

INSTITUTE OF GEOPHYSICS, RUSSIAN ACADEMY OF SCIENCES, SIBERIAN BRANCH

**NEAR SURFACE ELECTROMAGNETIC
FREQUENCY INDUCTION SOUNDING DEVICE
“NEMFIS”**

Instruction manual

Novosibirsk, Russia

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1. GENERAL DESCRIPTION OF NEMFIS.

Electromagnetic multifrequency sounding device NEMFIS is developed in Laboratory of EM fields of Institute of Geophysics, Russian Academy of Sciences, Siberian Branch. The manager of the Laboratory – Dr. Michael Epov; manager of the device development group – Dr. Alexander Manstein.

PHYSICAL BASIS OF ELECTROMAGNETIC SOUNDING.

Electromagnetic sounding is well known as a powerful tool for the study of the Earth crust at various depths – from few centimeters up to deep mantle. The technology of this study is based on the detection of peculiarities of spatial distribution of electromagnetic fields induced in the electrically inhomogeneous media by different sources. The task of the electromagnetic sounding depends on the problem investigated. So, for deep crust sounding a natural powerful source – ionospheric current system – is used. For other task – extraction of earthquake or volcano eruption electromagnetic precursors – the weak electromagnetic signals caused by the dynamic changes in the crust internal structure at various depths have to be extracted and ionospheric source is a powerful interference for this. And for the study of the upper part of the crust the active electromagnetic sounding with the artificial sources are widespread. The adequate interpretation of the field observation data gives possibility to get quantitative information about the geometric dimensions (size, depth) and electric parameters of inhomogeneities and also their dynamics.

In any case, electromagnetic sounding process must have a variable parameter, that allows to propagate to the various depths. Such a parameter can be time of measurement (Time Domain EM methods) or frequency (Frequency Domain methods).

Frequency domain electromagnetic induction sounding is the full title of the method, hardware in NEMFIS device. The procedure of such a sounding consists of the following phases:

1. Transmitter transmits primary EM field of the first frequency.
2. The primary field acts upon the media.
3. The secondary EM field induces in the media on the first depth.
4. Receiver receipts the secondary field.
5. Transmitter transmits primary EM field of the second frequency....

The number of such a steps depends on the number of frequencies.

PURPOSE AND APPLICATIONS OF SHALLOW DEPTH ELECTROMAGNETIC SOUNDING.

NEMFIS designed to study first ten meters of the Earth crust. The real depth of measurement depends on resistivity of the ground, however, can't exceed 7 m in real grounds because of limited sensibility of receivers. Meanwhile we can expect that in some special kind of media such as dry sands or ice the propagation depth can reach and even exceed 10 m.

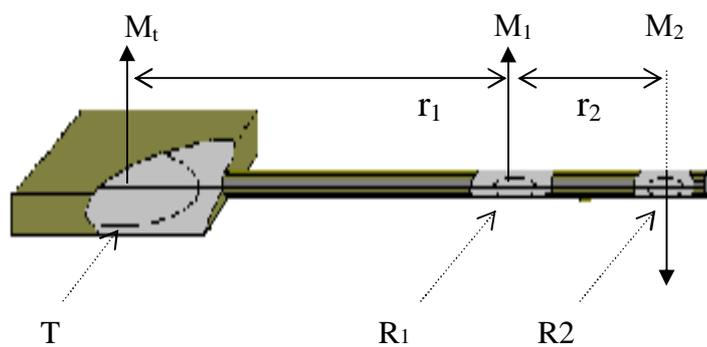


Figure1.

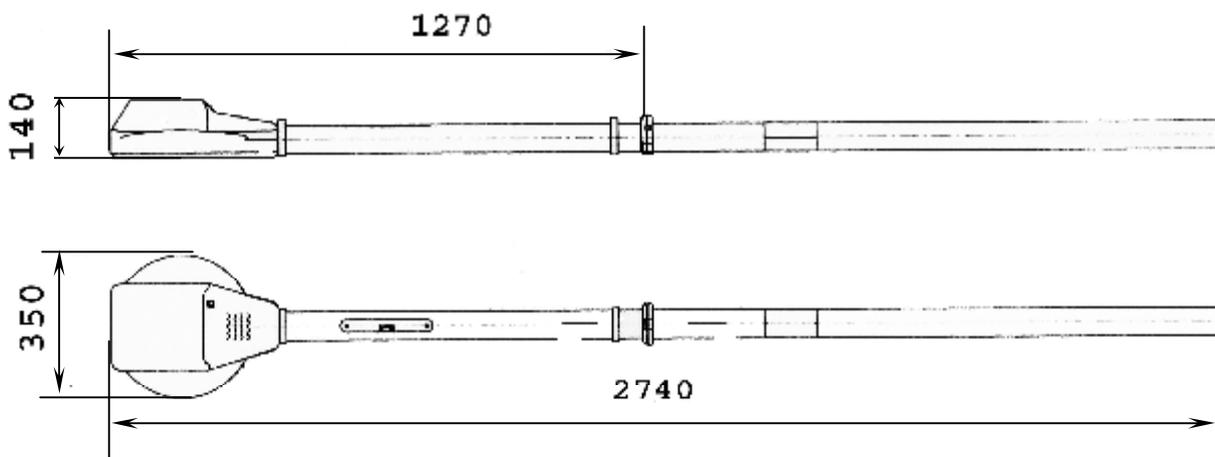
Due to this propagation limit, the purpose of the unit is limited by study of geoelectric situation on the depth up to 7 m. The device can operate on 14 frequencies. It means that the data acquired can describe the geoelectric situation at 14 levels of depth. In horizontal plane the responding media is the ellipse with one constant axis length (2.5 m) and

second axis length depending on the frequency 0.5 – 4 m. Having such a good resolution we can state that the unit is intended for 3D specification of geoelectrical parameters of the media at a depth up to 7 meters with heterogeneous inclusions dimensions 0.5 x 0.5 x 2.5 m or more. Meanwhile, the a very contrast targets such as metal objects can be even smaller.

