Re: IGBTs are pretty fast

Source: http://sci.tech−archive.net/Archive/sci.electronics.design/2006−02/msg01799.html

- *From*: Terry Given <my_name@xxxxxxxx>
- *Date*: Thu, 09 Feb 2006 19:52:37 +1300

Tim Williams wrote:

> "Terry Given" <my_name@xxxxxxxx> wrote in message
> news:1139452184.934258@xxxxxxxxxx
>
> > Screwdrivers aren't part of the design equation, you're
> > changing the
> > conditions! ;−)
>
> what, too chicken to try it? why not, you seem to like your gatedrive
> construction....

Hum...

LOL. I should take a picture of... no heck, take a video, of me dropping a screwdriver on the circuit, with the scope watching gate drive outputs and watching what happens.

Probably end up something like shorted power supply, or the signal just stops, or something. If I were to do this, I'd be more worried about the voltage regulators letting out smoke than anything else... simply because nothing else is designed to push as much current.

Oh− FYI, the breadboard itself is actually in pretty good condition. Nice and stout springs, not even any melted holes! (yet)

> > a pulse could cause a
> > comparator to switch early, but only when it's about to
> > switch anyway.
>
> how do you know that?

> It would've done it by now? Idunno.

QED

> How could I prove it either way? Lesse, I could use an air core coil say
> 10" dia. for the series matching inductor, and wave the board through it.
>
> That should induce a pretty sick current in anything of note, eh?

you raise a very good point − just how do you "know" that this is happening. self−interference can be devilishly hard to measure. The only sure−fire way I have found is with making changes and observing problems disappear; reverse the change, watch the problem come back. repeat until convinced.

then examine the root cause of the problem, and resolve never to do it again.

> > you blew up the igbts without breaking the gatedrivers? thats a good
> > trick, normally the collector shorts across to the gate
>
> Ya tell me about it... that's why my BK 3026 needs a fix... :−o

> > you obviously dont understand my point.
>
> No I understand your concern, I just don't really see it happening in near
> probability (I can see you worried about once−in−a−decade events, like
> dropping a screwdriver on something ordinarily sealed in a chassis, but to
> me that's a freak accident and I certainly don't mind the down time fixing
> the circuit, sans expensive transistors of course).

sooner or later, it will happen with your gatedrive − it may have already, there isnt really any way of telling.

heres a wee tale − it involves a gatedrive design for a 20−drive product range. we never tested it with the biggest IGBT, and it lacked a bit of grunt. the poor gatedrive increased losses enough that the drive would die

after 2 hours on soak test, so we didnt release the larger drives, and went back to the drawing board. time was short, so when we got a proto pcb laid out, our CEO went and ordered 1500, rather than the 10 we would have got. Sure enough, there was one mistake − 2 pins of a comparator were swapped. So we lifted a leg on a SOIC8, added a few dangly wires and off we went.

except the damn drive blew up after a couple hours on soak.

re−build
re−test
re−sounding bang.
re−peat, with teeth a−gnashing

eventually we tracked the problem down − an intermittent connection *within* the LM393. a heat gun could make the gate drive turn itself off and on − the pin concerned was the reference voltage against which the isolated gatedrive signal was compared. looks like we damaged the bond wire bending the leg. perhaps 10 times in a row (over a period of several days) using new chips each time. Hmm.

so we re−did the layout, the circuit worked perfectly, and has never been changed since then (although about 50,000 drives have been made, so 300,000 copies of that circuit).

a few weeks later, the CEO lambasted my manager for "wasting so much money on prototype pcbs" :)

> fancy pushing on some of the proto−board wires while its running? no?
> why not?

> Eh? I don't get you. Of course I push on wires, being a low voltage
> circuit I often twiddle wires and resistors and capacitors while live. As
> long as the high and low power sections are seperate I can develop then
> test, in that order. If there were scratchy contacts, I would've tracked
> them down by now.

I've learned to stay the hell away when its running, and fiddle with nothing. I also bite people who approach carrying cups of coffee etc.

> why not think about it from a risk management perspective? them IGBTs
> aint cheap, it should behoove one to try not to break them.

> Well, yeah...but that doesn't change the measured fact that the gate drive

> works (in lieu of catastrophic mechanical climate change, so to speak ;),
> and pretty reasonably for an LM393 and five 2N440x transistors. I have
> fault protection, albeit rudimentary (local desat would be better, but I
> would have to have three−way communication to shut down high side, low side
> drive and oscillator sections when either drive poops, plus reset them all).
> The only question remaining is mechanical rigidity (perhaps I didn't
> articulate this, but obviously this breadboard isn't permanent, it will be
> soldered some day −− when the circuit becomes *set in stone* mind you) and
> RFI concerns, which I have so far seen few symptoms of.

I'd consider it blowing up to be a symptom.

> > I can do point−to−point wiring on perfboard, or a step up
> > from that, the
> > perfboard RS sells that has individual copper pads. This
> > doesn't lend
> > itself to ground plane technique very easily.
>
> it does if you sit it on top of a ground plane.

> Pointy underside bits with voltage don't really like flat conductors. I
> don't know what kind of an insulator you would recommend there, besides
> distance, which in that case I would call it shielding (like those tin cans
> on various TV and monitor boards) more than a ground plane.

sidecutters, and flip the PCB over so the Cu side faces away from the rest.

its easier if you just learn how to assemble circuits on top of Cu−clad PCB. google manhattan method, there is a nice PDF and some truly lovely examples to look at.

> Speaking of shielding, the whole thing (if possible) will be inside a mild
> steel box or two, which should control coil EMI and switching noise
> reasonably. Plus a line filter..

if done properly.

> I dont do those things either, I build circuits on top of a piece of
> copper−clad board. some chips end up upside down, others dont. go read
> the two books edited by Jim Williams, and/or some of the analog devices
> & linear tech app notes on how to build a decent prototype.
>
> with a bit of practice, its no slower than using proto−boards.

BUT IT'S SOOOO FUCKING UGLY!

what, you think that POS proto−board isnt ugly?

besides, what self−respecting engineer trades functionality for aesthetics?

> Alright, let me put it this way. If plane practice is better...
> ...Why does everything I take apart have printed circuit boards?
> Production aside.

several reasons. Firstly, most of what you dismember isnt a whopping great piece of power electronics. pull a few of them apart....

PCBs can have ground planes too.

most consumer gear is incredibly cost−competitive (HTF does one make a DVD player that retails for NZ$48 ?!), which is why they use the cheapest, nastiest PCBs known to man (single−sided phenolic paper, with many machine−inserted links). and a team of engineers to ensure the damn thing passes EMI (but only just, thats enough)

a lot of consumer gear just doesnt work very well. its not uncommon to buy things that dont work at all, and nobody is suprised when mall−wart stuff falls to bits....

power electronics is nasty stuff, and is what generates the EMI that designers must work around.

also, if you know exactly what you are doing, ground planes are not mandatory. its just that they make life SO EASY....

> I'm not trying to attack your point of view, that's absurd− you're literally
> in the business. I'm trying to apply your view to my situation is all.
>
> Tim

I make quite a nice living out of fixing other peoples EMI problems, usually by using a decent ground plane.

one particular job, the PCB was large and a frightening mess. missed EMC by miles, and product regularly went bonkers. the solution: turn the artwork from a 2−layer PCB into a 4−layer PCB. Assign mid1 as 0V, mid2 as +5V. delete all 0V & 5V traces on top and bottom layers. Voila, product now passes. perhaps 2hrs of work. the build volume was very low, so it was cheaper to add $20 to the PCB cost and spend almost no NRE.

Cheers
Terry
.