Re: AC amplitude modulation for inductive loads

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- *From*: "Marcel Baum" <privat@xxxxxxx>
- *Date*: Wed, 24 Oct 2007 18:56:54 +0200

"Joerg" <notthisjoergsch@xxxxxxxxxxxxxxxxxxxxx> schrieb im Newsbeitrag news:mYITi.12158$4V6.8444@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

> Marcel Baum wrote:
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> > "Joerg" <notthisjoergsch@xxxxxxxxxxxxxxxxxxxx> schrieb im Newsbeitrag news:SyrTi.47541$RX.32874@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
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> > > Marcel Baum wrote:
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> > > > "Joerg" <notthisjoergsch@xxxxxxxxxxxxxxxxxxxx> schrieb im Newsbeitrag news:qWoTi.36574$eY.32446@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
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> > > > > Marcel Baum wrote:
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> > > > > > I have got a linear pump which needs a sinusoidal excitation. The pumpflow is controlled by the amplitude of the AC to the coils The amplitude is controlled via a DC input signal which on itself can change very

fast.
So far I have used a 24VAC pump, which is no longer available, the actual pumps have 230VAC (50hz). The rated power is roughly 150W.

My present design is powered from 24V DC and utilises a full (H−) Mosfet bridge. The bridge is controlled by a MC 33035 which is a PWM motor controller with an analogue input and a direction signal. The analogue input gets a sine have wave with variable amplitude, the DIR input sees a 50hz TTL signal in phase with the sinus.

To go on with this design I would have to rectify the 230V, change to a 500V Mosfet bridge and to add some HV photocouplers to feed the hi side Fets of the bridge.

Does anyone have better suggestion how to directly modulate the mains AC instead of synthesising the AC from a DC source?
I probably should mention that the pump wants to see a sinus like (or trapezoid) excitation which limits the use of a triac .

Any ideas are welcome.

> Just to avoid a
> misunderstanding: The
> PWM is usually not done
> with the
> bridge itself. It is done by a
> converter up front and that
> gets the
> sine−wave control signal.
> The H−bridge just switches.

Thank you for your response

The 33035 has got a pwm on chip, the high
side Fet is responsible for
the direction the corresponding low side one
is pulse modulated
according to the actual input voltage.
Its not that expensive here.
Its very much like in the LMD 18245 used
with stepper motors (this one
is really expensive).

> You want to pulse the bridge to get the sine wave and rely on
> the motor
> windings to smooth things out? That can backfire the minute
> the motor
> manufacturer changes the design. Personally I wouldn't do
> that. EMC can
> also become quite a nightmare, as can motor noise.

Its not a common motor. Its a pair of coils with an oscillating permanent magnet assembly in between, which actuates two membrane heads.
I use this circuit since 10 years without any problems.

> Ah, like an electric razor "motor"? Then you should be able to even shield
> the coils if necessary.

Exactly, and the entire drive is capsuled in an alloy cast, which again sits in a larger tight cabinet. And in addition this pump stands in a closed iron box, mainly for noise and safety reasons. If there is any EMI it wouldn't come out of this 3 fold cage.

> What I was thinking about is to use an existing DC−AC converter (e.g. 24VDC to 230VAC) lay out and to add a control input for the output voltage. No idea if this exists already. Have you ever looked into something similar?

Well, they work pretty much like I described. A switcher around a 3525 generates a voltage between zero and the desired peak voltage, usually as a forward converter. Sinusoidal half−waves. Then the bridge toggles that.

> Since this pump is part of a medical life supporting device it has to run on batteries for at least 20 minutes anyway. The most simple way is to run it from a UPS (having its internal batteries), or if not possible use a buffered 24V battery with a DC−AC step up converter.

I design medical devices for a living and running an AC motor at over 50V is usually frowned upon by the agency guys. Are you sure you can't get a 24V version anywhere? Also, nearly none of the parts vendors endorses life support applications but I am pretty sure you know that.

The pumps are not close to the patient and they are mounted totally floating in separate compartments, what counts is their leakage current to ground. Since I have an UPS in front, this will mainly determine the leakage current.
I had 24V pumps so far, but all the far east manufacturers of this pump principle stopped the production for this supply voltage. Manufacturers in far east are not that restrictive when applying their products in LSS.

I have 3 pumps in my system, it would be an awful lot of work to strip them down to a level at which I can remove the coils, moreover I would

> loose the manufacturers certificate for the use in an oxygen enriched
> environment as soon as I open the hood.

> Yes, loss of that certificate would certainly be a bummer.

It is hard enough to persuade them to deliver it with a written certificate.
Oxygen is very special, there is a standard defining the maximum amount of
grease (oil, fat) per cm^2 of surface in contact with oxygen. Furthermore
the material for your membranes , gaskets and sealings have to comply with
the standards for oxygen.

> Furthermore at this stage my system only goes into veterinary medicine, I
> have not got the infrastructure to manufacture human medicine devices
> myself.

> When first designing something for veterinary use I was surprised that the
> rules were pretty much as strict as for normal med use, at least in the
> US. Personally I regard the life of an animal as much as that of a human.
> The laws may be different sometimes but when they used one of our
> ultrasound machines on a million Dollar race horse I realized what can be
> at stake.

Interestingly we have no standards for veterinary medical devices, beside
the general IEC 601−1. The requirements for breathing machines used in human
anaesthesia are not obligatory for animal use. Anyway my machine will
fulfil all this requirements, however the effort in testing the software is
by far easier compared to human applications, as is the entire
documentation.
Today a one million Dollar horse is put on a horse anaesthesia machine,
which is roughly 40 years behind its equivalent for human use. That's one of
the reasons why a huge number of horses are experiencing lung problems after
a operation of 2 hours.
But this I guess is far off topic.

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