

Re: Quest for the simplest zero voltage switching

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- *From:* MooseFET <kensmith@xxxxxxxx>
  - *Date:* Mon, 13 Aug 2007 18:04:42 -0700
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On Aug 13, 4:21 pm, "petrus bitbyter"  
<pieterkraltlaatdit...@xxxxxxxxxxxxxxxx> wrote:

"MooseFET" <kensm...@xxxxxxxx> schreef in  
bericht[news:1187014014.937032.70700@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx](mailto:news:1187014014.937032.70700@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx)

On Aug 12, 3:58 pm, "petrus bitbyter"  
<pieterkraltlaatdit...@xxxxxxxxxxxxxxxx> wrote:

"JoeyB" <joseph.bur...@xxxxxx> schreef in  
bericht[news:1186924269.912470.58160@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx](mailto:news:1186924269.912470.58160@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx)

All,

I'd like to do proportional control on a 120VAC, 1.5kw heating element (capacitive load) as simple as is possible. Ideally, I'd like to have a single pot that I could adjust from zero to one hundred percent duty cycle input to a zero voltage switching controller chip. This ZVS controller chip would then control the Triac switching the load. I've found several chips out there that provide zero voltage switching but only one that DIDN'T require a dc voltage for operation AND simply allowed a pot to be connected to the control pins, the Motorola CA3059. Or at least, it was the only one that had a circuit in the

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data sheet showing such a configuration. Unfortunately, its discontinued and I cannot find any suitable substitute for its operation. The MOC3081 seems like a possibility however it requires a digital input control. This would mean some kind of timer circuit (again DC would probably be required) unless I'm missing some obvious passive solution to providing this input. Any help from the power circuit design pro's out there would be greatly appreciated.

The most simple zero cross switching can be obtained by buying a solid state relay with a built in zero cross switch. Building a timer to control it will be a little bit harder. I ever build one using a classic 555 with a stereo potmeter and some other passives and diodes. The 555 was used in astable mode and set to about 10Hz. The potmeter controlled the duty cycle from about 1 to 100%. As the zero cross switch only switched on zero voltage, I could control power by the half cycle. Unfortunately I had to add a small power supply. The old 555 required 10–15mA at 15V and the solid state relay added another 5mA. Using a resistor directly from the mains would have made me to get rid of over 3W heat (220–230V/50Hz mains). As you have only 120V mains and can use a CMOS 555, powering via a series resistor will not be difficult.

Nevertheless, these days I'd go for a PIC10F200 and a normal 10k linear potmeter

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to build the timer. With one or two extra components and a little effort you can build the zero crossing switch into it as well.

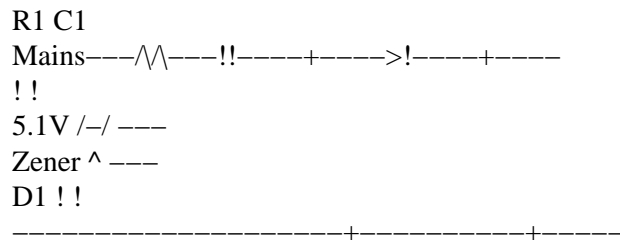
I think if you move up that product line just a bit you will do a little better. You want a comparator to do the zero crossing and a ADC to read the pot. You don't really need the PWM stuff because 60Hz is so low you can count off the cycles in a loop.

The PIC's output isn't quite strong enough to trigger a triac so an external (gasp) transistor would be needed.

The PIC's ADC uses the supply voltage as a reference. If the pot used the supply as its input, the value of Vcc drops out.

Since you are counting cycles of the mains, the RC clock of the PIC is more than good enough.

The total current draw of the control circuit would only be several mA at the most. Power can be done like this:



The ratings of R1 and D1 are mostly set by the turn on inrush. Once the circuit is up and going most of the mains drop is on C1.

You will need a relative good 5V power supply.

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I don't see why. The PIC doesn't need one, the pot doesn't need one and the SCR trigger doesn't need one.

I'd use two 1W series resistors (to dissipate 1W), a 10V zener and a 7805 type stabilizer.

Why would you want to waste all that power and use all those parts. If you really do need a better supply, you can raise the 5.1V zener to a 6.8V zener and use a regulator but I really don't see where the need comes from.

Plus, of course, some capacitors. The PIC I mentioned requires less than 0.5mA @4MHz. Add another half for the potmeter and 5mA to drive the SSR.

If you use a triac, you need far less average current. The PIC only needs to make the output high long enough to trigger it.

It's good to add some margin but an 8mA power supply will be enough.

Remember your LM7805 is eating about 5mA. You need to provide for that too.

The PIC can also sink the 5mA required to drive the SSR directly. (If you want to use a triac, things change of course). The PIC also has an 8 bits ADC so you can read the potmeter.

If commented on the fact that there is an ADC. You will also see that I pointed out that the ADC and the POT both use the supply as a reference so the exact value of the supply voltage drops out of the equations.

Using the 5V power supply will not give a problem. (Not in the appliance I'm currently building anyway.) Only if your SSR has no zero cross switch build in, you'll need some extra components to produce a zero crossing pulse for the PIC to do the zero cross switching.

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You don't need a "zero crossing pulse". You only need a divided down copy of the AC waveform. The PICs have comparitors in them. You just need to use one comparitor to detect the zero crossing.

petrus bitbyter