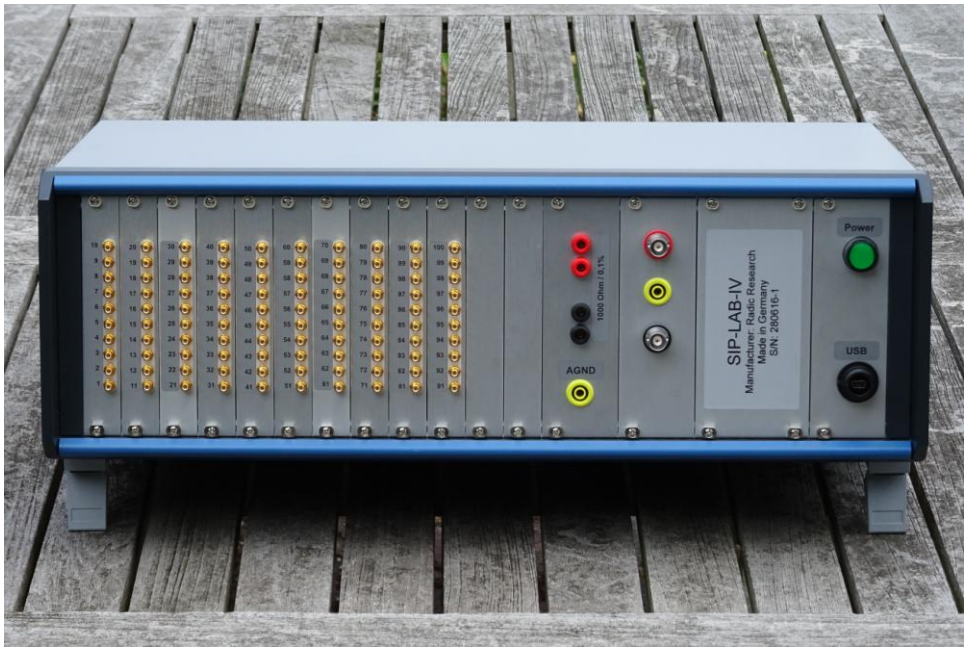
SIP-LAB-IV

Spectral Induced Polarization

Geophysics

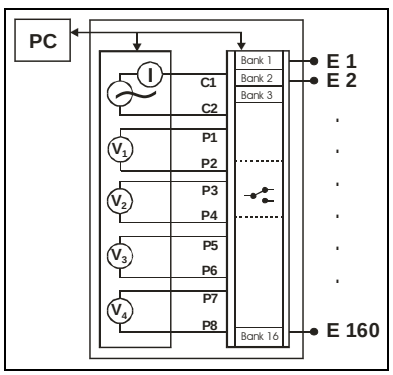
- **For comfortable frequency domain measurements on complex resistivity of sediment and rock samples**



The **SIP-LAB-IV** system measures the frequency dependence of resistivity (amplitude and phase) of rocks and sediments over 8 decades. The frequency dependence of mineralized rocks is controlled by the grain size of the electronic conducting minerals, while it is controlled for non-mineralized rocks by the pore space geometry and fluids. Therefore the frequency dependence delivers additional information for an improved characterization and discrimination of the materials. The instrument is optimized for multi-channel and multi-electrode measurements in the laboratory. An optional noise monitor helps to reduce possible lab noise, which could interfere the measurement. A scheduler, combined with an automatic data quality check and an interface to control up to 160 electrodes, makes measurements very comfortable.

SIP-LAB-IV equipment consists of:

- a multiplexer to control up to 160 electrodes.
- a comfortable PC operating software to measure and export resistivity data and to display and download time series.
- minimum two channels for true parallel current and voltage measurement.
- a optional noise sensor to record and reduce lab noise in the voltage records.



◀ Simplified schematic diagram of the SIP-LAB-IV instrument. For details see functional diagram of a switch bank.

