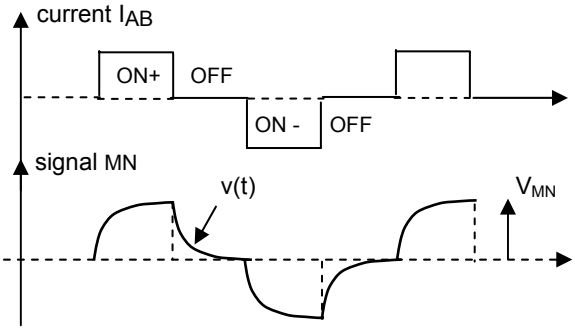
INDUCED POLARISATION:

step-by-step operation of VIP 10 000 Tx and ELREC Pro Rx

PRINCIPLE OF INDUCED POLARIZATION METHODS

The Induced Polarization (IP) **is a phenomenon which occurs with some types of minerals such as sulphide particles.** It is equivalent to a charge / discharge behaviour of capacitors when currents are switched on and off.

When IP effects are present, a **decay curve** is observed at the receiving electrodes when the pulse of current is switched off. The **chargeability** is a measurement of this decay. Several chargeability windows can be measured for better define the shape of this decay.



DEFINITION OF THE INDUCED POLARIZATION PARAMETER:

CHARGEABILITY = $\int v(t)\,dt / V_{MN}\,\Delta t$

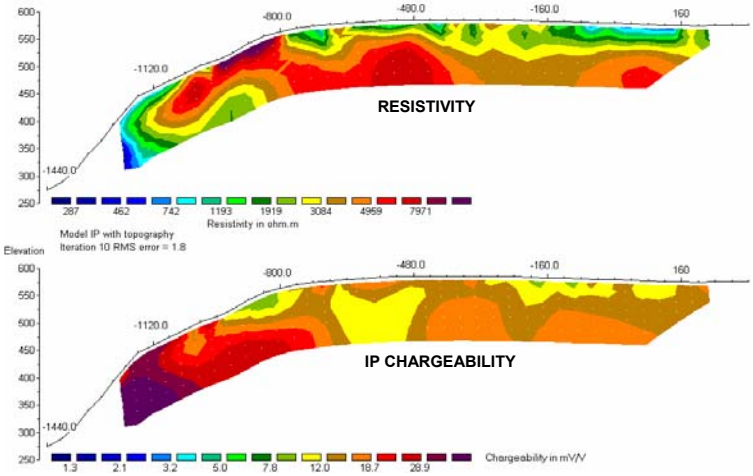
unit of chargeability: mV / V, or per mil

RECOMMENDATIONS TO GET GOOD QUALITY IP DATA

- *decrease the ground resistance* of the electrodes as much as possible to have the maximum current available from the transmitter
- *use the stacking process* at the receiver to increase the signal-to-noise ratio

MINERAL EXPLORATION HIGH PRODUCTIVITY SURVEYS

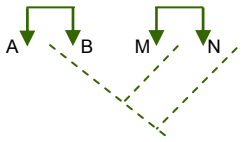
Massive and disseminated sulphide ore body detection



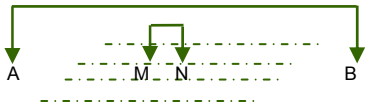
ELECTRODE CONFIGURATIONS

Various electrode arrays can be used, such as dipole-dipole, pole-dipole, pole-pole, gradient, … .

Dipole-dipole array:

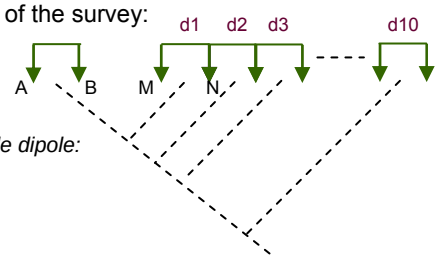


Gradient array:



With the **ELREC Pro**, 10 dipoles are measured at the same time (d1 to d10), which decreases the duration of the survey:

Example, with dipole dipole:



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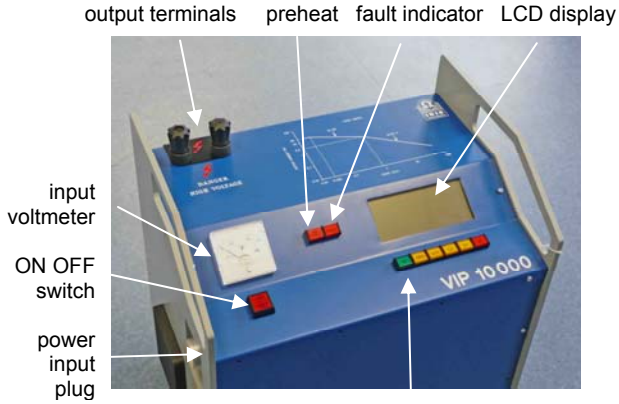
VIP 10 000 TRANSMITTER OPERATION: FIELD SET-UP

