Re: Motor speed control via back−EMF detection

Source: http://sci.tech−archive.net/Archive/sci.electronics.design/2008−09/msg00030.html

- *From*: Jim Thompson <To−Email−Use−The−Envelope−Icon@xxxxxxxxxxxxxx>
- *Date*: Mon, 01 Sep 2008 18:31:56 −0700

On Mon, 01 Sep 2008 17:54:08 −0700, Joerg
<notthisjoergsch@xxxxxxxxxxxxxxxxxxxxx> wrote:

> Jim Thompson wrote:
>
> > On Mon, 01 Sep 2008 17:36:33 −0700, Joerg
> > <notthisjoergsch@xxxxxxxxxxxxxxxxxxxxx> wrote:
> >
> > > Jim Thompson wrote:
> > >
> > > > On Mon, 01 Sep 2008 16:24:07 −0700,
> > > > Joerg
> > > > <notthisjoergsch@xxxxxxxxxxxxxxxxxxxxx>
> > > > wrote:
> > > >
> > > > > Tim Wescott wrote:
> > > > >
> > > > > > John Larkin
> > > > > > wrote:
> > > > > >
> > > > > > > On
> > > > > > > Sun,
> > > > > > > 31
> > > > > > > Aug
> > > > > > > 2008
> > > > > > > 18:27:33
> > > > > > > −0700,
> > > > > > > "Bob
> > > > > > > Eld"
> > > > > > > <nsmontassoc@xxxxxxxxx>
> > > > > > > wrote:
> > > > > > >
> > > > > > > > "Phil
> > > > > > > > Pemberton"

<usenet08@xxxxxxxxxxxxx>
wrote
in
message
news:kgmro5−jbh.ln1@xxxxxxxxxxxxxxxxxxxxx

Hi
guys,
I've
been
tearing
apart
a
Brother
PT−1000
label
printer
with
the

eventual

goal
being
to
connect
it
to
a
desktop
PC
to
print
labels
for
my
various
component
storage
boxes.
I've
figured
out
how
the
print
head
communicates

with

the controller board, which just leaves the motor drive circuitry.

Naturally, being a low cost device (£15), the PT−1000 doesn't use

anything

remotely stepper−motor−like for the label feed. Instead, it uses a cheap Mabuchi DC pancake motor (an RF−300C−11440, for which I have yet to find a datasheet)

and a speed reduction gearbox. The speed control is performed by a ROHM BA6220 chip.

Ideally I'd like to eliminate the ROHM chip (seeing as it's basically unobtainium) and use a PIC of some description (probably a 12F675) to do PWM speed control of the motor.

But first I'd like to understand how the ROHM chip manages to do what it does.

I found a datasheet for the '6220 here: <http://www.classiccmp.org/rtellason/chipda
.. but like most ROHM datasheets, it doesn't say much about the chip, other than that it uses back−EMF sensing and

how
to
determine
one
of
the
two
external
resistor
values.

What
I
don't
get
is
that
there's
no
obvious
way
for
the
chip
to
sense
back−EMF.
Everything
I've
been
able
to
find
about
bEMF
sensing
suggests

that

it's
normally
used
with
PWM
control
−−
the
motor
is
powered

up for a short period of time, then in the off period the voltage across the motor is sampled and used to (roughly) determine the motor speed. Unless it's sensing current, but if it is, the "application circuit" (BA6220 datasheet, Fig. 2, page 2) doesn't look like

any current sensing circuit I've ever seen. In fact, it looks like a voltage comparator, but the polarity of the voltage reference doesn't look quite right...

I've hooked the scope up to the driver IC's pins (and the motor itself) and didn't see anything that suggested the driver

IC
was
switching
the
power

on

and
off.
In
fact,
the
voltage
remained
more
or
less
constant,
excepting

the

~50mV
sine
wave
(plus
one
~200mV
spike
per
cycle)
modulation
that
I

suspect
is

being
caused
by
the
motion
of
the
commutator
relative
to
the
brushes.

Can anyone shed some light on this?

Like I said, I'm getting rid of this thing anyway, but I'd rather like

to

understand how the existing circuit works first, if at all possible...

Thanks,
−−
Phil.
usenet08@xxxxxxxxxxxx
http://www.philpem.me.uk/
If mail bounces, replace "08" with the last

two digits of the current year.

The motor current is sensed inside the 6620 chip with a 20:1 current mirror. Though not completely clear because actual components are left out of the block diagram, there are two transistors being driven from the internal amplifier. They are the main parts

of
the
current
mirror.
The
motor
current
goes
to
the
collector
of
one
transistor
and
one
twentieth
of
that
current
flows
in
the
other
transistor.
The
current
ratio
is
established
by
the
mirror
geometry
from
the
ratio
of
collector
areas
in
the
chip.

This
sensed
current
with
the
motor
voltage

is
applied
to
the
internal
op−amp
in
a
way
that
forms
a
back
emf
bridge.
The
bridge
subtracts
the
motor
driving
voltage
from
the
current
generated
voltage
leaving
only
the
back
emf
which
is
proportional
to
speed.
This
can
be
shown
with
some
simple
algebra.

This
bridge
concept
allow
DC

motor
back
emf
and
thus
speed
to
be
sensed
in
the
steady,
DC
state.

That's
equivalent
to
driving
the
motor
from
a
power
supply
that
has
a
negative
output
impedance.
The
negative−impedance
supply
cancels
the
ohmic
losses
in
the
motor
and
in
theory
makes
the
motor
speed

independent of load, and dependent only on the equivalent applied voltage.

And ideal, lossless shunt or PM DC motor has perfect speed regulation with a constant applied voltage.

John

The only trick is making the negative output impedance match the armature impedance of the motor. I'm sure that there's a bit of tweaking involved in getting the figure right,

> > and in
> > compensating
> > the
> > amplifier so
> > it's stable
> > when you
> > hang a
> > motor off of
> > it, but it's
> > been
> > done for
> > years.
> >
> > AFAIK this
> > is how the
> > capstan
> > speed of all
> > but the
> > cheapest or
> > most
> > expensive
> > cassette
> > recorders
> > was
> > controlled.
>
> They even did that on record
> players. Couldn't believe it
> until I saw it.

Not on my Rek−O−Cut (SP? after all these
years :), it had a
synchronous motor and a tapered pulley so
you could set the speed with
a strobe.

Ah, I remember the old strobe disk. Having to switch taper would somehow
hint that the line frequency wasn't all that stable out there. Mine only
had tapers for the various record speeds. Why a strobe disk came with it
I have no clue because if the speed was off you couldn't do anything
about it. Plus it was relying on line powered lights so how could it
ever show a deviation? It would be like trying to calibrate a frequency
counter with its own clock.

> Mine tilted the motor mount ever so slightly to change the BELT position on the pulley to set the speed accurately.
>
> I still have it. I'll get it down from the upper storage shelving and take a picture.

> But against what would it compare? The TV station's V−sync? I can't imagine they provided a crystal controlled strobe lamp with it. Sunchronous motors have no slip. They are either in sync or stalled.

Variable pulley ratio... you dig?

...Jim Thompson
−−
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It's what you learn, after you know it all, that counts.
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