Terra EZ Res™ Pro 2,3 and 4 Probes

Earth R/P Analyzer

Easy Resistivity User's Guide

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Important Notices:

1. This User's Guide is intended to provide a general understanding of soil resistivity and and how to conduct soil resistivity surveys. Another smaller booklet User's Guide is also included, which offers in-depth technical information about the **Terra EZ Res™ Pro** and in-depth information about earth resistance and earth voltage. You should read and understand the small booklet User's Guide as well as this **Easy Resistivity User's Guide** to receive the most from this powerful and valuable instrument.
2. The **Terra EZ Res Pro** (unit) is warranted against defects in materials and workmanship for one year from date of purchase. Terra Exploration Group (TexGru) may, at its' discretion, repair or replace defective product under this warranty. Incidental or other damage while unit is out of TexGru control is not covered under this warranty. Submit warranty information as shown in the included Warranty Information sheet.

Terra EZ Res™ Pro---Easy Resistivity Guide

Thank you for purchasing the **Terra EZ Res Pro**, the easiest-to-use, yet, very sophisticated earth resistivity (and resistance) scanner. Contained within a black barrel zippered bag are the following: red and black wires (50 meters each), yellow and green wires (25 meters each), two short jumper wire sets, five probes in a canvas zipper bag, 10 marking flags and two-50 meter measuring tapes. For airline travel, the electronic host unit may be easily carried on-board as a carry-on, while the separate black bag with the wires and accessories can be packed in checked luggage. The five probes are simple steel landscaping spikes---if lost or worn out, they are easily replaced at hardware stores.

For best results, thoroughly read and completely understand this Easy Resistivity User's Guide.

- **The Terra EZ Res Pro conforms to IEC61010 in design, production and testing.**
- **Under all circumstances, pay special attention to the safe use of this device.**
- **Avoid nearby use of high-frequency signal generators like mobile phones to prevent electrical interference errors during device operation.**
- **Observe warnings and symbols shown on the device.**
- **Make sure that device and accessories are in good working order before use. Do not use if there are broken parts or exposed areas of test wires. Do not touch probes while measurement is in progress---risk of electrical shock!!!!**
- **During measurement, do not touch bare conductors or circuits under measurement.**
- **Before measurement, please set rotary FUNCTION switch to desired measuring position.**
- **Confirm that connector plug of leads have been completely inserted into device interface.**
- **Do not expose to Earth Voltage exceeding 600V AC or DC.**
- **Do not operate device in the presence of flammables, as a spark spark could initiate an explosion or fire.**
- **Do not use device if test wires are damaged with uninsulated wire exposed.**
- **Do not expose the device to high temperatures, high humidity or condensation.**
- **Do not leave device exposed to direct sunlight for extended periods to avoid excessive heating of electronics.**
- **For battery replacement, remove testing wire from device interface, and make sure that rotary FUNCTION switch is in "OFF" position.**
- **Dispose of used batteries in an appropriate manner.**
- **When the meter displays battery low voltage symbol, replace batteries.**

A. General Provisions of This Guide:

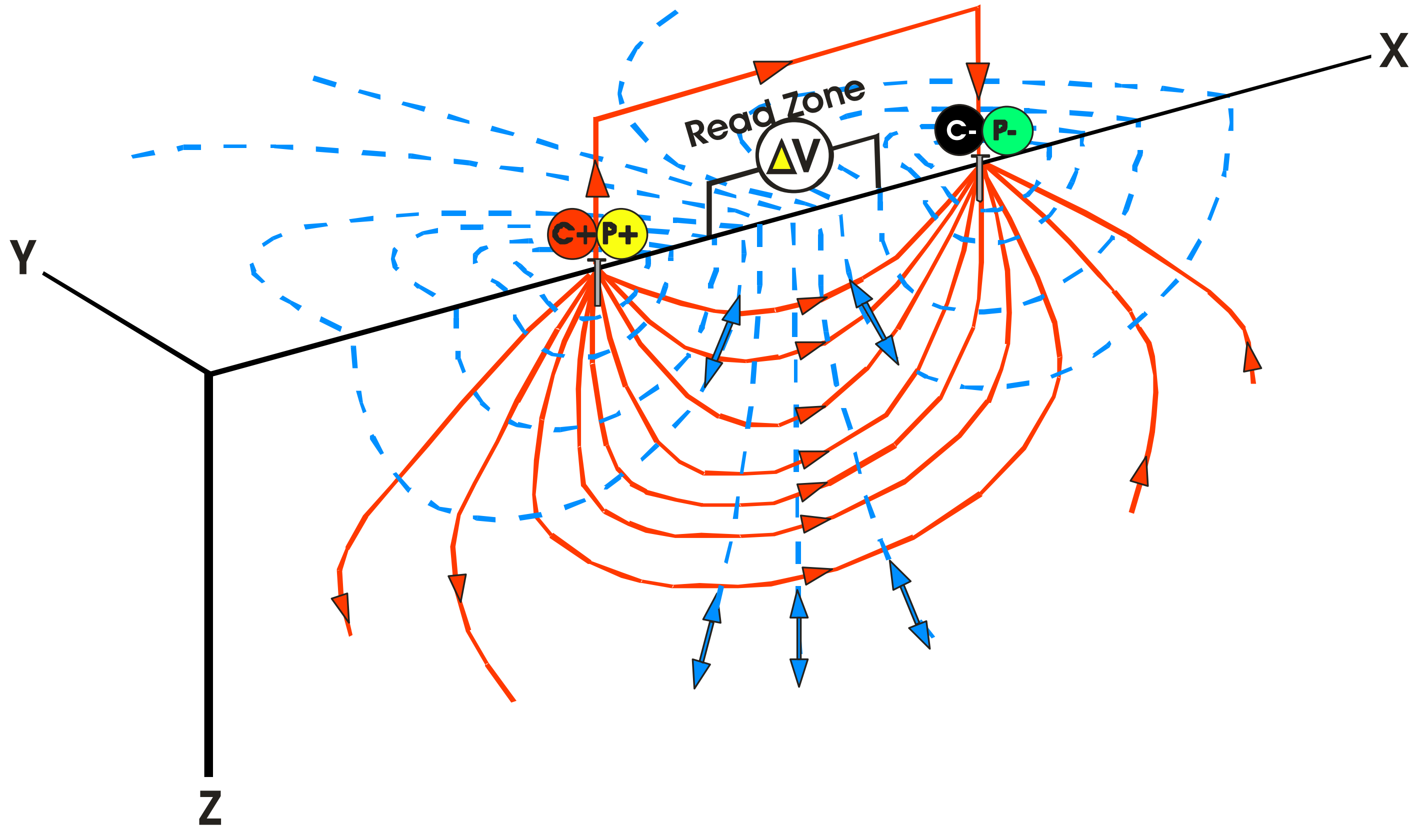
This guide will provide instruction in the general use and understanding of earth resistivity. It will concentrate on and show how to conduct two-probe resistivity arrays. Under the four probe category, it will give a basic understanding of Wenner, Schlumberger and Dipole-Dipole Resistivity arrays. This guide will show how to conduct resistivity scans in the search for caves/tunnels, water, large metal caches and/or metallic mineral veins. The analysis of resistivity results is very much a quest for anomalies. Whether one is looking for caves/tunnels, water, large metal caches and/or metallic mineral veins, anomalies and their identification are sought---a significant difference from what is seen at any depth within “normal” ground conditions. This guide boils down very complicated science and mathematics so that resistivity is more easily understood to provide a comfortable, confident and results-oriented work environment.

