# Re: Quest for the simplest zero voltage switching

***Source:*** http://sci.tech−archive.net/Archive/sci.electronics.design/2007−08/msg02778.html

- *From*: "petrus bitbyter" <pieterkraltlaatditweg@xxxxxxxxxxxxxxxxx>
- *Date*: Tue, 14 Aug 2007 12:44:04 +0200

"MooseFET" <kensmith@xxxxxxxxx> schreef in bericht
news:1187053482.282841.143630@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

> On Aug 13, 4:21 pm, "petrus bitbyter"
> <pieterkraltlaatdit...@xxxxxxxxxxxxxxxxx> wrote:
>
> > "MooseFET" <kensm...@xxxxxxxxx> schreef in
> > berichtnews:1187014014.937032.70700@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
>
> > > On Aug 12, 3:58 pm, "petrus bitbyter"
> > > <pieterkraltlaatdit...@xxxxxxxxxxxxxxxxx> wrote:
> > >
> > > > "JoeyB" <joseph.bur...@xxxxxx> schreef in
> > > > berichtnews:1186924269.912470.58160@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
> > >
> > > > > 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 swiching
> 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
> 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
> digitial 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 build in zero cross switch.
Building a timer to controll
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 controll 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, this days I'd go for a
> PIC10F200 and a normal 10k lin
> potmeter
> 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.

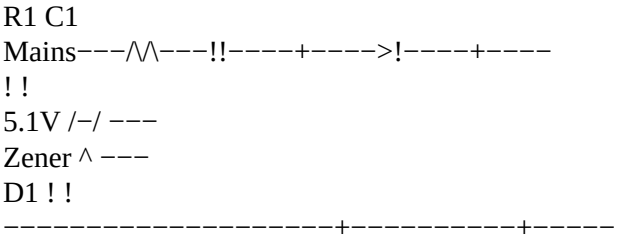
I think if you move up that product line just a bit you will do
a
little better. You want a comparitor to do the zero crossing
and a
ADC to read the pot. You don't really need the PWM stuf
because 60Hz
is so low you can count off the cycles in a loop.

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.

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.

Maybe you're right. I tend to stay on the safe side.

> 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.

Maybe you're right too. But I've had some bad experiences using series capacitors for current limiting on the 220−230V mains.

> Plus,
> of course, some capacitors. The PIC I mentioned requires less then 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.

Depends heavily on the triac. Some types require 50mA, and − as you say − the trigger pulse needs to last long enough. It has been some time now but I had problems with trigger pulse duration. Don't remember the required pulse length anymore.

The same applies for the SSR. If you use one with build in zero cross switch, the PIC does not need to look for the zero crossing at the cost of some energy.

> 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.

You're right. I used some low quiscent current types (three leg, not 78xx) lately but the standard 78xx series needs that current so it has to be taken into account.

> 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.

You're right again. I misunderstood.

> Using the 5V power supply wil 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.

> 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.

That small PICs have either a comparator or ADCs, not both. But speaking about the PIC10F222, it has two ADCs so you can use one to look after the mains phase.

> petrus bitbyter

BTW. Re−reading the posts I see I mentioned the PIC10F200 in my first reply. Should be PIC10F222 as the 10F200 has no ADCs. Sorry for that.

petrus bitbyter

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