ELECTRICAL IMAGING POLARES32

A QUICK PRESENTATION

POLARES32 is a light, easy-to-carry and fast AC electrical imaging system.
It is designed to accurately measure AC currents and voltages, in order to provide the user for apparent resistivity and phase values in frequency domain.
It works with adjustable transmission frequency, in the range between 7 to 125 Hz. POLARES32 can be used in many situations: laboratory measurements, electrical soundings, surface Electrical Resistivity Tomography, 3D surveys, moving surveys on channels, lakes and sea, etc.
The access to POLARES32 functions is user friendly through use of external PC connected by USB cable.
The use of an external Windows PC provides a far superior battery life and overall reliability of system improved. The failures of the IT part are solved by changing the PC without stopping the work, the software updates do not require delicate interventions on the firmware of the instrument, and last but not least allows the remote assistance of our company for the diagnosis of the failures.
The communication interface is a PC USB port, through which the user can upload configurations, install new software releases, download measured data and, furthermore, connect a number of different devices, such as network interfaces, WiFi routers, Bluetooth or GPS antennas, keypads, and more.

Which is the difference with traditional electrical tomography in C.C.?

The use of Electrical Resistivity Tomography (ERT) for geology has always been basically the same since its debut, based on the original Vertical Electrical Soundings (VES) principles: applying a continuous current to two stakes inserted into the ground and measuring the corresponding voltage between other two. The applied current and thus the relative tension have always been continuous, with an inversion in polarity for each measure. The innovative POLARES32 uses instead an alternate current, sinusoidal type, with adjustable frequency.

Why POLARES32 is an innovative instrument?

The alternating current stimulation has shown particular advantages with regard to the faster implementation of the measures with the same quality of results. This higher speed can reduce the time required to perform a set of field measurements by a factor of at least 10 (or 20 in most cases) in respect to traditional system. Moreover, the measure of the relationship between the detected voltage and the injected current, in sinusoidal state, both as amplitude and phase (delay of a signal over the other), these two informations, with only one measure, allow the simultaneous detection of the resistivity and the induced polarization of the ground.

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Which are the main strengths of POLARES 32?

COMPLEX RESISTIVITY ACQUISITION:
being designed as an AC system, POLARES32 infers both the conduction and polarization properties of the investigated material. In fact, since the module of complex resistivity deals with electrolytic properties of pore-filling fluids, phase shift between voltage and current signals is directly influenced by polarization of the material. Then, each single dataset can be used to analyze both resistivity and induced polarization.
Resistivity (as the reciprocal of conductivity) is a complex, and frequency-dependent, property of a material, and is explained with the following equation:

$$\frac{1}{\rho^*} = \sigma^* = |\sigma| e^{i\varphi} = \sigma' + i\sigma''$$

where σ* and ρ* define complex conductivity and resistivity, respectively, |σ| is the conductivity module, φ is the phase shift between voltage and current signal, σ' and σ" are the real and imaginary part of the complex resistivity.
Real (in-phase) and imaginary (or quadrature) components of the complex resistivity can be obtained by the following relationships:

$$\sigma' = |\sigma|$$

$$\sigma'' = \sigma' tan(\varphi)$$

Real resistivity is mostly related to electrolytic conduction phenomena (rock or soil resistivity, and even more to resistivity of pore-filling fluids), and to the various aspects of induced polarization (surface polarization, presence of metallic minerals, contaminants, and so on).
Many studies and works have shown a growing interest in AC geo-electrical surveys, which demonstrated their effectiveness for mineral exploration, textural characterization of geological features, and monitoring of contaminated sites.
For users who prefer to work with chargeability as IP parameter, POLARES32 automatically outputs the chargeability (in ms) associated to each measurement, thanks to the relationships between phase shift (IP in frequency domain) and chargeability (IP in time domain).

FASTNESS: POLARES32 can be used to measure single-frequency datasets at high frequency (from 7Hz to 125Hz).
In many common applications, ensuring a good electrode-ground contact, this is enough to acquire accurate datasets of apparent resistivity values, to be inverted with traditional inversion software.
The higher the frequency, the higher the speed! Then, for examples, field data from moderately noisy sites can be acquired with a rate of up to 3 measures/second, in whichever measurement array. In some cases, the time expense can then be reduced by a factor of 10 (or 20!).

