SIP-COMPACT-S

• Stand-alone long-term impedance measurements on sediments and rocks.

Spectral Induced Polarization

Geophysics

SIP-COMPACT-S

The instrument measures the complex electrical impedance of rocks and loose sediments over a wide frequency range (0.1 mHz - 40 kHz). After being programmed using a laptop computer via WiFi (WLAN), it measures the changes in impedance over time by repeating measurements. The internal battery is sufficient for a total measurement time of at least 20 hours. This measurement period can be spread over one year. Between measurements, the instrument enters a sleep mode that places almost no load on the battery. The data is stored on a SD-card in a fail-safe manner. They can be called up via WiFi at any time if required. An extended version (SIP-COMPACT-E) additionally allows GPS synchronized measurements together with other measuring devices of the same design, as well as the independent sending of data emails via the mobile phone network.

SIP-COMPACT-S features:

- WiFi interface for programming and data retrieval.
- Autonomous measurements over a period of up to one year.
- Measures the complex electrical impedance of rocks and soils.
- One channel for current measurements and three channels for voltage measurements.
- PC operating software to calculate complex resistivity, export data, display time series.

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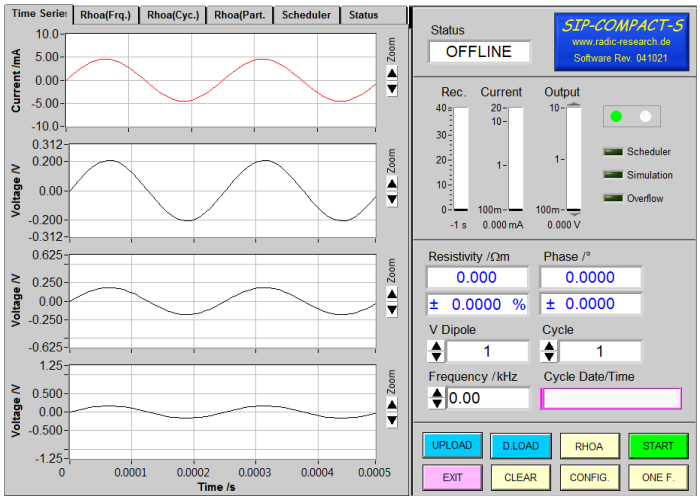
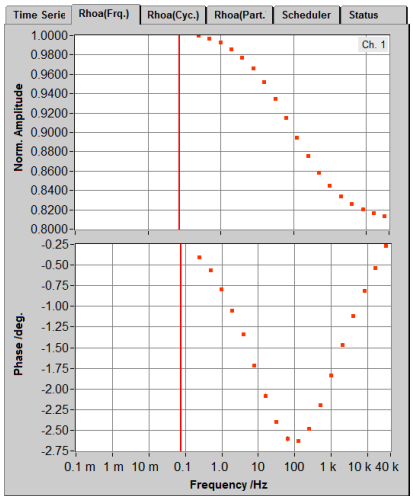
RADIC-RESEARCH





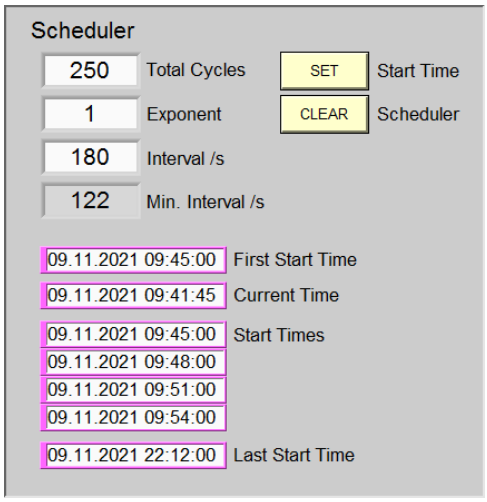
Left: main screen of PC operating software with recorded time series, right: measured impedance spectrum.

▲ OPERATING SOFTWARE

The main menu of the PC operating software displays (in real time) the recorded time series of current and voltages during the measurement. This makes a first check of the data quality very easy. The spectral resistivity measurement starts at the highest frequency. The recording time then increases from frequency to frequency. Depending on the lowest measured frequency, the recording of a spectrum takes between a few seconds (f_{min}=1 Hz) up to minutes or even hours (f_{min}=0.0001 Hz). The measured resistivities, together with the also calculated associated confidence limits of amplitude and phase, are displayed in the form of an impedance plot. In addition, the transmitter voltage and the resulting current intensity are displayed numerically and graphically.

ACTIVE GUARDING TECHNIQUE

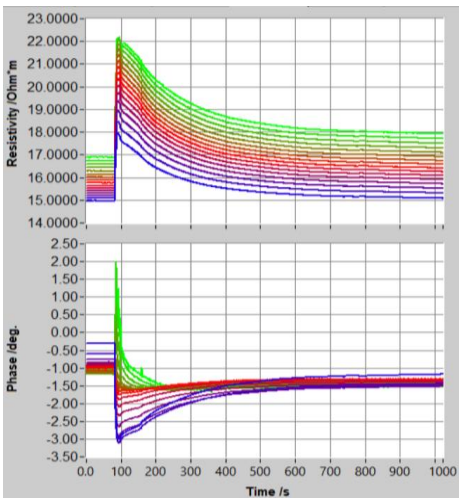
Active guarding technique minimizes the input capacity of the voltage measuring channels. Low input capacity is most important to increase the noise immunity in a laboratory environment. It also reduces systematic errors, which appear at high frequencies if the contact resistance of the potential electrodes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



◄ 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.
Top: Total Cycles, Exponent and Interval length.
Below: Resulting start times of individual cycles