B. How Earth Resistivity Works:

Resistivity is the opposite of conductivity. A highly electrically conductive substance will exhibit low resistivity while the opposite is true for low conductivity substances. Resistivity is the measure of resistance to electricity flow over varying distances. Higher electrically conductive substances, like metals for example, will exhibit much lower resistivity than air (as found in caves/tunnels). Factors that will DECREASE soil resistivity: (a) High moisture content (b) High soil salinity - more ions to conduct electricity; (c) Clay minerals. Factors that will INCREASE soil resistivity: (a) Low moisture content; (b) Low soil salinity; (c) Loose, non-compacted soil/gravel; (d) fractures in dry rock.

The complete resistivity scan process usually involves many individual scans, requiring numerous and repeated movements of probes---generally expanding a resistivity line outwards to achieve greater depth. Depth is generally 52% of the distance between a given set of probes---this varies slightly according to the type of array utilized and will be explained later.

Two-Probe Resistivity Electricity Flow Pattern



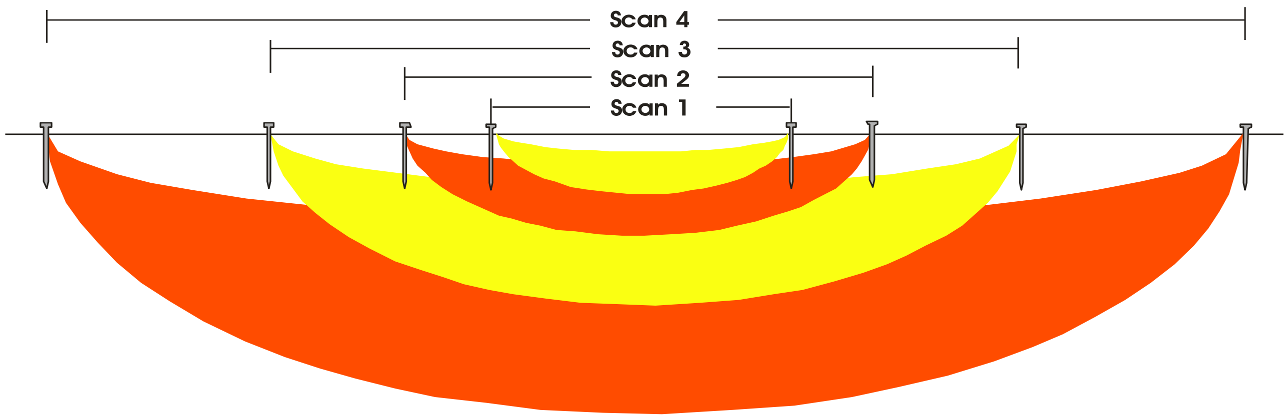
As shown in the above illustration of a two-probe array, current flows to and from the probes in all directions horizontally and vertically. As the probes are sequentially placed farther apart, the electric current goes steadily deeper. To calculate the apparent resistivity, the **EZ Res Pro** measures the voltage drop from the current sent from the **C+** and **C-** wires to the current received by the **P+** and **P-** wires. The strongest reading position is in the center of the probes.

