A second look at the dimensional problems of capacitance (July 2026)

Conventional belief is that capacitance is equivalent to a spatial quantity, and is therefore measured in centimeters. Its space/time dimension would therefore be s/1. But there are instances in electrical formulas where this dimension produces invalid results, namely: the RC time constant, impedance (Z) calculations involving inductance and capacitance, capacitive reactance (X_c), delay line interval with lumped L and C, and Q for series and parallel circuits.

These formulas may include inductance, and so to resolve this problem we must first examine the space/time dimensions of inductance, which is believed to be t^3/s^3. We will use this dimension in the well-known electrical formulas that use inductance, but not capacitance.

Presumed units

Frequency	[=]	1/t	Hertz	f
Inductance	[=]	t^3/s^3	Henry	L
Resistance	[=]	t^2/s^3	Ohms	R
Reactance	[=]	t^2/s^3	Ohms	X
Impedance	[=]	t^2/s^3	Ohms	Z
Current	[=]	s/t	amperes	i, I, A
Voltage	[=]	t/s^2	volts	V
Magnetic flux	[=]	t^2/s^2	Maxwell	ϕ
Q	[=]	1/1	ratio of reactance to resistance. (dimensionless)	
Time	[=]	t	seconds	t, t, t_d

Equations that are relevant to ***Inductance*** dimension

Inductance is magnetic flux divided by current:	**Energy stored in an inductor**	**Voltage across an inductor with changing current**
$L = \frac{\phi}{I}$ $= \frac{t^2}{s^2} \cdot \frac{t^1}{s^1}$ $= \frac{t^3}{s^3}$	$E = \frac{1}{2}Li^2$ t/s [=?] $(t^3/s^3)(s^2/t^2)$ t/s [=] t/s	$V = Ldi/dt$ t/s^2 [=?] $(t^3/s^3)(s/t)(1/t)$ t/s^2 [=] t/s^2

Time constant for inductance + resistance	Inductive reactance (Xl)	
t = L/R t [=?] $(t^3/s^3)(s^3/t^2)$ t [=] t	$X_l = 2\pi fL$ t^2/s^3 [=?] (1/t) (t^3/s^3) t^2/s^3 [=] t^2/s^3	

Equations that are relevant to ***Capacitance*** dimensions

The following equations *use* ***s^3/t*** *instead of* ***s*** for the space/time dimension of capacitance. This consistently produces dimensionally consistent results.

Time constant for an RC circuit	Time delay of an artificial transmission line	Capacitive reactance
$t = RC$ $t\left[=?\right]\frac{t^2}{s^3}\frac{s^3}{t^1}$ $t\left[=\right]t$	$t = \sqrt{L \cdot C}$ $t\left[=?\right]\sqrt{\frac{t^3}{s^3}\cdot\frac{s^3}{t}}$ $t\left[=\right]t$	$Xc = \frac{1}{2\pi f\,C}$ $\frac{t^2}{s^3}\left[=?\right]\frac{1}{\frac{1}{t}\ \frac{s3}{t}}$ $\frac{t^2}{s^3}\left[=\right]\frac{t^2}{s^3}$
Q of series RLC	**Q of parallel RLC**	**Frequency of resonance for LC circuit**
$Qseries = \frac{1}{R}\sqrt{\frac{L}{C}}$ $\frac{1}{1}\left[=?\right]\frac{1}{\frac{t^2}{s^3}}\sqrt{\frac{t^3}{s^3}\frac{t^1}{s^3}}$ $\frac{1}{1}\left[=?\right]\frac{s^3}{t^2}\sqrt{\frac{t^4}{s^6}}$ $\frac{1}{1}\left[=\right]\frac{1}{1}$	$Qparallel = R\sqrt{\frac{C}{L}}$ $\frac{1}{1}\left[=?\right]\frac{t^2}{s^3}\sqrt{\frac{s^3}{t^1}\frac{s^3}{t^3}}$ $\left[=?\right]= \frac{t^2}{s^3}\frac{s^3}{t^2}$ $\frac{1}{1}\left[=\right]\frac{1}{1}$	$f_r = \frac{1}{2\pi\sqrt{LC}}$ $\frac{1}{t}\left[=?\right]\frac{1}{\sqrt{\frac{t^3}{s^3}\frac{s^3}{t^1}}} = \frac{1}{t^1}$ $\frac{1}{t}\left[=\right]\frac{1}{t}$

Impedance of a series LC circuit	**Current through a capacitor**	
$Z = \sqrt{\frac{L}{C}}$ $\frac{t^2}{s^3}\,[=?]\,\sqrt{\frac{\frac{t^3}{s^3}}{\frac{s^3}{t^1}}} = \sqrt{\frac{t^3}{s^3}\cdot\frac{t^1}{s^3}}$ $\frac{t^2}{s^3}\,[=]\,\frac{t^2}{s^3}$	$i = C\frac{dv}{dt}$ $\frac{s}{t}\,[=?]\,\frac{s^3}{t}\,\frac{t}{s^2}\,\frac{1}{t}$ $\frac{s}{t}\,[=]\,\frac{s}{t}$	

Capacitance is consistently s^3/t which, interestingly, is the inverse of electric field intensity (t/s^3, measured in volts/centimeter).

And regarding the above problem with charge:

Charge = CV
[=] $(s^3/t)(t/s^2)$
[=] s

There is still a problem. Charge is scalar. And so a *t* in the numerator would be expected. But the *s* could also be interpreted as a “quantity” in which case it could be just *s*.