The fields application of the device are:

- Archaeological survey;
- UXO determination;
- Subsurface tunnels and empties investigations;
- Quantitative assessment of water saturation of the ground;
- Assessment of HC waste in the ground;
- Searching both fresh and salty water source;
- Subsurface buildings condition control;
- Searching and localization of burial place of industrial waste;
- Source and volumes of water leakage in water supply and heating systNEMFIS;
- Source and volumes of fuel/oil leakage in subsurface fuel tanks/pipelines;
- Definition of places of a lining of metal pipes and cables;
- Detail exploration of ore bodies;
- Environmental monitoring of dumping liquid mineralized waste.

PHYSICAL MODEL OF NEMFIS.



Basic components of NEMFIS is shown on Figure 1. NEMFIS implements the frequency induction sounding as follow. Alternating magnetic field with controllable phase is generating consequently on several frequencies by transmitting loop (T). Measurement of real and imaginary component of media-induced field is to be effected on each frequency. Transmitter field compensates by contrary connection of receivers.

The receivers shaped (R_1 and R_2) especially to obtain the equity of M/r^3 ratios of the receivers on the average frequency in “on air” mode. There M is the product of receiver and transmitter magnetic momentum.

$$M = \mu_c \cdot n_r \cdot S_r \cdot I \cdot n_t \cdot S_t$$

Where μ_c magnetic permeability of the dipole' core; n_r – number of loops for receiver; S_r – square of a receiver loop; n_t – number of loops for transmitter; S_t – square of a transmitter loop; and r is the distance between center of the receiver and transmitter.

Each measurement has two stages: transmitter signal measurement to determine current value in transmitting dipole and measurement of media-induced field. The measured value in the output of NEMFIS is the difference between electromotive forces of two receivers:

$$\varepsilon = \varepsilon_1 - \varepsilon_2$$

Taking in consideration only vertical component of magnetic field

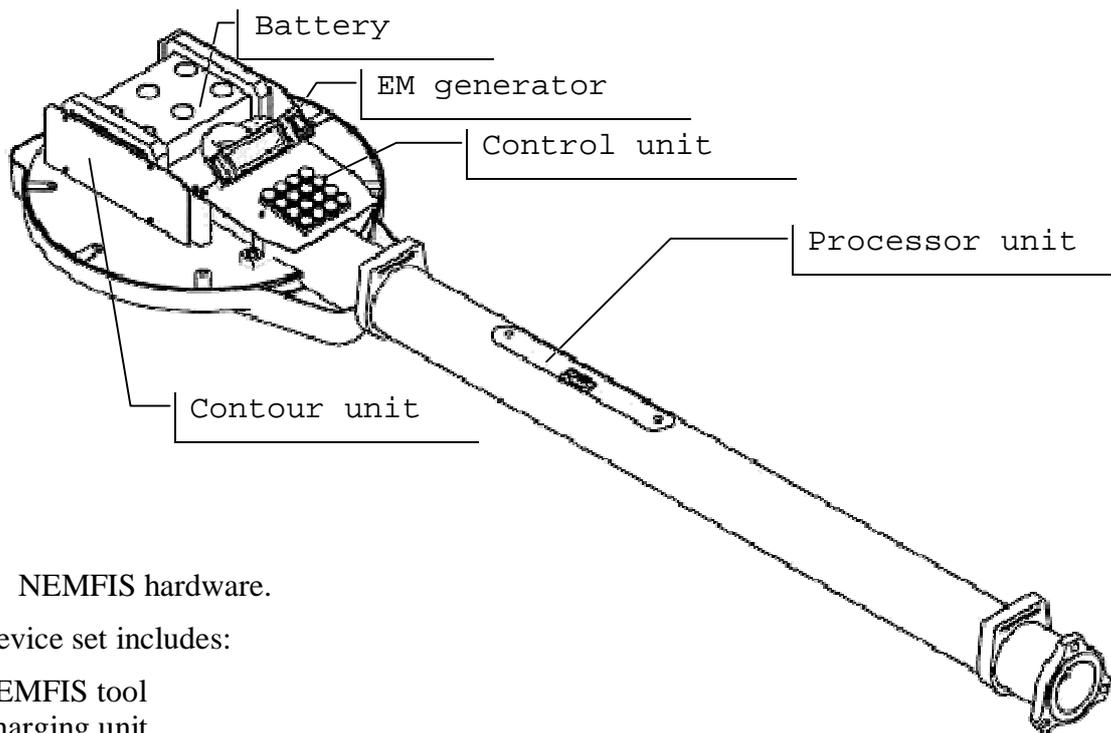
$$H_z = H_z^0 e^{i\omega t}$$

$$\text{For each receiver } \varepsilon_j = -i\omega\mu_0 ((M_j M_t)/(4\pi r_j^3)) h_{zj}; \quad j = 1, 2$$

Here $\omega = 2\pi f$; where f is the exiting frequency (Hz), M_t – momentum of transmitting dipole, M_1 and M_2 - momentum of receiving dipoles, $\mu_0 = 4\pi \cdot 10^{-7}$ henry/m, h_{zj} - magnetic number of the media for each receiver.

$$h_{zj} = 2/(k^2 r_j^2) [9 - e^{ikr_j} (9 - 9ikr_j - 4k^2 r_j^2 + ik^3 r_j^3)]. \quad [1]$$

where k is the wave number of the media $k = (i\omega\mu_0\sigma)^{1/2}$; where σ is the media electric conductivity (Sm).



