings. Incorrect balancing may reduce search capabilities of the device, causing unstable operation and false responses.

Brief description of the procedure. Each object has its own shape, conductivity and magnetic compound, all of them are assumed to be VDI (Visual Digital Index). We remind that VDI is an angle preference, its number equals to the inclination of the signal vector (hodograph on the device display) from the vertical axis. The ground, depending on the mineralization level (presence of iron oxides), covers target signal with its own signal, changing its VDI till it "converts" small and deep targets, as well as large targets made of high conductivity metals (copper, silver, aluminum), into the "iron". The accurate detector ground balancing in the search area is performed in order to reduce the ground influence to the minimum. Major balancing purposes:

1. **To make the ground "invisible" for the device, i.e. avoid phantom signals from the ground with no targets in it.**
2. **Set up correct (standard) reference system for VDI. Accurately balanced device must cut-out ground signal mathematically and identify the target correctly getting joint signal from target and ground.**


It should be noted that during "air tests" the balanced device will keep making correction for the ground ... which is not available at the moment. During an "air" test it may lead to an "invisible" large aluminum or copper object (pan, 5 kopeks of Catherine II), if the ground has got too deep into "plus". And if this "too deep" is too big, those targets may be detected as "iron" ... and the tester might get very frustrated. Or, to the contrary, it would decrease VDI of those targets, when balance gets too deep into "minus", and sensitivity to them "in the air" goes up incorrectly ... resulting in unreasonable happiness and hopes of the tester.

Memorize a simple formula: One degree of balance phase change gives VDI change for all targets by the same one degree to the change direction (+ or -). I.e. if you have 5 kopeks of Catherine II detected as "iron" "in the air" with VDI -86 instead of appropriate +82+84, then your device ground balance was set up by +10+12 degrees more than required for the "air test".

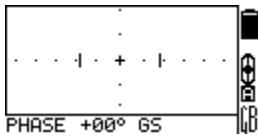
Ferrite piece balancing is required before the "air test" of the device. Put the device on the non-metal surface, turn on automatic ground balancing, count to three, and

set a piece of ferrite to the centre of the search coil surface from the distance of 25-30 cm, finishing the balancing. Puzzled? Let's make it easier: Take a CD and pass it flatwise in front of the search coil. If the CD gives vertical hodograph and VDI within $-1\ 0\ +1$, then the device is ready for the "air" tests.

If VDI of the CD differs from these values then in the manual balancing mode

(press twice ) correct the phase of the ground balancing by the difference level and to the required direction. Did the CD get VDI $-1\ 0\ +1$? Congratulations, your device is ready for the "air battle".

Balancing Procedure.




We would like to bring your attention to the **automatic balancing** procedure developed by experienced users.

1. Find a metal-free area.

You can find it by the threshold tone response in RT-ST mode.

On the unbalanced device there is a response to the pure ground, but the sound would be quiet and "diffused", without strict localization, while the sound would be sharp and with strict increase above the metal object. Select an area with no localized sharp threshold tone increase swinging the search coil 5-10 cm to the left and to the right above the ground. If there is no localized sharp threshold tone increase, it is the area suitable for balancing.

2. Having found the metal-free area, raise the coil 30-40 cm above the ground,


press , wait for 3 seconds, and move the coil to the ground smoothly but not slowly.

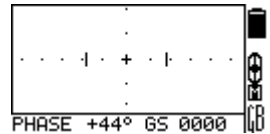
Warning! Do not move the coil to the ground closer than 10% of the search coil diameter (for the search coil $\varnothing 26$ cm – 2-3 cm). It is related to the change in the pattern of the search coil physical interaction with the ground in the so-called "Close Zone" and it may impact balancing accuracy resulting in false responses in clear areas with high values of sensitivity during search.


