Capacitor Theory Update (supercedes previous Reciprocal System work on capacitors)

by
Ronald W. Satz, Ph.D.
Transpower Corporation

The dimensions of electric and magnetic dimensions can be confusing at times. In the Reciprocal System, the dimension of capacitance has previously been expressed as

$$C_{RS} := s \tag{1a}$$

This is the same as for the cgs system of units. But this now appears to be incorrect. Capacitance is defined for a parallel plate capacitor as the dielectric constant (of the dielectric between the plates) times the area of one of the plates, divided by the plate separation. In cgs, the dielectric constant is a pure number, whereas in the Reciprocal System the dimensions of permittivity are s^2/t and must be included. Therefore, the revised dimensions for capacitance are

$$C_{RS} := \frac{s^3}{t} \tag{1b}$$

Conventional theory (see Ref. [3], p. 25) defines the farad in such a way that it too has the dimensions s^3/t:

$$C_{conv} := s^{-2} \cdot m^{-1} \cdot t^4 \cdot i^2 \qquad \text{farad\_Q} \tag{2a}$$

(p. 25 of Ref. [3]). In Reciprocal System space-time terms:

$$C_{conv} := s^{-2} \cdot \left(\frac{t^3}{s^3}\right)^{-1} \cdot t^4 \cdot \left(\frac{s}{t}\right)^2 \rightarrow \qquad \text{farad} \tag{2b}$$

For a DC RC electrical circuit, the experimental value of the time constant (for all types of capacitors) is

$$\tau := R \cdot C \qquad (3a)$$

where the SI units are seconds, ohms, and farads. In Reciprocal System space-time terms, this is

$$\tau := \frac{t^2}{s^3} \cdot \frac{s^3}{t} \qquad \tau := t \qquad (3b)$$

A few portions of Ref. [1] and [2] will have to be reworked, accordingly.

06/09/2012, last updated 06/09/2012

References

[1] R. Satz, "Theory of the Capacitor," http://transpower.wordpress.com, 04/13/2010.

[2] R. Satz, "Theory of Dielectrics, Diamagnets, Paramagnets, and Ferromagnets, including the Calculation of Electric and Magnetic Susceptibilities," http://transpower.wordpress.com, 10/31/2011.

[3] A. Cox, ed., *Allen's Astrophysical Quantities*, *4th Ed.* (New York, NY: Springer Science).