# ASTRA-100 Multifrequency Electromagnetics TEM/DEM Transmitter & MARY-24 Multifrequency EM / Resistivity Reciever

In 1998 multifunction electrical prospecting instrument called "MARY" (Russian abbreviation) was our first immersion into instrumentation production. It preserved the national traditions of equipment-making with our wealth of practical experience and the latest achievements of microelectronics. The resulting unit quickly turned into a must-have meter among Russian geophysical industry. As of now, we are manufacturing "MARY-24", the 4th generation of MARY receivers.

In 2002 the Nord-West launched the production of our first "Astra-100" generator. Astra is an transmitter for CSEM as well as for DC and IP methods. The 3d generation of "Astra-100" generators went into serial production from 2005, with output voltage increased up to 400 Volts. We are aiming at building yet a more powerful generator in the nearest future.

Our most recent instrumentation product is an 8-channels receiver "IMVP-8" developed for frequency- and time-domain inducted polarization (IP) measurements. It can also be used for all kind of DC techniques as well as for FD CSEM.



Astra-100



IMVP-8



MARY-24

Along with the in-house developed instruments, our company also trades in geophysical instruments produced by other manufacturers. Besides the production of "Phoenix Geophysics Ltd." (Canada) and Iris Instruments (France), we also offer our clients these electromagnetic prospecting instruments and equipment: systems "TEM-FAST" (Russia-Holland) and "Cycle-5" (Russia), generator "VP-1000" (Russia), various electrodes including nonpolarizable, conductors, reels, etc.

# ASTRA-100 Multifrequency Electromagnetics TEM/DEM Transmitter



Transmitter "Astra-100" is designed for different geophysical methods including DC apparent resistivity measurements, induced polarization measurements, frequency sounding and others.
This transmitter can be applied to solve different geotasks such as studying electrical properties of soils and rocks. None of the components of the transmitter or technical ideas are confidential. The exploitation of the transmitter does not lead to any negative ecological consequences.

## Specifications

| | |
|---|---|
| Max. output power | 100 W |
| Max. output voltage | 250 V |
| Output current values and corresponding resistance range RAB | 1.00 mA, 5.0 - 250 kΩ<br>3.16 mA, 1.5 - 80 kΩ<br>10.0 mA, 0.5 - 25 kΩ<br>31.6 mA, 150 - 8000 kΩ<br>100 mA, 50 - 2500 kΩ<br>316 mA, 15 - 800 kΩ<br>1000 mA, 5 - 100 kjΩ |
| Output waveform | Rectangular pulse |
| Frequency list: | 0.076, 0.153, 0.305, 0.610, 1.22, 2.44, 4.88, 9.77, 19.5, 39.1, 78.1, 156, 313, 625, 1250, 2500 Hz<br><br>0.042, 0.063, 0.083, 0.125, 0.167, 0.250, 0.333, 0.500, 0.667, 1.00, 1.33, 2.00, 2.67, 4.00, 5.33, 8.00, 10.7, 16.0, 21.3, 32.0, 42.7, 64.0, 85.3, 128, 171, 256, 341, 512, 683, 1024, 1365, 2048 Hz |
| Efficiency: | To 80 % |
| Stabilization fault on active load | 0.5 % |
| Fall time on active load | 2 mcs |
| Temperature range | from - 20°C to + 50°C |
| Power supply voltage | ~ 12 V (min 9.5 V, max 15.5 V) |
| Weight (without power supply) | ~ 2 kg |
| Size | 200 x 173 x 113 mm |
| LCD Panel | 4 lines x 16 symbols |
| Indication | - work frequency<br>- output current |

| | - the voltage of power supply<br>- status (wait, work, line break)<br>- load power |
|---|---|
| Sound indication | - generating<br>- overload<br>- underload (e.g. short circuit)<br>- low power supply voltage |
| Keyboard | 12 button |
| I/O | - AB<br>- shunt 1 kΩ<br>- synchronization<br>- power supply |
| Case design | Standard IP-65, Waterproof |

# MARY-24 Multifrequency Electromagnetics / Resistivity Reciever



MARY Receiver (Multifunctional Electrical Prospecting Meter) is one of the newest and leading technologic innovation of portable geophysical equipment. It is compact and easy-to-use and allows end-users to perform different types of measurements such as structural, mapping, explorative, hydro-geological, engineering, archeological, geotechnical and ecological in short periods of time.