Short tone (thrum) notifies of the finished balancing. If there is no tone or it does not sound during lowering, but sounds when moving up, repeat the procedure with the same formula: 30-40 cm above the ground, 3 seconds, lower the coil to the ground. Follow the ground vector on the screen in the process. It should shape as a strait, slightly trembling line, on the horizontal axis of the scale. If it makes sharp angles or tears around the screen, it means that you are trying to balance on the metal object in the ground. In this case the device may balance but it would be incorrect for the operation, and you will notice it by numerous phantom signals from the ground. If it happened, just rebalance the device in the clear area. If you had balanced mistakenly in the area where the auto-tune system got frozen and could not rebalance (extraordinary but possible event), don't worry and turn off the device, turn it on holding "+" button, similar to the coil replacement procedure (see "Search coil Replacement Procedure").

After you have learned how to choose the balancing area, memorize the approximate balance digit in lower left corner of the screen in the balancing mode. Its sharp difference, especially in same weather conditions, during next balancing may be caused by metal in the ground, and you should change the ground balancing area for your device. If there were a metal object under the coil that had not allowed to make automatic balancing (objects with VDI close to 0; foil, for instance), then the device would give two consequent short tones, with a tonality similar to the iron signal in the search mode, and an exclamation mark in a triangle would popup on the screen with the sound. So, the balancing should be performed in another area. The digital value of the balance level (phase) pops up in lower left corner of the screen when balancing is over, this is the value the device will use to correct the VDI of the target, eliminating the ground influence. Digits, showing ground mineralization level will be displayed in the right corner, in accordance with the device scale. It is worth to mention that every device has a unique average angle of the ground balance phase and may also depend on the technical parameter spread of the search coil and ambient temperature.



But, taking those values into account, don not forget that your device stays in the automatic balancing mode and it can elect to rebalance by ... a shovel, boots, your partner. That is why, if you want to review device screen and balance numbers after the

automatic balancing, press the button  one more time and enter the manual balancing mode to turn off the automatic mode. Letter **M** will replace letter **A** in lower right corner of the screen.



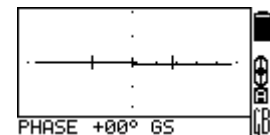
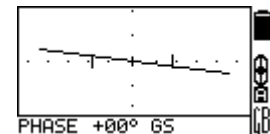
To exit ground balancing press  on the device panel.

So, to enter manual balancing mode press buttons two times successively 

In this mode use buttons  and  to adjust balance to the required position, swing the coil vertically above the ground (move up 20-30 cm/ move down 3-5 cm), keeping track of the ground vector result getting in line with the horizontal axis of the scale, and device move-up/down buzz should disappear.



Incorrect Ground Balance Vector (top picture).

Correct Ground Balance Vector (bottom picture).



On irregular mineralization soils, for instance on a plowland, the device can not always be accurately balanced in the automatic mode, because when a vertical balancing is performed, there is one soil under the search coil (a clod or an air layer) and during scanning these pieces go one after another, sometimes it leads to phantom responses of the device identification channel. At the same time, ground phase digit in automatic balancing operation may differ by 3 degrees on the same place. If you face such problem, perform manual ground balancing in the following way:

Find a clear area, 60 cm wide. Go to manual setup mode and making short horizontal search passes (but quicker) with a 50 cm amplitude, 3-5 cm above the ground, you will see a straight ground line on the screen (if it jerks, there is a metal). Upon that, if the balance is incorrect, you will hear a buzz from the ground and onscreen ground line won't be horizontal.


Use buttons  and  to make it horizontal, the buzz will stop.

Your device is balanced accurately.

To increase the identification depth of large silver and copper coins (samovars, bowls and other large objects made of high conductivity metals) slightly, after the automatic balancing, it is possible, in the manual ground setting mode, to adjust the digit of the balance phase by 1-2 degrees to the minus values.

Great adjustment (or drift) of the balance to the minus will lead to false responses with nonferrous signal, when bumping the coil over the ground and plants. Adjustment (or drift) of the ground balance to the plus values will lead to the reduction of the sensitivity to large copper coins (5 kopeks of Catherine II), up to their "invisibility" or even "iron" detection.

