SIP QUAD

- **Measures the electrical resistivity between 100 μHz - 230 kHz of up to 4 samples in parallel.**

Spectral Induced Polarization

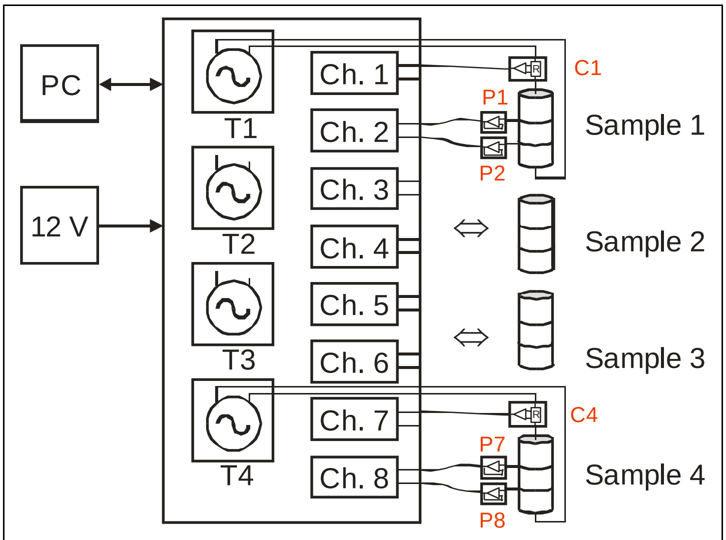
Geophysics

The **SIP-QUAD** instrument measures the frequency dependence of the electrical resistivity (amplitude and phase) on samples of rocks and sediments over $9^{1/2}$ frequency decades. At non-mineralized sediments the frequency dependence is controlled by the pore space structure. This delivers additional information for an improved characterization and discrimination of the materials. The **SIP-QUAD** instrument is able to measure up to 4 samples in parallel. If required, the instrument can register the electrical lab noise and, with the help of a multivariate time series analysis, remove this noise from the measured data.

SIP-QUAD

A Compact Chassis holds:

- 4x Transmitter Channels
- 8x Receiver Channels
- 4x Current Probes
- 8x Voltage Probes



Basic schematic diagram of the SIP-QUAD instrument.

RADIC RESEARCH - Dr. Tino Radić
Web: www.radic-research.de, Email: radic@radic-research.de
Zehntwerderweg 188A, 13469 Berlin, Germany, Phone: +49-30-40399210

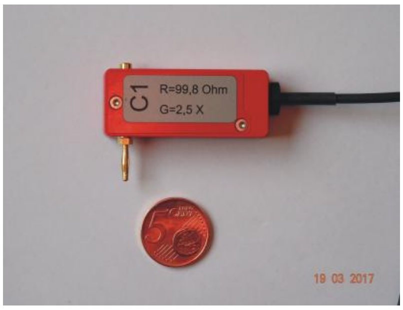
RADIC-RESEARCH

4 TRANSMITTER CHANNELS

Each sample is connected to an independent measurement signal source. This transmitter can provide up to ±20 mA at ±10 V. In this way, the measuring signal can be set to the ideal level for every sample. The measuring signal is sinusoidal. If required, the measuring signal can result from an overlap of up to 4 sinusoidal signals with different frequencies. In this way, up to 4 resistivities per sample can be simultaneously measured. The user can define the properties of the measuring signal themselves (number, frequency, duration) and can save them in an initialization file.