NEMFIS hardware.

The device set includes:

1. NEMFIS tool
2. Charging unit
3. Measuring tapes
4. 10-mm wrench
5. Soft case
6. NEMFIS head protector
7. RS 242 cable
8. Remote control unit
9. PDA
10. Software

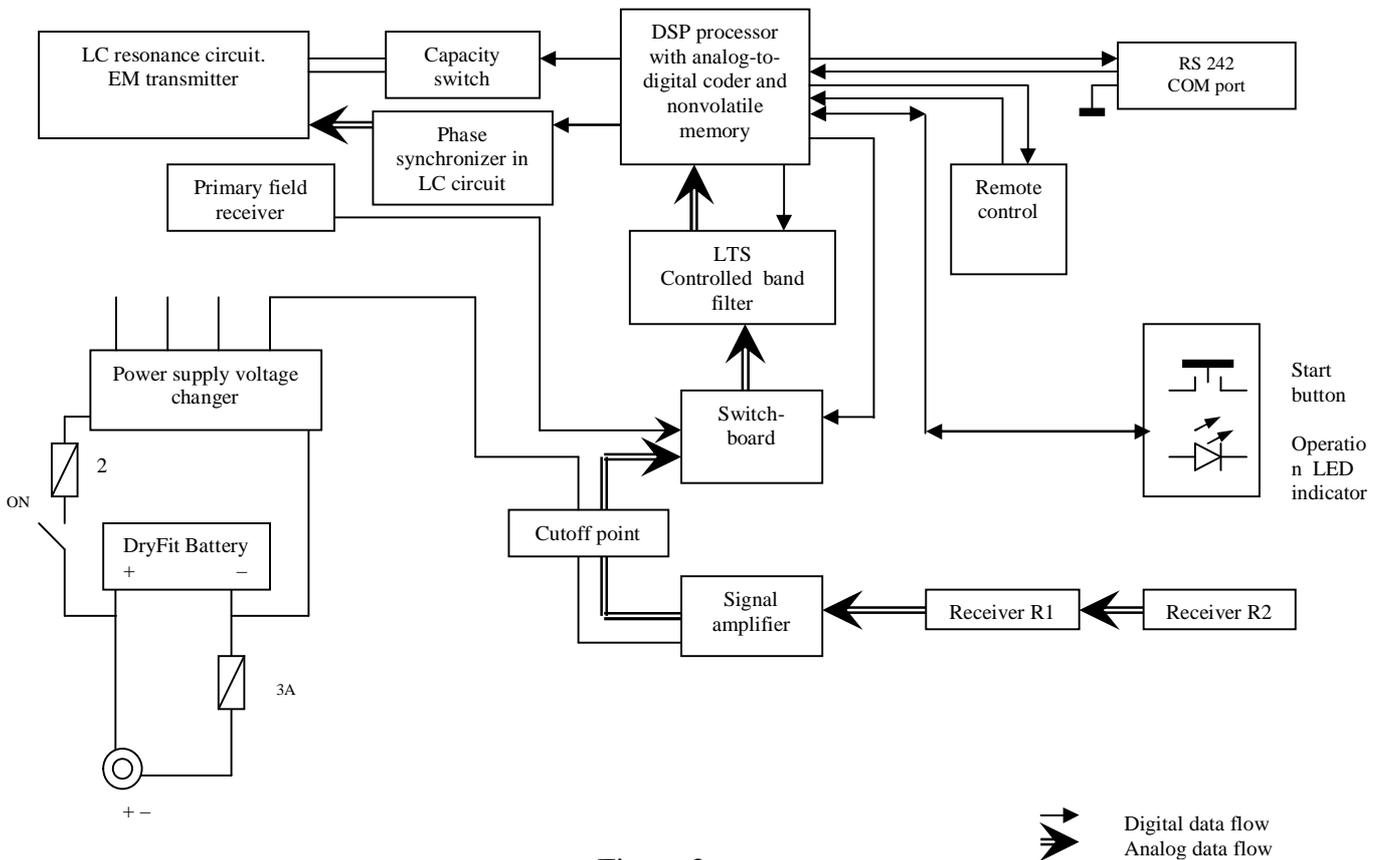


Figure 3.

NEMFIS shaped as 8 feet long “banjo” with 3-inches diameter neck and 12-inches diameter, 5-inches high “drum” with LCD and keyboard on the top (see Figures 2 and 3). Electronic block includes RAM enough to keep data of the current measurement session. After a session, the tool is used to be connected to a PC equipped with NEMFIS software.

Remote control unit.

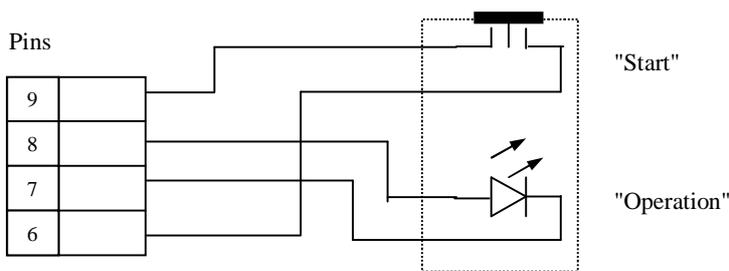


Figure 4.