If, by any reason, there is no clear area found, the balancing may be performed on a slice of excavated soil (1-1.5 kg), with all metal objects removed from it and having it in a plastic bag for the sake of convenience. After that fix the device and have its coil at the distance of 40-50 cm from the ground (put it on a bush, rest it on a tree with a coil on

top), turn ground balancing pressing , count 1,2,3, and move the ground to the coil smoothly but not slowly from the 30-40 cm distance from the external or operating side. (similar to automatic balancing in the usual mode, but this time the soil has to be moved, not the coil)

It is not recommended to put the device on the ground for such balancing. If could not find a clear area, there is much iron in the ground. The iron may get into the field of the balanced device coil and the balance will fail.

Warning! If the ground signal is weak (quartz sand) to the extent that the balancing program can not run, it is possible to balance the device using a ferrite piece or a red brick fragment automatically, putting them on the ground. Actually, an "air test" balance is suitable on such ground and even with balance adjustment by couple degrees to "minus" in order to increase sensitivity to large targets, if they are expected.

Sharp temperature changes on the search coil may impact balancing accuracy, the balance may shift and become incorrect with such changes. That is why, if you take the device from a heated car and start working in a low temperature conditions (early spring, late fall), rebalance one or two times while the coil adapts to the ambient temperature. The **t** icon on the right corner of the screen will tell you that since the last balancing the temperature of the search coil has changed by the value (approximately 8° C) which requires **ground** rebalancing .

In case of significant temperature drops (more than 15°C against normal +20°C) we recommend to perform electronic module and search coil adaptation procedure one more time (see Search coil Replacement). In this case the processor of your detector will

choose the optimum frequency of the excitation current for these temperature conditions. Thereby all basic device parameters are sure to be kept, including absorbed current.

In sea beach operations and other complicated soils with high conductivity we recommend to use the "General Boost" option for better balancing accuracy. Sometimes parameter decrease allows making balancing operation more accurate. Especially on sea beaches.

Discrimination search mode setup

Discrimination is device capability to respond to one type of objects, giving detection signal while ignoring other objects the operator is not interested in, for instance, nonferrous object signals only or large iron objects (helmets, kettles, buckets), ignoring small and medium iron trash (nails). This capability increases search comfort, but one should remember that a valuable object may be missed in this mode. Anyway, you get to choose.



The discrimination range of your device is set up by the allowed width of the search sector (a VDI sector between left and right borders of the discriminator). When the discrimination mode is on your device will respond to objects with a VDI and hodograph located within the allowed response sector only.

For example, sector covering almost all nonferrous objects and large-size iron objects (helmets, plow pieces, kettles etc), and ignoring small, medium and medium-large objects made of iron, will have the range of -30...+88.

Sector with shotgun pellet, foil ... and small pieces of jewelry, crosses blocked, will have the range of +10...+88.

Sector basically generated for the search for copper and silver coins of the Russian Empire ... and other valuable objects blocked (crosses, flakes, golden 5 and 10 rubles coins of Nicholas II and others) will have the range of +50...+86.

Position of some metal targets on the VDI scale(for 7 kHz search coils).