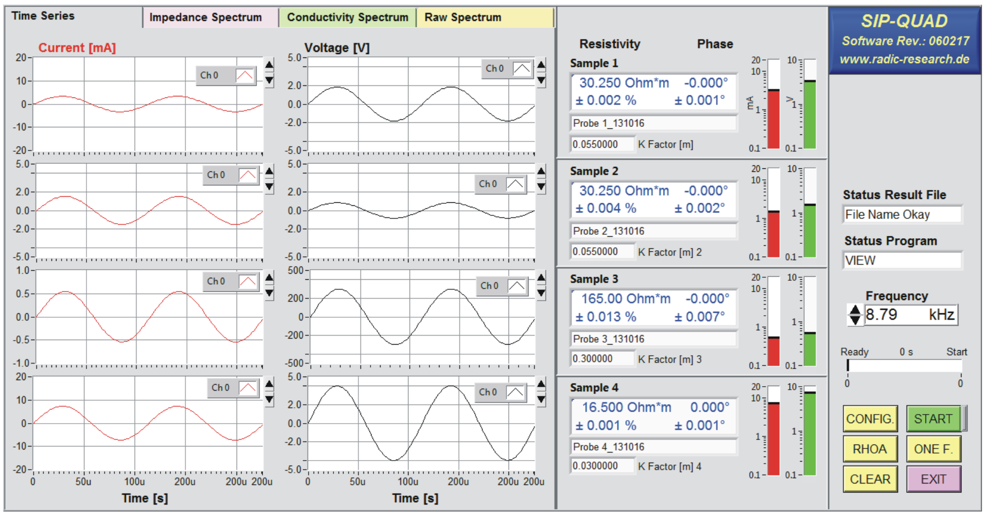
8 RECEIVER CHANNELS

The instrument has 8 receiver channels as standard. A channel measures either a current or a voltage signal, dependent on the used probe. Each channel is galvanically isolated. The resolution is 24-bit and its frequency range is 100µHz to 250 kHz.



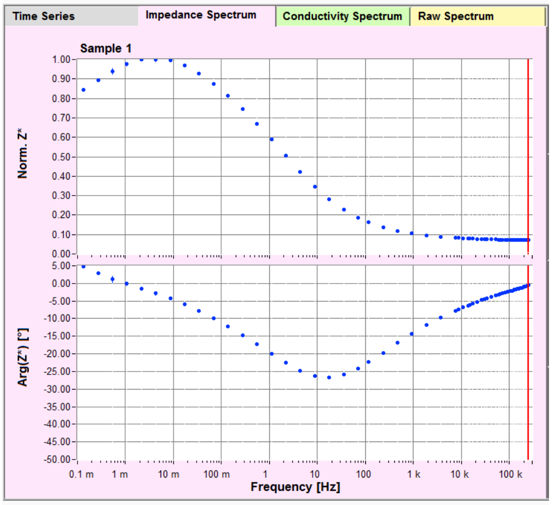
◀ PROBES FOR CURRENT AND VOLTAGE MEASUREMENTS

Probes (preamplifier) are used to measure all signals (current & voltage) direct at the electrodes of the sample holders. This minimizes the influence of lab noise and cable capacitance. For the current probes C, shunts with different resistances R and gains G are available. For the potential measurement two P probes are used. They do not amplify, but instead work as an impedance converter. The input impedance is typically 1.5 pF. Amplifying U probes for the voltage measurement are also available.



◀ OPERATING SOFTWARE

During the measurement the main menu of the laptop PC displays (in real time) the recorded time series of currents and voltages. This makes a first data quality check very easy. The measurement starts at the highest frequency. Depending on the lowest measured frequency the acquisition of a complete spectrum takes less than a minute (f_{min}=1 Hz) up to some hour (f_{min}=100 µHz). A second quality check permits the observation of the confidence limits of amplitude and phase.

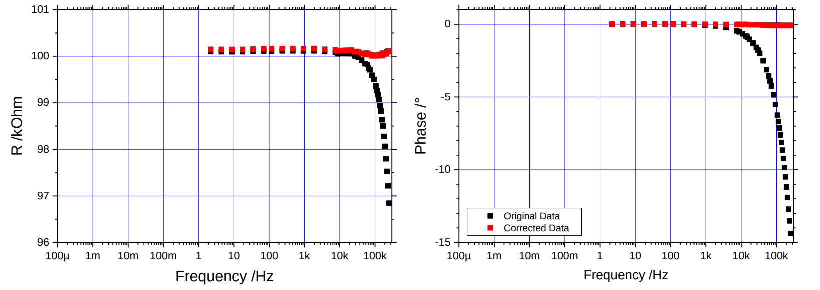


◀ IMPEDANCE SPECTRUM

The results of all measurements from one sample are also shown in the form of an impedance spectrum according to amplitude and phase. Alternatively, the conductivity spectrum (Re, Im) is shown too. The diagram on the left shows the impedance spectrum of a pyrite. A spectrum of the type Cole-Cole is typical for electronic conducting minerals. It is characterized by a pronounced phase maximum – here at a frequency of 20 Hz. This approximately coincides with the biggest decrease of the resistivity with the frequency. Ore mineralogists can determine the particle size from the location of the phase maximum.