MARY is intended for:
- Apparent resistivity **RES** measurements (amplitude of the first signal harmonic is measured);
- Induced polarization **(IP)** measurements (phase-shifts between carrier-harmonics are measured);
- Self-potential **(SP)** measurements (constant component of the field if measured);
- Frequency soundings

The device has a large LCD display, an ergonomic keyboard, and internal power supply, nevertheless it can use an external one.

During the process of measurement MARY registers input signal, processes it, shows the results on the display and records it to memory. In addition to this it allows recording source signals for further in-lab data processing.

**Specification**

| ADC | 24-digit |
|---|---|
| Self-noise | ≤ 1 uV |
| Max. input voltage | 2 V |
| Input cascade resistance | 5 MΩ |
| Built in memory | 8 MB |
| I/O | USB 1.1 |
| Max. power consumption | 2 W |
| Internal power supply | 12 V, 3 Ah |
| External power supply | 12 V |
| Min. autonomous duty time | 10 hours |
| Frequency list: | 0.019, 0.038, 0.076, 0.153, 0.305, 0.610, 1.221, 2.441, 4.883, 9.766, 19.53, 39.06, 78.13, 156.3, 312.5, 625.0 Hz<br>0.021, 0.032, 0.042, 0.063, 0.083, 0.125, 0.167, 0.250, 0.333, 0.500, 0.667, 1.000, 1.333, 2.000, 2.667, 4.000, 5.333, 8.000, 10.67, 16.00, 21.33, 32.00, 42.67, 64.00, 85.33, 128.0, 170.7, 256.0, 341.3, 512.0 Hz |

| | |
|---|---|
| | Additional:<br>50, 60, 100, 120 Hz |
| Temperature range | -20 - +60 °C |
| Size | 190x150x80 mm |
| Weight | 1.5 kg (2,5 kg) |

## IMVP-8 Resistivity and Induced Polarisation (IP) Time / frequency domain 8 channel System



"IMVP-8" is designed for different geophysical tasks such as apparent resistivity or induced polarization measurements in frequency or time domains. It also can be used for differentially-normalized geoelectrical method.

### Characteristics

"IMVP-8" receiver allows recording signals on 8 potential channels at once. The receiver is always controlled by a PC via USB interface. It has 8 independent ADC's, so it may be applied for using with a wide range of geoelectrical non-conventional arrays, e.g. an array with 8 potential lines sequently connected to each other.

### Advantages

This multi-channel receiver "IMVP-8" allows to increase labour productivity of the induced polarization method, and finally decreases prime cost of the research works. 24-digit ADC's and 2500Hz sample rate allow application of a wide range of algorithms for studying time-frequency characteristics of the process. This unit is modern, portable, easy-to-use. It simplifies data acquisition process and shows good field results due to its high accuracy.

| Specifications | |
|---|---|
| Number of channels | 8 |
| ADC | 24-digit, 2500Hz |
| Input cascade resistance | > 5 MΩ |
| Frequency range | From 0,001 up to 200 Hz |
| Frequency shift | $\leq 10^{-5}$ Hz |
| Frequency drift | $\leq 5 \times 10^{-6}$ Hz |
| Max. input voltage | +2,5 V |
| Self-noise | < 2 uV |
| I/O | USB 1.1 |
| Power supply voltage | V 12,6+2 |

| | |
|---|---|
| Temperature range | From -15 ° up to 40° |
| Weight | 350 g |
| Size | 190x150x60 mm |