VDI Scale	Objects
From -90 to -86	hot rocks, incorrectly set up ground.
From -86 to -70	small nails and other metal scrap.
From -70 to -50	medium size wrought nails, small arrow heads.
From -50 to -35	large wrought nails, medieval knives, flat arrow heads, horseshoes, locks and other fairly big iron objects.
From -35 to -10	in this "iron" sector ferrum is hardly presented, and nonferrous objects masked by iron come across, small odd-shaped objects made of low-conductivity nonferrous alloys (bronze crosses, thin golden earrings, chains). Pay special attention to arrow-like and thin loop-like hodographs in this sector.
From -10 to -10	foil, small bronze crosses, small shotgun pellets, small pieces of gold.
From +10 to +30	pre-Peter Russian coins ("flakes"), "sailor hat" bottle caps; 1,2,10,15,20 kopeks USSR coins, minted before 1961.
From +30 to +50	Golden chervonets of Nicholas II, screw plugs; USSR 3.5 kopeks, minted before 1961; Horde dirhams.
From +50 to +70	pula, "flake" of the Copper Riot, small coins of the Russian Empire and early USSR, billon coins of the Russian Empire and early USSR, small silver coins of the Russian Empire of the 18th century and the beginning of the 19th century
From +70 to +86	Large copper coins, silver rubles, as well as large flat or spherical iron objects (helmets, kettles, plows, axes etc).
From +86 to +90	ground on the unbalanced device, hot rocks, as well as very deep large objects made of high conductivity metals (for instance, aluminum bowl, big silver salver). Hot rock is notable for stretched "rubber" signal, while signal from a metal object is usually concentrated in a small point.


As we see, even in the "nonferrous" VDI sectors, "trashy" targets are found with valuable objects side by side. In other words, any valuable target may always have nonferrous trash with similar characteristics.

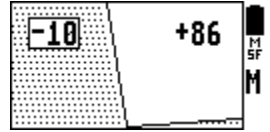
Besides, do not forget that target's VDI is truthful in the reliable detection zone only and if there is no other metal object nearby. For example, iron underlying golden chervonets of Nicholas II may "take" its VDI from standard +37 to "plug's" +18/+22. At full sensitivity limits in the ground it may suddenly sound like deep copper coin with VDI +85. It is a common feature not only for your device, but for all devices of this type.



So, any "cut-off" and no-dig of the "potential trash" is a compromise between comfort and loss of valuable catch. You never know, may be that hundredth "kind of plug", you did not dig after 99 of dug-up ones, was a rare principdom age coin.


Warning! When using search coils with a low frequency of excitation current VDI parameters will have lower levels. And vice versa, higher frequency gives higher VDI.

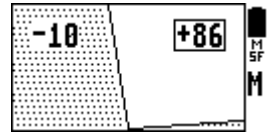
Discrimination Sector Setup.



To setup required discrimination sector, press  several times, select entry "setup left discriminator border". You will see a VDI digit in the square frame above the left



border of the discrimination sector. Use buttons  and  to change this number, moving the border to the left, increasing range of targets accepted, or to the right, decreasing the range. Targets with VDI located on the scale to the left from the discriminator border, will be cut-out.

Press  one more time to get to the "setup right discriminator border". You will see a VDI digit in the square frame above the right border of the discrimination sector.



Use buttons  and , to change this number, moving the border to the right, increasing range of targets accepted, or to the left, decreasing the range. Targets with VDI located on the scale to the right from the discriminator border, will be cut-out.

To exit discriminator setup press , or automatic exit 7 seconds after the end of the last setup input.


Warning! We recommend to setup VDI value of the left discriminator border equal to the low tone border (LTB).

“All metals” search mode

In this mode the device responds to all objects, either iron or nonferrous, with the tone corresponding to objects VDI. The advantage of this mode is in high descriptiveness and informativity, giving an insight into quantities and structure of the ground metal. Apparent disadvantage is a high sound overflow, especially in trashy areas. Your device allows reducing sound overflow using iron object sound volume decrease (setup Sound Volume Fe).



In this mode the device also responds to some so-called "hot rocks" of the prolate form. SOREX 7281 identifies most of these rocks and does not give sound response to them. If you are not interested in such signals, and they even disturb you, use discrimination mode, in practice it corresponds to the "all metals" mode. Setup left and right discrimination border to -86 and +86 respectively.

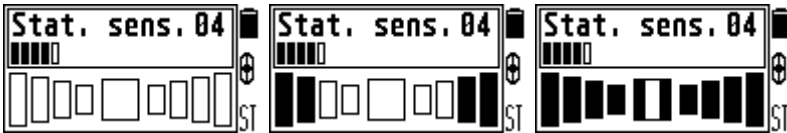
"Static" mode (Pin-Point)

This mode is used basically as a secondary mode to clarify target location in the ground. After target detection in dynamic mode (primary search mode), put the coil slightly aside from the assumed target location and press .

