Re: Transistors

Source: http://sci.tech−archive.net/Archive/sci.electronics.design/2007−11/msg02712.html

- *From*: Winfield Hill <hill@xxxxxxxxxxx>

- *Date*: Sun, 18 Nov 2007 08:50:10 −0800 (PST)

Jim Thompson wrote:

> Winfield wrote:
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> > Jim Thompson wrote:
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> > > John Larkin wrote:
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> > > > Jan Panteltje wrote:
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> > > > > John Larkin wrote...
> > > > >
> > > > > > Yup. THS3062, practically a unique opamp, blinding fast with +−15 supplies. But if it's amplifying a sine wave at, say, 20 volts p−p out, and the frequency goes up to roughly 12 MHz, it crashes, pulls tons of power, gets red hot, and phase

> inverts! If
> you drop
> the input
> signal way
> down, it
> recovers!

> Well, John!!!! the datasheet
> specifies input common
> mode range as
> +−13.9V MAX. Page 3 of
> ths3062.pdf. It is a video
> amp :−)

> We're running these at gains in the 3 to 5
> range, and it does this
> working inverting or non−inverting, loaded
> and unloaded, so it's not a
> common−mode issue. And at 12 MHz, we're
> not even slewing a volt per
> nanosecond yet.

> It crashes and phase inverts in either config!
> It made a nasty blister
> on me poor finger, it did! But the effect
> doesn't seem to be thermal,
> in that freezing it hard doesn't affect the
> frequency trip threshold
> much.

> I note the 2nd Harmonic Distortion rises rapidly around
> 10−20MHz.
> Probably an inadequately stabilized multi−loop that is
> amplitude
> dependent.

I think it's likely another matter, one I've struggled
with in high−frequency high−voltage−amplitude push−pull
amplifiers, namely getting the pullup devices completely
off before the pulldown devices turn on. And visa−versa.

> Actually, it's generally not possible, or even desirable, to completely achieve this goal, but one struggles hard to avoid having too much rail−rail current under these extreme conditions, because various local parts become overheated. I fear too that many high−frequency high−slew−rate amplifier designs don't pay enough attention to this issue and may experience failures as a result.

> I don't think so, not at 12MHz. I'm intimately familiar (not by choice :−) where multipli−intertwined feedback loops present problems, and defy analysis/simulation using existing LoopGain techniques.
>
> Dr. Auggie Ochoa (Zarlink) and I are busily trying to solve this issue.

I'll stick to my theory at 12MHz. Not that I don't think something like you're describing can happen with multiple feedback loops and serious rolloffs and their phase shifts as well as the pure time delays you like to use in your modeling, etc., but I haven't heard evidence for multiple intertwined loops in TI's opamp.

Back to inadequate transistor shutoff, unless the amplifier output stage circuit is operating class A this can be a serious issue. I've struggled with it at 3MHz and 5MHz for modestly−large discrete parts, and I know it's an issue at much higher frequencies for the small transistors in ICs. What's required is separate active perhaps class−A drivers for both the pullup and pulldown transistors, to insure they get at least partially turned off. Sadly one does not often see such pre−driving circuitry where it's so badly needed in high−power high−frequency ICs.

John can do a simple test to evaluate my theory: measure the opamp's rail−rail supply current as a function of high−voltage excursions at the highest frequencies and then as a function of current load under full swings in the same condition. Ideally the opamp should dissipate power only for current delivered to the load, i.e., small voltage drops across the output transistors at the high currents, without any high rail−rail currents in the process.

Looking at the THS3062 datasheet, I don't see any plots for opamp supply current vs frequency for

full−scale output voltage swings. To me this is a
bad sign of a serious issue that's been overlooked.
Check it out, John, and let us know.
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