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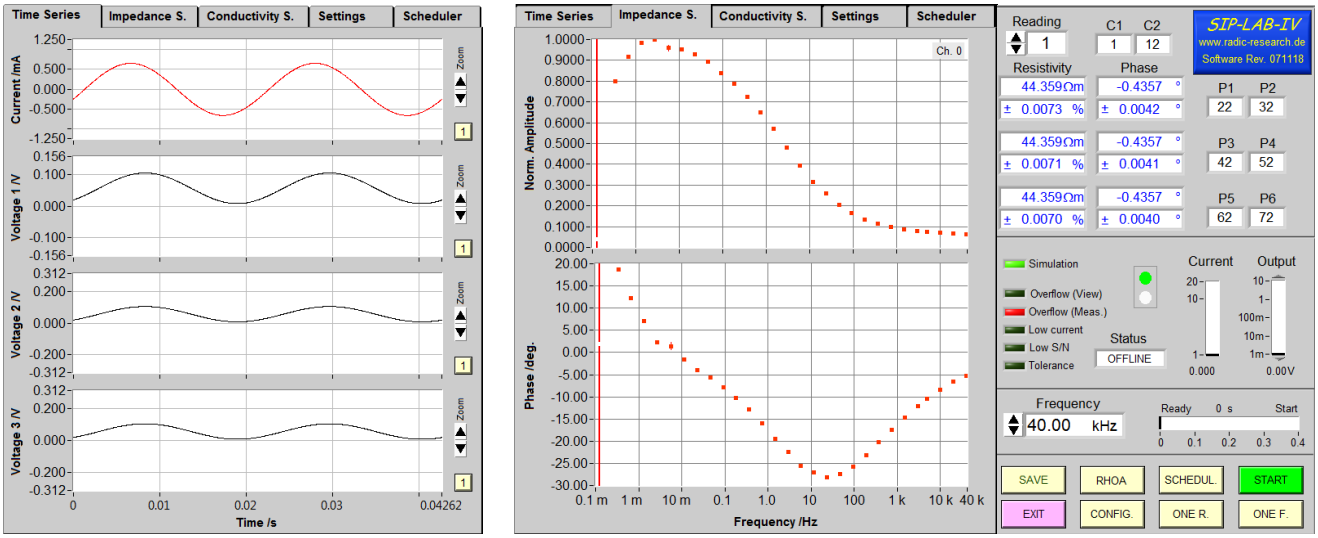


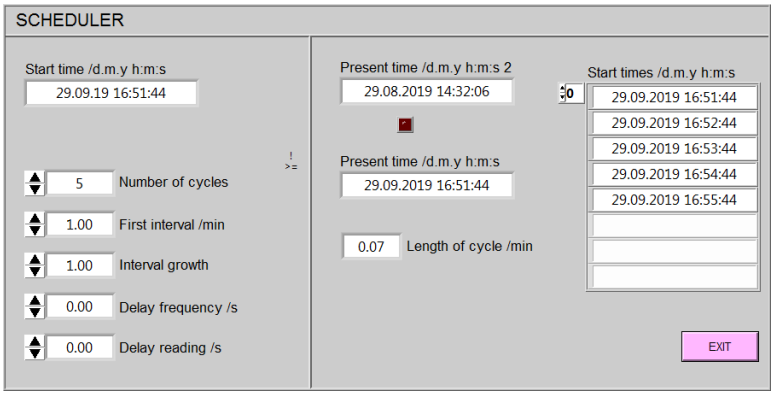
Main screen of PC operating software, left: recorded time series, right: measured impedance spectrum

▲ OPERATING SOFTWARE

The main menu of the operating software displays (real time) the recorded time series of current and voltage(s) during the measurement. This makes a first data quality check very easy. Recording starts at highest frequency. The recording time increases therefore from a few milliseconds up to tens of minutes per frequency. Depending on the lowest measured frequency, the acquisition of a complete spectrum takes from a few minutes (f_{min}=1 Hz) up to one hour (f_{min}=1 mHz). A second quality check permits the observation of the confidence limits of amplitude and phase. Moreover, the current intensity and whether the measured resistivities fulfil a smoothness criterion is checked.

SCHEDULER ▶

The scheduler menu supports auto repetitions of measurements. Time intervals between cycles of measurements can be set as constant as well as exponential in- or decreasing.
Left: Settings for start time, number of repetitions, first time interval length and exponent.
Right: Resulting start times of individual cycles.



Scheduler menu

ACTIVE GUARDING TECHNIQUE

Active guarding technique minimizes the input capacity of the voltage measuring bales. Low input capacity is most important to increase the noise immunity in a laboratory environment. It also reduces systematic errors, which appear at high frequencies if the contact resistance of the voltage probes is high. This feature improves measuring accuracy especially when unsaturated or low porous samples are investigated.

GEOELECTRICAL REFERENCE TECHNIQUE

Strong electrical fields from the lab environment can interfere with the voltage measurements and lower the data quality. To record this noise the **SIP-LAB-IV** instrument possesses a special noise monitor. A multi-channel coherency analysis routine was implemented which allows an identification and cancellation of these external noise voltages. Therefore the confidence intervals of the data can be reduced up to more than a factor of ten. This new technique does not prolong the measuring time.