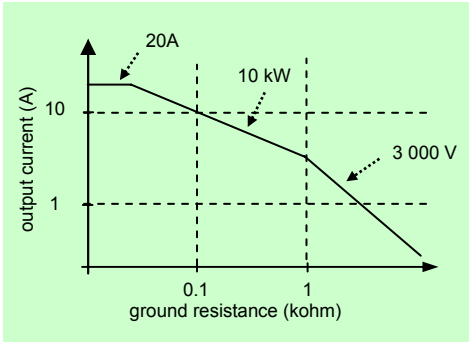
MOTOR GENERATOR (EP 20 000)

- 20 kVA, 220V, 60Hz, 3 phase voltage regulated motor generator (MG)
- the metallic frame of the motor generator must be connected to a grounded electrode, for the safety of the operator
- check oil and gas levels in the MG before starting the engine
- connect the cable between the MG and the VIP
- start the MG (key ON), switch ON the circuit breaker of the MG
- check on the VIP meter that the voltage is between 180 and 240V
- warning: voltages greater than 250V can damage the VIP
- wait for the motor to be warm before transmitting the full power
- use synthetic 5W30 oil (2.3l) and unleaded gas with octane grade > 87



VIP 10 000

current regulated Time Domain Induced Polarization transmitter
10 kW,
3 000V,
20A,
35 kg



VIP 10 000 LOAD LIMITS:
max current vs ground resistance

- HIGH VOLTAGE +
V = 1880V I = 2.10A
R = 0.9 kΩ P = 3970W
I setpoint = 2.10 A

VIP DISPLAY:
V: output voltage **I**: output current
R: ground resistance **P**: output power
$V = R \times I$; $P = V \times I = R \times I^2 = V^2 / R$

R	FRQ	AUX	I ↓	I ↑	HV

VIP KEYBOARD

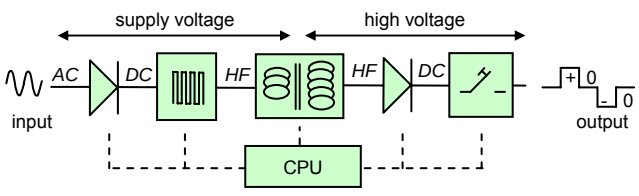
TIME PROGRAMMING: insert the programming key to modify the time parameters, for instance:
ON time: 0.25, 0.5, 1; 2 (standard), 4 or 8s

VIP OPERATING PROCEDURE

- connect the electrodes to the VIP output terminals
- press the **"ON/OFF"** button. The VIP displays "VIP self test, do not touch any key", then, after 20s: "VIP ready, time domain 2s on 2s off"
- press the "**R**" key to measure the ground resistance: R = 0.9 kΩ
- press the **"HV"** key. The VIP starts injecting 100mA. The maximum current which the VIP can transmit depends on the ground resistance R of the electrodes, from 20Ω to 60 kΩ (see diagram).
- to quickly increase the current, press the **" I ↑"** key. The successive values are 50, 100, 200, 500mA, then 1, 2, 5A, …
- to increase the current by step of 100mA, press the **" I ↑"** key, then the **"R"** key until the new value of the current is displayed
- when the maximum current is reached, the alarm sounds and the display shows **"I MAX"**
- to decrease the current by step of 100mA, press the "**I ↓**" key
- during the injection of current, the displays gives the values of the output voltage, current, resistance and power (see left)
- to stop the injection of the current, press the **"HV"** key
- in case of emergency, press the **"ON/OFF"** button

MESSAGE	INDICATION
OVERHEAT	too high internal temperature
INPUT POWER LOSS	motor generator weakness
INPUT OVER CURRENT	internal short circuit
NO OUTPUT CURRENT	check electrodes, or internal pb
NO OUTPUT VOLTAGE	check electrodes
OUTPUT OVER POWER	reduce injected current
LOAD VARIATION	stabilize ground resistance
OUTPUT FILTER OPEN	measuring board problem
RANGE ERROR	stabilize ground resistance

