Re: Capacitors & conservation of charge

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- *From*: cabraham01@xxxxxxx
- *Date*: Thu, 11 Sep 2008 10:44:02 −0700 (PDT)

On Sep 1, 12:41 pm, exxos...@xxxxxxxxxxx wrote:

> Hi all,
>
> While messing with buck/boost circuits I had some thoughts which don't
> hold up in real tests....
>
> A simple example (aside from losses) is that if transfer energy from
> say 10V 10uF into 1uF the voltage will increase to preserve the
> charge.
>
> Now, in my circuit, I charge 25V 1,000uF capacitor and charge a 10uH
> inductor. When the switch turns off, all the energy should be in the
> 10uH inductance. So if I have a 100pF capacitor, then the voltage
> should be like 100,000volts according to my workings out.
>
> Now I ran a computer simulation on this, at best I can only obtain
> 12KV on the 100pF. So most of the energy is lost in switching losses I
> assume.
>
> In realworld tests, I end up with less voltage than I started out
> with, So I am trying to find out why ?
>
> I know charging 22uH inductor at 100khz can be used as a buck/boost
> supply, I built a simple 12V to 30V inverter, can switch 10amps
> easily. Though I am not running at 100khz, only 100hz. Though the
> current pulse rises to something like 500amps over 500uS.
>
> I am not sure I follow all this exactly, Or even if it will work ?
> AFAIK, The longer a inductor has current pumped across it the more
> charge it obtains over time. So at turn off, all the energy given to a
> coil is recovered. It works well, even with my simple buck/boost
> circuit.
>
> So I am slightly confused as to why pushing 500A into a coil has no
> effect. I can only assume I have a huge loss somewhere, Or I do not
> follow the idea correctly ?
>
> Cheers,

Chris

You need to aquaint yourself with the buck−boost topology and theory of its operation. If you go to TI's web site and download their buck−boost app note no. SLVA059, studying this thoroughly, you will understand why.

In a nutshell, the 1000 uf input capacitor did not transfer ALL of its energy to the inductor. The output voltage is related to the input voltage and the duty cycle as follows:

Vout = Vin * (D/(1−D)) not accounting for losses.

The energy transferred to the inductor is half the inductance times the difference between the square of the final current and square of the original current. This is determined by the voltage across said inductor multiplied by the on time. During the power switch off time, the volt−seconds must equal that of the on time. The app note covers this. The value of the input capacitor does not determine the output voltage. The same goes for the output cap value. The values of both caps, however, are important regarding ripple. noise, and transient response.

Did I help? BR.
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