Two probe array:

The two probe array is the most simple to set up and the fastest/easiest to conduct. For a quick look before possibly following with more complex four-probe arrays, the two probe array is the best way to start a serious resistivity study. (See following cross-section illustration of two probe array):

Two-Probe Array

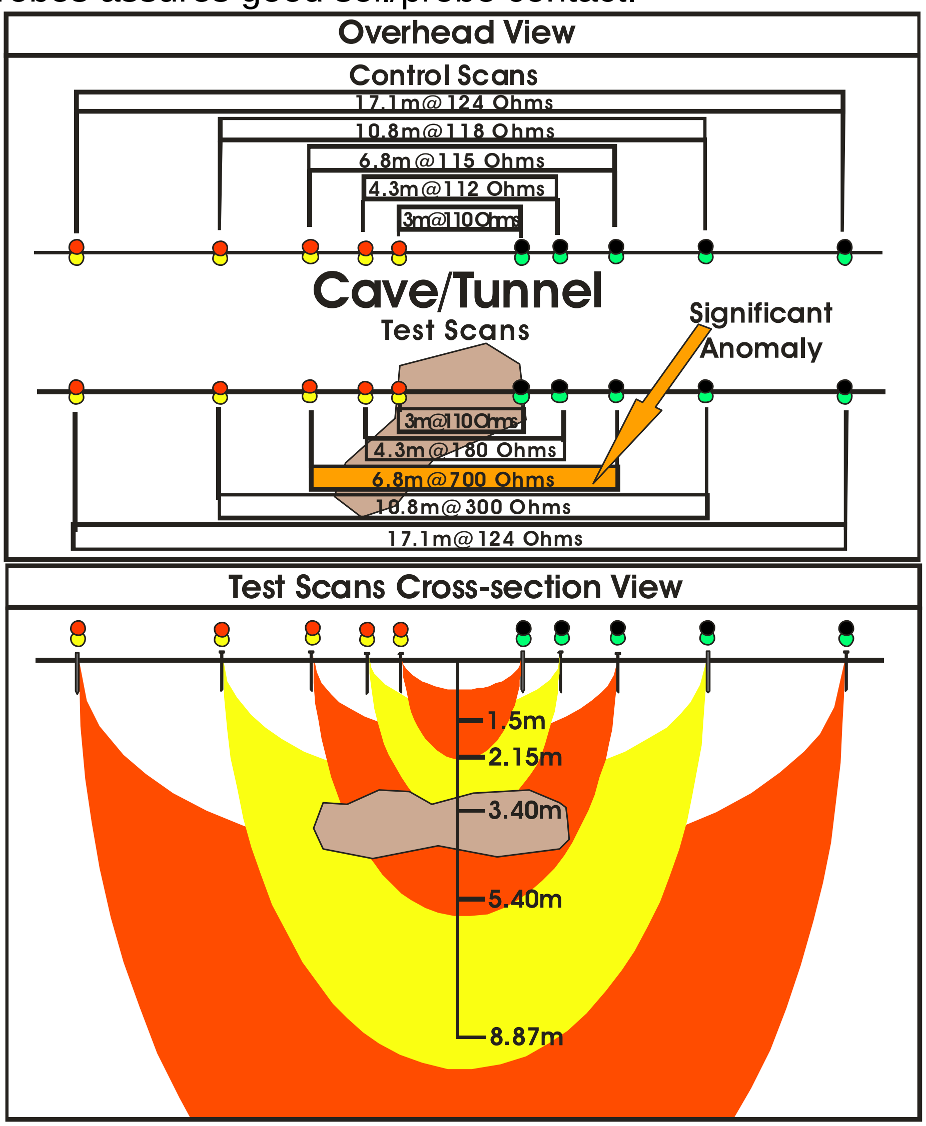
Center Depth = 52% of Distance Between Probes
Charge Zone = 50%-160% of Center Depth



