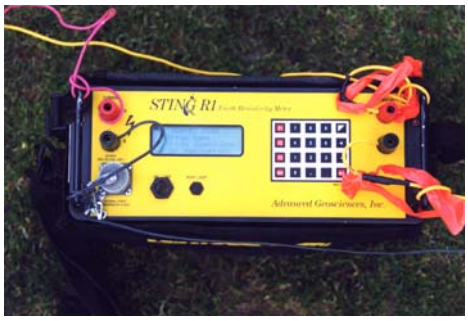
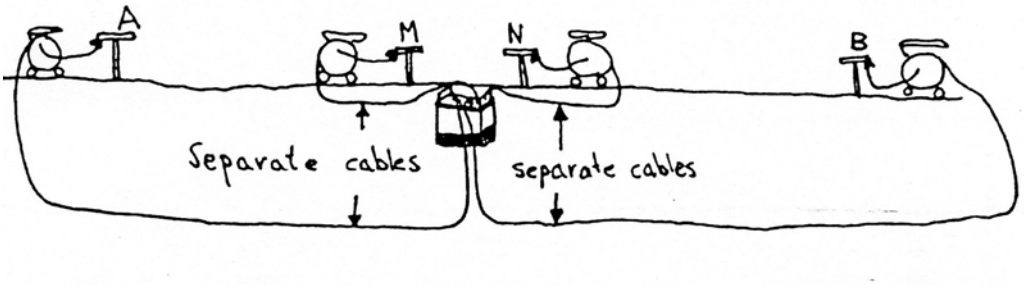
B6 Field techniques for DC resistivity exploration

B6.1 Instrumentation

- Typical DC resistivity instruments are powered by an internal battery and generate up to 400 volts and a current of 1 amp. The control unit weights a few kilograms. Data is saved in the memory and can be downloaded to a computer at the end of the day.

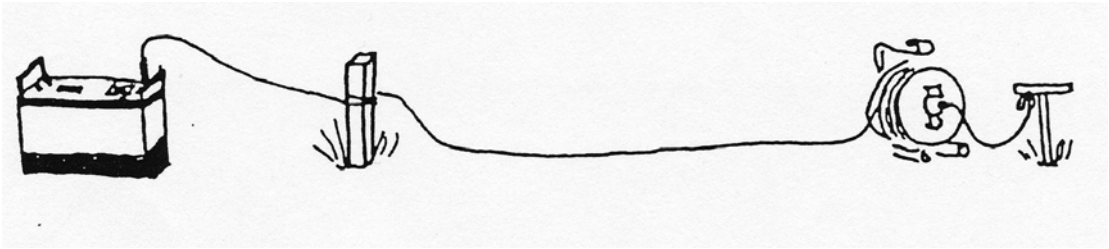


- The electrodes are usually stainless steel stakes. If the surface is very dry, then salt water may need to be poured over the current electrodes (M and N) to lower the contact resistance.



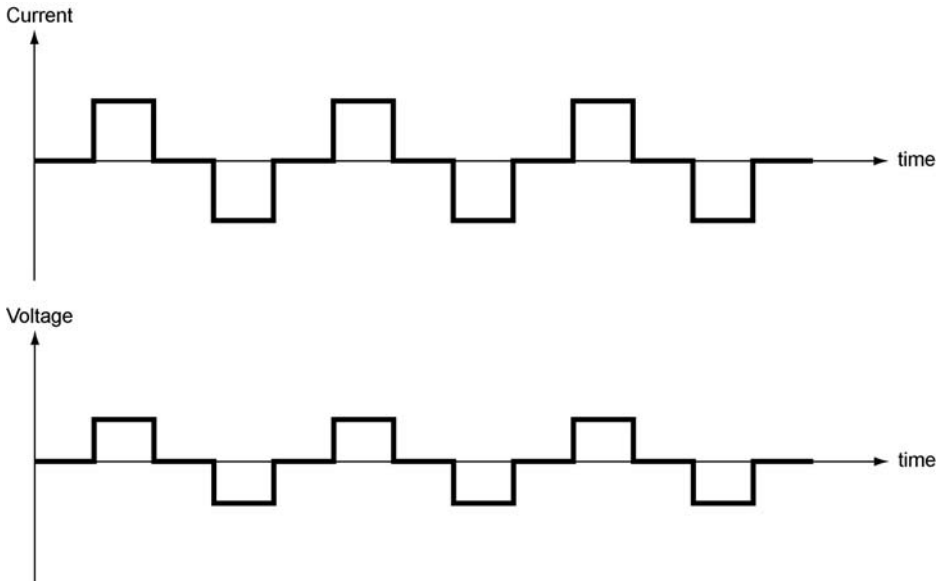
- Cables carrying electric current to current electrodes (A and B) and those detecting voltages at the potential electrodes (M and N) should be separated to avoid cross talk.