ACCURACY: the high resolution of the acquisition system (0.4 μA for current signal and 1.5 μV for voltage signal) permits to accurately interpolate the current and voltage sinusoidal signals. This gains further importance when POLARES32 is used for Spectral Induced Polarization surveys, where phase shift values have to be measured with the highest level of accuracy. For users requiring noise-free phase data, POLARES32 can be used with un-polarizable electrodes in order to avoid any EM inductive coupling along the wires between transmission and measurement circuits

MODULARITY: POLARES32 contains, in a strong Peli case, transmission and measurement system, 2 x 16 electrodes MUX, protections and so on. To increase the number of electrodes starting from the first 32 ones, the User can add one or more external MUX. Each of them can works with a cable with 16 electrodes, so it will be easy to expand the system from 32 to 48-64-80-96...electrodes.

POLARES32 Main Features

• Transmitter and receiver in a single unit; power supply with external 12V battery.
• Very fast measurements: up to 3 scan/sec.
• Fully automatic measurement controlled by a micro-processor: automatic self-potential correction, automatic ranging, digital stacking, error display in case of procedure troubles.
• Control of quality of electrode-ground connections before measurement.
• Measurement and recording of ground resistance, current, voltage, Chargeability (IP), self potential and standard deviation (SIGMA).
• Computation of the apparent resistivity for the various electrode arrays: Schlumberger, Wenner, Dipole-Dipole, Pole-Dipole, Pole-Pole, etc.
• Any 2D & 3D array of electrodes designed by the User can be supported.
• Measurement and display of the chargeability (phase shifting in sinusoidal current and voltage waves) at the same time of resistivity measurement: IP and resistivity are measured and acquired in the same session of measurements.
• Multi-electrode mode for use with the automatic switching system (unlimited number of electrodes).

Automatic fitting of the current and voltage output values

Output power: Max 200W
Maximum output voltage: Max 700 Vpp
Maximum output current: Max 4000mApp

Output current specifications

Resolution: 0.4uA
Accuracy: Standard 0.15% Max 1% from -20°C to 60°C
Waveform: Sinusoidal 7 to 150 Hz
Input impedance: 10 MOhm
Input over voltage protection: 1000 V
Input voltage ranges: +/-300 V and +/- 6V
Automatic 50/60Hz power line rejection

Voltage measurement specification

Actual resolution: 1.5uV
Accuracy: Standard 0.15% Max 1% from -20°C to 70°C
Chargeability (measure) accuracy: 0.1%
Power supply: External battery (8.5V= to 15V=) lead or lithium batteries, 30A internal fuse,
protection against polarity inversion power cable provided, battery to be provided locally
Operating environment temperature: -20°C to 60°C
Storage temperature: -40°C to 80°C

POLARES-32 technical specification

External data ports (only PC connection)	USB
Connectivity	USB
Optional Connectivity	Ethernet, Wi-Fi, Bluetooth, RS232, RS485, USB client, GPS, etc. (by external PC)
GPS	**USB receiver for georeference of measures to be connect to the external PC**
DSP (Digital Signal Processor)	ATMEL Cortex M4 120 Mips
Converters	A/D 24 bit
Voltage measurement range	300V or 6V with autoranging
Current measurement range	3A rms
Frequencies that can be generated	125Hz, 62.5Hz, 31.2Hz, 15.6Hz, 7.8Hz
Measurement validate	DC component, distortion, background noise, phase excess, sigma modulus, phase sigma
Max. number of steaks (electrodes)	Unlimited
Max. number of scans for measurement	Unlimited (limited by storage capacity of external PC)

Results that can be stored to memory (scan)	Unlimited (limited by storage capacity of external PC)
Scan velocity	Up to 3 scan/sec
Voltage that can be generated	**700V pp**
Current that can be generated	**4A pp**
Power that can be generated	200 W
Thermal protection	Heatsink and inside case alarms with system shutdown
Power supply	8.5V= / 15V= lead or lithium external battery (not included in the supply); 30A internal fuse, protection against polarity inversions, Safety Emergency external Switch
Operating temperature range	-20°C / +50°C
Storage temperature range	-40 °C / +80 °C
Dimensions and Weight	406x335x174mm; 7,2kg Shock resistant PELI case IP 67

Technical specifications subject to change without notice

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