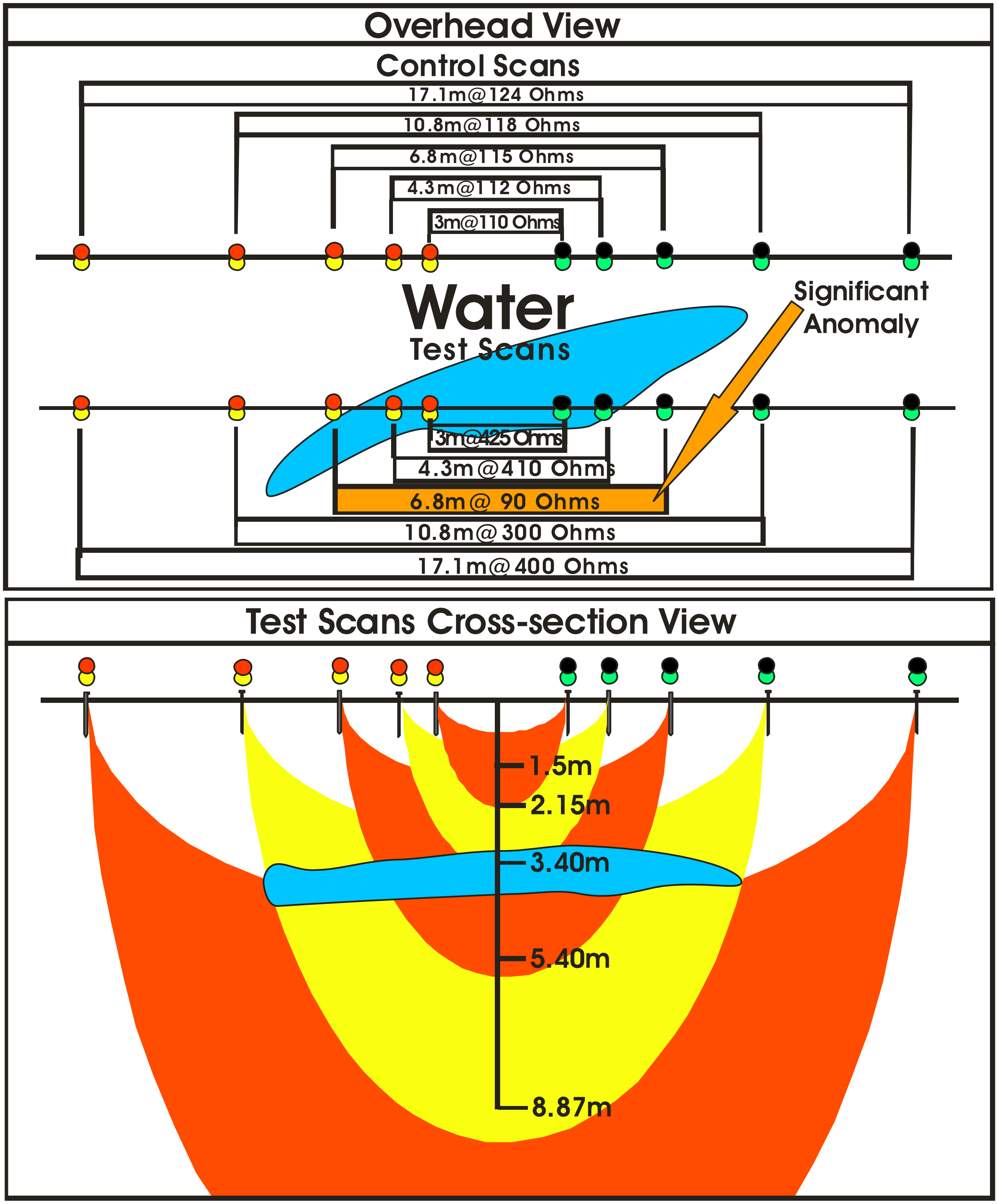
a. Locate the most likely position believed to be directly over the center of your target.
b. Estimate the depth of your target in **METERS**----for example 10 meters.
c. Multiply the estimated target depth in **METERS** by 80% to establish the first spacing of the two probes---10 meters x 80% = 8 meters initial spacing---centered over spot believed to be directly over the center of the target. Subsequent spacing of probes is calculated by multiplying the previous spacing by 1.585. Therefore, subsequent spacing is calculated as follows: #2 = 8m x1.585=12.68m; #3=12.68mx1.585=20m; #4=20mx1.585=31.70m; #5=31.70mx1.585=50.24m. This system provides a logarithmic progression of probe spacing so that the center of the second measurement zone overlaps the first and so on as is required to properly examine the area under study. This system provides for hitting the estimated target depth on the third spacing of the probes.
d. One of the two probes will be connected via alligator clip to the red long wire, which will be connected to the red and yellow jumper wire set, which then plugs into to the red and yellow binding posts on the face of the **Terra EZ Res Pro.** The second probe will be connected via alligator clip to the black long wire, which will be connected to the black and green jumper wire set, which then plugs into to the black and green binding posts on the face of the **Terra EZ Res Pro.**
e. After the two probes are in their initial position (hammered solidly into the ground and water soaked around the probes if the soil is dry) and the wires are connected properly between the probes and the **Terra EZ Res Pro**, turn the "**FUNCTION**" switch from "**OFF**" to "**P EARTH**". Press "**SET**" for about three seconds and enter the initial probe spacing in **METERS** (do not use feet) by using the "**UP**" or "**DOWN**" "**ARROW BUTTONS**" to select your probe spacing value in **METERS** (Meters = Feet/3.28). Press "**START**", and the LED screen will show measurement calculations in progress through movement of the indicator on the digital dial. Following each re-spacing of the probes, repeat the process of entering the new probe spacing in meters. Once each scan is complete, the resulting "**Ohms-Meters"** numerical value will be shown on the screen. Save this value to memory by pressing "**MEM**" button twice. **The EZ Res Pro** stores the results of each scan internally, but it is a good idea to manually record the probe spacing and apparent resistivity results of each scan for easy and quick field reference. Move the probes out to the subsequent carefully planned and measured spacing positions (maintain original center position) and repeat the scan procedure after each new probe placement.

C. How-to examples: use of the two-probe array is shown as it is the simplest array and the fastest/easiest scan to conduct:

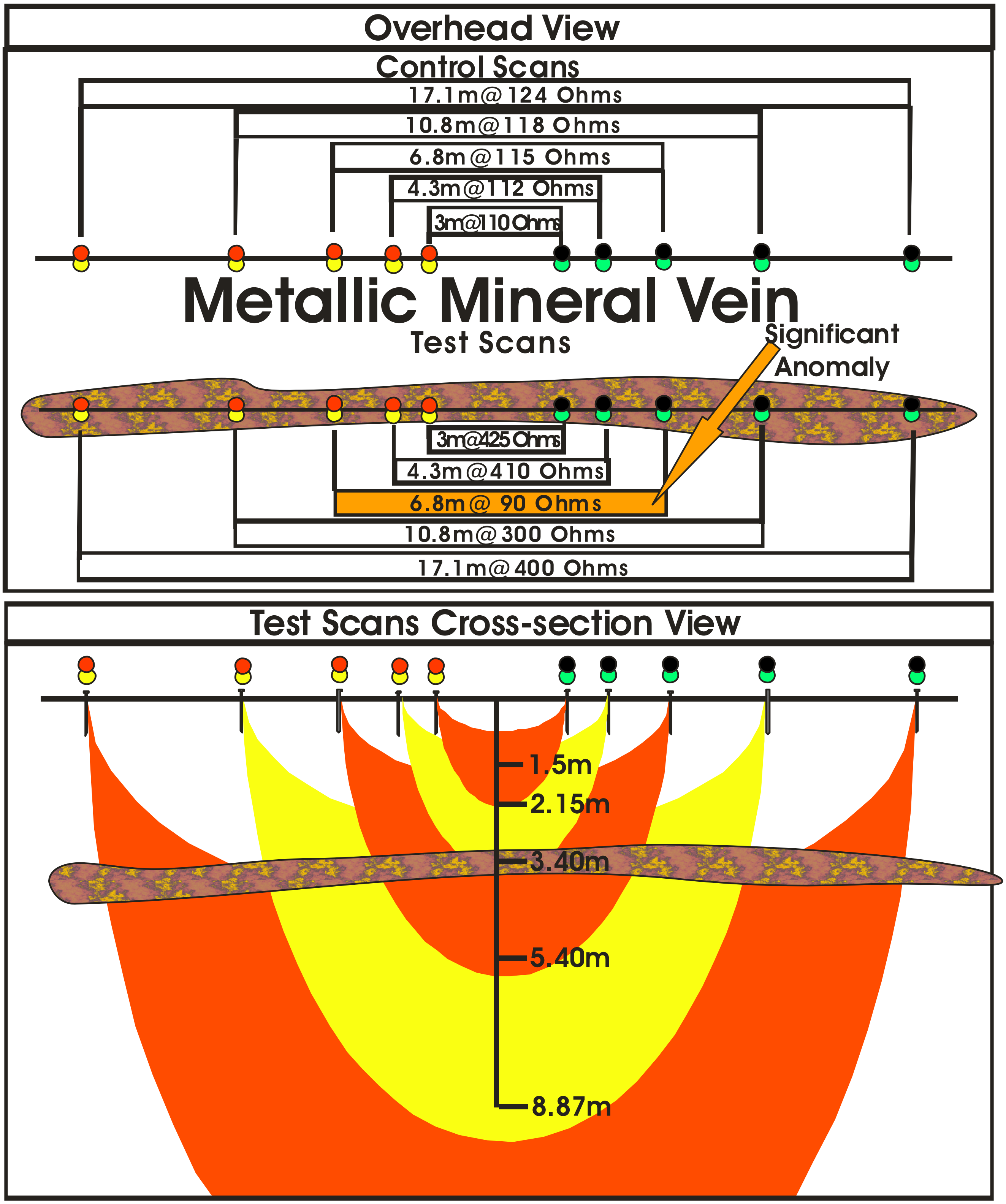
1. How to find caves/tunnels: The illustration below shows overhead and cross-section views of a two-probe resistivity array in a hypothetical search for a cave or tunnel. First, **Control Scans** are conducted to determine **"NORMAL"** soil resistivity at various depths. Once **"NORMAL"** conditions are known, Test Scans can be run in the search for a cave or tunnel. If a **very significant increase (vs Control)** in apparent resistivity is noted at some depth as is shown in the following illustration, there is a good possibility that a cave or tunnel has been found. To improve confidence in the possible cave/tunnel find, rotate probes alignment 90 degrees (maintaining the same center) and repeat the scans. Remember the strongest reading comes from the center of the probe spacing so, farther lateral movement of the moved array (to one side or the other) is warranted in trying to find higher resistivity numbers. If the array is moved linearly in one direction and the numbers drop, movement away from the target is indicated. On the other hand, if linear movement of the array produces higher numbers, movement toward the target is indicated. Always make sure probes are driven in to the soil within one inch of the probe head and that firm contact is made with the soil. Wetting (salty water is best) soil around solidly-placed probes assures good soil/probe contact.



2. How to find water: The illustration below shows overhead and cross-section views of a two- probe resistivity array in a hypothetical search for water. The methodology is exactly the same as explained in the cave/tunnel example with the only difference being that an indication of water at some depth will exhibit a **significant decrease** in resistivity numbers as water is generally more electrically conductive than the surrounding soil.



3. How to find metallic mineral veins or large metal caches: The illustration below shows overhead and cross-section views of a two-probe resistivity array in a hypothetical search for a metallic mineral vein. The methodology is exactly the same as explained in the water example whereby resistivity at some depth will exhibit a **very significant decrease** in resistivity numbers as metallic mineral veins are always more electrically conductive than the surrounding normal soil.