Warning! Avoid turning this mode on in the zone of target sensitivity (put the coil rather far aside).

Then smoothly pass it above the detected target, keeping constant distance from the ground. Sound signal volume and frequency will increase upon approaching the target, decrease upon moving away. Frequency and volume "peak" will be noticed at the centre of the target respectively. To finish centre clarification make two perpendicular passes. Signal "peak" cross, right under the centre of the coil is a target centre.

At the same time, target centre clarification may be visually controlled on the screen of your device. Onscreen scale cells will be filled when approaching the target centre and brighten when moving away from the centre. Target centre corresponds to the fully filled onscreen scale. Use buttons  and  to adjust static mode sensitivity.



If the signal is too strong and continuous, the target is large and relatively close to the surface. Raise the coil to the level where the target is less responsive and you will be able to detect target contour in the ground by crossing passes.


To exit the mode press  one more time

Search coil replacement.

Warning! Prior to coil replacement find a clear area, because ground balancing will be required after replacement.


Or, if there is no clear area detected, get a piece of ferrite or a piece of red brick.

Connect the required coil to the shaft, wind the cable around it and connect it to the unit slot.

Hold the device at the distance of one meter between the coil and the ground and away from metal objects, turn on the device, holding button  on the device panel. Hold the button until device stops playing the melody and the onscreen short-time search coil operating frequency indication appears.

Warning! The digit of the detected frequency of your search coil may depend on the particular search coil the device is tuning to automatically and software version. For search coils of any frequency range it may vary within $\pm 5\%$.

After that your device automatically enters the ground balancing mode. Perform balancing in the clear area, similar to the procedure described in the "Ground Balancing" section, or, if there is no clear area, use a substitute (soil clump, red brick, ferrite). See the appropriate section on "Ground Balancing".

Press  to exit from the balancing mode. Your device is ready for operation with a new search coil.

Warning! All aforementioned procedures are also necessary for software update (firmware update).

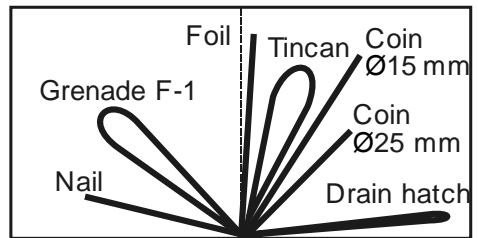
If your device is equipped with several interchangeable search coils, we recommend you, in case of idle periods (for instance, seasonal stop-over), to reset the detector before starting the search, i.e. to adapt the electronic module to the search coil in order to avoid confusion.

It should be mentioned here that the device has a built-in diagnostic system for the search coil excitation circuit. In case of circuit discontinuity and disconnected converter the device onscreen message says "SEARCHCOIL ADAPTATION ERROR" («АДАПТАЦИЯ ДАТЧИКА НЕВОЗМОЖНА») with the appropriate icon in the right part of the screen showing the DD search coil.

Visual Identification Tool - Hodograph

In the hodographic image mode target information is shown as a vector on the graph with axis X and Y. Its size, form and angle depend on the electric parameters of objects such as conductivity, magnetic penetration, depth, geometry etc. It is almost impossible to describe all nuances, understanding comes with step-

by-step progress in visual image memorizing and it depends on practical experience. But there are some consistent patterns which may help you to start the capture, such as:

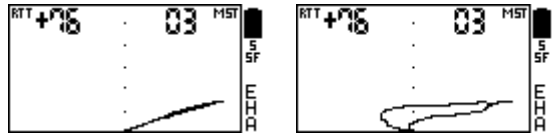


1. Hodographs of small and medium objects made of iron are located in the left half of the screen. In other words, they deflect to the left from the centre of the horizontal axis along the bottom border of the screen.
2. Hodographs of nonferrous metal objects in most cases are located in the right half of the screen. In other words, they deflect to the right from the centre of the horizontal axis along the bottom border of the screen. Rarely, small low-conductivity metal objects as well as nonferrous objects masked by iron objects may give hodograph in the left half of the screen, but with a great deflection from the zero. (to -35 VDI). Hodographs of large iron objects (helmet, axe, tin plate) also appear in the right half of the screen.