- Reels of wire should not be placed close to the unit, as they act as electromagnets when current flows through the wire.



- Cables should be secured to stakes to prevent them being pulled loose.

- An accurate measurement requires that sufficient current can be made to flow in the ground. If the ground is very resistive, then 400 V may not be enough to get the current flowing. Additional power supplies can be used (car battery, 10kW generator)

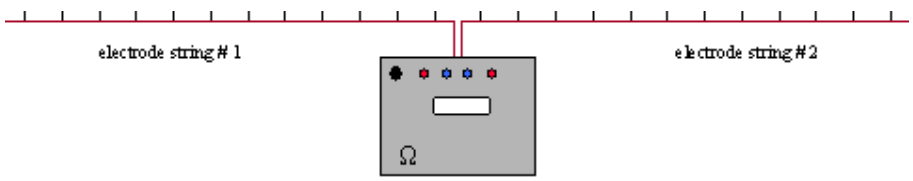


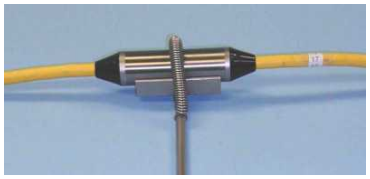
- The voltage is switched +/- several times as the measurements are made. This avoids **electrolysis** of the electrodes as electrochemical reactions occur at the electrodes.

- Reversing the current flow can also eliminate the effect of **polarization** that can occur on the metal electrodes.

- A consequence of switching the current +/- is that the electric current is usually a square wave that reverses every 1-10 seconds. An estimate of apparent resistivity is made for each +/- cycle and allows an **error** to be estimated for each apparent resistivity measurement. A high error can indicate that insufficient electric current is flowing in the Earth (e.g. see notes on Schlumberger array in previous sections).

- Most modern exploration uses an **array** of 100+ electrodes connected to a smart cable. Computer control and automatic switches allow any electrode to be activated as a **current electrode** or a **potential electrode**. This allows 2-D **pseudosections** of the subsurface resistivity to be generated (see B5).





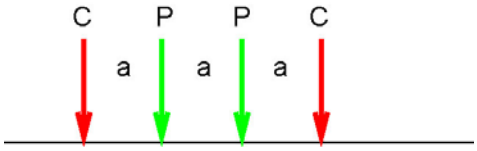

- Great care must be taken when working with **high voltages**, especially when watering electrodes. Animals and children need to be kept away.

Details of some commercial systems

Syscal	*http://www.terraplus.ca/products/resis/resistivity_meters.htm*
AGI sting	*http://www.agiusa.com/index.shtml*

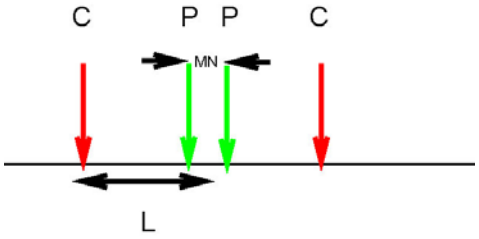
B6.2 Electrode arrays for DC resistivity exploration

Wenner array



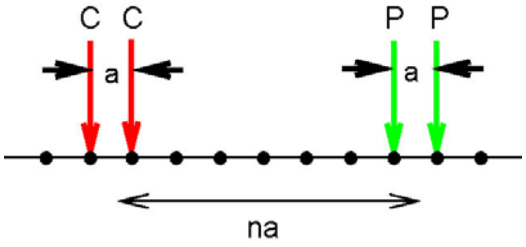
$$\rho_a = 2\pi a(\frac{\Delta V}{I})$$

Schlumberger array



$$\rho_a \approx \frac{\pi L^2}{MN}(\frac{\Delta V}{I})$$

Dipole-dipole array



$$\rho_a \approx 2\pi n^3 a(\frac{\Delta V}{I})$$