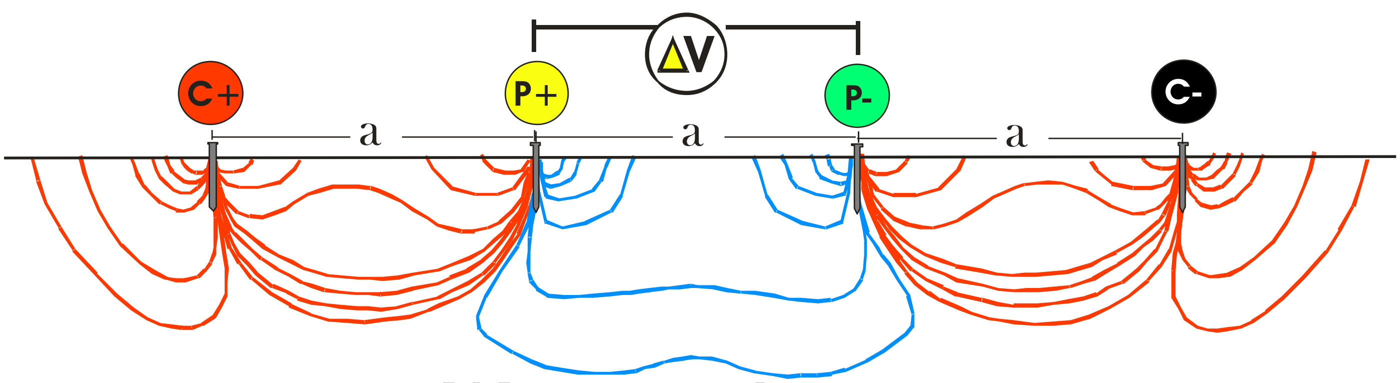


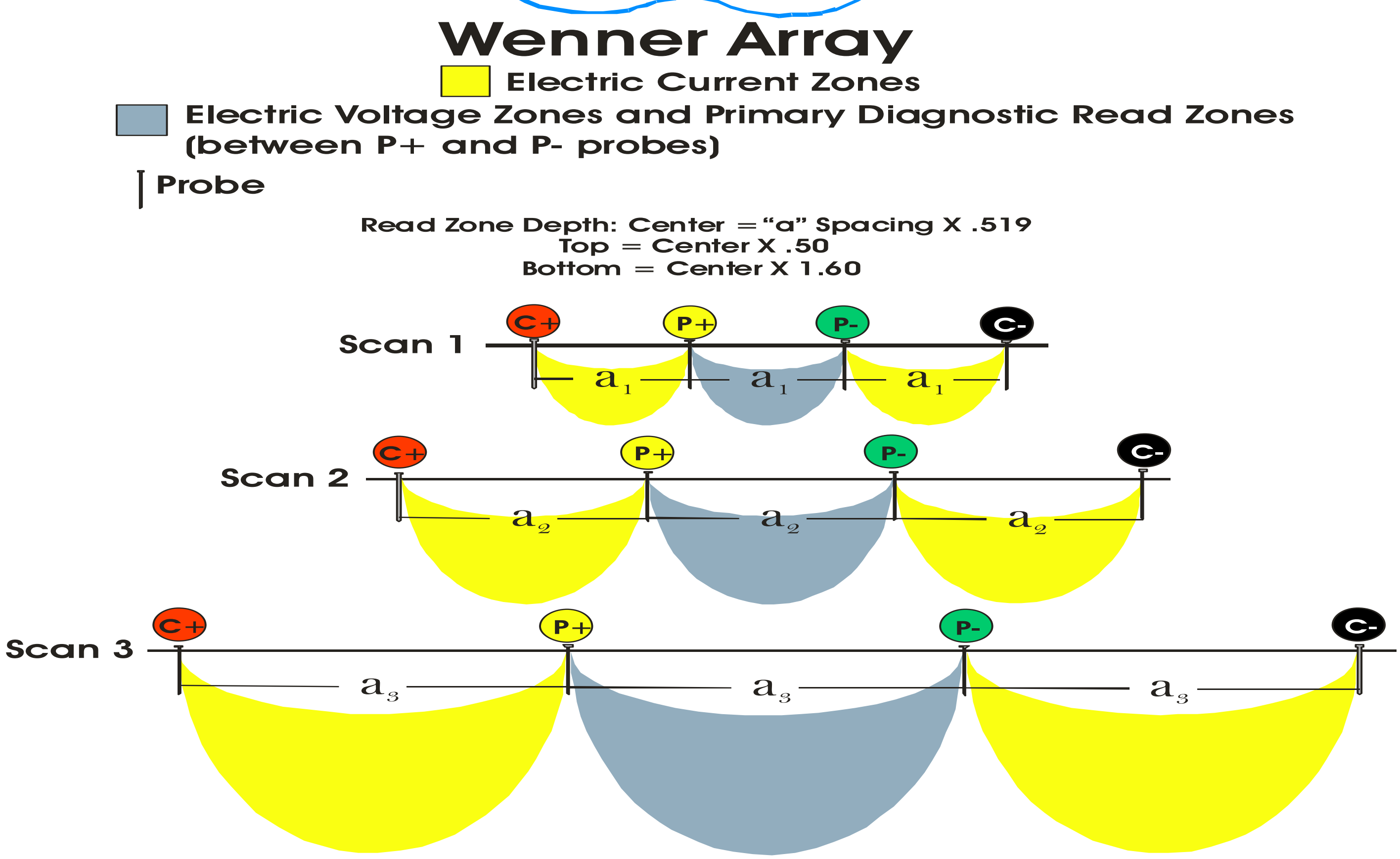
D. Four probe arrays: Wenner, Schlumberger and Dipole-Dipole

As discussed earlier, four probe arrays yield more precise results than the recommended procedure of starting with two probe arrays using four wires. The four probe arrays are also much more difficult and time consuming to conduct. The results of four probe arrays can be dramatically enhanced with earth-imaging software such as Voxler, AGI Earth Imager and Zond---available from the individual software producers.

1. Wenner Array: Four probes with "a" spacing of equal distances with all in a straight line. The red and black wires are connected to the outside probes. The yellow and green wires are connected to the inside probes. Multiple test scans should be conducted to determine "normal" ground conditions at various depths. After each scan is completed, all probes are moved farther apart (maintain original center point) each time by a factor of 1.585X previous spread and a new scan is conducted. **The EZ Res Pro** stores the results of each scan internally, but it is a good idea to manually record the probe spacing and apparent resistivity results of each scan for easy and quick reference. As in any resistivity scan, the search is for noticeable anomalies from "normal".