3. Larger reflection surface and higher conductivity of the object give stronger hodograph inclination to the right. For instance, with equal diameter and thickness, copper coin hodograph would be closer to the horizontal axis than the bronze coin hodograph. That happens because copper conductivity is higher than bronze alloy conductivity.
4. Hodographs of medium and large iron objects of non-round shape often have a form of wide loop, located both in the left and in the right half of the screen simultaneously. Hodographs of nails, arrow heads and other small iron objects have a shape of straight vectors in the left half of the screen.
5. Hodographs of nonferrous metal objects in most cases have straight shape or a narrow loop shape in the right half of the screen.

The advantage of hodographic indication over VDI

Two representative target hodographs are shown on pictures. These objects (a coin and a piece of rusty tin) give a nonferrous signal on



all similar devices. In both cases target VDI would be +57 +58. It is seen in hodograph shape only that in first case (left picture) the target is sure to be nonferrous. In second case (right picture) it is safe to say that there is a flat iron target under the coil, a piece of iron roof coating, fragment of a kettle, for example.

Multifrequency

You are likely to be amazed by the fact that most devices produced worldwide have similar sensitivity, for example, to a brass disc with the diameter 25 mm and a fifty mm copper disc, although the second target is much bigger. It is known that small targets (coins) are better found in high search coil excitation frequencies.

The point is that due to specific physical laws, each target group has its own optimum frequency which gives maximum sensitivity to those targets.

To provide device performance in the search for large and small targets many manufacturers produce 2, 3 or 4 frequency detectors. Sorex 7281 is world's first multifrequency device which allows working with search coils of any excitation frequency within the range of 2-20 kHz, putting into action the principle of the sensitivity acceptable for almost any group of targets.

Standard Sorex 7281 set may include the following search coils: 15DD – 3 kHz, 9,5x12,5DD – 7(3, 14) kHz, 10DD – 7 kHz, 6x10DD – 7(14) kHz.

Are there any practical recommendations on the selection of converter with a certain operating frequency?

3 kHz may be successfully applied in trashy areas to search for large targets made of ferrous and nonferrous metals as well as spoils of war.

7 kHz – medium universal frequency for a wide range of goals. It can be used for the search for medium, small coins and spoils of war. This frequency is suitable for the on-the-ground reconnaissance.

14 kHz is a frequency suitable for small and medium coins, especially when they are lay "on the ridge". This frequency is efficient for the beach search.

Search and identification methods

Sweep search coil above the surface keeping constant distance of 2-3 cm. This distance is optimum in terms of neutralizing soil mineralization, hence optimum for the right identification of the metal object type.

Warning! An important thing to remember. Moving the search coil to the ground surface (not to the grass, but to the soil in particular) closer than 2-3 cm you get into the so-called "Close Zone" (CZ) of the search coil interaction with the low-magnetic and low-conductivity environment - the soil, as it was mentioned in the "Ground Balancing" section. In this zone the physical interaction pattern changes significantly, and that may lead to false responses of sound indication with high sensitivity levels.

Avoid touching the ground with the search coil. It's important to keep constant distance between search coil and ground surface. Have in mind that proper object identification, number of false responses and sound indications of high sensitivity levels depend on the performance of this operation.



Try to avoid horizontal search coil jerks. Optimum scanning speed 40-50 cm/s. Each successive scan must overlap the previous one at least by a half.

