

SIP-LAB-FAST+

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



Front view: SIP-LAB-FAST+ instrument with up to 96 channels.

The SIP-LAB-FAST+ system measures the frequency dependence of the electrical impedance (amplitude and phase) of rocks and sediments over 8 decades. The frequency dependence of mineralized rocks is determined by the grain size of the electronically conductive minerals, while that of non-mineralized rocks is determined by the pore geometry and pore space fluids. Therefore, frequency dependence provides additional information for improved characterization and differentiation of materials. The SIP-LAB-FAST+ is optimized for the fastest possible multi-channel measurements in the laboratory. Up to 3 independent samples can be measured simultaneously. 8 voltages can be measured synchronously per voltage measurement unit. Up to 12 units are supported, which corresponds to 96 parallel measurement channels. Each measurement channel is connected to the sample material via actively shielded measurement cables with low capacitance. The software selects the two active current electrodes via multiplexer units. Eight current electrodes can be selected per multiplexer unit. The measurement process is fully automatic in accordance with the specifications of an initialization file. An optional noise sensor makes it possible to measure possible electrical interference voltages from the laboratory environment and remove them from the voltage signals using a statistical method. A scheduler enables automatic long-term measurements.

SIP-LAB-FAST+ equipment consists of:

- up to 3 signal sources to generate mono- or multi sinusoidal shaped currents.
- 2 - 6 multiplexer units to control 8 current electrodes each.
- 1 - 12 voltage measuring unit with 8 channels each.
- an optional noise sensor to record and reduce lab noise in the voltage records.
- a comfortable PC operating software to measure, display and export resistivity data.

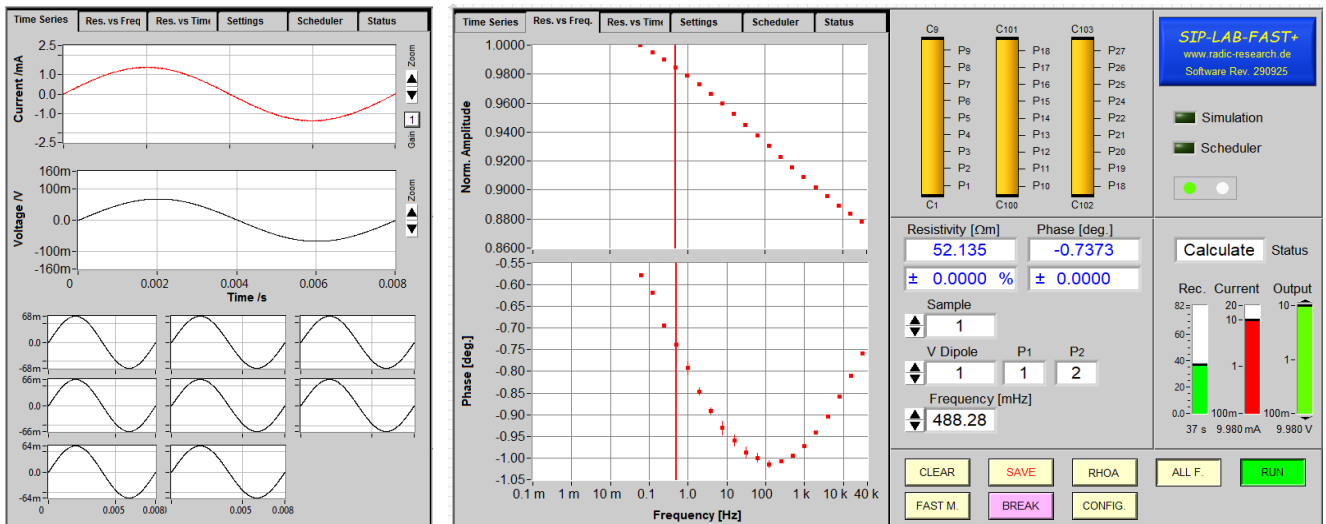
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Spectral Induced Polarization

Geophysics



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

▲ OPERATING SOFTWARE

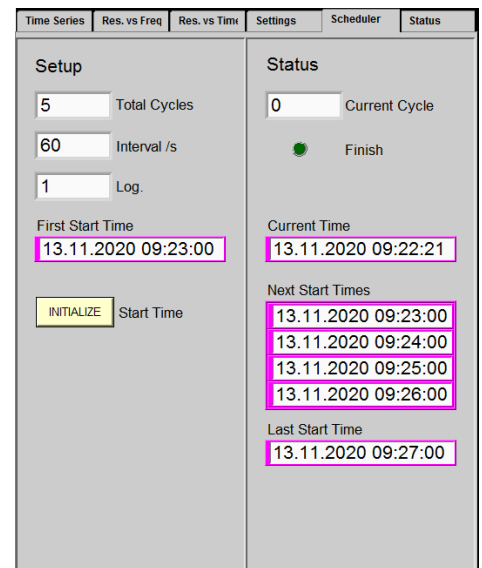
The main menu of the operating software displays (real time) the recorded time series of current and voltages during the measurement. This makes a first data quality check very easy. Recording starts at highest frequency. The recording time increases therefore from a few milliseconds up to tens of minutes per frequency. Depending on the lowest measured frequency, the acquisition of a complete spectrum takes from a less a minute ($f_{\min}=1$ Hz) up to hours ($f_{\min}=100$ μ Hz). A second quality check permits the observation of the confidence limits of amplitude and phase. Moreover, the current intensity and whether the measured impedances 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.