The charging unit intended for charging of the NEMFIS unit on-board battery. The battery is Dryfit A500 battery 12V/10.0Ah of Sonnenschein. The battery is absolutely maintenance-free. The temperature range of the battery is -30 +50 °C. However, at -15 °C the

capacity of the battery reduces at 50%.

To charge the battery plug the output of charger to the DC input on top of the head of the tool; plug the input of charger to 220 V AC power point. The continuous red light of the charger indicator shows that the voltage of battery reached 14 V and the battery is full.

RS 242 cable.

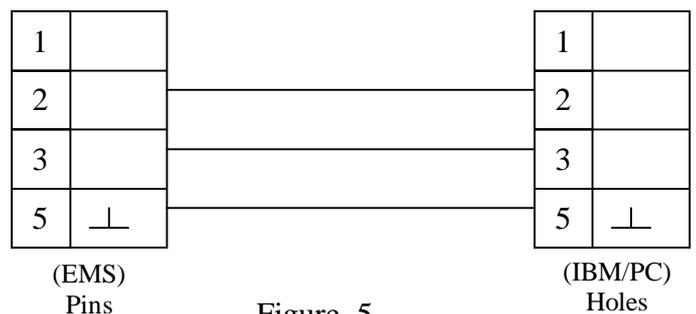


Figure 5.

Num Pad.

The num pad is situated on the head of device. Apart of numeric buttons there are some additional buttons:

A – to select the number of frequency.

B – to select the number of memory cell.

C – to select the regime of recording (same cell/next cell)

- to set continuous measurement mode (Z on LCD)

* - to set single frequency mode on (S on LCD)

D – to start the measurement.

NB! The numbers is used to be dialed on opposite direction. For example, to input the cell number 234 you must press 4 3 2 A.

LCD

Liquid Crystal Display on top of the head shows the following data.

Upper row

1	2	3	4	5	6	+	7	8	9	0	+/-	a	b	c	d
---	---	---	---	---	---	---	---	---	---	---	-----	---	---	---	---

Digits 1÷4 number of memory cell

Digits 5÷6 frequency number

Digits 7÷0 current (ppm)

Digits +/- ÷ d phase in degrees (maximum of current in transmitting LC relatively to internal DSP generator signal)

Lower row

1	2	3	4	+	C	+/-	5	6	7	8		+/-	a	b	c	d
---	---	---	---	---	---	-----	---	---	---	---	--	-----	---	---	---	---

Digits 1÷4 input data monitor

Digit + incremental switch (+ on, - off)

Digits +/- ÷ 8 real component of signal

Digits +/- ÷ d imaginary component of signal

2. SAFETY PRECAUTIONS.

Handle with care.

The device can't operate in conductive environment. Keep the working NEMFIS out of big metal objects. If during operation a metal plate 30 x 20 cm is situated in less than 10 cm from the "head", phase of the primary field could not be measured and operation must be terminated by pressing Reset Button.

Keep dry.

All the components used in the device have the working temperature range $-20 \div +60$ °C.

Turn off the device before changing of the environmental air temperature. After changing of the environment air from negative to room temperature remove all the covers and let the device warm up during at least 1 hour. Current circuit during warming can damage multilayer board.

Blinking of battery weakness LED indicator (see Figure 3) means that the battery voltage is below 11.5 V and it's time to charge the battery. You can still acquire the data for some time, but sensitivity of the device will reduce.

3. DATA ACQUISITION PROCEDURE

Preparation of the device for field work.

Be sure that the battery is full. We recommend to measure voltage on charging plug. The fully charged battery must show at least 13.3 V.

- Assemble the tool.
- Put soft cover on the head.
- Put the protector on.
- Plug the remote control unit in.

Preparation of work site.

The device is ready to work now. It's time to prepare your work site. If you need to explore a linear object, it's just the matter to put measurement marks on your profile. We use 50-m measurement tapes.

If you need to explore an area, exploration area supposed to be divided to squares depending on the task (usually 1x1 m). We use 3 measurement tapes: 2 as directors on parallel borders of area and one as moving profile tape. This tape is used to move each time when a profile is done. NEMFIS software is arranged to work with area data made by snake line as shown on the Figure 6.

The Figure 6 presents an example of area sounding layout. The process is going picket by picket and profile by profile. The area is divided to M equal parallel profiles. Each profile has N pickets.

Data acquisition process.

Turn the tool power switch on.

If you want to use PDA for control press F2 button on numeric pad and NEMFIS will connect with PDA by Bluetooth. How to operate with PDA – see paragraph

Using on-board numeric pad choose:

- the lower frequency to work. On default all the frequencies will work from lowest (#1) to higher (#14);
- Initial number of memory cell to write on. On default it will set on #0000.

Push C button to set + on LCD to make incremental measurements, otherwise all your measurements will be written in one cell and only last one will be saved.

After that, put the tool on the exploring surface on the bottom left corner of your area (see Figure 6), keeping the central point of tool on the measurement line. Push the start button. During the measurement you will see measured signals on the on-board LCD and red LED indicator will blink on the remote control unit. When the measurement is done, you will see the point number increased by 1. Now you can move the tool to the next picket and push the start button again.