Make additional scanning to detect object type above the center of the object, i.e. on the maximum signal line, keeping distance between the search coil and the ground if possible. For the same purpose it is necessary to scan found object in the direction with the least ground relief changes. In this case ground interference is barely noticeable.

Device response single tones or tone sequences may go along with search coil interaction with metal objects. Pay attention to the following:

If detector responds by single tone short signal with high pitch and signal level is pretty stable then there might be a small nonferrous metal object under the search coil at the 5

cm depth and deeper.

If several (3 as a rule) high pitch signals are heard it means that same object is in the zone near the search coil (less than 5 cm). At the same time signal level on the display is pretty high, more than 50.

Two low frequency short signals mean that there is a long ferromagnetic object (i.e. nail) located along the scanning direction. If such object is located across the scanning direction or perpendicular to search coil plane, then the device gives single low frequency short tone.

It's important to mention that DD-search coil has a complicated interaction

pattern with metal objects in close zone (signal levels more than 80). That is why try to choose scan gap (distance) to provide 20 - 50 of signal level while identifying object type.

In other words, try to identify objects beyond close range zone if conditions allow you to do so.

The so-called hot rocks cause problems during search operations, their VDI is more than +84. To distinguish hot rocks and relatively large flat nonferrous objects (for example, five kopeks of Catherine II) VDI within +78 ...+86, device has special high-tone signal that differs from the usual signal tone for the nonferrous metal object. Hot rocks signal can be excluded using discriminator and setting value of first border to +86. However the most effective hot rock neutralizer is not a discrimination HRN (hot rocks neutralization) algorithm. With ***discrimination*** exclusion of sound response to hot rocks, due to ground influence, the aforementioned valuable objects with interference vectors close to hot rocks can be missed. This disadvantage is eliminated by the NHR-algorithm.

Identification of flat iron objects.

Such objects include steel beer caps, pieces of roof layers, pieces of cast iron and so on. These are the objects causing most identification difficulties and they are often mistaken for nonferrous objects, such as coins.

Nevertheless, there is a range of technical tricks allowing distinguishing such objects.

If such target gives a strong response (rating 10 and higher), the search coil edge scanning technique may be applied. With this scanning technique the aforementioned targets would give low tone of sound indication, and the display would show specific shift of the hodographic picture to the left (to the iron sector).

These targets may also be scanned by a search coil located at the angle of 45° to the ground surface. It may not lead to the low-tone sound indication, but, at the same time, the hodographic picture will be more loop-like with a left-shift tendency (to the iron sector).

As a rule, such output of both types of indication means that the object is made of iron.

Search specifics in trashy areas.

The search in these areas is the most complicated due to obvious reasons in terms of the application of a metal detector. It is impossible to give well-defined and concise "trashy" technique due to the variety and multiplicity of such models. However, some general guidelines listed below may significantly increase performance in such areas. Of course, the main M/M algorithm is used.

1. Select correct general sensitivity of the device (adequate to the area trash level). The higher the trash level is, the lower the general boost and identification channel sensitivity should be – ST. Use the "Economy" mode. Remember, high sensitivity does not always mean high search performance.
2. Try to move a coin in close proximity to the search coil. You'll see that there is one target, but the unit gives three short tones. This comes from the fact that the actual interaction of the DD sensor with the target is complicated. What










would happen, had there been several objects? It's obvious that multiple targets located in the close zone are likely to tangle comprehension of the sound and visual information. This fact leads to the important practical conclusion. Do not search in trashy areas with a minimum gap between the search coil and the ground, especially those with the on-surface trash. Choose optimum scanning gaps. In this case they may amount more than 25% of the diameter of the search coil used.

3. Use short sweep technique (5-15 cm) to search for, identify and locate useful targets.
4. The right scanning direction for a group of targets may minimize influence of neighboring objects.

Based on the above stated, the most important factor of the «trashy» area search performance shall be your field experience and practical skills.

Additional menu


Model 7281 has the additional menu extending sound indication capabilities and including ground balancing automatic tuning option.