MAIN ERROR MESSAGES OF VIP TRANSMITTERS



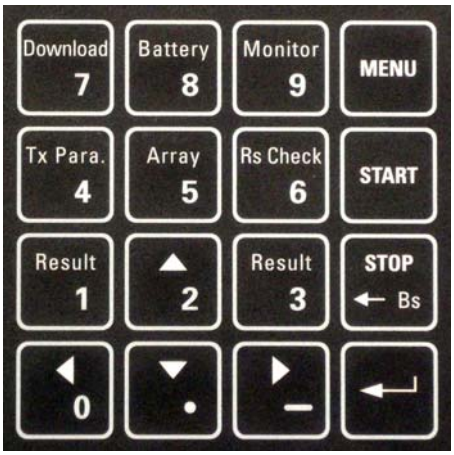
PRINCIPLE OF VIP TRANSMITTERS

SAFETY WARNING
lethal voltages are present
on the output terminals
when the High Voltage (HV) key is lighted

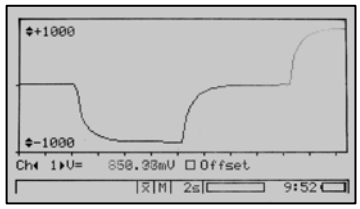
ELREC Pro RECEIVER OPERATION: FIELD SET UP

ELREC Pro, time domain IP and resistivity receiver

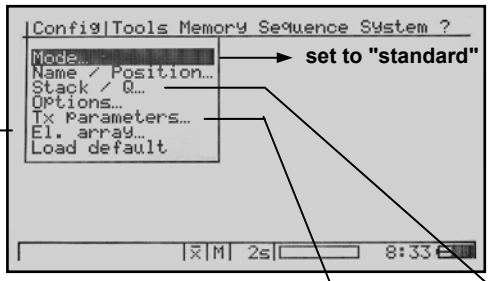
- 10 simultaneous dipoles readings
- 20 IP chargeability windows
- large graphical display for plotting the IP decay curves and the full Time Domain signal waveform (ON+, OFF, ON-, OFF)



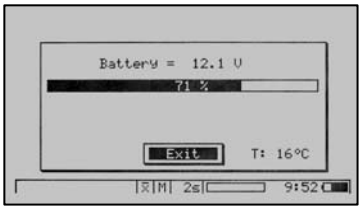
MENU: to reach the menu bar
▲,◄,▼, ►: to move in a menu
↵: to validate a value



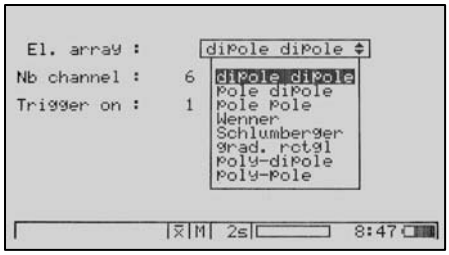
Press **"Monitor"** key to check that a signal is received on the electrodes



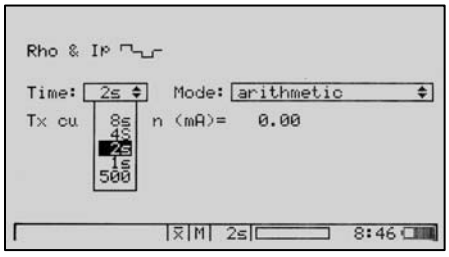
Main screen after **"switch on"**



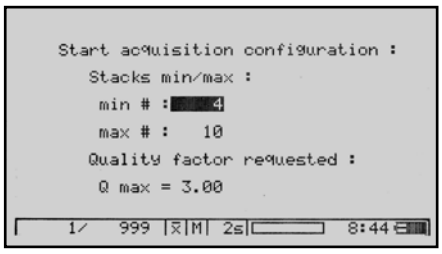
Press **"Battery"** key to check the internal battery



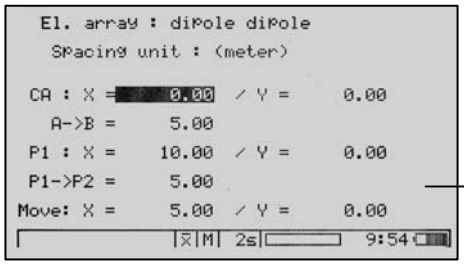
"El array" function for selecting the electrode array (dipole dipole)