# EM, MT and Resistivity Data Processing SOFTWARE(S)

We have developed a number of software packages for EM data processing, analysis and interpretation.
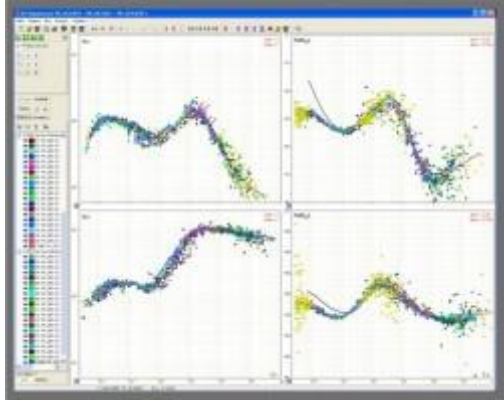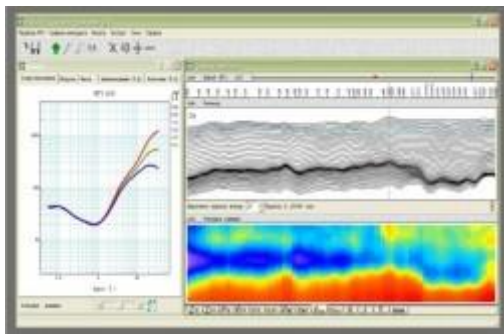


*MT-Corrector software*

MT-Corrector software is a convenient and friendly tool for the observed MT responses viewing, editing and spline-fitting. The software has a well-developed GUI with lots of functions. The MT-Corrector could be an important part of any MT interpretational system.

The necessity of the MT responses spline-fitting is caused by the fact that the frequency dependencies of impedance tensor and tipper components are often not smooth and contain outliers. The latter could be a severe problem for the analysis, correction and interpreting of the data.

Main capabilities of the software, that allow the user:

- To overview the curves (frequency dependencies) of impedance tensor and tipper vector components;
- To combine the separate (in frequency) curve segments;
- To delete the outliers, basing on various criteria;
- To add the reference points, basing on the noise charactheristics;
- To create the spline fits of the observed MT response curves, providing the trade-off between small misfits and maximal smoothness;
- To calculate the synthetic phase curves from apparent resistivities basing on dispersion relationship;
- To multiply apparent resistivity curve by arbitrary factor and to invert and shift the phase by 180 degrees.
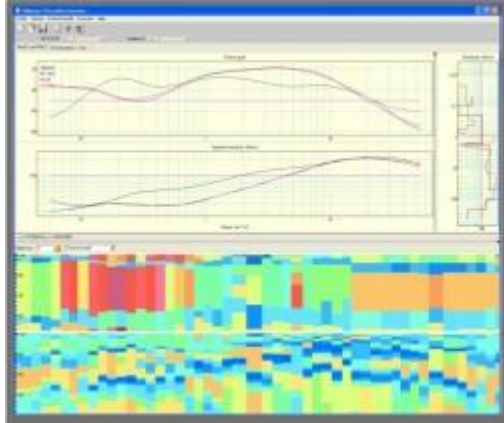


*MTS-Prof Software*

MTS-Prof could be used for the MT data visualization, analysis and static shift correction. It supports both 2D and 3D observation geometry. The visualized plots could be exported directly to Golden Software Grapher/Surfer applications.

The static shift correction procedure is realized through spatial smoothing of the amplitudes of impedance tensor components at selected frequency (period). There is a possibility to perform automatic and manual correction.

A variety of visualizing capabilities enables to plot apparent resistivity and impedance phase distributions along with different invariants of the impedance tensor and tipper in the form of pseuodosections, graphs, curves of frequency dependence, polar diagrams and induction vectors.

MTS-Prof is successively used by NORD-WEST for the data analysis before their inversion.



*MTS-Prof INV Software*

MTS-Prof INV is an inversion tool closely connected to the MTS-Prof package. It is designed for 1D automated MT-data inversion for both 2D and 3D observation geometry. The software uses 1D solver and provides apparent resistivity and impedance phase inversion accounting for the data error bars and stations geometry. An a-priory information on conductivity distribution model could be also accounted for.