To enter additional menu press and hold . To browse menu entries press  and . To select menu entry and enter the submenu press . To select the submenu parameter press  and . To change the parameter selected in the submenu press  and . To exit the submenu and enter the menu, to exit the menu and enter the search mode press .

Menu entries:

1. Tone borders (Border 2, Border 3, Border 4);
2. Tone tuning (RT Frequency, LT Frequency, Frequency 2, Frequency 3, Frequency 4, Frequency 5);
3. Additional Parameters (Contrast, Startup melody).

Tone borders.

In this submenu you can change borders of VDI sound sectors according to your major search targets. Narrowing or widening them you can achieve sound recognition of the group of targets common to your search area. To exit the submenu press .

Tone tuning

In this submenu you can change tonality of identification signals comfortable for your ear. The bigger number is, the higher the tonality goes. The lowest tonality corresponds to the iron, the highest one corresponds to large high-conductivity metal objects. When you change the tonality we suggest you to consider that the tonality of the

threshold tone has its own separate value. It is not recommended to assign this or close tonality to any group of targets, otherwise its identification signal will merge with the threshold tone signal and it would be indistinguishable against such background.

Add. Parameters (additional parameters)

Contrast

This option allows adjusting display contrast to the level comfortable for you.

Startup melody.

This option allows selecting one of two startup melodies of your choice or turning off the startup melody at all.

Troubleshooting

In case of any malfunctions, first of all, reset your device to factory settings. Turn off the device, press "M" button on the panel and turn on the device, holding it till the startup screen appears. You will see a "Factory Settings" (Заводские настройки) onscreen message. In most cases this reset will solve the problem.

Phantom search signals when there is no metal targets are possible in following cases:

1. Incorrect ground balancing. With incorrect ground balancing, when the balance phase (a digit in the left corner of the screen) is shifted to the "minus" values too much, false responses are possible in the nonferrous metals sector when bumping the search coil over mounds and plants. Balance the device accurately or adjust ground phase value by 1-2 degrees in the manual balancing mode pressing "+". If the balancing phase is shifted to the "plus" values too much, false responses are possible in the iron sector. Balance the device accurately or adjust ground phase value by 1-2 degrees in the manual balancing mode pressing "-".
2. Weakened contact in the slot of the coil jack in the module. Put the device into horizontal position and tap the unit cable with your finger. If the device responds with sound signals, the problem is in the slot. Slightly force apart pin sections of the unit (approximately 1 mm) and screw the nut tightly. If it did not help, your device is likely to have a defective search coil jack soldering, or the jack is damaged and repair is necessary.
3. If a light finger tapping on a coil (see section "Search coil Replacement") connected to a balanced device such device gives short tone signals, then the search coil is defective and subject to repair or replacement. The 15 DD search coil may give light phantom responses when bumping over the edges of the coil circle, it is a design feature of the large search coil.

Warranty

Manufacturer guarantees operational capability of the metal detector provided that the consumer follows operation conditions.

Warranty period 24 months starting from the sale date.

Manufacturing defects shall be repaired by the Manufacturer during the warranty period free of charge provided that there is no damages in electronic module and search coil.

This Operating Manual with the sale date mark should be provided together with the device in case of warranty repair. Warranty period is calculated from the date of manufacture in case there is no sale date mark.

Send claims to:

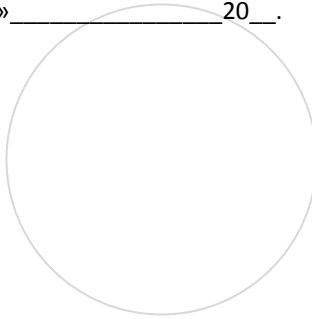


QA/QC certificate

Metal detector «**SOREX**» 7281, № _____

Date of manufacture « ____ » _____ 20__.

Manufacturer's Stamp



QA/QC Passed _____ Signature.

Sale Date « ____ » _____ 20__.