During the job on a site, the tool orientation should be constant to avoid the Earth magnetic field influence. Measure the device undercompensation on air. To do the air measurement ask one of your colleague (better

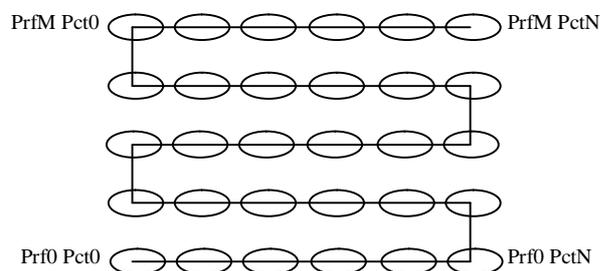


Figure 6

higher than 170 cm) to take off his watch and hold the device above his head. He must keep the head of device horizontally. Press the start button. It's better to record air measurement 3-5 times.

In some cases, when you need just 1 or 2 frequencies, the tool can be moved continuously during measurement.

After the measurement session, connect the tool to PC using COM port cable, load data to the NEMFIS data processing program and enjoy the view of your just-explored object.

4. DESCRIPTION OF THE PDA PROGRAM FOR NEMFIS CONTROL.

4.1 General description

The software is developed for a platform of the pocket computers (handheld computer, PDA) and intended for control of various operating modes of a hardware complex of frequency electromagnetic induction sounding NEMFIS, sounding data processing in a real time mode and a conclusion of results read in a user-friendly graphic kind.

The software is tested on platforms PocketPC 2003 and Windows Mobile 5.0. Data transmission between a PDA computer, equipment NEMFIS and GPS goes by Bluetooth.

4.2 Run the program

- 1) After the start of the program you will see sequences of windows dialogues with the options, regulating **static parameters** of work which don't vary (don't accessible) in the course of measurements.
- 2) Then you will see the sequences of windows dialogues with the options of dynamic parameters which can change in the course of measurements. These options remain accessible while scanning.
- 3) Program is ready for measure after the NEMFIS will open Bluetooth connection with a Pocket computer. The window of graphic data presentation will deduced, you can use dynamic parameters while measuring.
- 4) In case of measurement on GPS to a track by the first pressing the measurement button - the manager for connection PDA with GPS will appear.

4.3 Technical details

- 1) Program will notifies the user with sound signal when you finish current profile.
- 2) While the measuring there is a possibility to look maps, cuts, profile diagrams and curves of sounding by any of 14 frequencies for any picket (point of measurement).
- 3) All options automatically safe while you close the program.

4.4 Description of the interface

4.4.1 Static parameters of measurement

Static parameters:

1) Type of works (**Work type**), does not vary while measuring:

-**Map** - Sounding on knowing area. Operator can set the size of a scan area X Size, Y Size and steps on both axes in meters: X Step, Y Step. By default -all data takes from the last experiment, or X Size = 20m., Y Size = 10m., X Step = Y Step = 1m.

-**Profile** - Sounding on a profile. Operator can set the quantity of pickets X Size and the size of a step in meters X Step. By default - all data takes from the last experiment, or X Size = 20, X Step = 1 m.

-**Unbounded profile** - Sounding on a profile with any quantity of pickets. The size of a step to meters X Step must be set. By default - all data takes from last experiment, or X Step = 1 m.

-**GPS Track** - Co-ordinates of pickets are defined by external GPS. Bluetooth connection must be open.

The screenshot shows the 'Ems Control' window with the following settings:

- Work type: Map
- X size: 20, X step: 1
- Y size: 10, Y step: 1
- Active frequencies: 14 frequencies (1-14) are checked.
- Select device: <no device>
- Buttons: Add, Del, Next >>
- Tabs: Static Settings, Other Settings
- Session: [icon]

2) The set of active frequencies:

By default - all data takes from last experiment, or all 14 frequencies are included.

3) Calibration data (Select device):

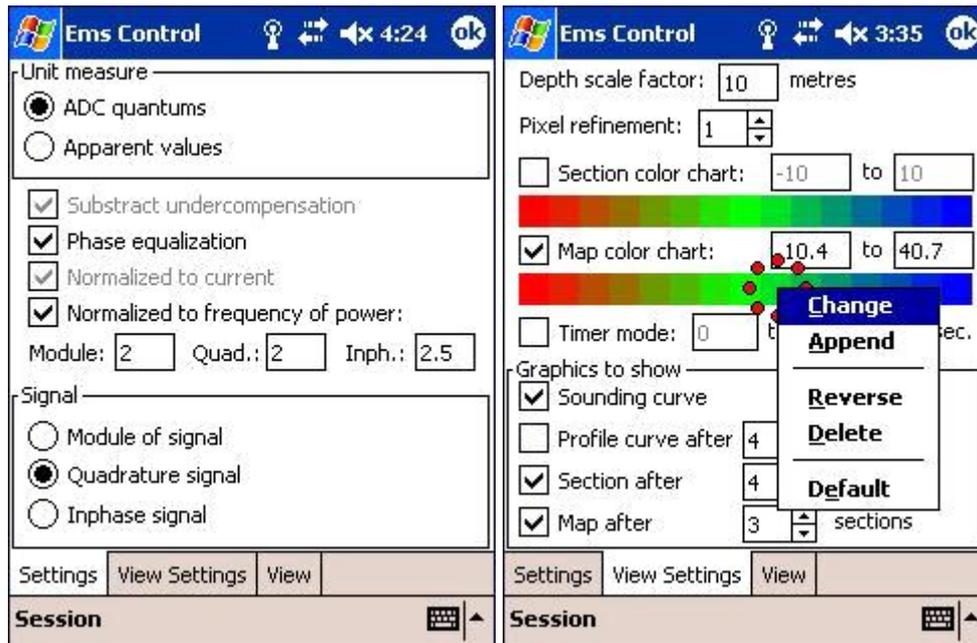
Allows to choose the necessary base of calibrations. By default (<no device>) the given calibrations for the device NEMFIS № 9 are used. Buttons <Add> and allow to add and delete the given *.ini calibrations files.