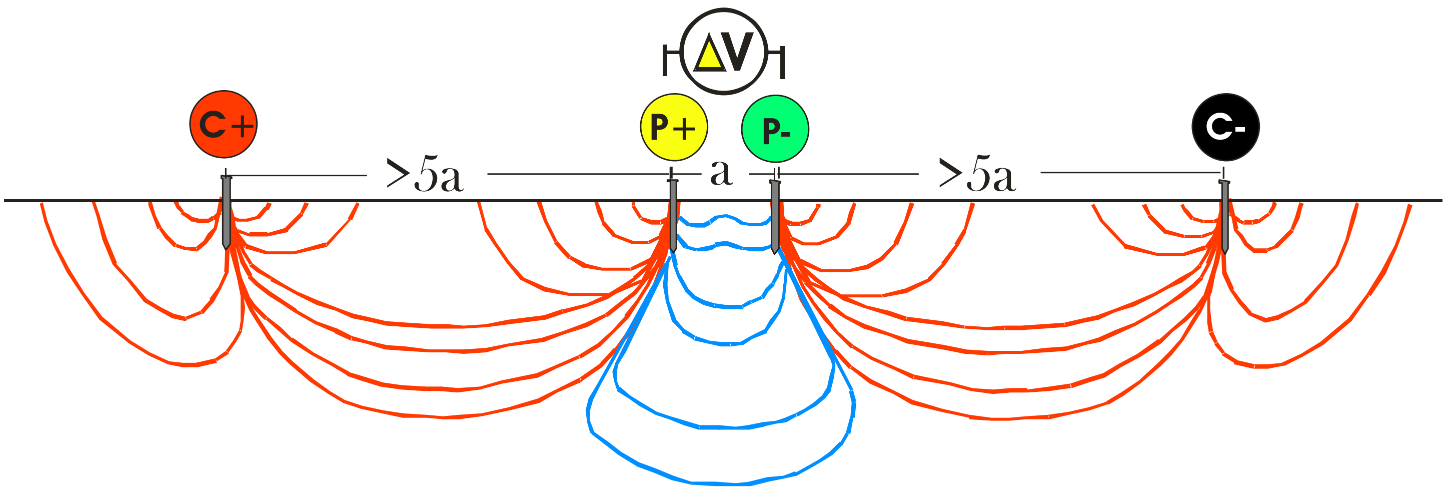
Wenner Array Electricity Flow Pattern





2. Schlumberger Array: Four probes with two center probes (**P+** and **P-**) spaced "a" distance apart. The two outside probes (**C+** and **C-**) are spaced at least 5X the "a" spacing from the closest inside probe---all in a straight line. The red and black wires are connected to the outside probes. The yellow and green wires are connected to the inside probes. Multiple test scans should be conducted to determine "normal" ground conditions at various depths. After each scan is completed, only the outside probes are moved farther apart (maintain original center point) each time by a factor of 1.585X previous spread and a new scan is conducted. **The EZ Res Pro** stores the results of each scan internally, but it is a good idea to manually record the probe spacing and apparent resistivity results of each scan for easy and quick reference. As in any resistivity scan, the search is for noticeable anomalies from "normal".