RADIC RESEARCH - Dr. Tino Radić
Web: www.radic-research.de, Email: radic@radic-research.de
Zehntwerderweg 188A, 13469 Berlin, Germany, Phone: +49-30-40399210

RADIC-RESEARCH



Impedance measurement on a 100 kΩ resistor.
Black dots: Original data, red dots: Corrected data.

INPUT IMPEDANCE COMPENSATION

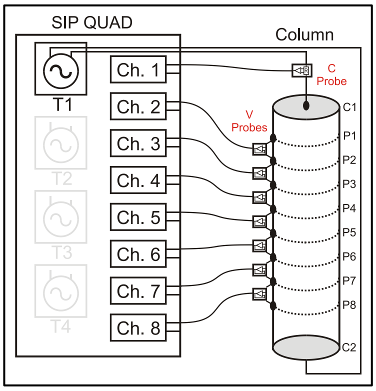
Like all real-life electronics, the measurement channels of the **SIP QUAD** have a finite input impedance. This influences the measurement results at high frequencies and if a sample is poorly conducting. As the input impedance is constant and known, its influence can be calculated and minimized by the measuring program (see fig. below).

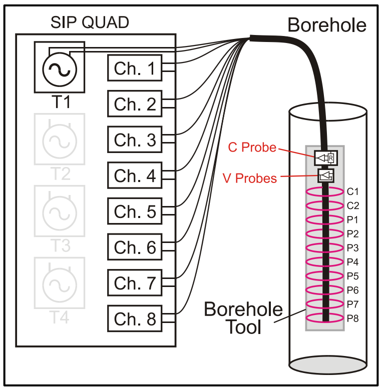
GEOELECTRICAL REFERENCE TECHNIQUE

A multivariate time series analysis allows an identification and cancellation of external noise voltages. Software and hardware support up to 2 noise monitors. Thus the confidence intervals of the data can be reduced up to more than a factor of ten. This new technique does not prolong measuring time.

FURTHER APPLICATIONS (on request)

Further measurement configurations are possible with the **SIP QUAD**. The diagram on the left shows such a configuration on a column. The diagram on the right shows a configuration with an borehole tool. In both cases only one transmitter (T1) is required to generate a current signal. With the help of a C probe, channel 1 measures the current strength through the current electrodes. The voltages are measured with the help of seven V (voltage) probes and the channels 2-8. In this way, 7 resistivities can be measured at the same time. This allows a high temporal as well as a high spatial resolution of the resistivity changes.





SIP QUAD

Technical Specifications

General

- Frequency range: 100 µHz - 230 kHz
- PC interface: USB
- Transmitter: 4
- C Probe: 4
- P Probe: 8
- Weight: 5 kg
- Power Supply: 12 V / 1 A
- Casing: 19”, 3 HE, 35 TE

Transmitter

- Frequency range: 100 µHz - 230 kHz
- Signal shape: Sinus
- Output signal: 1 - 4x Sinus
- Max. Output: ±10 V, ±20 mA

Receiver Channel

- A/D converter: 24 Bit
- Data rate: 512 kHz/2^n, n∈{0,1…16}
- Input voltage range: ±5 V
- Time series: max. 64k samples
- Data format: 32 Bit
- Digital power line filter
- Digital drift filter
- Stacking: 1 - 256
- Real-time DFT

C Probe (other on request)

- ±20 mA
- Shunt: 99.8 Ω
- Gain: 2.5x

P Probe Pair (other on request)

- ±5 V
- 200 MΩ
- Input Capacity: 1.5 pF

V Probe (other on request)

- ±5 V
- 200 MΩ
- Input Capacity: 1.5 pF

Noise Sensor (E-Field)

- Box with 2 capacitive electrodes

Operating Software

- Windows 7-10
- Control of the whole system
- Time series recording, storing, displaying, transfer function, confidents limits

Last update: January 27, 2019

RADIC RESEARCH - Dr. Tino Radić
Web: www.radic-research.de, Email: radic@radic-research.de
Zehntwerderweg 188A, 13469 Berlin, Germany, Phone: +49-30-40399210

RADIC-RESEARCH