

How Electric and Magnetic Fields are Measured

Electric and magnetic fields are measured using metallic antennas. Electric fields (remember, these are open lines that travel from positive to negative charges) are picked up by straight antennas, which are oriented parallel to the electric field lines. These straight antennas have a space in the middle that is left open to create a measurable voltage difference. An example is shown in Figure 1. This miniature electric field probe antenna was designed for assessment of compliance of electromagnetic devices with RF exposure guidelines. (Smith, 1983) Measurement of this value is difficult, because it requires measuring the localized electric field. Large metal objects (such as a measurement antenna) perturb the fields. This small dipole antenna was specifically designed to receive the localized fields being measured without perturbing them. Because this probe is inherently sensitive to the direction (polarization) of the electric field, three perpendicular probes are used in practice, as shown in the SPEAG probe in Figure 2. Each probe picks up the electric field parallel to its major axis. The three perpendicular electric field vectors can be measured independently or combined to give total electric field.

The magnetic field has closed field lines. These are picked up using a loop antenna. The loop is oriented so that the magnetic field line passes through the loop. As with the electric field, three separate perpendicular loops can be used to pick up the three components of the magnetic field, as shown in Figure 2.

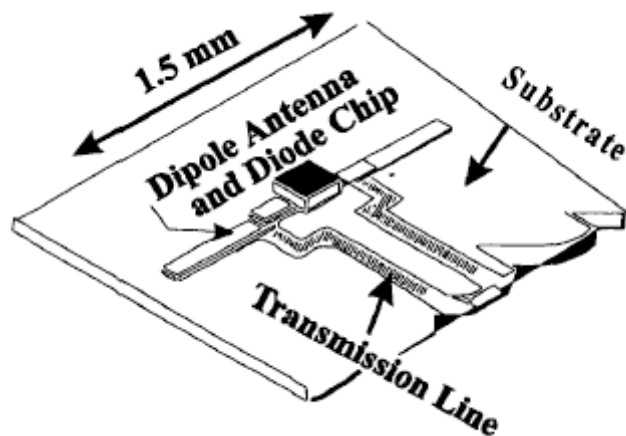


Figure 1 Miniature Printed Dipole Antenna for measurement of electric fields to determine cell phone RF exposure compliance. (from (Smith, 1983) © 1983 IEEE)

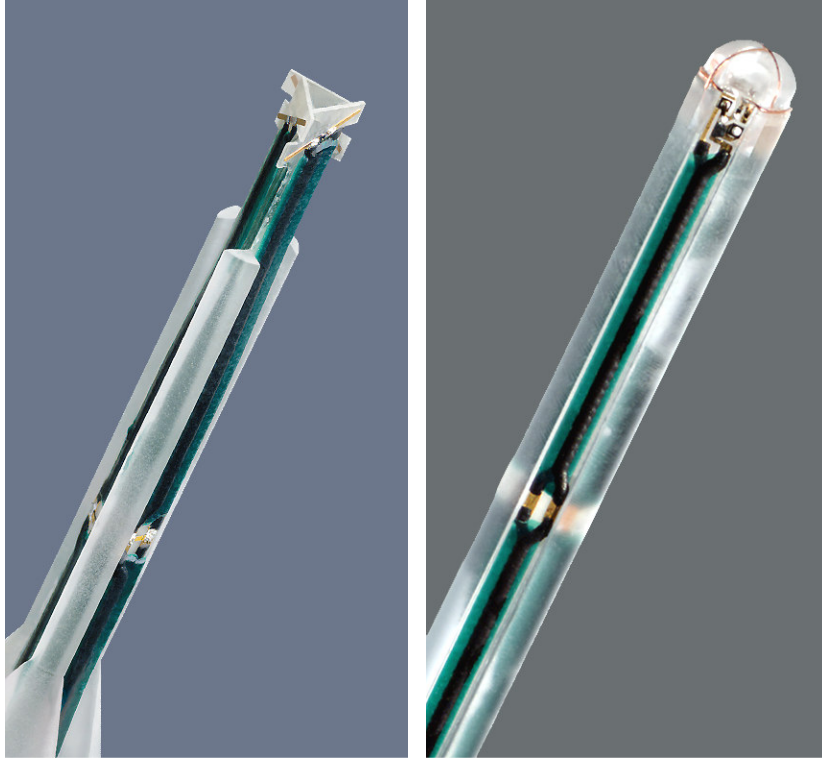


Figure 2 Electric and Magnetic Field Probes from SPEAG (reprinted with permission, Schmid & Partner Engineering AG, Zurich)

This application note is from: C.M.Furse, "Antennas for Medical Applications," Antenna Engineering Handbook, John Volakis, editor, 2006

References:

Smith, H. B. (1983). "Electric Field Probes-A Review", IEEE Transactions on Antennas and Propagation. *AP-31* (5).