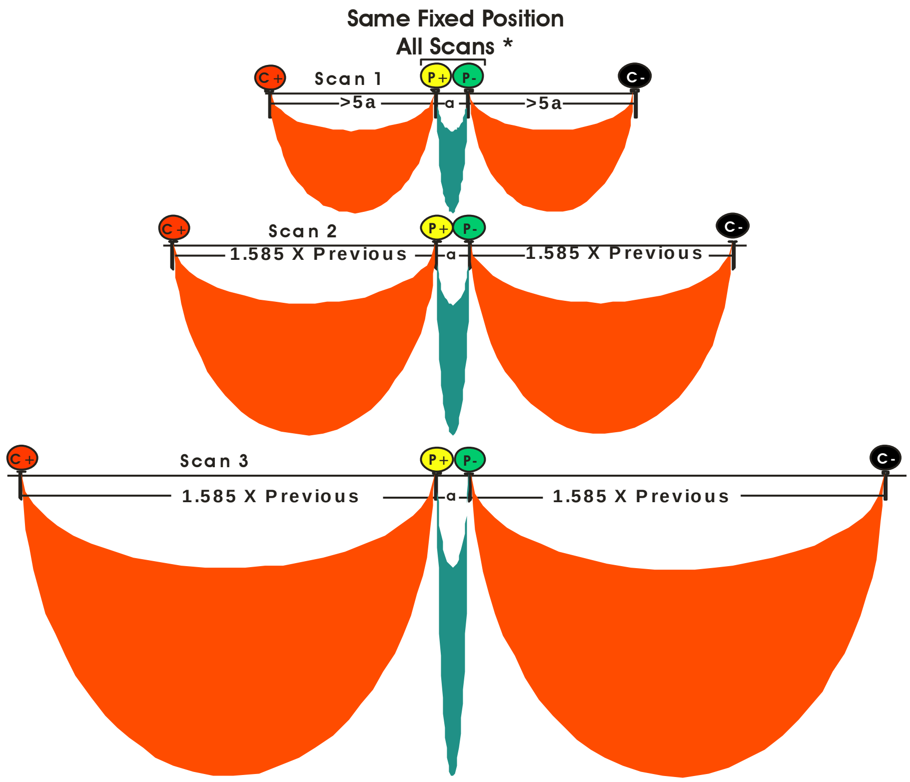
Schlumberger Electricity Flow Pattern



Schlumberger Array

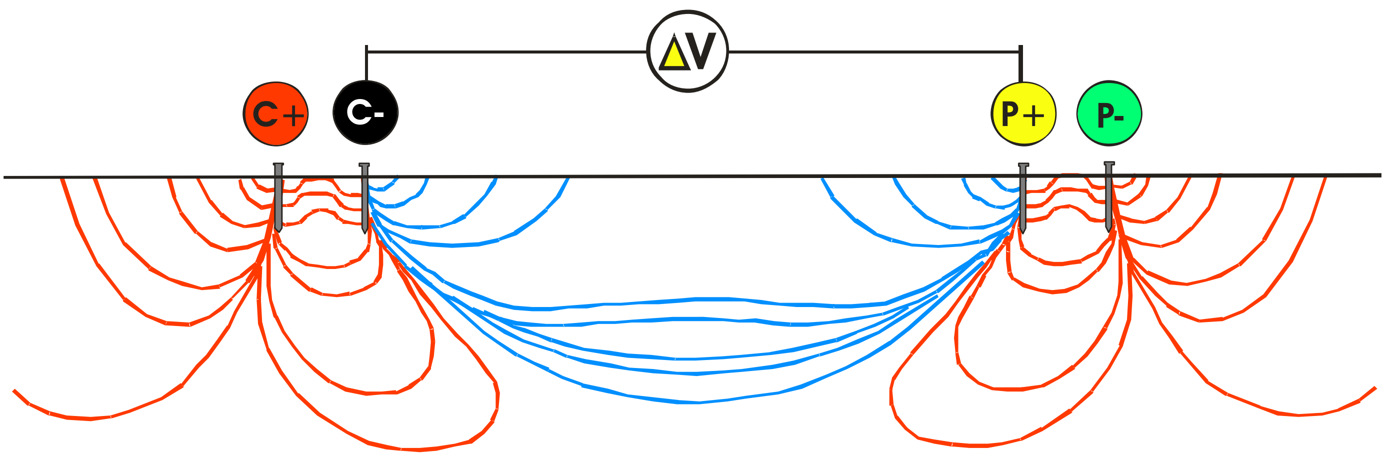
Electric Current Zones (between outer probes)
Electric Voltage Zones and Primary Diagnostic Read Zones (between P+ and P- Probes)

Read Zone Depth: Center = C+ to P+ Spacing X .57
Top = Center X .50
Bottom = Center X 1.60

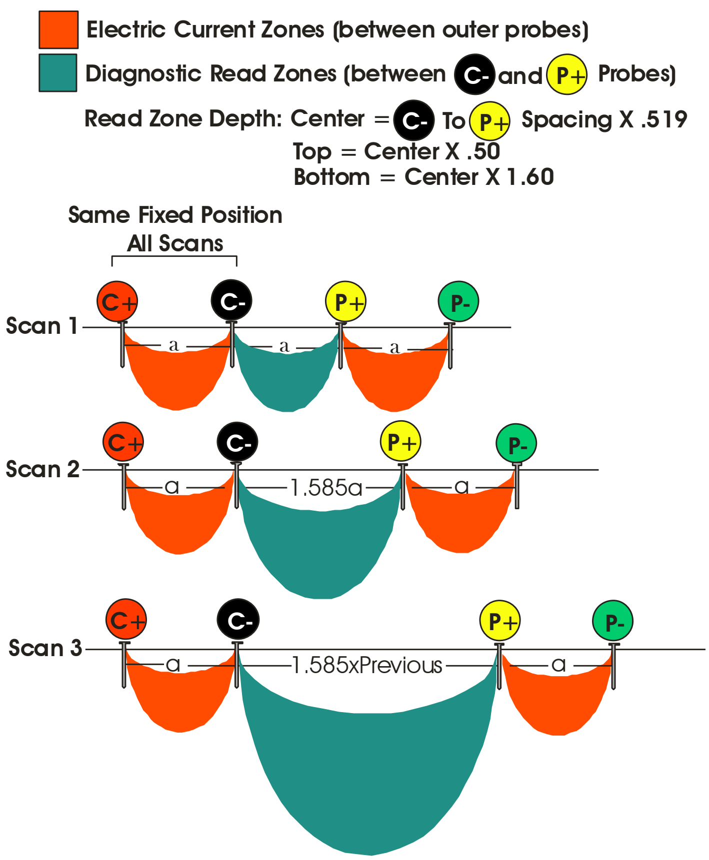


3. Dipole-Dipole Array: Four probes with two current probes (**C+** and **C-**) spaced “a” distance apart. The remaining two probes (**P+** and **P-**) are also initially spaced “a” distance apart---all three initial spacing of probes is equal---all in a straight line. The red and black wires are connected to one set of outside probes. The yellow and green wires are connected to the remaining two probes. Multiple test scans should be conducted to determine “normal” ground conditions at various depths. After each scan is completed, only the **P+** and **P-** outside probes are moved farther apart (maintain original positions of **C+** and **C-** probes for all scans). New “a” spacing between **C-**, **P+** and **P-** for subsequent scans is determined by a by a factor of 1.585X previous spread and a new scan is conducted. **The EZ Res Pro** stores the results of each scan internally, but it is a good idea to manually record the probe spacing and apparent resistivity results of each scan for easy and quick reference. As in any resistivity scan, the search is for noticeable anomalies from “normal”.

Dipole-Dipole Electricity Flow Pattern



DIPOLE-DIPOLE ARRAY



E. Battery Replacement

Remove four battery compartment screws and cover to expose batteries.

Caution:

1. **Do not replace batteries around flammable products.**
2. **Do not replace batteries with FUNCTION switch out of OFF position.**
3. **Observe correct battery polarity.**
4. **Use only high quality alkaline batteries.**
5. **Remove depleted batteries and install new batteries.**
6. **Replace battery cover and re-tighten screws.**
7. **Reinstall four colored plugs into correspondingly colored sockets in top of main unit.**
8. **Reinstall main unit into cut-out in face plate of protective case.**