4) Number of virtual COM port for Bluetooth connections (Bluetooth inbound/outbound COM port number): usually it COM5 and COM8 accordingly. To define these parameters it is possible in options Bluetooth of the manager of your handheld computer.

The screenshot shows the 'Ems Control' window with the following settings:

- Bluetooth inbound COM port number: 5
- Bluetooth outbound COM port number: 8
- Buttons: Next >>
- Tabs: Static Settings, Other Settings
- Session: [icon]

4.4.2 Dynamic parameters of measurement



Dynamic parameters of measurements concern:

1) Signal units of measure (**Unit measure**).

- Units ACP (**ADC quantums**). The signal is displayed in terms of ACP. Following options of correction of a signal are accessible: zero subtraction (**Subtract undercompensation**), phase correction (**Phase equalization**), normalizing on a current (**Normalized to current**), normalizing on frequency in the set degree (**Normalized to frequency**).
- **Apparent values** - are calculated apparent resistance in ohm-meters and conductivity in milisimensah/meter.

2) Measured signal (**Signal**).

Measured signal component: the module (**Module**), real or quadrature a component (**Quadrature**), imaginary or inphase a signal component (**Inphase**).

3) Factor K_h (Depth scale factor) in the meters, setting the scale of depth under the formula: $H_i = K_h * \sqrt{F_1/F_i}$. By default - data takes from last experiment, or the factor is equal to 10 meters.

4) **Pixel refinement** - sets the effective size of pixels (more pixel - fast speed of imaging, but lower graphic quality).

5) The color palette for profiles (**Section**) and maps (**Map**). The numerical range of values corresponding to a palette is defined automatically according to measurements (on the minimum and maximum values), or can be set manually if the corresponding option (on fig. - for a map) is chosen. The color palette can be changed through the contextual menu (long pressing stylus on a color palette).

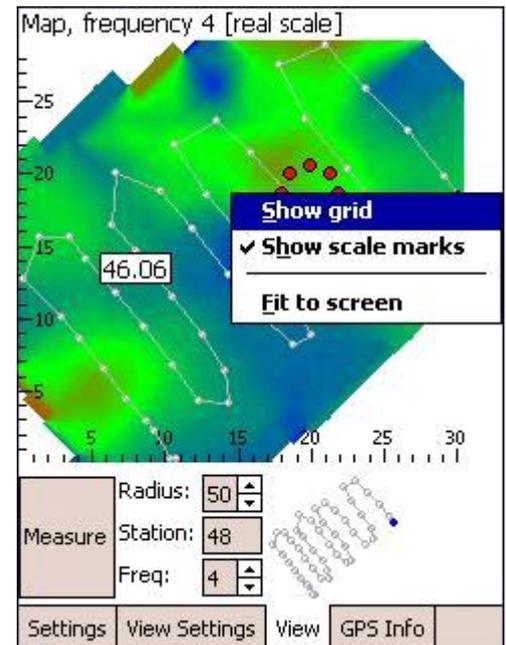
6) Measurements by the timer (**Timer mode**). Allows to make measurements in a continuous mode. It can be set quantity of measurements (0 - unlimited quantity) and a time interval between measurements in milliseconds.

7) **Graphics to show** - operator can set any of graphic which need to be displayed: sounding curve, profile diagrams (Profile curve, are displayed after the set quantity of measurements), cuts (Section, are displayed after the set quantity of measurements) and a card (Map, are displayed after the set quantity of the measured profiles). For measurements in **GPS track** mode - cuts and profile diagrams are imaging with

linear distance between consecutive sounding. Graphics are updated after pressing of navigating button Enter on PDA computer (in the bottom of the handheld computer panel, on the middle).

5.5 Graphic data presentation

Data of measurement are represented in a graphic kind in real time. At measurement on GPS track, the track also is displayed. The measured value in a concrete point can be visible after pressing by stylus in to this point. By long pressing of stylus there is a contextual menu. Values of a scale of distances are displayed in meters. In the left bottom corner of screen - there is the button of start the measurement (**Measure**).



5.6 Saving and loading of data

Saving and loading of measured data can be accessible through the basic menu (in the left bottom corner of the screen).

5.7 Hotkeys

- 1) The lateral button of a handheld computer - the button for start the measurement.
- 2) Navigating buttons (arrow) of PDA computers - allow establishing a current position of measurement.
- 3) Central navigating button - changes graphic data presentation for a current position.
- 4) 4 buttons of the bottom panel of a handheld computer - two of them are used for transition between dialogues of options, internals - for change of current frequency.

5. DATA PROCESSING

NEMFIS SOFTWARE.

All the programs for NEMFIS data processing are assembled in one information system ISystem. The ISystem allows to download recorded measurement, store, convert the data, prepare them for visualisation in Surfer and Voxler 3D of Golden Software or Microsoft Excel.

System requirements: IPM PC compatible, RS 242 COM port (if you did not use PDA), CPU - Pentium 100 MHz, and a 5 Mb of free memory on HDD, Operating System: Windows XP or Windows Vista.

