

Re: power supply issue

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- *From:* John Fields <jfields@xxxxxxxxxxxxxxxxxxxxxx>
 - *Date:* Tue, 03 May 2005 13:03:42 -0500
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>"Anders Nesheim Vinje" <a-vinje@xxxxxxxxxx> wrote in message
>[news:7RMde.8637\\$ai7.208762@xxxxxxxxxxxxxxxxxxxxx](mailto:news:7RMde.8637$ai7.208762@xxxxxxxxxxxxxxxxxxxxx)
>> Hi.
>> I have built this dual power supply.
>> Transformer rating: 2 x 24 V 60VA
>> Pretty standard with a bridge rectifier and ground connected to the center
>> tap. So i got + 24 and -24.
>> The i have two 4700uF 50v caps, one connected at each powerline to provide
>> filtering. Then there is a 7815 and and a 7915 as regulators.
>> Ok here is the issue. When i measure the voltage over the filtercaps i see
>> +37,5V and - 37,5V! How is this remotly possible?. Even the peak to peak
>> voltage isent that high. The 7815 and 7915 is only rated up to 35V so i am
>> scared they might blow or something.

With good reason.

Since each of the supplies is connected to the transformer as a full-wave center-tapped supply, the rectifiers will only drop about 0.7V in front of the filters, so with 27VRMS into the rectifiers the peak voltage (the voltage across each filter cap) will be:

$$V_p = (V_{rms} * \sqrt{2}) - 0.7V = 37.7V$$

Which is pretty close to what you got.

>> Another problem is that since there is a voltage drop 37.5 - 15 = 22 V over
>> the regulators. It cant provide much current before they shut down
>> because of the heat. I know from the datasheet they can handle up to 10W
>> with a decent heatsink and a max current of 1,5A. I dont need that much
>> current anyway since the transformer can only deliver 30VA / 24 = 1,25A
>> per secondary anyway.
>> I have another question too. How much current goes through the primary
>> side of the transformer with max load? I was thinking of having a fuse
>> there instead of buying a fuse to each of the secondary outputs.

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Since a transformer transfers power and the secondary can deliver:

$$P = IE = 1.25A * 24V = 30 \text{ watts}$$

into a resistive load, then the primary will need to take 30 watts from the mains in order to transfer that into the load.

Then, since:

$$P = IE$$

we can rearrange to solve for the primary current:

$$I = \frac{P}{E} = \frac{30W}{120V} = 0.25A$$

for 120VRMS mains.

Assuming your transformer is 80% efficient means that the mains will have to supply extra current to compensate for the transformer's losses, so that means you'll need to draw about

$$I_t = \frac{0.25A}{0.8} \sim 0.31 \text{ amperes}$$

from 120V mains.

- >I took a new measurement and found out the the ac value was acutally 27V not >24. So when i muliply with the square of two i roughly get 37,5V peak to >peak.
- >But why do i see the peak to peak voltage after it has been rectified???
- >Even with load 40ohms load.

Unless you're measuring the difference in voltage between the filter caps you're not measuring peak-to-peak, you're measuring peak.

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You don't say whether the load is across the filter cap or across the output of the regulator but, assuming it's across the filter cap, the current through the resistor will be

$$I = \frac{E}{R} = \frac{37.7V}{40R} \sim 0.94 \text{ amperes}$$

This will cause the voltage across the filter to vary as it charges up through the rectifier and discharge when the voltage out of the rectifier falls below the voltage on the cap. This voltage change is called 'ripple', and its amplitude varies with the load current, like this:

$$dV = \frac{I \, dt}{C}$$

where dV is the ripple voltage in volts,
I is the load current in amperes,
dt is the ripple period in seconds, and
C is the capacitance in farads

So,

$$dV = \frac{0.94A * 8.3E-3s}{4.7E-3F} = 1.66 \text{ volts}$$

That means that that the caps could charge up to 37.7V, but that that voltage would fall to about 36V when the rectifier output fell to lower than that. Your DC voltmeter would probably read the average of those two voltages, about 36.8V, so you probably wouldn't even notice the difference between loaded and unloaded unless you were intent on noticing it.

If the 40 ohm load was connected across the output of a regulator, the current would be:

$$I = \frac{15V}{40R} = 0.375A$$

and the ripple voltage would fall to:

$$\begin{aligned} &0.375\text{A} * 8.3\text{E-}3\text{s} \\ \text{dV} = \frac{\quad}{4.7\text{E-}3\text{F}} &\sim 0.66 \text{ volts} \end{aligned}$$

so you'd probably be even less likely to notice that difference.

There are a few more problems to consider, but in order to do that we need to know what your maximum load current is going to look like.

—
John Fields
Professional Circuit Designer
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• **References:**

- ◆ **power supply issue**
 - ◇ *From: Anders Nesheim Vinje*
- ◆ **Re: power supply issue**
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