The inversion is based on the construction of Tikhonov's regularizing functional and its subsequent non-linear minimization. An a-priory information on the model properties could be introduced into inversion both in the deterministic and probability estimates.

In order to provide the automated input of the inverted data and their dynamical modification a special script language is used. The capabilities of the language allow to create a self-learning inversion scenery wich could be efficiently applied if no a-priory information is available.

The software's GUI is designed for plotting, analysis and selection of the resulting model at any site and iteration. A number of extended facilities is provided for export of model cross-sections and maps, integrated conductivities and data misfits.
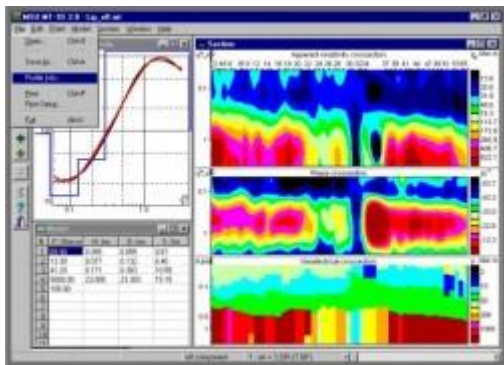


*MT1D Software*

The MT1D software package is designed for the 1D interpretation of the magnetotrelluric (MT) profile data. It has a well-developed multifunctional GUI providing the possibility of manual and automated inversion of the MT responses (apparent resistivities and impedance phases) along with the analysis and visualization of the response pseudosections and reconstructed geoelectrical model.
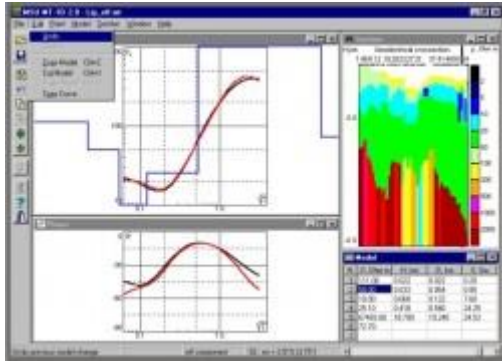
*FS1D Software*

The FS1D software is designed for modeling and inversion of the controlled source electromagnetic (CSEM) data in frequency domain (FD). It allows to calculate all the components (Ex, Ey, Hx, Hy, Hz) of the low-frequency EM field excited by the dipole source (horizontal electric dipole AB or vertical magnetic dipole Q) located on the ground surface of the horizontally layered medium. The solver accounts for the medium chargeability. The software provides computational accuracy of about 1% in a wide range of frequencies, offsets and medium properties.

The graphic user interface (GUI) works under MS Windows family. It provides a variety of capabilities for geoelectrical model and observed data visualization/edition, modeled response analysis, data fitting, etc. The FS1D software is an efficient tool for the CSEM data interpretation.
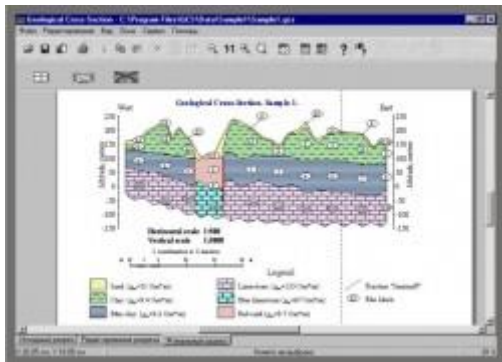


*Geological Cross-Section Software*

Geological Cross-Section (GCS) software is applied for the plotting of the geological cross-sections of print quality as a result of profile EM data interpretation. The software has a friendly GUI and lots of the capabilities. The main advantage is the possibility to create the ready-to-print final plots from the geoelectric models very rapidly without the use of any specialized vector graphics software (Corel Draw or Adobe Illustrator).