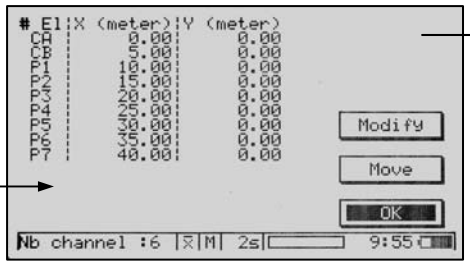
"Tx parameters" function for:
- Rho & IP form ON+, OFF, ON-, OFF
- pulse duration: 2s
- type of IP windows: arithmetic
- intensity of current transmitted in mA



"Stack" function for fixing the minimum and maximum stack numbers and the max Q standard deviation, in mV/V: the acquisition will stop automatically when Q is reached or at the max stack number

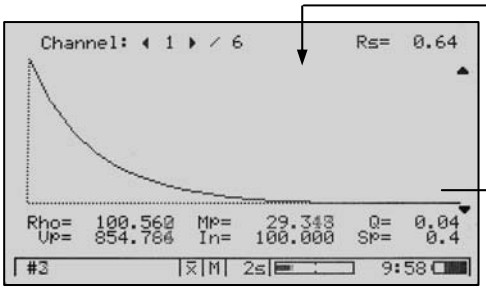


Introduce the position of the **A** electrode, the **AB** spacing, the position of the first **M** electrode, the **MN** spacing, the **Move** distance

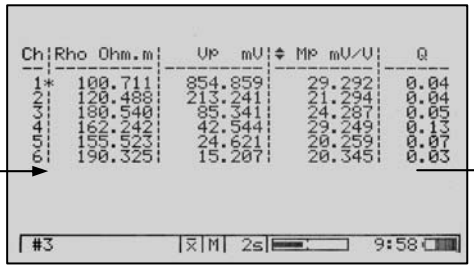


Press the **"Start"** key: first check the positions of the electrodes; "Modify" is for correcting a value; "Move" is for translating the positions of all the electrodes

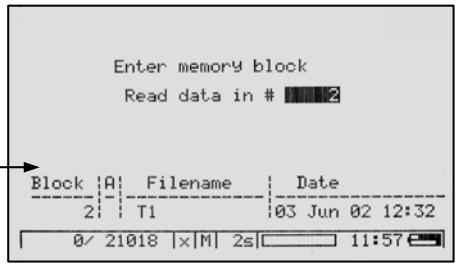
Then, the ground resistances of all the electrodes of the dipoles are measured. If a resistance is larger than 100 kohm, try to decrease it, if not click OK to continue



During & after the acquisition, press **"Result 1"** key to see the graphic curve and the values of a given dipole; press the arrows to change



During & after the acquisition, press **"Result 3"** key to see the graphic curves and the values of all the dipoles; press the arrows to change

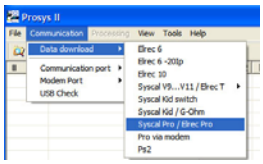


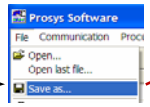
At the end of the reading, storage of the measurement: confirm the memory location (block 0 to 21 000, 1 reading dipole = 1 block)

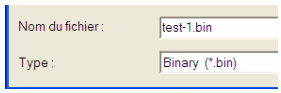
ELREC Pro RECEIVER OPERATION: DATA TRANSFER & PROCESSING

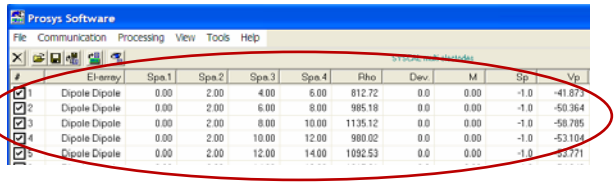
▪ TRANSFER THE DATA FROM THE ELREC TO THE PC:

- connect the serial cable to the ELREC and to the PC, run the PROSYS software
- click on "communication", "data download", "SYSCAL Pro / ELREC Pro"",
- give the first and last memory block number to transfer
- switch the ELREC on, press the **"Donwload"** key,
- at the end of the transfer, a name must be given to the file transferred (test-1.**bin**); repeat the operation for other data transfers if necessary.
- data are displayed, one reading (block) per line, with the co-ordinates (spa1, …4) of the electrodes, and the values of resistivity (Rho), voltage (Vp), current (In), quality Q (Dev), chargeability (M, M1 to M20)
- the ELREC can then be switched off.