ISYSTEM INSTALLATION

1. Set in your operation system “.” as decimal point (“System preferences”-“Language and regional standards”).
2. Install Surfer.
3. Set metric system on Surfer.
4. Restart your PC.
5. Create a folder for ISystem.
6. Unpack the archive file.
7. That’s all!

DATA DOWNLOAD

If you use PDA for control NEMFIS you must download *.ems files from PDA into SD card and then download this files to PC for open in ISystem.

If you did not use PDA - to download the data from NEMFIS device you should connect COM port of PC to NEMFIS device using RS 242 cable and start ISystem. Number of COM port can be chosen from Port Option dialog of Options menu. Then

1. Open Communication dialog window from Tools menu or using the button on the panel;
2. Mark on Read Data From NEMFIS switch;
3. Choose a folder to store your data on Data panel;
4. Choose initial data cell and frequency number to be read.

Now, if Convert Data unchecked, ISystem is ready to data download. Press OK button. You will see the reminder to press Reset button on the device. Do it, then press Enter. The download start. During the download ISystem reads the NEMFIS readings and write *.ems files. One reading – one file. On the right side of the Communication window can be seen the name of last written file corresponding to number of reading.

NB: Right before download, Reset button MUST be pushed, otherwise the program will work improperly.

DATA CONVERSION

Downloaded data is stored as text *.ems files. Each file includes necessary information about one point of measurement: number of frequency, module of primary field, phase, real and imaginary parts of secondary field (signal). During conversion, NEMFIS files converts to sgd or csd files, that contains, apart of the above mentioned data, information about date and time of data conversion, numbers of profile and picket, work site name and optional data such as name of operator, kind of work and comments.

You can convert your data right after download process (quick conversion), or you can convert previously downloaded data.

NB! We recommend to make a quick conversion only if you have the full and accurate information about number of profiles and pickets. If you have recorded few data sets, then it's better to download it first, write them in correspondent folders and after that perform the conversion. It will allow to avoid the data mismatch.

Prior to convert the data, choose the sort of work that you have performed. It can be Square Sounding or just Sounding. Files of Square Sounding on Ortogonal Grid (see Output panel) and Sounding files has the same extension (*.sgd). The file name consist of work site name (name), profile number (npr) and picket number (npc) as follow: name_npr_npc.sgd. For example: testsite_1_10.sgd. For non-ortogonal (chaotic) grid data acquisition, the data must be converted with unchecked Ortogonal Grid checkbox. In this case the file name will include work site name (name) and number of point (npt). For example: testsite_10.csd. Air data file converted have name.air filename. Profiling work is not correct kind for the moment and still present in the current version for future software development.

So, for the conversion the following steps could be done:

1.a. For quick conversion put all the reading parameters on the Communication window (see above); check Convert Data checkbox and choose on Data panel the kind of work.

1.b. For conversion of previously read data put the switch on Convert Transferred Data on, choose the kind of work on Convert Settings panel from list box and choose the folder where *.ems files are stored.

2. On Output panel define the dimensions of work site (number of pickets, profiles, points), number of air records (we recommend to record air few times. During conversion, all the data will be averaged). During conversion of stored data of sounding or Square Sounding on chaotic grid, the work site dimensions will be defined automatically. Converted files will be moved to new Converted Data subfolder, if other folder is not specified. You can specify another folder or replace old files with converted ones. The log file created during conversion describe missing readings, if any. Set the number of air files. All the files will be averaged and one *.air file will be created.

3. Description panel should contain the work site name. The name should not contain dots and underlines (“.”, “_”). It’s better to write the name of operator, kind of work and indicate in Comment the step between pickets.

4. Press OK button.

DATA PROCESSING

Well, the data converted and ready to process. Now we recommend to use for processing the real part of the signal. However, imaginary part and module can be useful for some cases. That’s why ISystem can process the module and both components. For processing you may use normalization of the signal to current in transmitter, you may also distract undercompensation, normalized to the current. Also to approach the processing result to apparent conductivity or just to reduce the dynamic range you can use normalization to the square of frequency. All the corresponding settings you can make on Process Options window (Options\Process\Process Options). We recommend to process using the both normalizations and subtraction of undercompensation. However, in case of non-satisfactory result, you can try various combinations.

Process Options sub-window of Output window allows to change format of output files using switch groups Map Format and Section Format. The use of Excel sheet format makes the data arranged as 2D matrix without indication of coordinates, but keeping their layout. In this case you can not automatically present your data in Surfer, but in this format it’s easier to analyze numeric data. By default the checkbox of log file creation is checked on. In the log file you can find the data of missing points, profiles and frequencies. You can check the Current File creation checkbox to create the file with transmitter current measurement on each point.

The area sounding on orthogonal grid allows to create a set of maps of signal on all the frequencies, cross-sections on the both directions of the net and all kinds of diagrams. Area sounding on chaotic grid allows to create just maps. Sounding data can be presented as cross-sections and diagrams.

When all the options of processing and data output are set, you are ready to start the maps, cross-sections and diagrams creation process. To do this, you must open the corresponding dialog using Tools menu, contents menu or predefined keys.

MAP

To create a map you could choose the kind of data net (Orthogonal or Chaotic Grid). Then you should choose a kind of work (Area Sounding on default). Then you should open the Data Files Name dialog to choose a data file of the work site. ISystem automatically fills up the Work Directory, Air File Name and Out File Name fields. The working directory will be automatically scanned to identify the first and last profiles and pickets, and first frequency. After that the correspondent boxes will be checked. You can also check the Reverse Map checkbox of Options panel to invert the data.

