# Investigation into the Assertion that Apparent Resistance remains Constant with Probe Spacing

**eLB001-001**
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**Background:** Initial test using scale models are useful in determining general principles. Further tests in the field will confirm the relevance or otherwise to longer distance ECC communication paths. The idea for this came from discussions with G0KZZ.

**Aim:**

To determine the behaviour of the apparent resistance between probes as a function of probe spacing.

**Equipment:**

- DVM and test leads
- Plastic round wash dish (approximately 30cm in diameter and 15cm in depth)

**Method:**

- Fill plastic wash dish to ¾ with ordinary tap water (suggest avoiding rain water because of lack of impurities)
- Measure resistance using ordinary test DVM test leads at various spacing between probes

**Results:**

1. When the test probes were immersed in the water with a spacing of 1cm the resistance was found to be approximately 140Kohms. Moving the test probes around the wash dish while keeping the test probe spacing at 1cm showed little variation (approx. ±1K).
2. Varying the test probe spacing from 1cm to 20cm showed slightly more variation (approx. ±3K).
3. Bringing the test probes closer than about 1cm (about the same as the immersed length of the test probes) showed a drop in resistance (approx. 132Kohms).
4. The above measurements were taken with the ~1cm of test probe metal immersed in the water. Slowly withdrawing the probes showed an increase in the resistance reading (up to approx. 1.5Mohms) when just the tips of the test probes were in the water.
5. Adding a small pinch of common salt to the water caused the resistance to drop to approx. 56Kohms for the fully immersed test probe configuration.

**Discussion:**

**Result 1.** The measurement of 140Kohms in Result 1. above would likely be different to the resistance result for water of a different origin (dependent on the level of dissolved salts and other impurities).

**Result 2.** The small variation in resistance (±3K is approx. ±2% of 140K) with a large variation in probe spacing (20:1) is consistent with expected results where resistance is largely independent of probe spacing (for a homogeneous medium).

**Result 3.** The drop in resistance when the probe spacing is roughly the same or smaller as the probe length is probably because the distribution of current lines is not fanning out from a point source as the dimension of the probe is comparable with the distance between the probes.

**Result 4.** The increase in resistance when the immersed surface area of the the test probes is reduced shows the importance of getting a good contact with the medium to achieve low resistance to maximise the current between the probes.

**Result 5.** The addition of salt to increase the conductivity of the water had a marked effect on the apparent resistance.

**Conclusion:**

The wash dish simulation of the earth showed a relatively constant value of resistance between probes for a spacing variation of 20:1. However, the surface area of the probe had a direct effect on the resistance (with less surface area causing high resistance readings).

Although these tests seem to confirm the assertion that apparent resistance between probes is largely independent with distance it should be remembered that these tests were done using a homogeneous medium and different results are expected where spacings cover areas where the medium is not homogeneous.

The resistivity of the medium and probe effectiveness (as far as providing a good contact with the medium) are the main factors in determining the apparent resistance between probes – not probe spacing.