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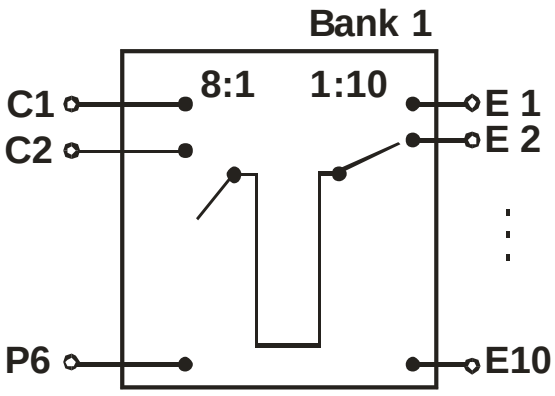
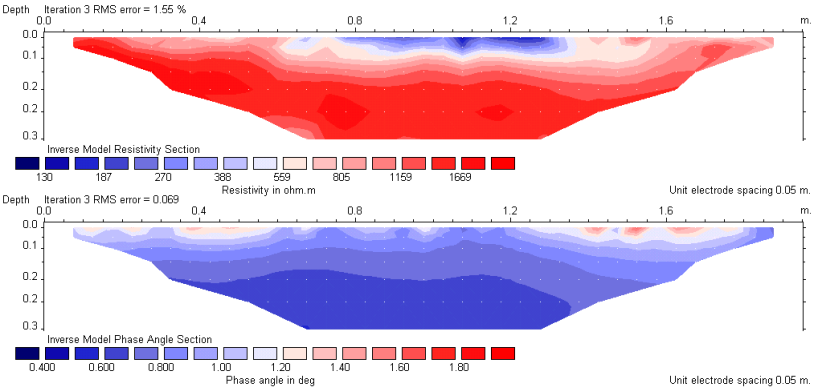


Schematic diagram of the first of up to 16 switch banks.

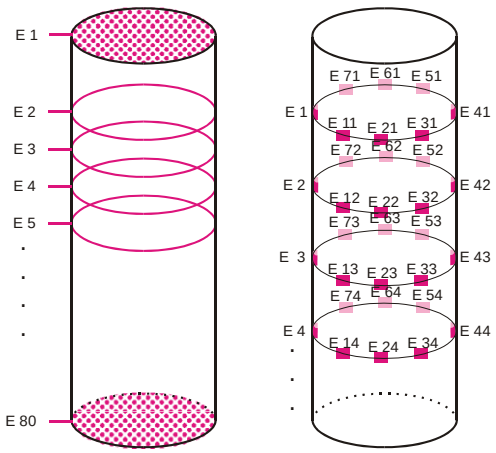
▲ CONTROLLING 160 ELECTRODES

The **SIP-LAB-IV** instrument can control up to 160 electrodes. In each case, 4 of these electrodes are combined through a relay matrix with the 4 terminals of the electronics. For this the operating software evaluates a control file. In order to lower the costs for the relay matrix, this is subdivided into banks. Since every bank can always combine only one of their 10 electrodes with the electronics, the number of the possible capabilities is limited insignificantly.



▲ FIELD INVESTIGATIONS

The **SIP-LAB-IV** instrument is also useful for small-scale field investigations. This includes e.g. surface measurements in the decimetre range and cross borehole measurements with configurations as shown in the graphic below.



1-D Column measurement

3-D tomography in a Lysimeter

◀ TYPICAL APPLICATIONS

The **SIP-LAB-IV** instrument is suitable at best to measure the spatial distribution and variation with time of the complex resistivity. For the most investigations, columns and lysimeters are used to enclose the sample material. The graphic shows two typical measuring arrays.

SIP-LAB-IV

Technical Specifications

General

- Frequency Range:100 µHz - 40 kHz
- Voltage Source: ±10 V, ±10 mA
- Signal: mono/multi sinusoidal
- Buffer Length: 128 k samples / ch.
- Data Format: 32 Bit
- Digital Power Line Filter (50/60Hz)
- Digital Drift Filter
- PC Interface: USB (WLAN on req.)
- Powered by: 12 VDC or 110-230 VAC (50/60 Hz)
- Weight: 5 kg
- Case: 19-inch rack, 3U

Measuring Channel Current

- A/D Converter: 24 Bit
- Data Rate: 96 kHz / 2^n, n=0,1,2…18
- Input Range: ±10 mA / ±0.4 mA
- Shunt: 300 Ω (default)

Measuring Channel Voltage

- A/D Converter: 24 Bit
- Data Rate: 96 kHz / 2^n, n=0,1,2…18
- Input Range: ±5.0 V / ±0.2 V
- Up to 4 Voltage Channels possible

Switch Bank

- Need: 4 - 16
- Each connects 4 terminals with 10 electrodes.

PC Operating Software

- Control of the whole system
- Time series recording, displaying, storing, calculation of transfer function and confidents limits
- Data export

Minimum PC requirements

- Windows 7 - 10
- Clock: 1 GHz, RAM: 1 GB
- Display: 768 x 1024 pixel
- USB interface

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