FAST MODE ►



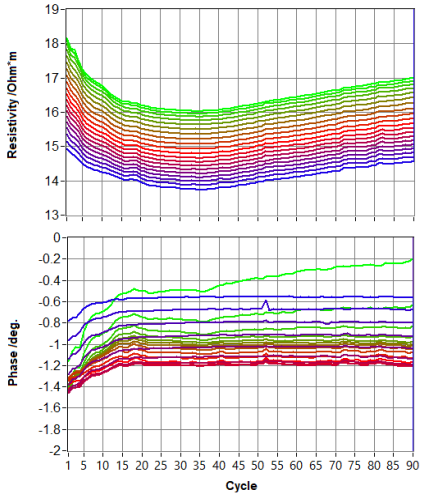
The electrical resistivity can change rapidly, e.g. during irrigation tests. Fast mode is available to record even rapid changes. Here, the resistivity is calculated individually for each measured period. In this way, a continuous measurement with high temporal resolution is achieved. The Fast Mode can be combined with the Multi-Frequency Mode. In the example on the right, a lawn is irrigated for 10 seconds starting at the 80th second. For the measurement, 16 frequencies (1 Hz - 32 kHz) were measured simultaneously. The temporal resolution was 1 second. The measurement time ~1000 seconds.

WiFi

Communication between the PC measuring computer and the SIP-COMPACT-S measuring instrument is wireless via WiFi. This is more convenient in the field than using a USB cable. In this way, the status of the measuring instrument can be checked and measurement data can be read out. In addition, the measuring instrument can be reprogrammed.

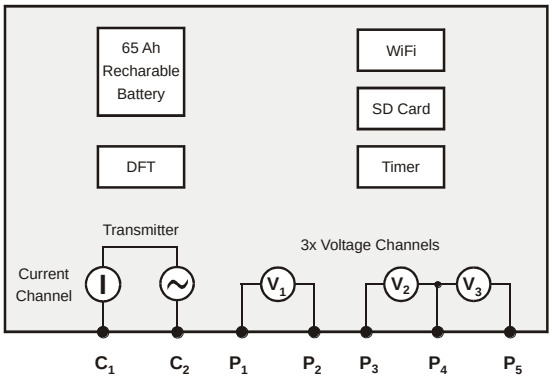
AUTONOMOUS MODE ▶

For long-lasting measurements, the measuring device offers an autonomous measuring mode. For this purpose, the measuring instrument is programmed and then carries out repeat measurements independently (without PC control). The device automatically goes into sleep mode between two measurement blocks (cycles). In sleep mode, the power consumption is negligible. In this way, repeat measurements can be spread over a period of up to one year. The figure on the right shows the resistivity measured over a period of 10 hours. Measurements were made at 20 frequencies (0.06 Hz- 32 kHz). The measurement follows seamlessly the Fast Mode measurement presented before. The temporal resolution was 400 seconds. The phase values of the two lowest frequencies are unstable due to a drift of the potential electrodes. Here, non-polarizable electrodes would have been helpful.



SD CARD MEMORY

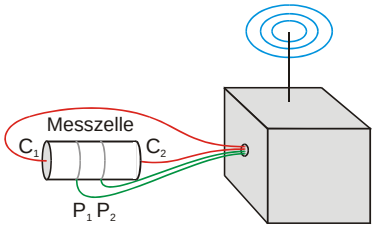
In the case of long-term use in the field, for example, an empty battery could result in a device failure. To ensure that the measurement data obtained up to this point are not lost, they are continuously written to the integrated fail-safe SD card. The SD card can be read out at any time via WiFi.



Schematic diagram of SIP-COMPACT-S.

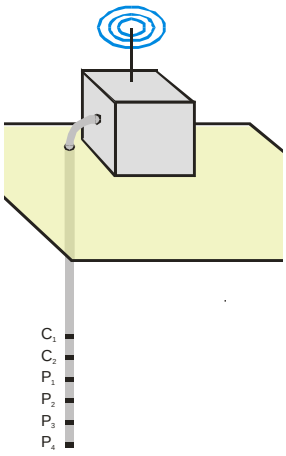
LAB APPLICATION ▶

The SIP-COMPACT-S is ideally suited for impedance measurements on material samples. Usually a 4-point configuration is used. The adjacent figure shows a typical measurement setup.



FIELD APPLICATIONS ▶

The SIP-COMPACT-S is also suitable for field measurements with a fixed configuration. Typical applications are long-term monitoring of landfills, groundwater levels or landslides. For this purpose, spectral impedance measurements are repeated at intervals of hours, days or weeks. By comparing the spectra, even the smallest changes in the pore space can be detected and characterized. However, the measurement cables should not be longer than 10 meters. If longer cables are required, please contact us.



SIP-COMPACT-S

Technical Specifications

General

- Freq. Range: 100 µHz - 40 kHz
- Voltage Source: ±10 V, ±20 mA
- SD Card: 30 GB
- DFT: 2x 8 Byte
- PC Interface: WiFi
- Battery: Build-in, NiMH
- Weight: 1.5 kg
- Casing: Plastic
- Size: 90/180/250 mm^3
- Signal: mono/multi sinusoidal
- Remote Reference Technique

Measuring Current

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

Measuring Voltage

- Channels: 3
- A/D Converter: 24 Bit
- Data Rate: 128 kHz
- Input Range: ±10.0 V

PC Operating Software

- Lab Mode:
  Control of the whole system,
  Time series recording & displaying
  calculation of resistivities &
  confidents limits,
  Data storing
- Autonomous Mode:
  Initialization,
  Data download & displaying,
  Data storing

Minimum PC requirements

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