If your grid is orthogonal, only one thing to do is to choose the frequency for map creation and press the OK button. To create all the maps push Full Map Process button.

NB! When you press the Full Map Process button, ISystem begins to create all the maps starting from frequency chosen in Number of Frequency field of Orthogonal Grid panel.

Processing Chaotic Grid maps: set the number of frequency, first and last points numbers, press OK. When Empty Data Array transparent will be changed by Full Data Array transparent, sounding data loaded. Then, txt coordinates file must be load by setting the Load Coordinates From File switch on and choosing the file or setting Specify Coordinates switch on and using Point's Number, X Coordinate, Y Coordinate and Add Coordinate to input coordinates point by point. We recommend to use txt coordinate file. The file should contain three column: point number, X coordinate, Y coordinate. Coordinates can be seen on separate window setting Show Coordinates List checkbox on. When coordinates are set, press OK button.

See an example of chaotic grid map on Samples folder of ISystem.

CROSS SECTION

Open data file using Data File Name panel. ISystem will fill up Work Directory, Air File Name and Out File Name fields. The working directory will be analyzed, numbers of first and last profiles and pickets will be identified. Check the frequencies to be used, fill the correspondent fields. Choose direction of profile using Along Profile Section, Cross Profile Section switch on Section Along Direction Of Orthogonal Grid panel. Set the number of profile or picket to build the profile through. NB: Processing data of one profile sounding, ISystem sets all the parameters automatically. Check the Reverse Section checkbox, if you need to reverse your section.

You can also create all the profiles using Full Section Process button.

On default a cross section dept defined proportionally to skin layer and first frequency depth set as 10 meters. Using Depth Scale field you can define coefficient for depths to be multiplied to. For example, the total depth of 14-frequencies cross-section with 0.4 coefficient will have 4 m of total depth.

AUTOMATIC VISUALIZATION OF MAPS AND CROSS-SECTIONS.

As soon as you can see Computation Successfully Completed message, processing is done and files are set for presentation in correspondent visualization program. ISystem is suited to work with Golden Software Surfer. To use Surfer the checkbox Use Surfer on Options panel of Process dialog must be checked on before pressing of OK button. If the checkbox Create And Show Map is unchecked, only grid file will be created (see Surfer manual). It can be useful for creation of a cross-section grid for further application of topographic data (see below). So, on default, using the Surfer, ISystem is creating output files, automatically build up grid files, create document, build up the map, save it in predefined folder and show it to the operator.

For some settings Surfer have used SurfOpt sub-dialog of Process Options dialog. On the sub-dialog you can set number of vertical gradations (NumRows) or horizontal gradations (NumColumns). This feature should be used if the work site have essential difference on various directions, because Surfer on default selects the number of gradations to make the various directions of grid more or less the same. During the automatization process the method of Radial Basis Function is always used for data interpolation. The RSquared parameter on the window is used by Surfer for Radial Basis Function interpolation and is responsible of detalisation of building. Major Interval is the same Axis setting of Surfer (see Surfer manual).

If you have chosen Simple Table format, visualization can be done on Microsoft Excel.

DIAGRAM

Diagram creation is used the same way as maps and cross-sections and it's no need to describe it especially. ISystem have no automatic diagram creation. You can create the diagram based on processed data using any graphic editor.

TOPOGRAPHIC CROSS SECTION.

Sometimes building a cross-section it's useful to take into consideration the topographic relief. To do this it's necessary to create grid-file of cross-section and txt file that contains the topographic data of relief. In the file the first row must contain the number of points and below two columns with coordinates X and Z. Then the file should be open from Tools menu or contents menu of Relief Section dialog.

Open the browsing dialog on Section panel to choose the grid file of your cross-section. Xmin, Xmax, Ymin and Ymax fields of Section panel and Number of Break Points of Common Settings panel will be filled up automatically. Then activate file selection dialog on Relief panel. Choose the topographic data file. Then, since the file is chosen and Xmin, Xmax, Ymin and Ymax fields of Relief panel is filled up, you can check Preview Relief checkbox to see the interpolating curve of relief.

Using Interpolation Method listbox set the method of curve interpolation. If vertical scale of cross-section and relief is not match, it's possible to equalize them using Scale Coefficient.

The next step is to set the out file name on Common Settings panel or check The Same Name checkbox. Then check Create Base Map and Put It Onto Section checkboxes. Since NEMFIS have the focused responding media with dead zone on top it's make a sense to divide the surface of cross-section from relief line. To do this use Distance Between Relief and Section field.

The last setting to be done is to indicate the link point of cross-section to relief using Zero Point Corresponds To field. Now by pressing OK processing will be initiated.

See an example of topographed cross-section on Samples folder of ISystem.

MULTIMAP DOCUMENT

When you have done an area sounding job and have created all your maps, it's pretty useful to present your result as a multimap document. To have this possibility you have Create Grids and Maps window that can be chosen from Tools menu.

NB! Usually user wants to present maps having upper ones on top of page. To have such a presentation, the checkbox Invert Sort must be checked before the choosing of dat files.

Using Data File Names button choose your maps. After that check Create MultiMap Document checkbox, otherwise ISystem will create your maps in separate files. Now choose number of rows and columns to let ISystem know how to lay out your maps on the page. Check the Apply 3D view checkbox if you wish to. Chose 3D view parameters as in Surfer. Now ISystem ready to present your data in 3D view. Press OK. If the gaps between maps in the page are too big, reduce it using xSpace and ySpace parameters. They can be negative.

See an example of multimap documenton Samples folder of ISystem.