ACTIVE GUARDING TECHNIQUE

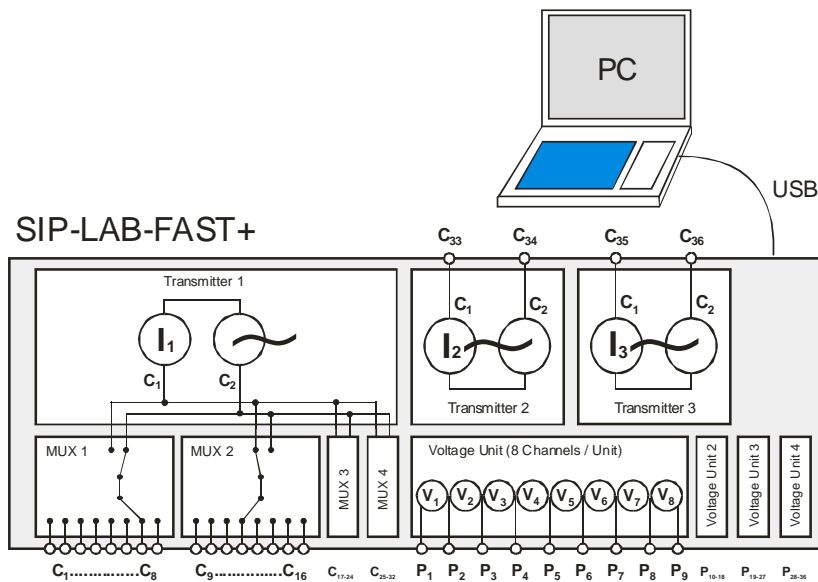
Active guarding technique minimizes the input capacity of the voltage measuring channels. Low input capacity is most important to increase the noise immunity in a laboratory environment. It also reduces systematic errors, which appear at high frequencies if the contact resistance of the potential electrodes is high. This technique 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-FAST+** 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.

HIGH-SPEED MODUS

In the special case that the 3-D conductivity distribution in the object under investigation changes significantly within seconds, the hardware supports a high-speed measurement mode. The current dipole can be changes every 0.01 sec. Up to 10 complete 3-D images of the conductivity distribution at (>10 kHz) can then be measured per second.



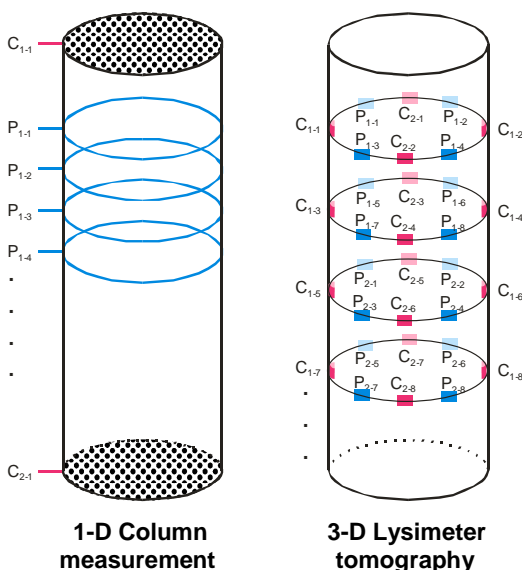
Schematic diagram of SIP-LAB-FAST+.

▲ CONTROLLING THE CURRENT ELECTRODES

Multiplexer units connect the signal source of the meter to the current electrodes. Each multiplexer unit controls 8 electrodes. Additional multiplexers can be used to further increase the number of possible current input points.

▲ VOLTAGE MEASURING UNITS

Measuring cards with 8 channels each are available for voltage measurement. Each additional measurement card increases the measurement progress, since all channels measure synchronously and independently calculate Fourier Coefficients. In order to minimize the number of measurement cables, the measurement channels of a measurement card are connected to form a chain. Instead of 16, only 9 measurement cables are required per measurement card. With a sufficient number of measuring channels, the 3-dimensional conductivity distribution of a test object can be determined in an acceptable time for the first time.



◀ TYPICAL APPLICATIONS

The **SIP-LAB-FAST+** 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 (simplified) measuring arrays.

SIP-LAB-FAST+

Technical Specifications

General

- Frequency Range: 100 μ Hz - 40 kHz
- Voltage Source: ± 20 V, ± 10 mA
- Signal: mono/multi sinusoidal
- Buffer Length: 128 k samples / ch.
- Data Format: 32 Bit
- PC Interface: USB (WLAN on req.)
- Powered by: 12 VDC battery or 110-230 VAC (50/60 Hz)
- Weight: 5 kg
- Case: 19-inch rack, 3U

Current Measuring Unit

- A/D Converter: 24 Bit
- Data Rate: 128 kHz / 2^n
- Input Range: ± 20 mA / ± 0.5 mA
- Shunt: 120 Ω (default)

Voltage Measuring Unit

- Channels: 8 / Unit
- A/D Converter: 24 Bit
- Data Rate: 128 kHz / 2^n
- Input Range: ± 10.0 V
- Voltage M. Units: 1 - 12

Current Multiplexer Unit

- Multiplexer Units: 2 - 6
- Each multiplexer controls 8 electrodes.

PC Operating Software

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

Minimum PC requirements

- Windows 7 - 11
- Clock: 1 GHz, RAM: 4 GB
- Display: 768 x 1024 pixel
- USB interface