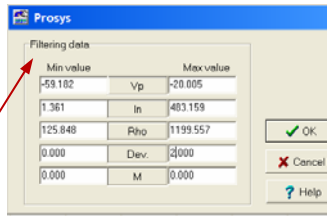


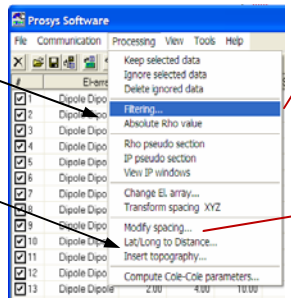


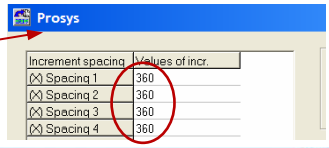


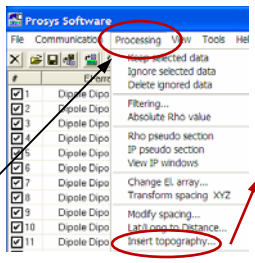
▪ CHECK AND PROCESS THE DATA BEFORE INTERPRETING THEM:

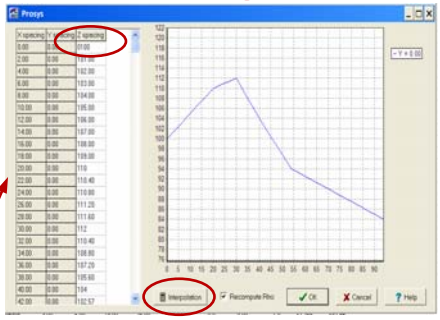
- click on "processing" and "filtering" or "auto filtering" to eliminate the data with high deviations (ex: only keep the readings which have a quality coeff. < 1mV/V) or with a good Vp signal
- click in a box to ignore ☐ or to validate ☑ a reading
- click on "processing" and "modify spacing" to modify the abscissa (X value) of the electrodes of a file, if the data of this file have been obtained after a translation of a first sequence. Introduce the value of the translation (ex: 360m) for spa1, 2, 3, and 4 electrode co-ordinates.
- if two files have to be merged, because they are successive segments of the same profile:
  - click on "file, open", give the name of the 1st file
  - then click on "file", "add", give the name of the 2nd file to merge with the 1st one
  - then click on "file", "save as" to give a name for the new combination file.
- click on "processing" and "insert topography", to give Z spacing values for the electrodes; an interpolation function for the points located between two Z referenced electrode positions is available
- click on the "Rho" of the table header to display the curves of the voltage measured at various depth levels. Check these values by validating the various levels selectively (clicking in the level boxes). Large spikes may represent bad data readings
- click on "processing" and on "rho pseudo section" to display a color image of the apparent resistivity

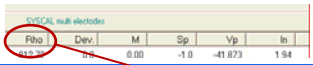


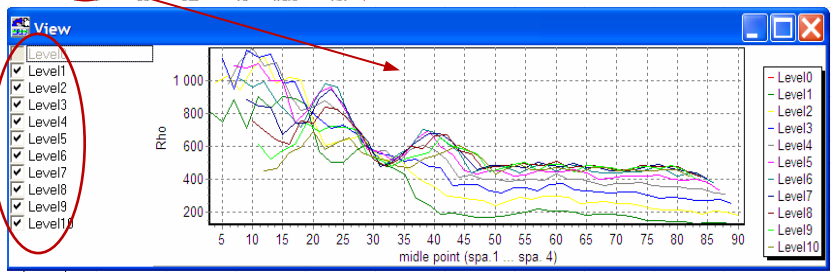






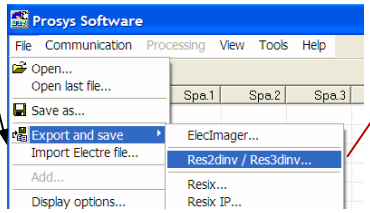


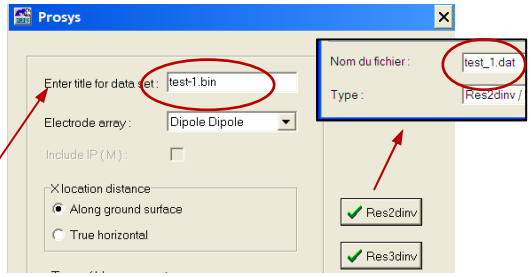




▪ MAKE A FILE READABLE BY THE INTERPRETATION SOFTWARE:

- click on "file", "export and save", "Res2Dinv / Res3Dinv", then click on "Res2Dinv"
- confirm the name of the current file to export: test-1.bin
- give a name to the file which will be read by Res2Dinv: test-1.**dat**





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